

UNIVERSITY OF MIAMI

A REANALYSIS OF THE 1944-1953 ATLANTIC HURRICANE SEASONS-  
THE FIRST DECADE OF AIRCRAFT RECONNAISSANCE

By

Andrew B. Hagen

A THESIS

Submitted to the Faculty  
of the University of Miami  
in partial fulfillment of the requirements for  
the degree of Master of Science

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The main historical archive of all tropical storms and hurricanes in the North Atlantic Ocean, Caribbean Sea, and Gulf of Mexico from 1851-present is known as HURDAT. This official database of historical Atlantic tropical cyclones (TCs) is maintained by the National Hurricane Center (NHC). The original database of 6-hourly tropical cyclone positions and intensities was assembled in the 1960s in support of the Apollo space program to help provide statistical TC track forecasting guidance (Landsea et al. 2008; Jarvinen et al. 1984; Neumann, personal communication). Today, HURDAT is widely utilized and relied upon by many groups including research scientists conducting climatic change studies (e.g. Landsea et al. 1999), operational hurricane forecasters, insurance companies, and emergency managers (Jarrell et al. 1992). The accuracy of the HURDAT database is important to many; however, the original database contains many systematic biases and random errors (Landsea et al. 2008). Therefore, a reanalysis of the HURDAT database is necessary. The Atlantic Hurricane Reanalysis Project (AHRP) is an ongoing effort to correct the errors in HURDAT, and to provide as accurate of a HURDAT database as is possible with utilization of all available data. For this thesis, HURDAT is reanalyzed for the period 1944-1953, the first decade of the “aircraft reconnaissance

era.” The track and intensity of each existing tropical cyclone in HURDAT is reassessed, and previously unrecognized tropical cyclones are noticed, analyzed, and recommended to the National Hurricane Center Best Track Change Committee (NHCBTCC) for inclusion into HURDAT (existing TCs may be removed from the database as well if analyses indicate evidence that no tropical storm existed). Changes to the number of tropical storms, hurricanes, major hurricanes, accumulated cyclone energy (ACE), and U.S. landfalling hurricanes are recommended for most of the years of the decade studied. An error analysis for the decade is also provided. It is noted that all changes to HURDAT mentioned in this thesis are preliminary and have not yet been approved by the NHCBTCC.

In addition to the HURDAT reanalysis, the second part of this study is conducted to determine whether the apparent recent increase in Atlantic Basin Saffir-Simpson Hurricane Wind Scale (SSHWS) Category 5 hurricanes is real or whether the increase is an artifact of recent technological advances and better observational capabilities. Several previous studies have stated that there has been an increase in the number of intense hurricanes both in the Atlantic Ocean and globally (e.g. Webster et al. 2005) and attribute this increase to anthropogenic global warming (AGW) and/or global climate change. Other studies (e.g. Landsea 2007) claim that the apparent increased hurricane activity in the record is an artifact of better observational capabilities and improved technology for detecting these intense hurricanes. This study delves deeper into the question of whether the recently observed increase in the number of Category 5 hurricanes in the Atlantic basin (late 1940s vs. 1990s-2000s period) is an artifact of better observations/technology or

rather possibly due to climate changes. Ten Category 5 hurricanes were recorded in the Atlantic Basin from 1992-2007 [Hurricane Andrew (1992) to Hurricane Felix (2007)]. A new (fairly objective) methodology was created to determine how many of these ten recent Category 5s would have been recorded as Category 5s if they had occurred during the late 1940s using only the observations that would have been available with late 1940s technology. A new best track intensity was drawn for the entire lifetime of these ten recent Category 5s (using late 1940s technology), and it is found that only two of these ten (Andrew and Mitch) would have been recorded as Category 5 hurricanes if they had occurred during the late 1940s period. The results suggest that intensity estimates for extreme tropical cyclones prior to the satellite era are unreliable.

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## CHAPTER 1

### PURPOSE AND OBJECTIVES

This thesis explains the reanalysis of the Atlantic hurricane database for the period 1944-1953 (the first decade of aircraft reconnaissance). Since the original database was developed in the 1960s, HURDAT has been utilized for many purposes including “setting appropriate building codes for coastal zones, risk assessment for emergency managers, analysis of potential losses for insurance and business interests, intensity forecasting techniques, verification of official and model projections of track and intensity, seasonal forecasting, and climatic change studies” (Landsea et al. 2008). However, the original database was not designed with these purposes in mind, and recent studies depend on a complete and unbiased database. For these reasons, the main objective of the Atlantic Hurricane Reanalysis Project is to improve the accuracy and completeness of HURDAT (or, at the very least, to understand and to quantify the existing biases). This reanalysis is necessary to correct the many random errors and systematic biases in HURDAT. Also, new data sources have become available recently containing observations from past decades, and it is essential that all available observations from these sources are utilized for the reanalysis. Another objective is to provide landfall parameters for U.S. landfalling hurricanes because many of the intensities have not been specified at landfall and are not accurate. Furthermore, there were TCs that existed but were not included in the original HURDAT database. Many of these TCs were noticed due to the recent availability of new data sources. Analyses are conducted for these missing storms, and they are recommended for inclusion into HURDAT. Also, any cyclones in HURDAT that are found to not have actually been tropical cyclones are removed from HURDAT.

In addition to the reanalysis of the HURDAT database, a study was performed to determine whether the recent increase in the number of Category 5 hurricanes in HURDAT is real or an artifact of recent technological advances and better observational coverage to detect these intense hurricanes. Numerous recent studies (e.g. Webster et al. 2005) relate increases in the number of intense hurricanes to AGW. Other studies, such as Landsea (2007) and Landsea et al. (2010) show that recent technological advances and improved observational capabilities have allowed better detection of TCs. Although the two latter studies focus mainly on TC frequency instead of intensity, the main concept from those studies can be applied here. The observational network during the late 1940s was not as complete as it is today, and better technological advances for monitoring TCs (satellites- geostationary, polar orbiting, microwave, scatterometer; dense coastal radar network; dropsondes, SFMR, and better aircraft radars, etc.) were invented after the late 1940s. These improvements in technology and observational capabilities with time are nicely illustrated by McAdie et al. (2009) and are depicted in Figure 2. Most of the ten Category 5 hurricanes in the Atlantic from 1992-2007 were only at Category 5 strength for a short period of time. For example, Hurricanes Katrina and Wilma of 2005 were only Category 5 hurricanes for 18 hours each, and Hurricane Emily (2005) was only a Category 5 for six hours, and none of those three storms made landfall as a Category 5. Because of the improved monitoring capabilities coupled with the very short duration of Category 5 hurricanes at that intensity, the question to be addressed with this study is: How intense would the ten recent Category 5 hurricanes have been if these cyclones had occurred during the late 1940s?

The Atlantic hurricane database contains many random errors and systematic biases (Landsea et al. 2008, 2004a). Some of the random errors include errors to the track/position of tropical cyclones at given times from the true position due to uncertainty based on lack of available observations. Random intensity errors can also arise on days when there are a lack of sufficient observations near a TC. It can be argued that when there are a lack of observations near the center, the intensity of the TC may have been underestimated in HURDAT, therefore making this a bias rather than a random error; however, although that may be true more often than not, overestimating the intensity in certain situations with a lack of data may have occurred occasionally as well.

The many systematic biases contained in the original HURDAT database are usually more noticeable and quantifiable than the random errors. When the original database was constructed, the position and intensity of TCs were estimated only twice daily (at 00Z and 12Z) during the 1944-1953 period. The 06Z and 18Z positions and intensities were interpolated (Jarvinen et al. 1984, Landsea et al. 2008). This interpolation often created intensity inaccuracies for landfalling hurricanes. As in Landsea et al. (2008), which describes the reanalysis of the 1911-1920 Atlantic hurricane seasons, it was found here that for numerous TCs during the first decade of aircraft reconnaissance that the translational velocities at the beginning and/or the end of TC tracks often showed unrealistic accelerations or decelerations because of the digitization of hand drawn track maps back in the 1960s during the compilation of the original HURDAT database (see Figure 1). Some of the systematic biases appeared in the original HURDAT database because the understanding of tropical cyclones was not as advanced as it is today. For example, knowledge of pressure-wind relationships and

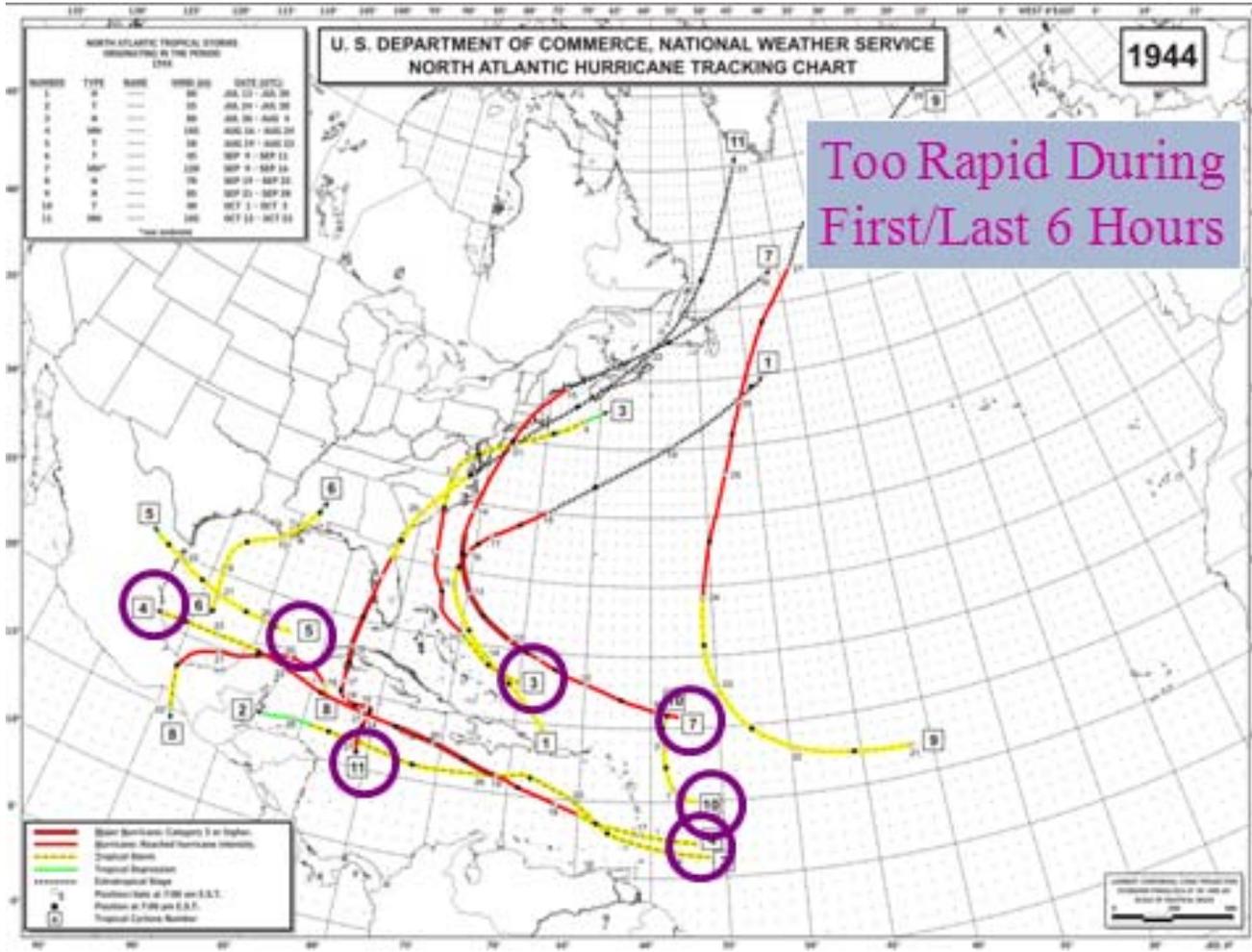


Figure 1. Examples of rapid accelerations and decelerations during the first or last six hours of tracks in HURDAT originally.

knowledge of how wind speed changes with height in TCs were both limited. In many cases, the reported maximum flight-level wind was the wind speed placed into the original HURDAT database. Furthermore, wind speed estimates and measurements provided by aircraft reconnaissance in the pre-satellite era contained a systematic high bias (Neumann, personal communication). These measurements became more accurate during the 1970s with the invention of an inertial navigation system on the P-3 aircraft (Hugh Willoughby, personal communication). Landsea (1993) documents an artificial change to the central pressure-maximum wind relationship from the 1940s – 60s period compared with the 1970s – 80s period. This artificial change is due to changes in maximum wind measuring and estimating techniques. It is important to note that there have been no changes with techniques used for measuring central pressure (Landsea 1993). The bias of the earlier years, which includes the first decade of aircraft reconnaissance, is confirmed by the research conducted in the present study- available aircraft central pressure observations are compared with the maximum wind speed reported, and on numerous occasions, maximum wind speeds derived from central pressures using the Brown et al. (2006) pressure-wind relationships are 20 to sometimes more than 40 kt less than the estimated maximum wind speed of the storm as provided by the flight aerologist. This inconsistency likely arose from three factors- insufficient knowledge of pressure-wind relationships, insufficient knowledge of wind speed change with height, and inaccurate wind speed measuring/estimating techniques. Another systematic bias is that the Saffir-Simpson Hurricane Wind Scale (SSHWS) categories for U.S. hurricane landfalls, first assigned by Herbert and Taylor (1975), do not match up with the maximum wind speed at landfall (Landsea et al. 2008). This is because those

designations were based on central pressure rather than maximum sustained wind speeds. Today, the SSHWS category is determined by maximum wind speed. For the reanalysis, detailed landfall parameters are analyzed and added to HURDAT including consistency between the maximum wind and the Saffir-Simpson category at U.S. landfall.

Many users of HURDAT have requested that these aforementioned landfall parameters be provided in HURDAT for U.S. landfalling hurricanes. Since the HURDAT database did not previously contain landfall parameters, these parameters are analyzed and added to HURDAT as part of the reanalysis. These parameters include the latitude and longitude of the landfalling point to the nearest tenth of a degree, time of landfall to the nearest hour, intensity (kt) at landfall, central pressure (mb) at landfall, radius of maximum wind (RMW) (if available), outer closed isobar (OCI) (mb), and radius of outer closed isobar (ROCI) to the nearest 25 nmi. Without these parameters available, users of HURDAT could only estimate a few of these parameters such as location and time of landfall by interpolating the 6-hourly HURDAT position to landfall. However, hurricanes do not always move in straight paths and at constant speeds.

In addition to reanalyzing each tropical cyclone listed in the HURDAT database from 1944-1953, a thorough search was conducted for tropical cyclones that existed but were not originally listed in HURDAT. If a potential TC not existing in HURDAT is identified, thorough analyses of all available data from all sources are conducted. If the analyses indicate that the system in question is likely a TC that was previously missed and therefore undocumented in HURDAT, it is then recommended for inclusion into the database. More details on the methodology for determining new TCs added to HURDAT can be found in the next chapter of this thesis.

Intensity error estimates for both the reanalysis and the Category 5 study are provided in this thesis. For the Category 5 study, the uncertainty estimates in the intensity values chosen are more straightforward since the intensity is chosen by simply removing observations (of recent technology) from the analysis. However, for the HURDAT reanalysis, it is shown that uncertainty varied tremendously from case to case since there are huge variations in the amount of observations available to analyze the intensity. Whenever there is significant track or intensity uncertainty for a particular storm, it is discussed in the metadata section. The methodology regarding intensity determination of individual TCs on any given day is also discussed in the metadata section for each TC. In addition, general average intensity errors as well as position uncertainties for this reanalysis are estimated and discussed later in this thesis for each type of situation (low-level aircraft penetration, aircraft circumnavigation, no aircraft flights, etc.).

## CHAPTER 2

### BACKGROUND INFORMATION

Previous to this study, the AHRP has been completed and approved by the NHCBTCC for the years 1851-1925 and the new changes have already been made available to the public (Landsea et al. 2004a, 2008). The preliminary research has already been conducted for the years 1926-1943, and NHCBTCC is currently reviewing these years. The current study discusses preliminary changes for the years 1944-1953. It is important to note that the work for four of the TCs between 1944-1947 was conducted by others (Donna Strahan and Chris Lockett) prior to the current study (1944 Storm 7- “The Great Atlantic Hurricane”, 1945 Storms 5 and 9 which made landfall in Texas and Homestead, FL respectively, and 1947 Storm 4- “The Fort Lauderdale Hurricane”) (Landsea et al. 2007). For completeness, the metadata from these studies are included in the appendix. The tables in the results section include the information from these cyclones. The research conducted here will be submitted to the NHCBTCC together with the four hurricanes that were reanalyzed by others.

#### **Database of Atlantic Basin Hurricanes- about HURDAT**

The HURDAT database contains the positions and intensities of each recorded Atlantic Basin tropical storm and hurricane from 1851-present. Although this study only focuses on the reanalysis of HURDAT from 1944-1953, it is important to understand how observational practices have evolved over time. Since 1851, the observational network has become more dense, and new tools and technology have been created for better monitoring TCs. Due to the technological advances described in Landsea (2007) and

McAdie et al. (2009) (see Figure 2), numerous papers have been published since 2005 that use different methods to estimate the number of “missed TCs” for various eras of the HURDAT database (e.g. Landsea 2007, Vecchi and Knutson 2008, Mann et al. 2007, Landsea et al. 2010). Prior to the aircraft reconnaissance era, TCs that stayed far away from any land areas would only be noticed and recorded if a ship encountered the storm at sea. Beginning in 1944, the first year of aircraft reconnaissance, this was only true for TCs east of about 55W longitude. Therefore, some studies (e.g. Landsea 2007) have presumed that there are no missing cyclones in the western half of the Atlantic basin post-1944. It will be shown later in this thesis that several missing storms in the western half of the basin were identified and added into HURDAT. For the decade studied, the greatest reasons for missed cyclones in the western half of the basin are due to changes in analysis techniques and designation practices. A secondary reason is that more data has recently become available for detecting these cyclones. For cyclones in the eastern half of the basin or in locations where aircraft reconnaissance was not available, the primary reason for missed cyclones was a lack of real-time (or operationally available) ship data for detecting these cyclones. The COADS ship database remains the most useful data source (which became available in 1987- Woodruff et al.) for locating evidence of missing TCs in the eastern half of the basin during the reanalysis of the first decade of aircraft reconnaissance.

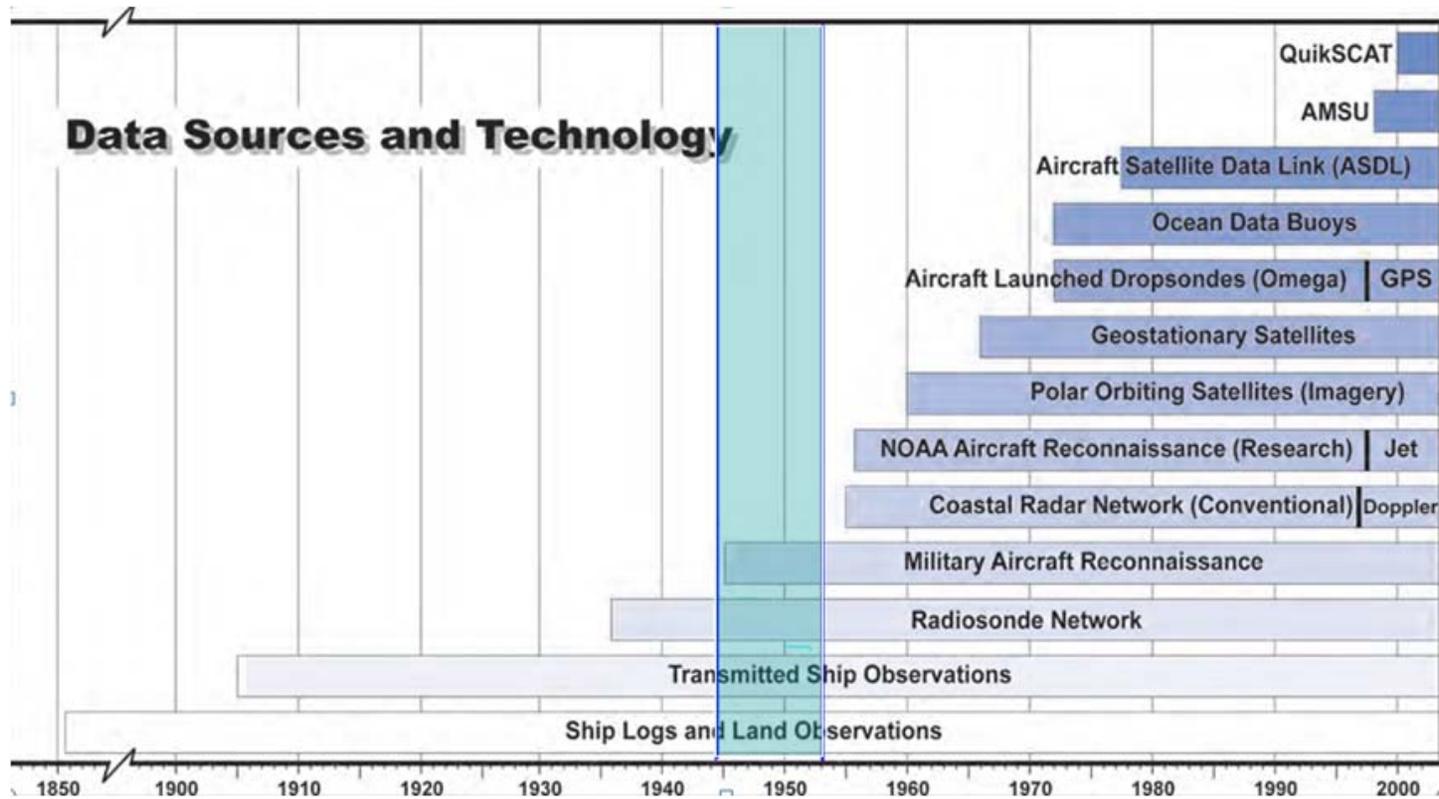


Figure 2. This graphic, taken from McAdie et al. (2009), shows how tropical cyclone observational capabilities have evolved as a function of time.

### **Beaufort Scale**

Ships at sea estimated wind speeds by using the Beaufort Scale, created by Sir Frances Beaufort in 1806. This scale is based on the observed sea state. The scale ranges from Forces 0 to 12, (0 is a calm wind, and 12 is a hurricane force wind). Ship observations of wind speed during the 19<sup>th</sup> century and well into the 20<sup>th</sup> century were estimated using the Beaufort Scale. Table 1 describes the Beaufort Scale. During situations when a wind observation is only available in Beaufort form, the conversions to kt listed in the second column of the table are used in the reanalysis. In official military coding messages, aircraft reconnaissance would report surface wind speed at the location of the aircraft if the sea-state was visible and was not obscured by clouds. The highest number that could be reported in the military coding was 12. If a higher surface wind speed was observed, the aerologist on the flight would use plain text to deliver his wind speed estimate to the Joint Hurricane Warning Center in Miami, FL, but this information was sometimes not communicated, inaccurate, or not available.

### **Pressure-wind relationship**

Typically, as the central pressure of a TC decreases, the maximum wind increases. There was little knowledge of and there were no publications on relating central pressure to maximum wind speed until a paper was published by Kraft (1961), which only uses a small sample of surface observations at landfall to derive an empirical relationship. Brown et al. (2006) derives a revised pressure-wind relationship for Atlantic Basin tropical cyclones based on a large sample size of aircraft data from 1998-2005. The observations used for the Brown et al. study are more reliable than the data used for the

Beaufort Number	Knots	Description	Specifications at Sea
0	<1	Calm	Sea like a mirror
1	1-3	Light air	Ripples with the appearance of scales are formed, but without foam crest
2	4-6	Light breeze	Small wavelets, still short but more pronounced; crests have a glassy appearance and do not break
3	7-10	Gentle breeze	Large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses
4	11-16	Moderate breeze	Small waves, becoming longer; fairly frequent white horses
5	17-21	Fresh breeze	Moderate waves, taking a more pronounced long form; many white horses are formed (chance of some spray)
6	22-27	Strong breeze	Large waves begin to form; the white foam crests are more extensive everywhere (probably some spray)
7	28-33	Near gale	Sea heaps up and white foam from breaking waves begins to be blown in streaks in the direction of the wind
8	34-40	Gale	Moderately high waves of greater length; edges of crests begin to break into spindrift; foam is blown in well-marked streaks along the direction of the wind
9	41-47	Strong gale	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble, and roll over; spray may affect visibility
10	48-55	Storm	Very high waves with long overhanging crests; the resulting foam, in great patches, is blown in dense white streaks along the direction of the wind; on the whole, the surface of the sea takes on a white appearance; the tumbling of the sea becomes heavy and shock-like; visibility affected
11	56-63	Violent storm	Exceptionally high waves (small and medium-sized ships might be for a time lost to view behind the waves); the sea completely covered with long white patches of foam lying along the direction of the wind; everywhere the edges of wave crests are blown into froth; visibility affected
12	>63	Hurricane	The air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected

Table 1. Beaufort Wind Scale. Source: Fitzpatrick (1999)

Kraft study. Brown et al. found that the pressure-wind relationship systematically differs slightly depending on latitude and whether the cyclone is currently undergoing a strengthening, weakening, or steady state phase. The Brown et al. pressure-wind relationship is used for the reanalysis of HURDAT. It should be noted that subsequent to the Brown et al. publication, Knaff and Zehr (2007) have published a version of the pressure-wind relationship that takes into account storm size, environmental pressure, and storm speed in addition to the factors shown in the Brown et al. study. Although the Knaff-Zehr pressure-wind relationship is an updated and slightly more accurate version than the Brown et al. relationship, the newest version is not used in the HURDAT reanalysis. Several decades of the HURDAT reanalysis have already been completed using the Brown et al. pressure-wind relationship, and it is important that the reanalysis methodology remains the same for the entire reanalysis for systematic consistency reasons (to avoid any intensity bias issues from one time period to another). Despite this, reanalysis methodology described in Landsea et al. (2008) allows for analyzed intensities to deviate by as much as 10 kt from the Brown et al. pressure-wind relationship for cases when storm size, RMW, speed, and/or environmental pressure deviate significantly from average values of these parameters. After this 5 or 10 kt adjustment factor is added or subtracted on a case-by-case basis, it is believed that the analyzed wind speeds would show similar accuracy as if the Knaff-Zehr pressure-wind relationship would have been used. Testing this hypothesis is beyond the scope of this thesis.

Central pressures were measured much more often than the maximum wind speed in a TC. Also, central pressure measurements were most often more accurate than wind speed observations and estimates during this decade. The only accurate and truly

objective wind speed measuring devices that existed were the anemometers at the official U.S. Weather Bureau stations. But even these were located at different heights, and many were obscured by buildings and trees.

The Brown et al. pressure-wind relationships are used to translate available central pressure observations in the reanalysis to maximum wind speed values. For example, a central pressure of 980 mb for a TC south of 25N latitude with a steady-state intensity yields a maximum wind speed of 78 kt according to the Brown et al. pressure-wind relationship. An 80 kt intensity would be chosen for the reanalysis since the precision of the database is 5 kt. However, if the original HURDAT listed a 75 kt intensity at the time of the central pressure measurement, the 75 kt intensity would not be changed to 80 kt because changes are typically only made to the HURDAT intensity when there is evidence to make greater than a 5 kt change (i.e. a 10 kt change or more).

Central pressure measurements for TCs over the open ocean prior to the aircraft reconnaissance era were extremely uncommon. After the initiation of aircraft reconnaissance, central pressure observations were more common, and the Brown et al. pressure-wind relationship is utilized often during the reanalysis of 1944-1953. During times when central pressures were measured, the reanalysis of intensity is more accurate than when central pressures are not available.

### **Saffir-Simpson Hurricane Wind Scale Categories**

The Saffir-Simpson Hurricane Scale (SSHS), a damage scale based on hurricane intensity, was originally devised by Herbert Saffir (an engineer) and Robert Simpson (a meteorologist) (Simpson 1974). The scale ranks hurricanes from 1 to 5 based on wind

speed. Corresponding central pressure and storm surge values were listed in this scale as well. In 2010, the scale was revised to remove mention of the corresponding storm surge and central pressure values and to update the wind-caused damage descriptions. The revised scale (Table 2) is called the Saffir-Simpson Hurricane Wind Scale (SSHWS) – (see online reference <http://www.nhc.noaa.gov/sshws.shtml>).

SSHWS Category	Winds (kt)
1	64-82
2	83-95
3	96-113
4	114-135
5	> 135

Table 2. Saffir-Simpson Hurricane Wind Scale categories. (Source: <http://www.nhc.noaa.gov/sshws.shtml>).

## CHAPTER 3

### METHODOLOGY

Many sources of data are utilized for the reanalysis. Two different types of synoptic maps heavily utilized are the Historical Weather Maps Series (HWM) (Reichelderfer 1944-1953) and NHC microfilm of synoptic weather maps (microfilm). HWM (see Figure 3) provides a surface analysis for the entire northern hemisphere once daily at 12Z as well as a once daily 500 mb map. HWM is a series of daily maps that

Historical Weather Map

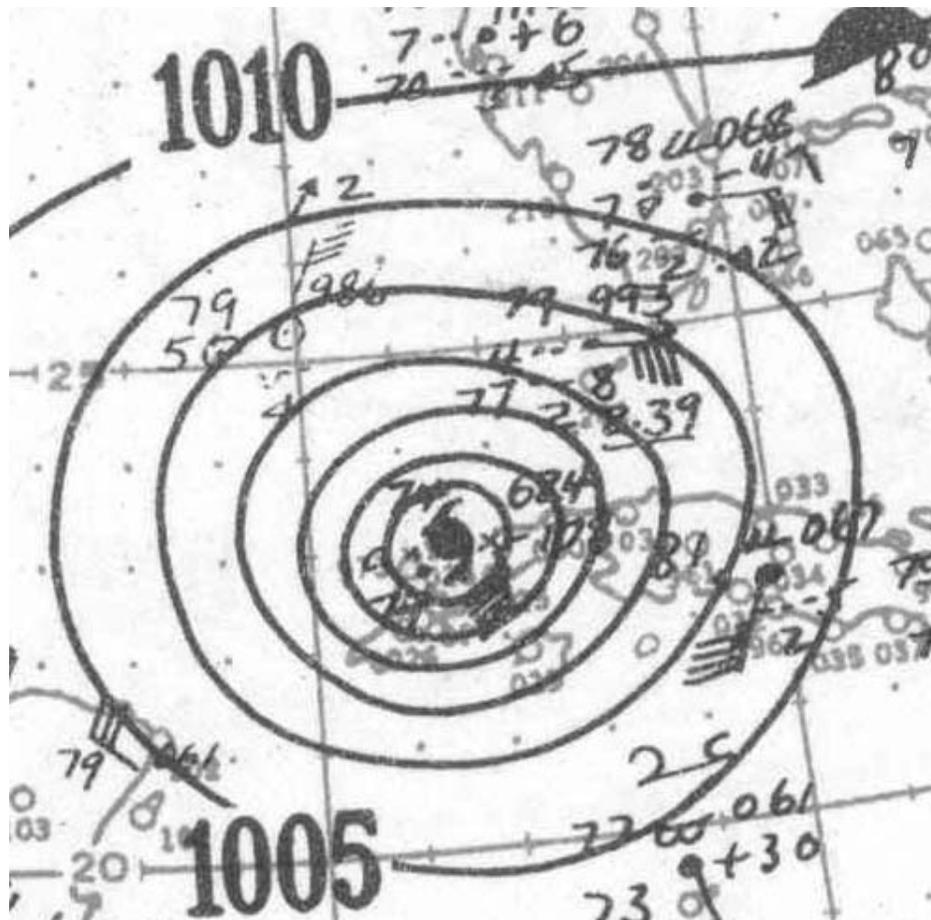


Figure 3. Historical Weather Map for October 18, 1944 zoomed in to 1944 Storm #13.

were reconstructed by the U.S. Weather Bureau at the end of each decade. Each HWM series volume is grouped by month and by decade so that all of the maps from September 1-30, 1940-1949, for example, are in the same book. The microfilm synoptic maps, which are kept only at the National Hurricane Center, were originally constructed operationally by the U.S. Weather Bureau hurricane forecasters in Miami, FL. These analyzed maps were utilized as part of the foundation for hurricane forecasting. The microfilm synoptic maps from every six hours are available in most cases except for TCs in the eastern half of the Atlantic. South of about 25N latitude, the eastern edge of the microfilm map was about 55W longitude. This may be because microfilm maps did not extend beyond the range of aircraft reconnaissance. This could be a reason for missed TCs in the eastern half of the basin. The Comprehensive Ocean-Atmospheric Dataset (COADS) first introduced by Woodruff (1987) is a global database containing millions of ship observations. These observations include wind speed, wind direction, pressure, air temperature, and SST along with the date/time of the observation and the position of the ship. The wind and pressure observations can be very useful, especially for ships involved close to TCs. The temperature observations are important for extratropically transitioning (ET) TCs to help diagnose the timing of ET. The availability of the COADS database has provided numerous additional ship observations that were not available during the real time operational forecasting or the post-season analysis process. The utilization of COADS along with the HWM and microfilm maps is necessary for the reanalysis process and has led to numerous changes made to HURDAT.

The Monthly Weather Review (MWR) provides a monthly chart of cyclone tracks referred to here as the “MWR tracks of centers of cyclones chart.” This chart is located towards the back of each monthly issue of MWR. The MWR also provides a descriptive post-season hurricane summary for the Atlantic as well as a post-season track map. The post-season summary article (along with the track map) was usually written by a Weather Bureau forecaster who monitored the TCs throughout the season and kept statistics on the TCs (e.g. Summer 1944b, 1946a, 1946b 1947, 1948; Zoch 1949; Norton 1951, 1952, 1953a, 1953b). MWR also lists a table of maximum monthly wind speed for U.S. coastal stations as well as summaries of river flooding. These articles and maps that appeared routinely in MWR were usually prepared by Weather Bureau employees. The table of maximum monthly wind speed for coastal stations was obtained by MWR from the observers of the various U.S. Weather Bureau stations each month. The summary of river flooding is an article authored by a forecaster similar to the post-season summary article. Many of the pieces of information utilized that were originally found in MWR from 1944-1949 were subsequently published in the National Monthly Climatic Data Summary beginning in 1950. Other sources utilized include the Original Monthly Records of U.S. Weather Bureau coastal station observations (made available by the National Climatic Data Center- NCDC), and the Local, State, and National Monthly Climatological Data Summaries from NCDC. This data contains U.S. coastal station information and is useful for U.S. landfalling hurricanes and for TCs that pass close to the coast. Meteorological observations obtained from the meteorological offices of several Caribbean island countries and Mexico are utilized. Newspaper articles, reports and personal accounts in publications such as Barnes (1998) and Tucker (1995) are

utilized. The U.S. Navy weather logbooks are available each year beginning in 1950. The U.S. Air Weather Service (USAWS) reports (e.g. AWS 1948, 1949, 1951) are vital as well, but these are not available for the first few years of aircraft reconnaissance. Several studies are utilized for aid in determining TC intensity. Some of these include the Brown et al. (2006) pressure-wind relationships, the Kaplan and DeMaria (1995) Inland Decay Model, the Ho et al. (1987) inland pressure decay model, the Schloemer equation (Schloemer 1954) for calculating central pressure of a cyclone, the Vickery et al. (2000) climatological RMW values, and the Schwerdt model (Schwerdt et al. 1979) for determining the extent of hurricane force winds at landfall. Some of the sources utilized for landfalling hurricanes include the studies of Connor (1956), Dunn and Miller (1960), Harris (1963), Jarrell et al. (1992), and Perez et al. (2000). These studies provide estimates of landfall point, landfall intensity, RMW, OCI, damage, impacts, etc.

“Reanalysis is a process that checks, and if needed, corrects various intensity and track errors in the original hurricane database. The reanalysis is also done to corroborate previous analyses in the original HURDAT record. A reanalysis includes an examination of every available raw observation surrounding a tropical cyclone, including data that were not available during the original post-season analyses” (Glenn 2005). Glenn’s statement regarding HURDAT reanalyses for five seasons within 1916-1935 is also applicable to the reanalysis of the first decade of aircraft reconnaissance. There are several systematic steps that are included in the research process of reanalyzing the HURDAT database for each year. The first step while reanalyzing the existing TCs in HURDAT is to obtain all available raw meteorological data and observations from all sources and compile these observations into a single database- an Excel spreadsheet. A

Date	Time	P	W	Dir	T/ eye rad	S	type/place	Lat	Lon	Source	Identifier	Comment
9	18Z	1012	35	WNW	83	80	SHIP	115	330	COA	5141	
14	1842Z	1005	26				aircraft	112	535	micro		center fix
14	pm		90				aircraft			MWR		
15	1450Z	999c	90		7 nmi		aircraft	145	597	micro		center fix
16	0828Z	1010	35	ESE	80		San Juan	185	661	micro		G 40-45
16	12Z	1006	40	SE	82		SHIP	161	660	micro	California	
16	1220Z	1000					SHIP			micro	Rockwel	min p
16			55				SHIP			micro	Rockwel	max w
16	13Z	1007	45	SE			SHIP	162	667	micro	Rockwel	
16	1415Z	992c	70 fl		10nmi		aircraft	162	679	ATS		center fix
16	1415Z	992c	70 fl		10nmi		aircraft	160	673	micro		center fix
16	15Z	1001	55	SSE			aircraft	163	666	micro	fl 500 ft	fl wind?
16	15Z	1004	40	SW			SHIP	160	675	micro	Sun Valley	
16	15Z		75				aircraft			micro	fl wind?	probably
16	1815Z	1000	40	SE	AF		aircraft	163	683	micro	fl 40 SE	1600 ft
16	1830Z				AF		aircraft	162	688	micro	DR	center fix
16	1935Z		50		6 nmi		aircraft			micro	700 Z 9870 ft	
17	1129Z		80		6 nmi		aircraft	166	730	micro	radar	center fix
17	1145Z	1006			Navy		aircraft	174	727	micro	fl 50 ENE	500 ft
17	1230Z	978c	90		11nmi		aircraft	164	729	micro	radio	center fix
17	1245Z	1005			Navy		aircraft	165	729	micro	fl 50 S	700 ft
17	1830Z				AF		aircraft	182	758	micro	fl 55 ENE	10,500 ft
17	1837Z	971c	110		3 nmi		aircraft	171	748	micro	radar	center fix
17							aircraft				700 mb Z-	9,400 ft above fix
18	0215Z		70-80				Kingston	180	768	micro		
18	~0245Z	973					Kingston	180	768	met mag		min p
18	0245Z		75+				Kingston	180	768	met mag		G 95
18	~0315Z	973	100+				Kingston	180	768	micro	min p	max w
18		973					Kingston	180	768	MWR		min p
18			95+ e				Kingston	180	768	MWR		max w
18			75-80				Kingston	180	768	met mag	G 105-110 kt est	

18	03-04Z			ESE		Kingston	180	768	micro		
18	05-06Z		30	SSE		Kingston	180	768	micro		
18	2045Z	998	20	NW		aircraft	180	818	micro		
18	20Z	1002	50	ENE	79	Gr. Cayman	193	814	micro		
18	21Z	1000	55	ENE		Gr. Cayman	193	814	micro		
18						Gr. Cayman	193	814	MWR		G 80
18	2112Z	982c	75		AF	aircraft	188	816	micro	or 2137Z	center fix
18	2145Z				AF	aircraft	198	815	micro	fl 75 E	5,000 ft
19	0Z	1003	50	ESE	76	Gr. Cayman	193	814	micro		
19	0Z	1008	40	SE	79	84 SHIP	213	848	COA	3372	
19	3Z	1007	50	SE	76	Gr. Cayman	193	814	micro		
19	12Z	1005	15	SW	82	85 SHIP	181	841	COA	11411	
19	12Z	1003	10	ENE		Cozumel	205	870	micro		
19	1245Z	1005				aircraft	207	862	micro	fl 50 NE	500 ft
19	13Z	1007	24	N		Cozumel	205	870	Mexican obs	EDADS	
19	13Z	999				aircraft	200	864	micro	fl 50 NE	600 ft
19	1330Z	976c	115		10nmi	aircraft	193	847	micro	DR	center fix
19	1345Z	998				aircraft	196	856	micro		
19	1400Z	984				aircraft	193	844	micro	fl 85 SSE	400 ft
19	1415Z					aircraft	198	840	micro	fl 90 SSE	400 ft
19	1430Z	1005				aircraft	205	844	micro	fl 80 E	500 ft
19	1730Z		25	NNE		Cozumel	205	870	micro		G 34
19	18Z	1011	50	E	80	84 SHIP	220	852	COA	3372	
19	1830Z	1005	30	NE		Cozumel	205	870	micro		G 45
19	1850Z		60-70	E		aircraft	230	850	micro	fl wind	9000 ft
19	1930Z		30	NNE	81	Cozumel	205	870	micro		G 45
19	20Z	999	50	NNE		Cozumel	205	870	Mexican obs	EDADS	
19	2030Z		40	NNE	75	Cozumel	205	870	micro		G 60
19	21Z	1008	35	ESE		SHIP	215	849	micro		
19	21Z	1002	20	WNW	85	SHIP	186	865	micro		
19	2130Z		40	NE	76	Cozumel	205	870	micro		G 50
19	22Z	1000	50	SE		SHIP	202	843	micro		G 60
20	0Z	997	55	NE		Cozumel	205	870	micro		G 70

20	0Z		50	ESE		SHIP	205	846	micro		
20	0Z	1008	40	SE	79	SHIP	213	849	micro		
20	0Z	1000	30	SW	83	SHIP	191	862	COA	532	
20	0Z	1003	25	WNW	84	85 SHIP	186	867	COA	1111	
20	0Z	1005	20	SSW	83	86 SHIP	175	866	COA	8012	
20	0130Z		80	NNE		Cozumel	205	870	micro		G 95
20		965				Cozumel	205	870	micro	min p	
20		971	65	E		Cozumel	205	870	Mexican obs	EDADS	
20	0230Z		40	ESE		Cozumel	205	870	micro		G 60
20	0330Z		40	SE		Cozumel	205	870	micro		G 60
20	0435Z		40	SE		Cozumel	205	870	micro		G 55
20	0530Z		40	SE		Cozumel	205	870	micro		G 55
20	6Z	1002	40	ESE		Cozumel	205	870	micro		G 50
20	6Z	1011	40	SE	83	84 SHIP	203	842	COA	3372	
20	6Z	1005	30	SSE	80	88 SHIP	205	860	COA	532	
20	6Z	1005	30	SSE	80	SHIP	205	860	micro		
20	6Z	1005	30	N		Merida	210	896	micro		G 45
20	6Z	1005	20	NW	82	Campeche	198	905	micro		G 23
20	0730Z		20	ESE		Cozumel	205	870	micro		G 40
20	0830Z		30	N		Merida	210	896	micro		G 35
20	0830Z		20	SE		Cozumel	205	870	micro		G 35
20	0930Z		30	N		Merida	210	896	micro		G 35-45
20	1030Z		20	N		Merida	210	896	micro		G 35-45
20	1130Z	992?	30	N		Merida	210	896	micro		G 35
20	1130Z	1003	15	WNW		Campeche	198	905	micro		G 25
20	12Z	1001	20	W	78	Campeche	198	905	micro		
20	12Z			NNW		Merida	210	896	micro		
20	1330Z	986	30	WNW		Merida	210	896	micro		G 35
20	1330Z	1003	20	WNW		Campeche	198	905	micro		G 24
20	1430Z	988	25	SW		Merida	210	896	micro		G 35
20	1430Z	1003	20	S		Cozumel	205	870	micro		G 25
20	1530Z	993	30	S		Merida	210	896	micro		G 45
20	1530Z	1003	20	WNW		Campeche	198	905	micro		G 25

20	1730Z	998	25	SE			Merida	210	896	micro		G 45
20	18Z		30	SSE			Merida	210	896	micro		G 38
20	2030Z		40	SE			Merida	210	896	micro		G 47
20	21Z	1006				Navy	aircraft	232	900	micro	fl 40 ESE	500 ft
20	2115Z						aircraft	231	905	micro	fl 45 E	500 ft
20	2130Z		40	ESE			Merida	210	896	micro		G 52
20	2130Z	1003					aircraft	225	909	micro	fl 60 ENE	400 ft
20	2145Z	1001					aircraft	223	916	micro	fl 65 NE	500 ft
20	22Z	1002					aircraft	217	925	micro	fl 60 NE	600 ft
20	2215Z	1000					aircraft	211	926	micro	fl 55 N	500 ft
20	2230Z		35	SSE			Merida	210	896	micro		G 43
20	2230Z	995					aircraft	207	920	micro	fl 70 N	500 ft
20	2243Z	989c	115				aircraft	206	915	micro		center fix
20	2243Z	989 l	115				aircraft	219	911	ATS		center fix
20	2245Z	989					aircraft	206	915	micro	fl 20 NW	500 ft
20	2315Z	996					aircraft	209	909	micro	fl 115 SE	500 ft
20	2330Z		35	SE			Merida	210	896	micro		G 43
20	2330Z	1001					aircraft	213	914	micro	fl 65 ENE	600 ft
20	2345Z	1003					aircraft	217	915	micro	fl 65 NE	700 ft
21	0Z	1009	40	ENE	82	86	SHIP	240	922	COA	57011	
21	6Z	1010	35	E	83	86	SHIP	242	912	COA	57011	
21	12Z	1012	40	ESE	84	84	SHIP	242	896	COA	57011	
21	1538Z	988c	70			15nmi	aircraft	217	943	micro		center fix
21	16Z						aircraft	210	949	micro	fl 50 W	
21	18Z	1012	35	NE	88	86	SHIP	244	954	COA	4581	
21	18Z	1000					aircraft	201	945	micro	fl 60 WNW	800 ft
21	1830Z	997					aircraft	206	939	micro	fl 65 SW	700 ft
21	1845Z	996					aircraft	212	933	micro	fl 65 S	600 ft
21	1915Z	995					aircraft	226	936	micro	fl 100 E	500 ft
21	1930Z	1001					aircraft	231	940	micro	fl 80 ENE	500 ft
21	1945Z	1006					aircraft	238	944	micro	fl 60 E	500 ft
21	21Z	1005	35	E			aircraft	235	927	micro	fl 40 E	5000 ft
21	2130Z	1005					aircraft	231	945	micro	fl 60 E	800 ft

21	2145Z	1005					aircraft	226	956	micro	fl 60 NE	800 ft
21	22Z	1005					aircraft	220	960	micro	fl 60 N	700 ft
21	2215Z	1003					aircraft	212	957	micro		
21	2230Z	997					aircraft	205	950	micro	fl 90 NNW	600 ft
21	2245Z	983					aircraft	205	943	micro	fl 90 NW	500 ft
21	2247Z	982c	100			20nmi	aircraft	205	944	ATS	DR	center fix
22							aircraft	218	968	micro	fl 120 WSW	
22	0Z	1008	40	NW	83		SHIP	198	963	COA	74712	
22	0Z	1011	35	E	87	86	SHIP	250	946	COA	4581	
22	9Z	1005	40		80		SHIP	206	969	micro		
22	12Z	1005	35	W	80		SHIP	209	971	COA	74712	
22	12Z	1000	20	SW	75		Tampico	222	978	HWM		
22	13Z	996					aircraft	232	976	micro	fl 70 NE	600 ft
22	1326Z	972c	130 fl			18nmi	aircraft	223	968	micro		center fix
22	~1326Z		130 fl	N			aircraft	219	970	micro		
22	~1326Z		120 fl				aircraft			ATS		center fix
22	~1345Z	998	70 fl				aircraft	216	962	micro	600 ft	
22	1530Z	990	45	WNW			Tampico	222	978	micro		G 75
22	1630Z	990	60	WNW			Tampico	222	978	micro		G 75
22	1730Z	976	87G95	NW			Tampico	222	978	micro, adv, MWR, ATS, Connor		
22	18Z	1003	35-40	WNW			land	223	985	micro		
22	18Z		40	SSW			SHIP	222	973	micro		
22	18Z	975	30	WNW			Tampico	222	978	micro		
22	18Z	1003	10	S			Tuxpan	210	974	micro		
22	1830Z	974	35	NNW			Tampico	222	978	micro		
22	~1915Z		calm				Tampico	222	978	micro		
22	1930Z	973	45	NE			Tampico	222	978	micro		
22	2030Z		17	SE			Tampico	222	978	micro		
22	2130Z?		95	SE			Tampico	222	978	Connor, MWR		max w
22	2315Z		60	WSW			Tampico	222	978	micro		G to 70
22		972					aircraft	223	968	micro	fl 130 N	
23	0Z	999	45	ESE			Tampico	222	978	micro		G 70
23	12Z	1008	20	SE	78		Tampico	222	978	micro		

Table 3 (previous pages). Raw observations from 1951 Hurricane Charlie. Date = the date during August, 1951; P = pressure (mb), and “c” implies central pressure whereas “l” implies lowest pressure observed; W = wind speed (kt) where “fl” indicates a flight-level wind measurement; Dir = wind direction; T = temperature (F) for ships and land stations and Eye rad = eye (or center) radius (nmi) from aircraft reconnaissance reports (also Navy means the Navy was flying and AF means the Air Force was flying); S = sea-surface temperature; Sources: COA = COADS, micro = microfilm, MWR = Monthly Weather Review, ATS = Annual Tropical Storm Report, met mag = Meteorological Magazine (Fowler 1952), Mexican obs were obtained from NCDC, HWM = Historical Weather Map, Connor is from (Connor 1956), and adv = Weather Bureau public advisories; and Identifier = ship identifier.

listing of raw observations for 1951 Hurricane Charlie are shown in Table 3. It is crucial to obtain the original observations when available rather than relying upon the secondary sources which could misinterpret and inadvertently alter the observations. Both the HWM and microfilm synoptic weather maps are scanned using two special scanners (both located at the NHC Library in Miami, FL). HWM maps are scanned using a standard hi-resolution scanner. A much more specialized scanner is utilized for the microfilm scanning. The maps are scanned and printed out in order to plot all observations from all sources onto a single synoptic map corresponding to a specific time. The observations in the aforementioned Excel spreadsheet are plotted onto the maps one to four times daily for each storm, depending on the amount of data available on a particular day. The microfilm synoptic map containing some observations plotted from other sources is shown in Figure 4 for August 19<sup>th</sup> at 12Z for 1951 Hurricane Charlie. After the synoptic observations are plotted and the Excel spreadsheet is completed, a daily metadata paragraph is written for every TC. (The metadata for all years of this study is shown in Appendix C.) The metadata includes a description of the synoptic analyses shown on the HWM and microfilm maps as well as the locations near which the different sources place the center of the TC or area of low pressure at 12Z each day. The highlighted observations from each day are also included in the daily metadata paragraph. Important descriptions or accounts of visual observations, storm damage, etc. are also included in the daily metadata paragraph. The daily metadata paragraph for August 18, 1951 for Hurricane Charlie quoted below:

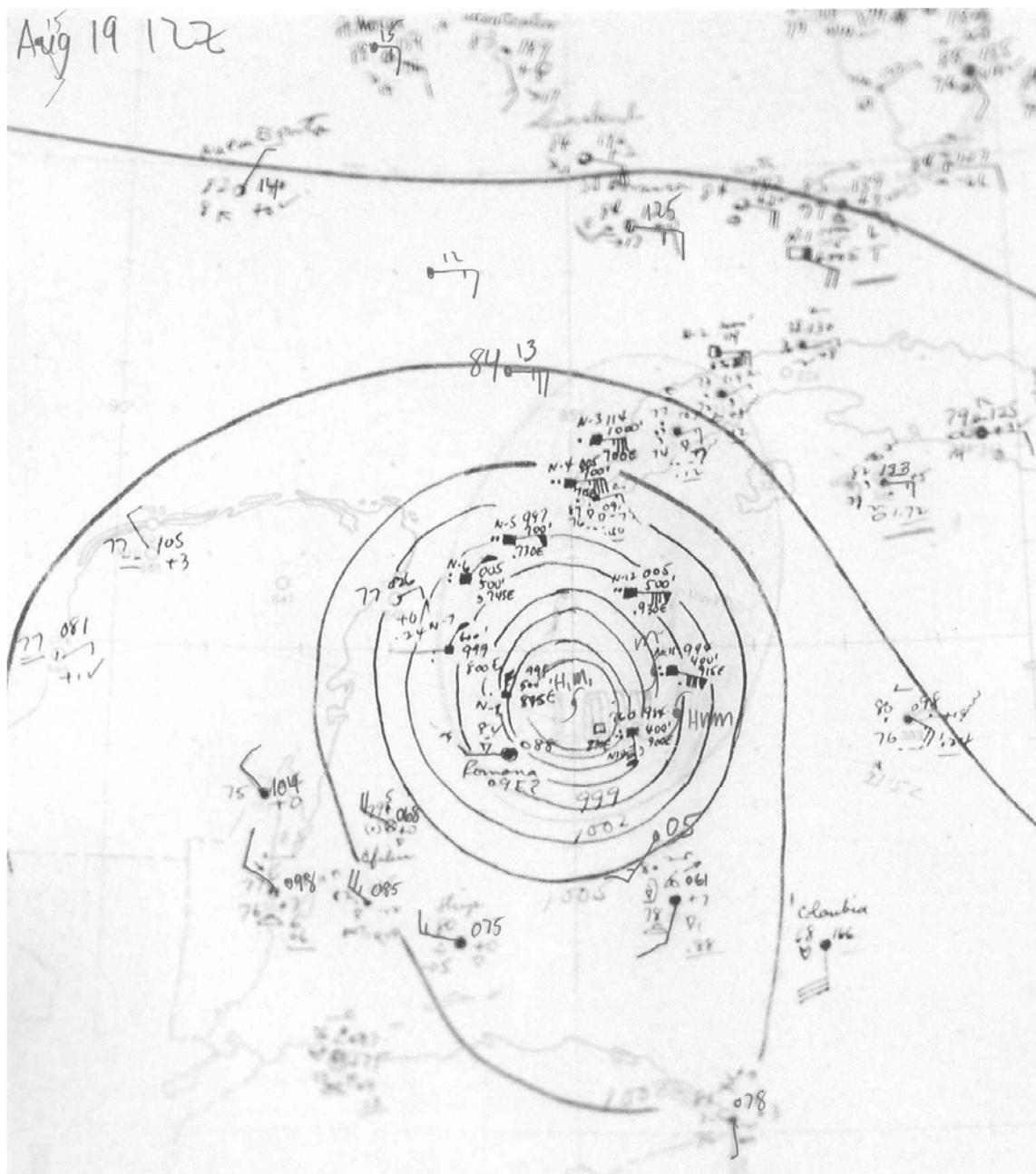


Figure 4. Synoptic map of August 19, 1951 at 12Z for Hurricane Charlie with observations plotted.

*August 18:*

*HWM analyzes a hurricane of at most 1000 mb centered near 17.7N, 80.1W. HURDAT lists this as an 85 kt hurricane at 18.2N, 80.5W. The MWR tracks of centers of cyclones shows a 12Z position near 18.2N, 79.6W with a 980 mb pressure and the MWR post-season track map shows a 12Z position near 18.2N, 80.0W. Microfilm analyzes a closed*

low of at most 1002 mb centered near 18.1N, 79.8W. Land/station highlights: 75-80 kt estimated highest average wind speed, 95 + kt estimated max wind, and 105-110 kt estimated max gusts around 0215Z to possibly after 0315Z at Kingston, Jamaica (micro, MWR, met mag); 973 mb (min p) around ~0245Z at Kingston, Jamaica (micro, MWR, met mag); 55 kt ENE G 80 kt and 1000 mb at 21Z at Grand Cayman (micro, MWR, advisories). One other gale and low pressure at 20Z at Grand Cayman. Aircraft highlights: Air Force center fix at 2112Z at 18.8N, 81.6W with 982 mb central pressure and 75 kt max flight-level winds encountered at 5,500 feet at 19.8N, 81.5W (ATS, micro). One other low pressure. "The center skirted the south coast of Jamaica during the night of the 17<sup>th</sup> and the entire island had destructive winds, which caused the worst hurricane disaster of the century on Jamaica. Property and crop damage was estimated at \$50,000,000, 152 persons killed, and 2,000 others injured, and about 25,000 made homeless. The strongest wind at Kingston was estimated at over 110 mph; lowest pressure [measured] 28.74 inches (973 mb); and rainfall 17 inches. The center passed several miles south of the city" (MWR). "Center of hurricane passed just south of Palisadoes at 18/0315 GMT. Wind exceeded 100 kt. Lowest pressure 973 mb by barograph. Rainfall 430 mm plus. Weather office wrecked and all coms dislocated" (micro). "The strongest wind at Jamaica was 110 miles per hour" (Tannehill). "The eastern parishes [of Jamaica] were the first to be affected... torrential rain and winds of 80-90 mph being experienced by about [0130Z]. These conditions moved slowly westward over the southern half of Jamaica and finally cleared the extreme west by [10Z]. The hurricane struck Kingston at [0245Z] when the wind suddenly increased to an average speed of over 85 mph with gusts in excess of 110 mph. This approximation is necessary as the two recording wind instruments in the district ceased to register above these limits. There have been rumors that other anemometers recorded gusts of 140-160 mph before being wrecked but these instruments are of the revolving-cup pattern, which over-read considerably at high speeds. It is considered that a reasonable approximation may be given as an average wind speed of 85-90 mph with gusts to 120-125 mph. These hurricane force winds continued for about six hours, during which time trees were blown down, roofs blown off and much general damage was done by flying debris, such as branches of trees, pieces of timber and sheets of corrugated iron, the latter being used extensively for garage roofs and outbuildings. The number of deaths in Kingston was 56 and the total for the whole island was 152. There was considerable damage to shipping in Kingston Harbor and five large vessels were driven ashore. The minimum value recorded at Palisadoes was 973 mb. It is estimated that the center passed about eight miles south of Palisadoes Airport- that is, about ten miles south of Kingston- and that the pressure at the center, allowing for a five-miles area of uniform pressure in the 'eye', was about 964 mb" (Met Mag). "Damage in Jamaica was estimated at \$15,000,000 to property and \$50,000,000 to crops" (ATS). "After the hurricane left Jamaica, Grand Cayman experienced 92 mph winds in gusts" (MWR). "An Air Force Reconnaissance aircraft flying out of Ramay AFB, Puerto Rico, located the hurricane on 18/2112Z at 18.8N, 81.6W. This fix showed the hurricane had continued on its WNW track at a speed of 15 kt and had weakened somewhat [from its passage over Jamaica]. Maximum winds reported were 75 kt in the northern semicircle, extending 15 miles from the eye. Minimum pressure reported was 982 mb" (ATS).

Next, the reanalyzed positions and intensities for each storm for every six hours are carefully chosen (this process is discussed in the next subsection). Changes are made to HURDAT only when available observations provide enough evidence that the previous HURDAT position or intensity is in error. Typically, changes to the existing HURDAT are only introduced if the position needs to be adjusted by at least 0.2 degrees latitude or longitude and the intensity adjusted by at least 10 kt (Landsea et al. 2008). (The precision of the database is 0.1 degree latitude/longitude and 5 kt for position and intensity respectively.) After the HURDAT tracks and intensities have been reanalyzed, opening and closing paragraphs are added to the metadata for each TC. The opening paragraph contains a sentence explaining whether minor, major, or no changes were made to HURDAT for the cyclone. Track changes of larger than two degrees lat/lon are considered major track changes, and intensity changes of 20 kt or greater are considered major intensity changes. Large changes to the genesis, decay, or structure (TC or extratropical) of the cyclone are also noted in the opening metadata paragraph for each TC. The final sentence of the opening paragraph of the metadata contains all sources/references that were utilized in the analysis for that specific TC. The opening paragraph of the metadata from 1951 Hurricane Charlie is quoted below:

*Minor track changes and major intensity changes are analyzed for this straight-moving Caribbean hurricane that made four landfalls- all with major hurricane intensity. Major changes were also made to the genesis and the timing that tropical storm intensity was attained. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, Fowler (1952), Caribbean station observations, Connor, and Tannehill.*

The closing paragraph(s) of the metadata for each storm contain(s) a summary of the highlight changes introduced into HURDAT and explain(s) the reasoning behind the changes made. The closing paragraphs from 1951 Hurricane Charlie are shown below:

*The origins of a tropical disturbance that would soon become Charlie took shape in the eastern tropical Atlantic Ocean in early-mid August, 1951. The tropical cyclone might have formed from the interaction of a tropical wave with the ITCZ. HURDAT started this system on 12 August at 06Z near 12N, 46W as a 25 kt tropical depression. The 7<sup>th</sup> through the 11<sup>th</sup> of August was searched for data between that location and the African coast, and an observation of 35 kt WNW with 1012 mb at 18Z on 9 August was found at 11.5N, 33.0W (COA). The time series for this ship as well as another ship located somewhat farther away from the center were plotted, and the data indicates the likely existence of a tropical storm at that location. Genesis is analyzed to have begun August 9<sup>th</sup> at 00Z as a 30 kt tropical depression at 12.0N, 28.8W (78 hours earlier and 17 degrees longitude further east than in HURDAT originally). The depression is analyzed to have strengthened to a tropical storm by 12Z on the 9<sup>th</sup> (5 and a half days earlier than in HURDAT originally). A 40 kt intensity is analyzed from 18Z on the 9<sup>th</sup> through 06Z on the 11<sup>th</sup> as the cyclone moved westward in a data sparse region. On the 12<sup>th</sup>, an abundance of ship data in the storm area indicates a very weak closed circulation, and the cyclone is analyzed to have weakened to a tropical depression at 00Z on the 12<sup>th</sup>. A 30 kt intensity is analyzed at all times on the 12<sup>th</sup> and 13<sup>th</sup> (up from 25 kt in HURDAT originally), as data was sparse on the 13<sup>th</sup>. On the 14<sup>th</sup> at 1842Z, an aircraft reconnaissance flight in the area reported a minimum pressure of 1005 mb. There is conflicting information with this report that spreads considerable uncertainty as to whether this value is a central pressure. A central pressure of less than or equal to 1005 mb yields a wind speed of greater than or equal to 37 kt according to the Brown et al. southern pressure-wind relationship. The tropical depression is analyzed to have attained tropical storm strength again by 00Z on the 14<sup>th</sup> (which is still 24 hours earlier than HURDAT lists this cyclone becoming a tropical storm for the first time). Charlie continued westward, and on the 15<sup>th</sup> at 1450Z, aircraft located the center at 14.5N, 59.7W, and a central pressure of 999 mb was measured. Maximum flight-level winds of 90 kt were reported to have been encountered, but the central pressure value recorded indicates that the wind speed is likely too high. The 999 mb central pressure is added to HURDAT at 12Z on the 15<sup>th</sup>. A central pressure of 999 mb yields 49 kt according to the southern pressure-wind relationship. The RMW was slightly smaller than the climatological value and the speed of the storm was 18 kt, so 55 kt is chosen for the intensity at 12Z (up from 50 kt originally) and the 60 kt intensity listed in HURDAT at 18Z on the 15<sup>th</sup> is maintained. All track changes from the 12<sup>th</sup> through the 15<sup>th</sup> are half a degree or less. All intensity changes from the 12<sup>th</sup> through 12Z on the 15<sup>th</sup> are minor upward adjustments. Charlie passed between Dominica and Martinique late on the 15<sup>th</sup>. The position at 18Z on the 15<sup>th</sup> is shifted four-tenths of a degree south of the previous HURDAT position, showing that the center passed closer to Martinique than Dominica*

whereas HURDAT previously showed a possible landfall on Dominica. Observations are only available from the islands every six hours, and no observations of gale force winds from any of the island stations are found. Nevertheless, the HURDAT intensity of 60 kt at Charlie's passage through the islands is maintained. The cyclone then moved west-northwestward into the central Caribbean Sea, and it intensified. On the 16<sup>th</sup> at 1415Z, a central pressure of 992 mb was measured by Navy Aircraft, and this value is added to HURDAT at 12Z on the 16<sup>th</sup>. A central pressure of 992 mb yields 61 kt according to the southern pressure-wind relationship. The RMW was near the climatological value but the speed of the storm was about 19 kt, so 65 kt is chosen for the 12Z intensity on the 16<sup>th</sup> (down from 75 kt originally). It is analyzed that Charlie attained hurricane strength by 06Z on the 16<sup>th</sup> (6 hours later than in HURDAT originally). Later on the 16<sup>th</sup>, at 1935Z, an Air Force plane recorded a 700 mb height in the eye of 9,870 ft which implies a central pressure in the range of 970-990 mb. The next day (17<sup>th</sup>) at 1230Z, a Navy aircraft measured a central pressure of 978 mb, and this value is added to HURDAT at 12Z on the 17<sup>th</sup>. A central pressure of 978 mb yields a wind speed of 78 kt according to the southern pressure-wind relationship for steady state and for intensifying systems, and 85 kt is chosen for 12Z on the 17<sup>th</sup> (down from 95 kt originally). The intensity adjustments made to HURDAT from 00Z on the 16<sup>th</sup> through 12Z on the 17<sup>th</sup> are all minor downward adjustments. At 1837Z on the 17<sup>th</sup>, an Air Force aircraft measured a central pressure of 971 mb, and on the same flight, a 700 mb height in the eye of 9,400 feet was measured, implying a central pressure in the range of 956-974 mb. The 964 mb central pressure in HURDAT at 18Z on the 17<sup>th</sup> is removed and replaced by the 971 mb value, which yields a wind speed of 90 kt according to the intensifying subset of the southern pressure-wind relationship. The 964 mb central pressure that was removed from HURDAT was likely placed into the original HURDAT because of an estimate of the central pressure at Jamaican landfall provided in the *Meteorological Magazine*, but this landfall occurred well after 00Z on the 18<sup>th</sup>, so even if correct, it was listed in the incorrect time slot. The eye diameter reported by the Air Force plane on the flight that measured the 971 mb central pressure was very small and indicates an RMW of about 5 nmi, which is much smaller than the 14 nmi climatological RMW. The maximum high-level (700-mb) wind encountered by the aircraft was 110 kt. The intensity of 95 kt listed in HURDAT at 18Z on the 17<sup>th</sup> is unchanged.

The center of Hurricane Charlie passed very near Kingston, Jamaica and the observation site at Palisadoes Airport (18.0N, 76.8W) around 03Z on 18 August, and landfall in Jamaica occurred around the same time at 17.9N, 76.9W. The vast literature and numerous sources that discuss the hurricane's impact in Jamaica do not mention any lull being experienced at Kingston. All information is consistent and indicates that the right RMW of Charlie passed either over or just south of Kingston around 03Z as the cyclone was moving west-northwestward. Due to the descriptions of the damage and impacts in Jamaica and in Kingston itself, which are indicative of major hurricane winds, along with available meteorological observations, the RMW could not have been very far from Kingston. The minimum pressure recorded at the Kingston (Palisadoes) airport located on the southern coast was 973 mb. The description of Charlie's impact in Jamaica provided in the July, 1952 issue of the *Meteorological Magazine* estimates [using crude methodology] a central pressure of 964 mb. A run of the Schloemer equation was

performed to obtain the central pressure. Two of the four parameters needed are known (the peripheral pressure of 973 mb at Kingston and the OCI of 1010 mb). The RMW and the distance from the 973 mb observation to the storm center are unknown. However, these two values were both estimated in the *Meteorological Magazine*. Also, aircraft reconnaissance provided an eye radius value about nine hours earlier (mentioned above) which indicates an RMW of about 5 nmi. In the Schloemer equation, the ratio of the RMW to the distance from the 973 observation to the storm center is what matters, not the individual values. According to the revised track, the center of Charlie passed 7 nmi from the airport at closest approach, and this is also consistent with the publication. The Schloemer equation was run twice using RMWs of 5 and 7 nmi respectively for each run to obtain a possible range of central pressure values. The run with a 5 nmi RMW yields a 938 mb central pressure and the run that assumes the airport was at the RMW at the time of the minimum pressure yields a central pressure of 951 mb. Since there is some uncertainty in the parameters used, it was decided to average the 951 mb obtained here with the 964 mb central pressure reported by the *Meteorological Magazine*, and a central pressure of 958 mb is chosen for landfall. Although the reliable data indicates that the central pressure was likely 964 mb or lower, there is considerable uncertainty as to how much lower than 964 mb (if any) the central pressure was as Charlie passed south of Kingston and made landfall southwest of Kingston. If 964 mb is assumed to be the central pressure, 964 mb yields a wind speed of 98 kt according to the intensifying subset of the southern pressure-wind relationship. After adding 5 kt for the speed/size of Charlie, 105 kt would be chosen for the landfall intensity. Since a landfall central pressure of 958 mb is decided upon, this value yields a wind speed of 105 kt using the same pressure-wind relationship, and after adding 5 kt for speed/size, 110 kt is chosen for 00Z on the 18<sup>th</sup> (up from 75 kt originally) and Jamaican landfall at 03Z. Although there is little doubt that Charlie impacted Jamaica as a major hurricane, it could have been a Category 4 at landfall. It should be mentioned that the previous HURDAT was faster with Charlie and showed landfall occurring about five hours earlier than the analyzed landfall. The HURDAT intensity at the point just before Jamaican landfall was previously 95 kt, and this intensity is revised upward to 110 kt. The center of Charlie was over Jamaica from 03Z to 07Z on the 18<sup>th</sup>. A run of the Kaplan and DeMaria inland decay model yields an intensity of 84 kt for 06Z on the 18<sup>th</sup>. The next time intensity information is available is 15 hours later. At 2112Z on the 18<sup>th</sup>, aircraft measured a central pressure of 982 mb, and this value is added to HURDAT at 00Z on the 19<sup>th</sup>. A central pressure of 982 mb yields 75 kt according to the southern pressure-wind relationship. Analyzed intensities on the 18<sup>th</sup> for 06, 12, and 18Z are 80, 75, and 75 kt respectively (80, 85, and 90 kt originally). The position of the aircraft fix at 2112Z on the 18<sup>th</sup> is consistent with the 21Z observations of 55 kt and 1000 mb recorded at Grand Cayman, about 50 nmi north-northeast of the center fix. The revised track late on the 18<sup>th</sup> and on the 19<sup>th</sup> is still slower than the previous HURDAT track, and also slightly to the right (north), and these track changes are in agreement with aircraft fixes. On the 19<sup>th</sup>, Charlie continued moving west-northwestward through the western Caribbean Sea. At 1330Z on the 19<sup>th</sup>, a Navy aircraft measured a central pressure of 976 mb and encountered maximum flight-level winds of 115 kt at around 500 ft. A central pressure of 976 mb is added to HURDAT at 12Z on the 19<sup>th</sup>, and this value yields 83 kt according to the southern pressure-wind relationship and 84 kt for the intensifying subset. An

intensity of 85 kt is chosen for 12Z on the 19<sup>th</sup> (down from 105 kt originally- a major change). Next, Charlie approached Cozumel, Mexico, where a minimum pressure of 965 mb was recorded around 0200Z (could have been anytime between 0130Z and 0230Z) on 20 August, but it was unlikely to have been a central pressure measurement. A central pressure of less than 965 mb yields a wind speed of greater than 97 kt according to the intensifying subset of the southern pressure-wind relationship. Cozumel only reported winds at hourly observations, and the highest wind reported at these hourly intervals was 80 kt G 95 kt from the NNE at 0130Z. The previous HURDAT track has the center of Charlie passing south of the island, but the revised track, which is shifted about two-tenths of a degree to the right, shows the center of Charlie passing over the extreme southern tip of the island. The weather station on the island is located on the northern part of the island and likely did not experience calm conditions associated with the eye. It is unknown whether Cozumel experienced a lull associated with the center. The Schloemer equation was run three times, keeping three of the four variables constant and only changing the RMW each time. A value of 1008 mb is used for environmental pressure, 965 mb for the measured peripheral pressure at Cozumel, and 12 nmi for the distance from the station to the center. RMWs of 10, 15, and 20 nmi were used for the three different runs, and central pressures of 932, 947, and 954 mb are obtained. These values yield wind speeds of 130, 116, and 109 kt respectively according to the intensifying subset of the pressure-wind relationship. The HURDAT intensity of 115 kt at 00Z on the 20<sup>th</sup> is unchanged due to the uncertainty in the RMW. The aircraft fix 12 hours before Charlie reached Cozumel reported a 976 mb central pressure with a RMW of about 15 nmi. Charlie then deepened rapidly during the final 12 hours before reaching Cozumel, so there is a distinct possibility that the eye contracted during this time. Charlie is analyzed to have made landfall on the southern tip of Cozumel Island (20.3N, 87.0W) at 01Z on 20 August as a 115 kt hurricane. Landfall in the Yucatan Peninsula is analyzed to have occurred at 03Z at 20.4N, 87.3W with a 115 kt intensity. Charlie was still moving west-northwestward, and the center was over the Yucatan Peninsula from 03Z to 16Z on the 20<sup>th</sup>. Observations from Merida, Mexico indicate that the center passed just north of that station around 14Z. Runs of the Kaplan and DeMaria inland decay model yield wind speeds of 84 and 63 kt at 06 and 12Z on the 20<sup>th</sup> respectively, and intensities of 90 and 70 kt are chosen for 06 and 12Z respectively (down from 115 and 100 kt originally). The minimum pressure recorded at Merida was 986 mb experienced simultaneously with 30 kt winds at 1330Z. Seven hours after the center of Charlie moved into the Bay of Campeche, an aircraft central pressure of 989 mb was recorded at 2243Z on the 20<sup>th</sup>, and this value is added to HURDAT at 00Z on the 21<sup>st</sup>. A central pressure of 989 mb yields 65 kt according to the southern pressure-wind relationship. Charlie is analyzed to have weakened from 115 kt to 65 kt while over the Yucatan Peninsula, and a 65 kt intensity is also analyzed for 18Z on the 20<sup>th</sup> and 00Z on the 21<sup>st</sup> (down from 95 and 90 kt originally). The new positions analyzed for the 20<sup>th</sup> are still about half a degree slower than the previous HURDAT track, continuing the trend that began on 17 August, but by the 21<sup>st</sup> at 12Z, the revised track caught up with the previous HURDAT track at 21.6N, 93.8W (position unchanged). Aircraft central pressures of 988 and 982 mb were measured at 1538 and 2247Z on the 21<sup>st</sup> respectively. These values are added to HURDAT at 18Z on the 21<sup>st</sup> and 00Z on the 22<sup>nd</sup>. A central pressure of 988 mb yields 67 kt and 982 mb yields 75 kt according to the southern

pressure-wind relationship. The RMW was larger than climatology and the speed was about 8 kt. The 65 kt intensity analyzed from 18Z on the 20<sup>th</sup> through 00Z on the 21<sup>st</sup> is kept through 18Z on the 21<sup>st</sup> and increased to 70 kt by 00Z the 22<sup>nd</sup>. At all times on the 21<sup>st</sup>, the 90 kt intensity previously listed in HURDAT is lowered to 65 kt. On the 22<sup>nd</sup> at 1326Z, with Charlie located about 60 nmi east of Tampico, aircraft measured a central pressure of 972 mb, and this value is added to HURDAT at 12Z on the 22<sup>nd</sup>. This flight encountered a maximum flight-level wind of 130 kt around 600 ft. A central pressure of 972 mb yields 89 kt according to the intensifying subset of the southern pressure-wind relationship, and the RMW is larger than climatology. An 85 kt intensity is chosen for 12Z on the 22<sup>nd</sup> (down from 115 kt originally). Major downward intensity adjustments of between 25-30 kt are analyzed at all times from 06Z on the 20<sup>th</sup> through 12Z on the 22<sup>nd</sup>. Charlie is analyzed to have made its fourth (third Mexican) and final landfall at 19Z on 22 August at 22.3N, 97.8W. All information is consistent in that Tampico experienced the calm associated with the eye for 30 minutes. The revised HURDAT track is one-tenth of a degree to the north of the previous track at landfall. The previous track shows the center passing a hair south of the station and the revised track shows the center passing a hair north of the station. The time series of observations reported from Tampico yields uncertainty as to whether the center of the eye passed north or south of the station, but commentary from both MWR and ATS states that Tampico was in the southern edge of the eye and that the center passed just north of the station. The highest wind recorded at Tampico before the passage of the eye was 85 kt from the WNW (or NW) with a 976 mb pressure, and the highest wind recorded after the passage of the eye was 95 kt from the SE. The central pressure was either not recorded or is not available. The lowest available pressure observation at Tampico was 973 mb with 45 kt NE winds inside the RMW. This observation came two hours after the observation with the 85 kt WNW-NW, and it came 30 minutes to 1 hour before the calm eye. Charlie was therefore likely to have been moving slowly. A conservative estimate of the central pressure at landfall is 968 mb (using the 10 kt per mb rule inside the RMW, but this rule is for marine exposure, and Tampico is located somewhat inland). The central pressure was likely slightly lower than that but not significantly lower. The MWR tracks of centers of cyclones chart shows a 960 mb pressure, but it is not known how this value was attained. A central pressure of less than or equal to 968 mb yields a wind speed of greater than or equal to 93 kt according to the intensifying subset of the southern pressure-wind relationship. From this information combined with the 95 kt max wind recorded at Tampico, 100 kt is chosen for 18Z on the 22<sup>nd</sup> and for the 19Z landfall. HURDAT previously listed a 110 kt intensity at 18Z on the 22<sup>nd</sup>, but this intensity was listed in HURDAT previously likely due to the 115 kt placed into HURDAT at 12Z, which was likely based on misleading aircraft winds. Runs of the Kaplan and DeMaria inland decay model yield 69, 50, and 36 kt for 00, 06, and 12Z respectively on 23 August. Highest observed winds within 2 hr of synoptic times are 60, 20, and 30 kt at 00, 06, and 12Z on the 23<sup>rd</sup> respectively. The intensities of 65, 45, and 35 kt listed in HURDAT previously at 00, 06, and 12Z on the 23<sup>rd</sup> are all unchanged. Charlie continued westward and weakened to a tropical depression at 18Z on the 23<sup>rd</sup> as it moved further inland. No changes are made to the timing of dissipation, but the final point is adjusted half a degree north to 22.4N, 99.9W at 18Z on the 23<sup>rd</sup> as a 25 kt tropical depression. Thereafter, the depression dissipated over the high terrain of Mexico.

After the existing TCs during a year are reanalyzed, a thorough search is conducted for potential missing TCs (sometimes referred to as *suspects*) using synoptic maps as well as all other available sources. First, an initial list of suspect candidates is compiled from these sources. For any suspects that appear to have a chance to have been a TC, the COADS ship data is obtained and further analysis is conducted. After conducting a search through all sources for data, if the suspect meets the criteria for adding a new TC into HURDAT, as specified in Landsea et al. (2008), then the system is recommended to the NHCBTCC to be added to the database. Potential new systems must meet the following three criteria specified in Landsea et al. (2008): “1) non-frontal (not an extratropical cyclone); 2) closed surface wind circulation; and 3) at least two separate observations of sustained tropical storm force winds (at least 34 kt) or the equivalent in sea-level pressure (roughly 1005 mb or lower). The two separate observations could come from the same ship/station or two different platforms” (Landsea et al. 2008).

COADS was utilized for all existing storms, all missing storms that are being recommended for inclusion into HURDAT, as well as many suspects that are not being recommended for inclusion into HURDAT. COADS often contains observations that are not found in either HWM or microfilm. However, the vice-versa is occasionally true, and often times there are observations found on microfilm that are not in COADS. An example of the write-up pertaining to a noteworthy suspect in 1951 that is not being recommended for inclusion into HURDAT is shown below:

*HWM, microfilm, COADS, the August and September MWR tracks of lows, August and September Local, State, and National Monthly Climatological Data from NCDC, the 1951 Navy log book (ATS), David Roth, and Jack Beven’s list of suspects indicate that a tropical cyclone formed from an old frontal boundary on 31 August off the Carolina*

*coast. At 00Z on the 31<sup>st</sup>, it was still extratropical and located near 33.5N, 72W. It became a tropical depression by 12Z on the 31<sup>st</sup> near 33N, 75W with an intensity of about 25 kt. By 18Z on the 31<sup>st</sup>, the intensity had increased to 30 kt and it was moving west-southwestward located near 32.8N, 76.2W. By 06Z on 1 September, the 30 kt tropical depression was located near 32.7N, 78.7W, and by 12Z, it was nearing landfall in southern South Carolina south of Charleston. The likely 12Z position on the 1<sup>st</sup> is 32.3N, 79.6W and 18Z position is well inland near 32.1N, 81.8W. The highest available wind recorded from a coastal station was 25 kt (max w/1-min) recorded at Charleston on the 1<sup>st</sup>. The lowest pressure recorded from a coastal station was 1004 mb at Charleston on the 1<sup>st</sup>. A central pressure of less than or possibly equal to 1004 mb yields a wind speed of at least 36 kt according to the Brown et al. north of 25N pressure-wind relationship. Environmental pressures were a little lower than typical, so it may have only been a 30 kt tropical depression. The highest available wind for the entire system is 30 kt recorded at Frying Pan (33.5N, 77.5W) at 18Z on 31 August (the elevation of the anemometer at Frying Pan was not investigated). Since there is only one piece of evidence (the 1004 mb recorded at Charleston) and since there were no gales recorded for the entire lifetime of this system, it is not added to HURDAT. It should be noted that there is a chance that this could have been a 35 kt tropical storm at landfall. No coastal station information could be found for any locations between Charleston, SC and Savannah, GA. This is the #2 suspect for closest to being added in to HURDAT of all the additional notes of 1951.*

<i>DAY</i>	<i>LAT</i>	<i>LON</i>	<i>STATUS</i>
<i>Aug 29</i>	<i>36N</i>	<i>70W</i>	<i>Extratropical</i>
<i>Aug 30</i>	<i>35N</i>	<i>72W</i>	<i>Extratropical</i>
<i>Aug 31</i>	<i>33N</i>	<i>75W</i>	<i>Tropical depression</i>
<i>Sep 01</i>	<i>32.3N</i>	<i>79.6W</i>	<i>Tropical depression</i>
<i>Sep 02</i>	<i>31N</i>	<i>83W</i>	<i>Tropical depression</i>
<i>Sep 03</i>			<i>Dissipated</i>

### **Choosing the position and intensity based on available observations**

Types of data used for track and intensity analysis include data from ships at sea, surface and land-based stations, aircraft data, and radar data. For TCs in the eastern Atlantic far from land, only ship data was used since the other two types of data were not available. The most helpful types of meteorological data for analyzing the position and intensity of a tropical cyclone (when only ship data is available) is data on wind speed, wind direction, and surface pressure. For TCs that are approaching the subtropics and mid-latitudes, temperature and dewpoint data is also helpful to determine whether the

cyclone has acquired fronts. The wind and pressure field typically become more asymmetric as a cyclone transitions to extratropical. Due to the counterclockwise rotation in a tropical cyclone combined with TC inflow, positions are chosen with a 15 degree inflow angle to the wind direction for ship observations within the TC circulation (Landsea et al. 2008). Observations outside of the OCI and the TC circulation, although not as helpful as the closer observations, can still be helpful when there is no data near the TC. For example, if the original HURDAT lists a TC at 12.0N, 33.0W at 12Z on a particular day, and there is one ship observation at 12.0N, 28.0W with a south wind of 10 kt and a pressure of 1014 mb, it will be determined that there is not enough data to change the HURDAT position since it is entirely possible that the position is accurate. However, in another hypothetical example, if HURDAT lists a hurricane center at 18.0N, 50.0W, and a ship observation at 18.0N, 50.5W at that time reports a south wind of 50 kt with a pressure of 1000 mb, the HURDAT position will be adjusted about a degree west to 51.0W. In the absence of aircraft data, a more accurate analysis will depend on the number of ship observations near the TC, the distance of these observations from the TC, the accuracy of the observations, and the ability of these observations to be correctly interpreted in the reanalysis. An important part of this process is realizing when an observation appears to be faulty compared to other surrounding observations. When this occurs, the observation in error is discarded. If there is some uncertainty as to whether an observation is faulty, it is not discarded. All of the available observations are considered as a whole to determine the best possible estimate of the position and intensity. If observations are insufficient in number on a particular day, changes will not be made to HURDAT.

For the period of 1944-1953, aircraft data was available on more than half of the days of all recorded tropical cyclones. For recorded tropical cyclones west of 55W from 1947 onward, aircraft flights were performed on more than three-fourths of the days of all known TCs at that time. The most important goal of these flights back in the 1940s and 1950s was to determine the location of the TC center. An aircraft center fix is a position estimate of a TC from an aircraft flight. The center does not have to be accurately located in order for a center fix to be reported. Sometimes, the center was estimated based on observed pressures and wind directions during circumnavigations, even if the center was not seen on aircraft radar. Aircraft center fixes were performed by penetration, circumnavigation, locating the center on radar, or a combination of methods. Dead reckoning (DR) was the method of navigation and the interception of loran signals (radio signals) was helpful for knowing the plane position with more accuracy. When determining the track, all aircraft center fixes for the entire lifetime of the TC are obtained. The center fixes are then interpolated to 6-hourly positions, placing more weight on the more reliable center fixes. The center fixes from 1948 Storm #3 are shown in Figure 5. Next, all ship data is analyzed to determine whether the positions suggested by the aircraft center fixes are accurate. Occasionally, a ship observation near the center will reveal that the aircraft fix was at least 30 nmi off in one direction compared to the ship. Sometimes there is enough information to determine whether the ship or aircraft navigation was more correct. When there are no such indications, a blend of the ship data and the aircraft is used. If reliable ship observations occur when there is no aircraft data within 12 hours of that time, the ship data will be relied on even more heavily for position estimates. However, for many TCs, there were multiple aircraft center fixes each day.

## 1948 Storm 3

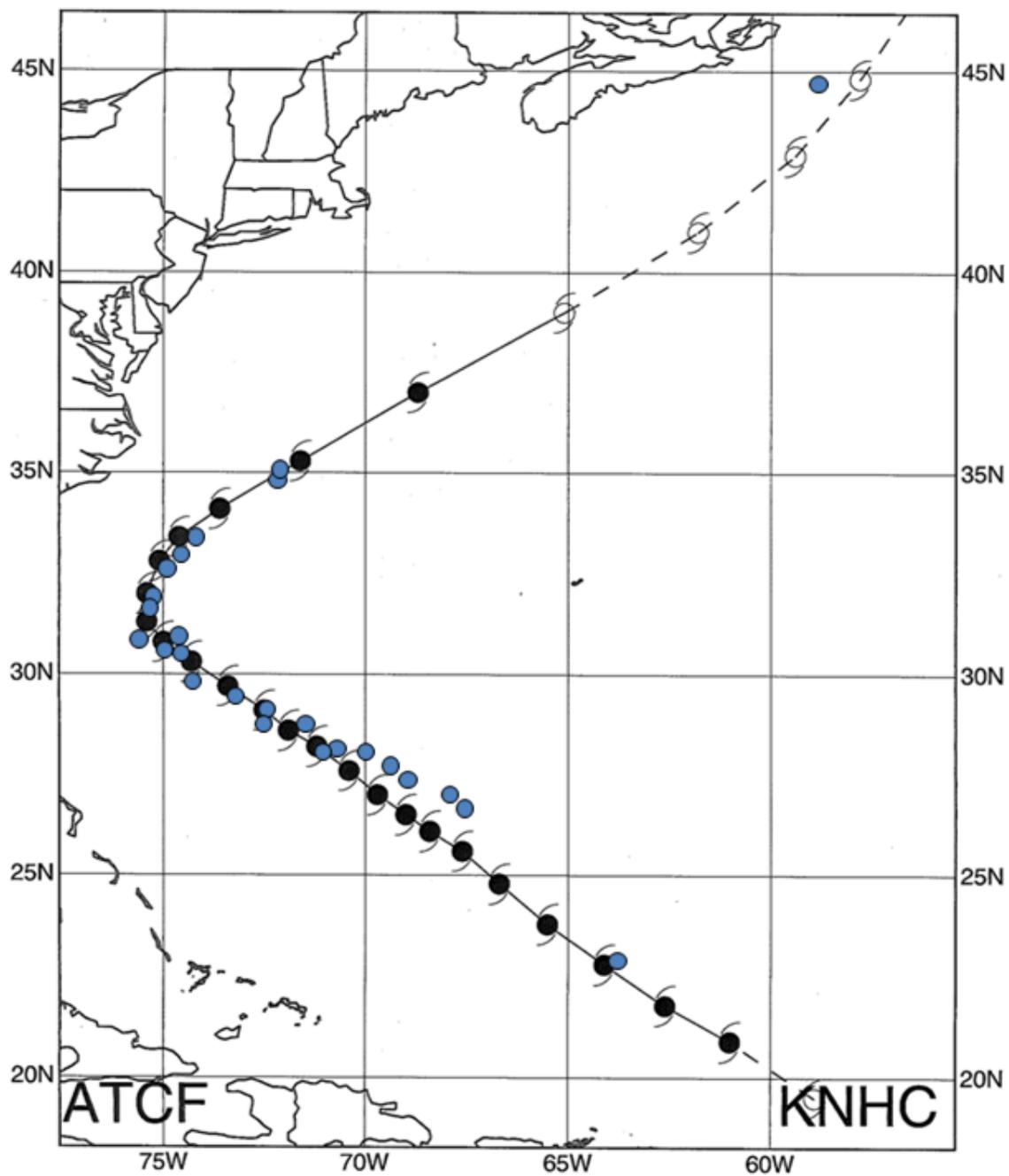


Figure 5. Aircraft center fixes (Teal dots) for 1948 Storm 3. The original HURDAT track (with black hurricane symbols) is also shown.

Beginning in 1950, the operational hurricane forecast center of the U.S. Weather Bureau conducted post-season analyses and drew a best track for all storms. Interestingly, the original HURDAT positions and intensities often do not match this best track. Data available in this reanalysis have shown positions from both sources to be inaccurate on several occasions. Reasons for this include having both more data available about past storms and more meteorological knowledge today.

For the intensity reanalysis, central pressure measurements are relied on as the most accurate intensity information. If no central pressure is measured, but a peripheral pressure is available along with knowledge of the distance of this peripheral observation from the center, the RMW, and the environmental pressure, the central pressure can be calculated using the Schloemer equation (Schloemer 1954)

$$\frac{P_R - P_0}{P_n - P_0} = e^{\frac{-RMW}{R}}$$

where  $P_R$  is the observed sea level pressure at radius  $R$ ,  $P_0$  is the central pressure, and  $P_n$  is the environmental pressure. The Schloemer equation is only utilized if these other variables are known with a high degree of accuracy and confidence.

### **Category 5 hurricanes**

For the Category 5 study, a new methodology is developed to determine whether the ten most recent Category 5 hurricanes in the Atlantic (from Hurricane Andrew in 1992 to Hurricane Felix in 2007) would have been recorded as Category 5 hurricanes if they had occurred during the period of the late 1940s. All observations available to NHC associated with these hurricanes are utilized for this study. This includes surface based

observations from ships and land stations, aircraft observations including information from dropsondes and SFMR, land-based Doppler radars as well as aircraft radars, and all geostationary, microwave, and scatterometer satellites. During the late 1940s, much of this technology did not yet exist. Therefore, only those observations that would have been available during the late 1940s are utilized for determining what peak intensity would have been recorded if the hurricane had occurred during the late 1940s. This methodology excludes all satellite observations, but includes all surface-based observations including all buoy and C-MAN stations even if they went into operation post-1950 (a conservative methodology). Also, surface observations that are considered by NHC to have been “unofficial observations” are included as information to be utilized for this study. Since aircraft would only penetrate the center of tropical storms and weak hurricanes during the late 1940s, it is assumed that no aircraft could penetrate the center of a hurricane with a central pressure of less than 950 mb. Also, aircraft intensity information was only available during daylight hours during the late 1940s since the sea-surface is not visible at night. Due to these considerations, all aircraft wind and pressure observations at night are excluded. All aircraft pressure observations of less than 950 mb are excluded. For aircraft fixes during which the central pressure was less than 950 mb, the late 1940s intensity is determined by utilizing the Brown et al. pressure-wind relationships for 950 mb, and then adding 5 kt to account for the fact that the central pressure is actually some value lower than 950 mb. Aircraft surface wind visual estimates of the ten recent Category 5 hurricanes are included (excluding SFMR data), but only at times when the central pressure is 950 mb or higher. After eliminating intensity observations that would not have been available during the late 1940s, new best

track intensities are drawn for the entire lifetime of these TCs. After performing these analyses, answers to five questions are addressed: (1) Would the Category 5 hurricane have been recorded as a Category 5 if it had occurred during the late 1940s? (2) What intensity would the storm have been assigned at the time it was a Category 5 and why? (3) What/when was the strongest wind/lowest pressure for the storm that would have been used to determine the intensity during the late 1940s, and how was the best track intensity decided upon? (4) What would the U.S. landfall intensity have been (where applicable) with late 1940s technology and why? (5) How would the total ACE for the hurricane have been different? These questions were answered for all ten Category 5 hurricanes and are discussed in the results section.

According to the NHC best track, the average Category 5 duration for the ten recent Category 5 hurricanes is ~1.4 days. Observations of peak intensity in strong hurricanes were much less common during the late 1940s compared with more recently, and the ability to measure the central pressure of major hurricanes was limited during the late 1940s (unless the storm made landfall near/at a weather station or in a somewhat populated location. The only way that a Category 5 hurricane over the open ocean would have been counted as a Category 5 in this study is if a ship (or buoy) recorded Category 5 strength winds or a corresponding pressure value, which barely ever happens. However, if a Category 5 hurricane makes landfall at or near a weather station or near a place with a sufficient coastal population, then it is certainly possible that Category 5 conditions would have been recorded. Of the ten Category 5 hurricanes in this study, four of them made landfall as a Category 5 (Andrew- south Florida, Mitch- Swan Island, Dean-

Mexico's Yucatan Peninsula, and Felix- Nicaragua), but this does not necessarily mean these would have been recorded as a Category 5 hurricane if they had occurred during the late 1940s.

## CHAPTER 4

### AIRCRAFT RECONNAISSANCE

The first year during which routine planned military aircraft reconnaissance missions were conducted into Atlantic hurricanes and tropical storms was 1944 (Sheets 1990, Summer 1944b, Porush and Spencer 1945). Different types of aircraft were utilized for reconnaissance missions during the first decade of aircraft reconnaissance. The Army Air Force (AAF) Hurricane Reconnaissance Unit operated four B-25 aircraft in 1944 (Porush and Spencer 1945). A drift meter was installed on these aircraft for flight-level wind speed measurements. The B-25 in 1944 contained a pressure altimeter, but not a height altimeter. In 1944, surface pressures were either not measured or not reported because no aircraft central or peripheral pressures could be found from all of the available 1944 data used for the reanalysis. In 1945, some surface pressures began to be reported. Surface and flight level wind speed and direction are available from 1944 onward. B-29 aircraft were used by the Air Force (formerly the AAF) from 1946 to beyond 1953 (the final year of this study). The Air Force 53<sup>rd</sup> Weather Reconnaissance Squadron, which operated the B-29, flew out of various locations including Bermuda and Ramey Air Force Base, Puerto Rico. The Air Force also utilized B-17 aircraft during 1947 (Sheets 1990; AWS 1948, 1949, 1951).

According to Porush and Spencer (1945), the Navy conducted flights into storms during 1944 as well. In 1944 and 1945, the Navy used a version of the B-24 called the PB4Y-1 Liberator for Atlantic hurricane reconnaissance (Reade, personal communication, 2010). In 1946, the Navy switched to the PB4Y-2 Privateer aircraft for low-level hurricane reconnaissance. The PB4Y-2 was the aircraft that was utilized the

most by the Navy for Atlantic hurricane reconnaissance from 1946-1953, and in 1953, the Navy added the P2V aircraft to compliment the PB4Y-2. The Navy VP-23 squadron (based in Miami, FL) operated the PB4Y-2. The Navy also operated a PB-1W aircraft (the Navy version of the B-17) equipped with an Airborne Early-Warning (AEW) radar starting in 1947 as an extra aircraft utilized only for U.S. hurricane landfall threats (NHC microfilm; AWS 1951; Reade, personal communication, 2010).

The Navy PB4Y-2 was used for low-level flying only (defined here as 0-2,000 ft altitude) beginning in 1946 (Neumann, personal communication, 2010). The PB4Y-2 contained four engines. The radar onboard was virtually useless and was rarely used because rainfall heavily attenuated the signal. Night flights were not performed with the PB4Y-2 because low-level flights were not conducted at night because of the inability to see the ocean's surface in darkness. The aircraft was equipped with a high quality radar altimeter so the in-flight altitude readings were reliable. But the pilot only had a pressure altimeter that was not very useful for low-level flights into hurricanes. The flight aerologist, located some distance from the pilot had use of the height altimeter. During hurricane penetrations, one of the crew members stood behind the aerologist and relayed the altitude to the pilot over the intercom. It was not unusual for downdrafts to bring the plane down to 300 feet. The automatic pilot feature was used to help keep the plane level. Loss of automatic pilot was a reason to abort the flight (Neumann, personal communication, 2010).

The B-29 also contained four engines (Sheets 1990). In 1947, the B-29 was used only sporadically by the Air Force, but in 1948, the B-29 was much more heavily utilized, especially for high-level surveillance, but not very often for hurricane

penetrations (AWS 1948, 1949). The B-17 was heavily utilized by the Air Force during 1947 for low-level hurricane penetrations, but the Air Force decided to stop using the B-17 after the 1947 season (AWS 1948). In 1950, the Navy utilized the PB-1W for radar fixes at night, but penetrations were not performed. The PB-1W was equipped with an AEW radar for performing center fixes from the periphery of hurricanes at night for U.S. hurricanes threats (AWS 1951). The AEW radar was the best (least attenuation) aircraft radar in existence by that time (Reade, personal communication, 2010).

Beginning in 1953, the P2V aircraft began being used by the Navy to compliment the PB4Y-2 aircraft (Neumann, personal communication, 2010; Sheets 1990). This 2-engine P2V aircraft differed from the 4-engine PB4Y-2 aircraft. Although the P2V aircraft had a longer range, was more reliable, and was equipped with a much better radar than the PB4Y-2, it did not afford the flight aerologist with adequate sea surface viewing (which is necessary for estimating surface wind speed- discussed later). For this reason, the P2V was not a very useful aircraft for reconnaissance, but it was new whereas the PB4Y-2s were old. There was not any new instrumentation on the P2V compared with the PB4Y-2 for measuring wind or pressure, and aneroid barometers were used on the P2V.

During the first decade of aircraft reconnaissance, aircraft observation capabilities were significantly more limited than they are today. The aircraft of today (including the P-3s, C-130s, G-IV, etc.) contain many more instruments and recent innovations for observing more accurate and continuous observations of wind, height/pressure, temperature, moisture, precipitation, etc. (NHOP 2009). Observational capabilities and techniques, prepared flight patterns, and flight rules and guidelines often changed,

sometimes on a yearly basis, especially during the first decade of aircraft reconnaissance. The military was still becoming accustomed to hurricane reconnaissance and learning the most efficient ways to operate that maximized the quantity and quality of important meteorological data to forecasters while maintaining the safety of the flight crew. There were some changes and advances in pre-season plans and observing techniques and aggressiveness throughout the first decade of aircraft reconnaissance. It is clear that as time went on during the decade, aircraft reconnaissance gradually improved. The most significant changes occurred between the 1949 and 1950 hurricane seasons, especially as to observing surface pressures indicative of major hurricanes and obtaining center fixes. For example, penetrations would be performed more often and central pressures for moderate intensity hurricanes were much more frequently reported after 1950.

The types of flight patterns utilized by aircraft for hurricane reconnaissance can be separated into two general groups. One group is the low-level penetrations. When aircraft are able to penetrate the eye at low-levels, a central pressure can be reported and the reanalysis of intensity generally is much more accurate. An example of a low-level penetration from 1948 Storm 5 by a Navy reconnaissance aircraft in the north central Gulf of Mexico is shown in Figure 6. It was reported that a central pressure of 990 mb was measured on this flight. The other common type of flight method is called circumnavigation. Low-level circumnavigation was generally performed for major (Saffir-Simpson Category 3-4-5) hurricanes. Sometimes, penetration would be attempted, but in many cases, when the 75 kt isotach was encountered, the pilot would abort penetration and commence circumnavigation. A classic example of the circumnavigation flight technique from a flight in 1948 Storm 3 on the afternoon of



## Hurricane Flight Track

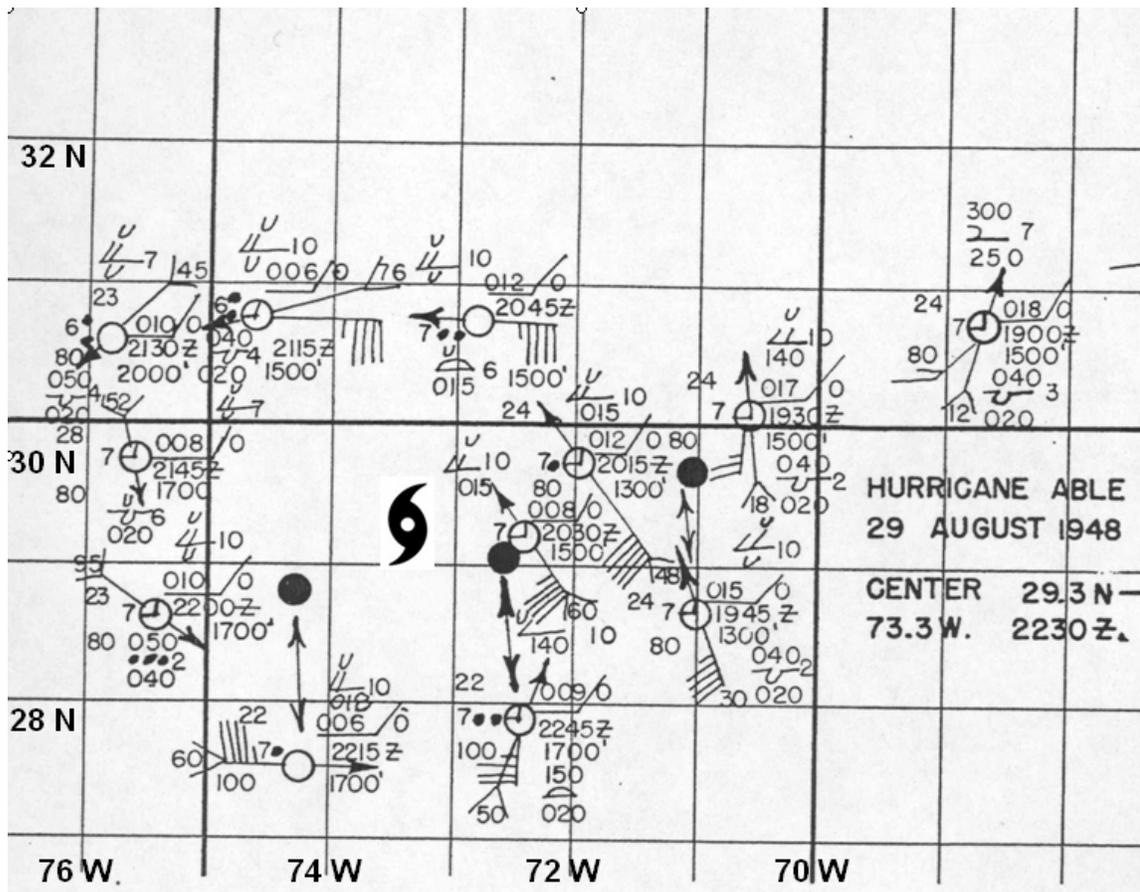


Figure 7. The August 29, 1948 afternoon flight track from 1948 Storm #3. The figure shows observations recorded every 15 minutes of an aircraft circling around the periphery of the hurricane, never penetrating closer to the center than the 1006 mb isobar. Flight-level wind speeds (kt) are indicated by the number shown in the tail of the wind barb. For example, focusing on the observation at 27.5N, 74.2W, the flight-level wind is 60 kt from the west at a flight-level of 1,700 ft at 2215Z. Surface wind (obtained from visual surface estimates) is indicated by the wind barbs where 1 barb is equal to 2 forces of wind on the Beaufort Scale (four and a half barbs is equal to 40 kt). Pressure at the location of the aircraft extrapolated down to the surface is shown above and to the right of the circle (in whole millibars with the first digit removed- 1006 mb in the example observation at 27.5N, 74.2W). Other numbers pertain to clouds, temperature, and humidity. The estimated center fix position is indicated by the tropical cyclone symbol. (Figure from AWS 1949).

the navigator calculated the new position of the aircraft based on the speed and direction the aircraft was traveling during the previous 30 minutes. Once the periphery of the TC was reached, the new position would be calculated every 15 minutes. Most flights during the 1940s and many flights during the early 1950s used the TC azimuthal winds as a tail wind to gradually circle closer to the center of the TC before deciding to perform penetration or to simply circumnavigate the storm. Because of the frequent heading changes in high wind conditions, navigators often fell behind in their position calculations (Neumann, personal communication, 2010). The navigational position error was dependent on the distance from the TC to any land/island and on the amount of time spent by the aircraft in high wind conditions as well as the intensity of the winds. The reported aircraft positions and center fixes when DR is the only method used should be considered an estimate, accurate perhaps to within 35 nmi about 50% of the time. This figure of 35 nmi for the average error for center fixes obtained by DR only was derived after estimating that aircraft center fixes on average (including more accurate methods such as when loran and radio fixes are used) are accurate to within half a degree latitude/longitude (30 nmi) 50% of the time. The reason why these figures are close is because loran and radio signals were only available on about 25% of flights to improve the DR position fix. This DR method was used from 1944 to beyond 1953 for low-level aircraft reconnaissance (Neumann, personal communication, 2010). In one case during 1946 (not shown), an NHC microfilm synoptic weather map shows that two different aircraft reported center fixes at the same time 60 miles apart. The position of one or both of these aircraft was obviously in error.

Aircraft center fix position accuracy could also be aided by intercepting radio or loran signals. The aircraft must have been in a location where radio signals can be intercepted, and this was only accomplished sometimes (on ~25% of flights). Although DR was used on all reconnaissance flights, whenever loran was available, positions are considered more accurate than when loran is not available.

In some cases, the center could not be located even after penetration was attempted. Aircraft radar aided with this process sometimes, but for PB4Y-2 flights, unless the aircraft was very close to the eye, attenuation would prevent the eye from being seen on the radar display. The Navy radar aircraft (PB-1W), which performed center fixes at night for U.S. landfalling hurricane threats beginning in the late 1940s, had an AEW radar onboard, which was much better than the radar on the PB4Y-2s (USAWS 1951). The Navy radar aircraft did not usually attempt to penetrate the center. This aircraft flew to the periphery of the TC, located the center with the radar and reported a position. Since the aircraft always only flew within a few hundred nmi of land, the aircraft positions were likely known with a good degree of accuracy despite the darkness of night.

Night radar flights were only conducted by the Navy with PB-1W aircraft for U.S. landfalling hurricane threats prior to the use of the P2V, but with the better radar of the P2V, night flights started being conducted more often. The only purpose of night flights was to perform center fixes (to report the position of the TC), and this would be accomplished by locating the storm on aircraft radar and not by penetrating the center (in most cases). Surface wind speed could not be estimated at night because the sea-surface is not visible at night. Navigation at night was surprisingly nearly as good as daylight

navigation. The stars would sometimes be used to aid in position estimates, though the accuracy of this was limited. The navigator could also identify the position of the aircraft by locating islands visually or by radar (Neumann, personal communication, 2010).

Low-level eye or center penetrations were only conducted for tropical storms and weak hurricanes and usually were not attempted at night. Intense hurricanes were not generally penetrated and would instead be circumnavigated. This is important because central pressures obtained via low-level eye penetrations were accurate and are relied on as the most credible intensity information for reanalyzing these TCs via the Brown et al. (2006) pressure-wind relationships. Central pressures reported by aircraft were accurate because the pilot and navigator knew the pressure of the aircraft, and the navigator knew the height of the aircraft at all times. Pressures in the storm center, or eye, could therefore easily be extrapolated down to the surface from low-levels. The Brown et al. pressure-wind relationships are utilized for the reanalysis where central pressures are available. Unfortunately, aircraft central pressures were only reported occasionally during the daytime for tropical storms and weak hurricanes, and much fewer aircraft central pressures were reported during the years 1944-1949 than from 1950 onward (as shown in Figure 10 in the results section).

Surface winds on low-level reconnaissance flights were estimated visually by viewing the foam/sea-spray state of the sea. The determination of wind speed was made by the aerologist onboard. These surface wind speed estimates often contained high biases (discussed later). No standardized systematic method of visually estimating the wind speed from the sea-state existed until 1952 when a sea-state wind speed catalog was published (Neumann 1952). A photo from this publication corresponding to 70 kt surface

winds is shown in Figure 8. Flight-level winds were measured more objectively, by taking drift measurements, but these likely contained significant errors as well that increased with increasing winds (Willoughby, personal communication, 2010). The Navy, which was very influential in hurricane forecasting and best-track preparation from 1946-1964, placed considerable reliance on the maximum wind reports from the aircraft. This may have led to many overestimates of intensity in the best tracks due to the high-biases of sea-state wind estimates. These often highly inaccurate guesses were placed into the official best tracks and are the values found in the original HURDAT database (Neumann, personal communication, 2010).

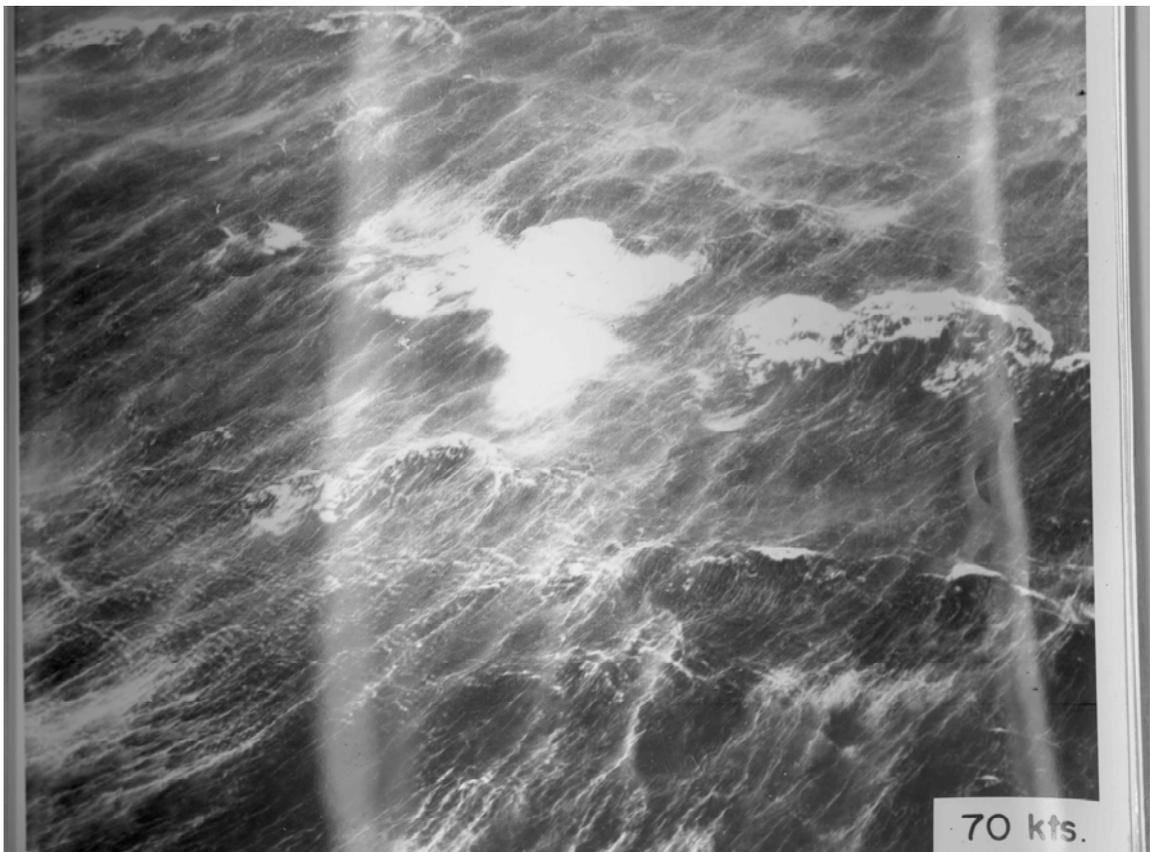


Figure 8. Photo of the sea-surface in 70-kt winds (photo from Neumann 1952).

During the six years of 1944-1949, on average there was less than one reported aircraft central pressure per TC (a very low number compared to dozens or perhaps hundreds today). Operational intensities in the 1940s and 50s were assigned based on the aerologist's guess of the maximum winds in the storm. No pressure-wind relationship was used because knowledge of these relationships was very primitive until the publication of Kraft (1961). For the purposes of the reanalysis, significantly more weight is placed on central pressure observations than both surface wind estimates and flight-level wind speed measurements for determining intensity. Due to the fact that major hurricanes were almost never penetrated between 1944-1949, central pressures below 970 mb were only reported on six occasions (in only three separate hurricanes) out of 43 aircraft central pressures obtained during the entire 6-year period. A central pressure lower than 950 mb was only obtained one time- in 1947- a year during which the pre-season flight plans were more daring with regards to hurricane penetration than all other years from 1944-1949 (AWS 1948, 1949). For flights when central pressures were not reported, the estimated surface winds and measured flight-level winds are not used verbatim to make changes to the HURDAT intensity; however, they are taken into consideration and weighted slightly in many cases. Regardless of the types of observations available, changes are made to HURDAT only if there is enough convincing evidence that the previous HURDAT intensity is incorrect.

For these reasons, the years 1944-1949 are grouped together for the Category 5 study, which assumes that aircraft could not penetrate the center for major hurricanes with central pressures of less than 950 mb. From 1944-1949, almost no successful penetrations were performed for major hurricanes. All penetration attempts from 1944-

1949 were performed at low levels and only during daylight hours. High-level flying (~3,000 – 11,000 ft) was only conducted for surveillance via radar fixes, not for penetration. In 1950, several practices changed. For many tropical cyclones east of about 70W longitude, the B-29 Air Force plane would penetrate TCs at 700 mb. The 700 mb height in the eye would often be reported. Also, 1950 is believed to be the first year during which dropsondes were used regularly in the Atlantic for TC monitoring. Information regarding the surface pressure encountered by the dropsonde just before splash landing was received by the plane crew. However, there was no wind information or position information for the dropsondes, so these surface pressures cannot be considered central pressures as many of them would splash under the eyewall (Willoughby, personal communication, 2010). Most of the dropsondes were released in the eye from approximately the 700 or 500 mb levels, but occasionally, the aircraft would fly as high as 25,000 ft to drop a sonde. Extrapolation of surface pressure from 700 mb was not performed since temperature data outside the aircraft either was not available or not reported. Extrapolations of 700 mb heights to obtain surface pressures without temperature data is considered to have errors too large to be counted as central pressure values in HURDAT. Nevertheless, the combination of reported 700 mb heights and dropsonde pressures complimented accurate central pressures from low-level penetrations to provide more intensity information than was available during the 1940s. In addition, operating procedures for low-level flights changed slightly in 1950. It appears that low-level penetrations were performed (or at least attempted) for slightly stronger hurricanes beginning in 1950 compared with the 1940s (about 1 Saffir-Simpson category stronger on average). Nevertheless, it was still a common occurrence in the 1950s for a plane to

attempt a penetration and have to abort before the RMW or even the inner core was reached due to extreme turbulence causing the plane to become uncontrollable. Beginning in the early 1950s, for intense hurricanes with medium and large sized eyes, aircraft would occasionally penetrate at the 700 mb level, descend in the eye so an accurate central pressure could be obtained, and then reascend and depart the storm at the 700 mb level. An example of this from a quote found on NHC microfilm from an aircraft reconnaissance report for Hurricane Carol (1953) is as follows:

*“Storm center position two eight five one north - six six five five west - loran fix - lowest seven hundred millibar height eight five four zero feet - eye well defined... will descend to one five zero zero feet to secure sfc pressure and winds”* (NHC microfilm).

There were a total of 43 central pressures reported by aircraft reconnaissance during the six-year period of 1944-1949. Only one of these was less than 950 mb, and only five of these were between 950-970 mb. There were 15 times when aircraft reported central pressures between 970-989 mb, and aircraft central pressures of 990-1009 mb were reported on 22 occasions during the 1944-1949 period. The number of aircraft central pressures may have been greater (for any or all of those pressure bins) if some values were not reported and archived. During the four year period from 1950-53, 150 aircraft central pressures were reported. About 38 aircraft central pressures per year were reported in 1950-53 compared with about 7 aircraft central pressures per year from 1944-1949. In 1950, the lowest aircraft surface pressure obtained was 943 mb from a dropsonde in Hurricane Dog, and this value may not have been a central pressure and thus is grouped into a separate category for *possible central pressures/peripheral pressures*. The lowest aircraft surface pressure in 1951 was 937 mb in Hurricane Easy,

and this value was a central pressure obtained by low-level penetration. The lowest aircraft central pressure obtained during the first ten years of Atlantic aircraft reconnaissance was 929 mb in Hurricane Carol of 1953. Penetrations and obtaining/reporting central pressures were not the highest priorities during the first decade of aircraft reconnaissance, especially from 1944-1949. The most important priority was locating the position of the center (and thus determining a direction and speed of movement). Secondary priorities included estimating or measuring the maximum wind speed of the cyclone, estimating the size of the storm, reporting eye diameter (when possible), central pressure or lowest pressure encountered, cloud type, and perhaps writing a short description of how well the center is organized (AWS, 1948, 1949, 1951). It was generally known by meteorologists during the first decade of aircraft reconnaissance that normally, as the maximum winds in a hurricane increase, the central pressure should decrease, but specific knowledge of pressure-wind relationships did not exist during this time. It was common for a central pressure to be reported with a maximum wind estimate for which the maximum wind estimate was 20 to sometimes more than 40 kt above what the central pressure would suggest according to the Brown et al. (2006) pressure-wind relationship. For example, in Hurricane Baker of 1952, an aircraft center fix reported a 993 mb central pressure and 130 kt maximum flight-level winds encountered (Raftery 1953). The flight-level wind of 130 kt reduces to 104 kt at the surface after multiplying by the appropriate reduction factor of 0.80 for low level flights of 1000 feet or less (Franklin et al. 2003). According to the Brown et al. southern pressure-wind relationship, a central pressure of 993 mb yields 59 kt. The RMW at that time was about half of the climatological value, and a 70 kt intensity is chosen for that

time in the reanalysis (down from 90 kt in HURDAT originally- a major change). This type of scenario was common during the first decade of aircraft reconnaissance. There has been no systematic change to the way aircraft central pressures have been observed and reported from the 1940s to today, but there have been many significant changes to the way the maximum wind speed has been measured, estimated, and reported by aircraft reconnaissance (Landsea 1993, Franklin et al. 2003).

It is important to understand the difference between surface wind speed visual estimates based on the sea-state conditions and the estimated maximum storm intensity. The former is an estimate of the local surface wind speed near the location of the aircraft. The latter is a guess of the maximum storm intensity by the onboard aerologist even if the most intense part of the cyclone is not sampled. If the aerologist believed that the aircraft sampled the most intense part of the cyclone, then the former and the latter were equal. This is usually assumed in the reanalysis for low-level eye penetrations unless there is a statement indicating that the most intense quadrant was purposely avoided. The latter were not given much weight at all in the reanalysis efforts. For circumnavigations, the maximum visually estimated surface wind speed should not be equal to the guess of the maximum storm intensity as the circumnavigations were conducted outside of the eyewall and RMW region.

Surface wind speed visual estimates based on the sea-state observed from an altitude of 2,000 feet or less are believed to have been generally accurate to within 15 kt the majority of the time for tropical storms and Category 1 hurricanes from 1944-1953. There was likely a high bias (estimated at 5 to 8 kt on average). However, as described above, this does not mean that estimated maximum storm intensities were accurate within

15 kt the majority of the time. Surface wind visual estimates are local to the aircraft location, and if an aircraft was unable to penetrate as far as the RMW, the maximum observed surface wind speed would be lower than the maximum storm intensity. However, during most flights, the aerologist was required to provide a best estimate of the maximum intensity of the storm regardless of whether the most intense portion of the storm was sampled. In cases for which the center could not be penetrated after attempting, the aerologists almost always reported intensities of 100 to more than 120 kt, even if the maximum visual surface wind and maximum flight-level winds encountered were significantly lower than that reported value. Quotes from the Air Weather Service report and the Navy Annual Tropical Cyclone report for Hurricane Dog of 1950 provide a good example of a maximum intensity guess that was made on September 6, 1950:

*“At noon on the 6<sup>th</sup> the Navy flight circumnavigated the storm center and on the north side reported tremendous SE swell estimated 100 feet high. On the basis of these the weather observer wrote, ‘It is believed that highest winds near the center were probably in excess of 150 kt’ ” (AWS 1951).*

*“As in previous flights into this storm, no penetration was planned because of the severity of the turbulence...it was considered desirable and adequate to circumnavigate at approximately the 70 kt wind circle. Features of this flight include the observation of the extremely large swells ahead of the hurricane, and the extent of hurricane winds over a very large area. It is believed that highest winds near the center were probably in excess of 150 kt” (ATS 1950).*

These practices often led to many high biases in reporting maximum winds (for hurricanes that were not actually that strong in reality). During many cases, including cases when penetration was successful, the maximum flight-level wind encountered would often be reported as the storm intensity, leading to additional high biases in HURDAT since the maximum flight-level (400 – 1000 ft) wind encountered during

penetration cases is usually higher than the maximum surface winds in a TC (Franklin et al. 2003). There were many cases when aircraft penetrated the center, reported a central pressure and also reported a maximum wind estimate. Many of these reported wind speeds are 20 to more than 40 kt above what the Brown et al. (2006) pressure-wind relationship would suggest.

An additional complication regarding the issue of using surface wind estimates, flight-level wind measurements, or maximum intensity estimates regardless of whether penetration occurs and the most intense part of the storm is sampled is that often times reports from the flights available for the reanalysis are unclear as to what type of wind is being reported- a surface wind, maximum flight-level wind encountered, or maximum storm intensity estimate. About one-third of all aircraft wind reports are unclear in this regard. For this reason and other reasons (mentioned later in this section), wind estimates and measurements for aircraft are only weighted slightly in the reanalysis compared to any available central pressure measurements. Slightly more weight is placed on aircraft winds for cases when the wind level and observing method are known as compared with almost no weight being placed on aircraft winds when there is considerable uncertainty as to whether a surface wind is being estimated, a flight-level wind is being reported, or a maximum storm intensity is being guessed.

### **Error Estimates for Aircraft Reconnaissance**

An assessment of the accuracy and bias of aircraft wind speed estimates is conducted. The evaluation is performed only when an aircraft observed central pressure was available. Since these central pressures have been placed into the revised HURDAT

data file, they are compared with the wind speed values in both the original and the revised HURDAT database. The original and revised HURDAT winds are then compared with the Brown et al. (2006) pressure-wind relationship value for the reported central pressure to calculate average biases for various central pressure bins. The Brown et al. curve utilized for this statistical analysis is an average of the southern pressure-wind relationship with the pressure-wind relationship for 25-35N. As was previously stated, the original wind speeds in the Best Track were usually taken directly from the aircraft reconnaissance wind speed estimates. This objective method is not a perfectly random data sample because for TCs that were major hurricanes in reality, central pressures were observed much less frequently. For TCs that were tropical storms and Category 1 hurricanes in reality, central pressures were observed much more frequently.

The results of the method are shown in Table 4 and Figure 9. For times when aircraft reconnaissance reported a central pressure value (1944-1953), the intensities in the original HURDAT database contain an average error of 16.5 kt with a bias of +13.3 kt compared to the wind speed suggested by the Brown et al. pressure-wind relationships (the data only uses 193 of the 6-hourly HURDAT points during the entire ten-year period). This positive bias decreases with increasing intensity as shown in Table 4. The high standard deviation seen in the aircraft wind speed biases (about 15 kt) suggests a limited knowledge of pressure-wind relationships and a lack of standardized reliable wind observations. The values obtained for the original HURDAT are much worse than those obtained for the revised HURDAT (4.5 kt for average accuracy and +2.7 kt for average bias). There are a few possible reasons for why the average bias in the revised HURDAT is not exactly zero (as it was hoped that the biases in HURDAT could be

eliminated with the reanalysis). One reason could be that the Brown et al. curve utilized for this comparison is not an exact match for the average applicable Brown et al. curve. Another reason is that the size, speed, RMW, and environmental pressure were not taken into account on a case-by-case basis for this comparison. If more than half of the storms were smaller than climatology or fast-moving, it would lead to an apparent average high bias. A third reason is because the central pressures that are compared with the maximum wind speeds can be off in time by as much as three hours. For TCs undergoing rapid intensity changes, the analyzed wind speed could differ significantly from the pressure value in the same time slot. Although the average bias in the reanalyzed HURDAT is not zero according to this analysis, the value of +2.7 kt is significantly improved over the value of +13.3 kt indicated by the original HURDAT maximum winds for cases when central pressures listed in the revised HURDAT are due to aircraft reconnaissance pressure information only. A graphical representation of the data utilized for Table 4 is shown in Figure 9.

Wind Speed Biases based on Aircraft Data (Revised vs. Original HURDAT)  
Brown et al. Method

Aircraft central pressure (mb)	Average accuracy (kt)		Average bias (kt)		Stdev of biases (kt)	
	Revised	Original	Revised	Original	Revised	Original
All (N = 193)	4.5	16.5	2.7	13.3	5.1	14.8
990-1009 mb (N = 90)	5.3	17.1	3.8	15.9	5.6	13.9
970-989 mb (N = 73)	3.5	16	1.9	13.6	4	13.1
929-969 mb (N = 30)	4.2	15.8	1.2	4.6	5	18.2

Table 4. Wind speed accuracy (MAE) and biases of the original vs. revised HURDAT measured against the Brown et al. pressure-wind relationships for times when central pressures are listed in the revised HURDAT that are there only because of aircraft pressure observations. Accuracy and standard deviation of biases can only be positive numbers since they are absolute values. All average bias data are positive biases. The data used to construct Table 4 and Figure 9 is identical.

### **Additional discussion on aircraft error estimates**

Visual surface wind speed estimates on low-level flights (below 2,000 ft) for actual surface winds of 80 kt or less near the location of the aircraft between 1944-1953 are determined to have been accurate to within 12 kt on average. Average bias is estimated to be about +7 kt for these cases. Visual surface wind speed estimates on low-level flights (below 2,000 ft) for actual surface winds of 85 kt or greater near the location of the aircraft between 1944-1953 are determined to have been accurate to within 15 kt on average. Average bias is estimated to be about +8 kt for these cases.

Visual surface wind speed estimates for flights between 2,000 – 5,000 ft for actual surface winds of 80 kt or less near the location of the aircraft are determined to have been accurate to within 15 kt on average. The average bias is estimated to be about + 8 kt for these cases. It is important to note that there are not many cases that fit into this category because surface winds could only be estimated visually if the sea-surface was visible. In most cases, clouds extend down to well below 2,000 feet, so this is only valid for cases/locations when the sea-surface is visible. Visual surface wind speed estimates for flights between 2,000 – 5,000 ft for actual surface winds of 85 kt or greater near the location of the aircraft are determined to have been accurate to within 20 kt on average. Average bias is estimated to be about +10 kt for these cases. Visual surface wind speed estimates for flights above 5,000 ft for actual surface winds near the location of the aircraft should be disregarded altogether due to very large errors and very few cases.

Flight-level winds contained slightly less error than the surface winds for low wind speeds only (~Category 1 hurricanes and weaker) since flight-level winds were obtained more objectively than visual surface winds estimates. For winds stronger than a

Category 1 hurricane, flight-level winds were just as erroneous as surface wind estimates. This large error for high wind conditions is for the same reason that position errors contained more error in high wind conditions. In concordance with drift meter measurements for measuring flight-level wind, the flight-level winds were calculated by the navigator along with the position every 15 minutes based on the speed that the aircraft should have been traveling and the extra distance covered as a result of the tail wind on the aircraft as it slowly circled toward the center of the TC with the winds (Neumann, personal communication, 2010). Significant errors in positioning, which were rather common, contributed directly toward significant flight-level winds calculation errors.

The estimated maximum storm intensity by aircraft on low-level flights for which the RMW is not penetrated and/or the strongest quadrant of the storm is not sampled for hurricanes has little to no reliability and is not weighed at all in the reanalysis. The average absolute error in central surface pressure measured from aircraft in the eye at low-levels is believed to be about 2 to 3 mb. The absolute error in determining the central surface pressure value if only the 700 mb height in the eye is available with no temperature data is about 8 mb on average.

### Central pressures (aircraft only) - (1944-1953)

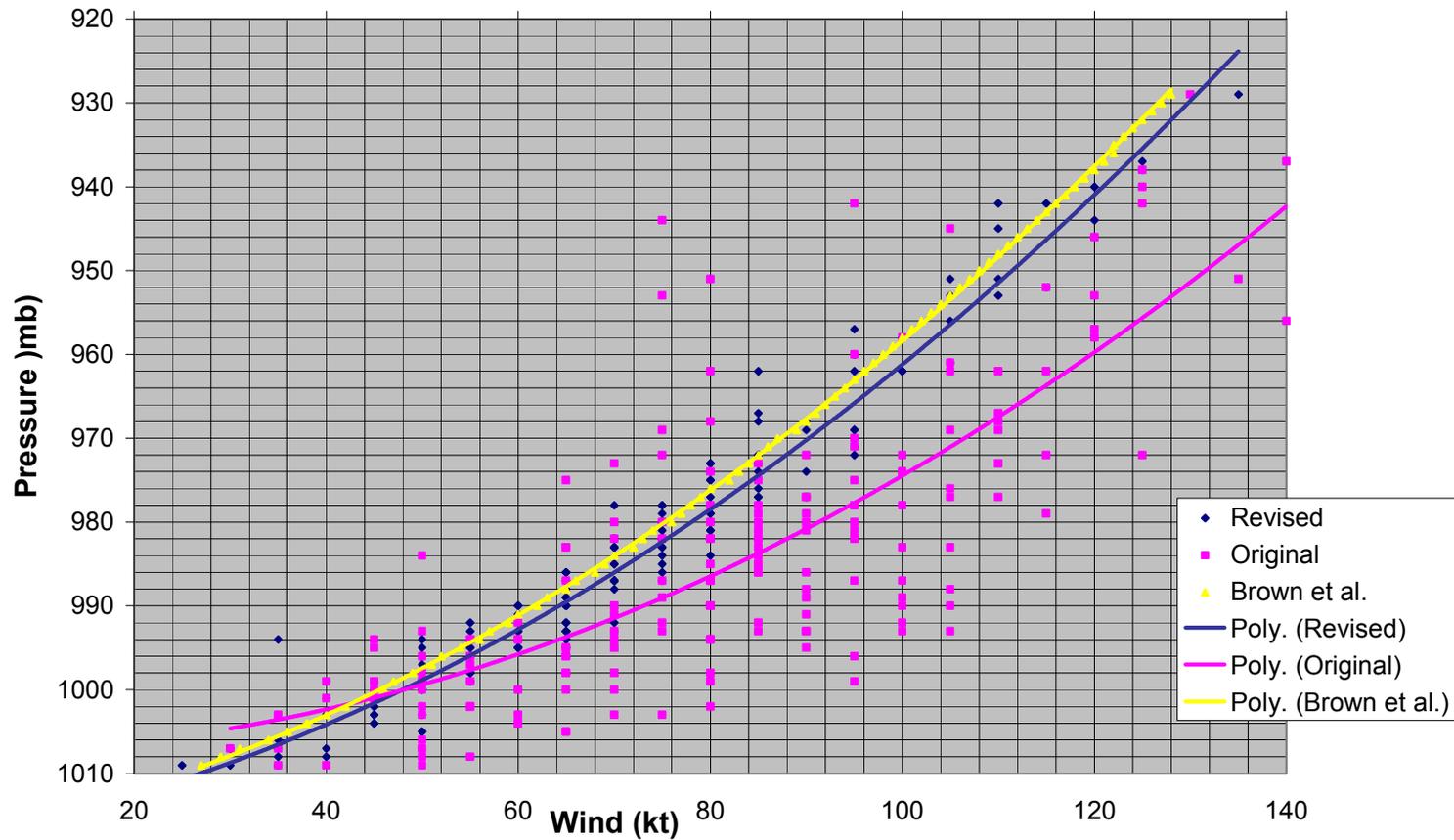


Figure 9. Comparison plot of original HURDAT winds vs. revised HURDAT winds with central pressures listed in the revised HURDAT that came from aircraft data only.

## CHAPTER 5

### REANALYSIS RESULTS AND DISCUSSION

Recommended changes to the number of tropical storms and hurricanes, hurricanes, major hurricanes, and ACE for each year (1944-1953) are shown below in Table 5. Twenty-one additional tropical cyclones were identified and added into HURDAT during these ten years, and there was one removed, bringing the total number of TCs for the period from 103 to 123. This is an increase of two per year. Eighteen of the 21 additional TCs were tropical storms, and three were hurricanes. These three new hurricanes, along with two previous tropical storms that are reanalyzed to have been hurricanes and two previous hurricanes that are reanalyzed to be only tropical storms, increases the total number of hurricanes for the nine year period from 64 to 67, which is an increase of 0.3 hurricanes per year. The number of major hurricanes decreased from 36 to 27 (a decrease of 0.9 major hurricanes per year) after conducting the reanalysis. Ten hurricanes previously listed in HURDAT as major hurricanes were revised

#### Preliminary Original vs. Revised HURDAT Comparison

Year	tropical storms and hurricanes	hurricanes	major hurricanes	ACE
1944	11/14	7/8	3/3	96/104
1945	11/11	5/6	3/1	67/60
1946	6/8	3/4	1/0	22/24
1947	9/10	5/5	2/3	112/90
1948	9/10	6/6	4/4	106/93
1949	13/16	7/7	3/3	98/99
1950	13/16	11/11	8/6	243/211
1951	10/12	8/8	5/3	137/126
1952	7/11	6/5	3/2	87/71
1953	14/15	6/7	4/2	104/96
avg 1944-53	10.3/12.3	6.4/6.7	3.6/2.7	107/97

Table 5. Original/revised tropical storm and hurricane, hurricane, major hurricane, and ACE counts for 1944-1953 along with the 1944-1953 averages.  $ACE = 10^{-4} \sum v_{\max}^2$  where  $v_{\max}$  is the maximum wind value (kt). The maximum winds are summed for all 6-hourly periods for the entire year.

downward in intensity to non-major hurricane status, and one minor (Category 1 or 2) hurricane was revised with an increase in intensity to major hurricane status. Seven of the ten major hurricanes that were reanalyzed downward to be minor hurricanes are the result of overestimation of winds by aircraft reconnaissance. During these cases, central pressure observations within a few hours of the aircraft wind estimates indicate the wind estimates (and also the HURDAT recorded winds) were too high. Those seven cases are just some of the numerous examples of hurricanes with various intensities that were revised downward. Most of these were cases when aircraft overestimated the maximum winds when central pressures were also available. This is the overwhelming reason why the reanalyzed ACE is lower than the original ACE for 1944-1953 despite the addition of many new storms during the decade. The average seasonal ACE declined from 107 to 97 units.

Table 6 lists all hurricanes and tropical storms that impacted the coastline of the continental United States as well as those that made a direct landfall. There were a total of 23 hurricanes that impacted the coastline of the continental U.S. from 1944-1953. The busiest ten-year period on record is the 1879-1888 period when 28 hurricanes impacted the U.S. For comparison, a recent ten-year period that was also particularly active, 1996-2005, had 24 U.S. hurricanes. Eight major hurricanes impacted the U.S. during the 1944-1953 period, and there were nine during the 1996-2005 period. In addition to the 23 U.S. hurricanes, 24 tropical storms (not of hurricane intensity) impacted the U.S. during the decade (1944-1953), which means the total number of tropical cyclones impacting the U.S. during the period was 47.

### U.S. Tropical Cyclones (1944-1953)

Date- Storm #	Landfall time	Lat (°N)	Lon (°W)	Location	Landfall int. (kt)	Orig. int. (kt)	CP (mb)	OCI (mb)	ROCI (nmi)	RMW (nmi)
8/1/1944- Storm 3	2300Z	33.9	78.1	Oak Island, NC	65	80	990	1014	175	12
8/22/1944- Storm 5	1700Z	26.0	97.1	Port Isabel, TX	40*	----	----	----	----	----
9/10/1944- Storm 6	1600Z	29.1	90.4	W of Grand Isle, LA	50	40	1001	----	----	----
9/10/1944- Storm 6	2300Z	30.3	88.3	Dauphin Island, AL	50	35	1001	----	----	----
9/14/1944- Storm 7	1300Z	35.2	75.0	Cape Hatteras, NC	90*	----	942	1010	325	17
9/15/1944- Storm 7	0300Z	40.9	72.3	Southampton, NY	95	75	953	1008	325	29
9/15/1944- Storm 7	0345Z	41.3	71.5	Matunuck, RI	95	75	955	1008	325	29
10/18/1944- Storm 13	2000Z	24.6	82.9	Dry Tortugas, FL	105	105	949	1010	350	29
10/19/1944- Storm 13	0700Z	27.2	82.5	Venice, FL	90	90	962	1011	375	34
6/24/1945 - Storm 1	0800Z	28.6	82.7	Brooksville, FL	70	80	985	1011	200	----
6/26/1945 - Storm 1	0100Z	34.7	76.6	Cape Lookout, NC	60*	----	----	----	----	----
8/27/1945- Storm 5	1600Z	28.3	96.6	Port O'Connor, TX	95	120	963	1010	150	18
9/5/1945 - Storm 7	0000Z	26.5	82.1	Fort Myers, FL	40	35	----	----	----	----
9/15/1945- Storm 9	1930Z	25.3	80.3	Ocean Reef, FL	115	120	949	1011	125	12
9/15/1945- Storm 9	2000Z	25.4	80.4	Florida City, FL	115	120	949	1011	125	12
9/17/1945- Storm 9	1100Z	32.1	80.8	Hilton Head, SC	75	45	991	1013	275	----
7/6/1946 - Storm 2	0800Z	33.9	78.2	Oak Island, NC	40	40	----	----	----	----
10/8/1946- Storm 6	0200Z	27.5	82.6	Bradenton, FL	75	65	980	1009	325	35
11/1/1946- Storm 7	2100Z	26.6	80.1	Palm Beach, FL	40	40	1002	----	----	----
11/3/1946- Storm 8	0500Z	35.0	76.1	Ocracoke Is., NC	35	----	----	----	----	----
8/2/1947- Storm 1	0000Z	26.0	97.1	Port Isabel, TX	35*	----	----	----	----	----
8/22/1947- Storm 3	1400Z	29.1	90.3	W of Grand Isle, LA	40	----	----	----	----	----
8/24/1947- Storm 3	2200Z	29.1	94.9	Galveston, TX	70	70	984	1010	75	----
9/17/1947- Storm 4	1600Z	26.2	80.1	Fort Lauderdale, FL	115	135	940	1010	275	27
9/19/1947- Storm 4	1400Z	29.6	89.5	SE of New Orleans, LA	95	80	966	1010	250	23
9/8/1947- Storm 5	1400Z	30.3	88.2	Dauphin Island, AL	45	35	----	----	----	----
9/23/1947- Storm 6	2200Z	28.9	82.7	Crystal River, FL	55	50	----	----	----	----
10/7/1947- Storm 7	0400Z	30.8	81.5	St. Marys, GA	50	40	----	----	----	----
10/11/1947- Storm 9	1900Z	24.5	82.8	Dry Tortugas, FL	75*	----	983	1010	275	----
10/12/1947- Storm 9	0200Z	25.4	81.2	NW of Cape Sable, FL	80	70	978	1009	250	----

10/15/1947- Storm 9	1100Z	31.8	80.9	Savannah, GA	90	75	966	1009	300	-----
7/9/1948- Storm 2	0700Z	30.3	87.3	Pensacola, FL	35	35	-----	-----	-----	-----
9/4/1948- Storm 5	0800Z	29.2	90.4	W of Grand Isle, LA	65	65	986	1009	225	-----
9/21/1948- Storm 8	1700Z	24.6	81.6	Sugarloaf Key, FL	110	105	950	1008	250	10
9/22/1948- Storm 8	0500Z	25.8	81.3	Everglades City, FL	115	100	940	1007	300	-----
10/5/1948- Storm 9	1800Z	24.7	81.2	Marathon, FL	90	110	963	1009	225	13
10/5/1948- Storm 9	2100Z	25.1	80.9	Flamingo, FL	90	110	963	1009	225	-----
8/24/1949- Storm 1	1200Z	34.3	76.1	Cape Lookout, NC	70*	-----	977	1016	175	-----
8/26/1949- Storm 2	2300Z	26.6	80.0	Palm Beach, FL	120	130	954	1011	225	23
9/4/1949- Storm 5	1200Z	29.3	90.6	Houma, LA	50	40	-----	-----	-----	-----
9/13/1949- Storm 7	0800Z	34.3	77.8	Wrightsville Beach, NC	35	-----	-----	-----	-----	-----
10/4/1949- Storm 11	0500Z	28.8	95.6	SW of Freeport, TX	100	115	960	1009	200	15
8/31/1950- Baker	0300Z	30.2	88.0	Fort Morgan, AL	75	75	979	1003	250	21
8/31/1950- Baker	0400Z	30.7	87.9	E of Mobile, AL	75	75	979	1003	250	21
9/11/1950- Dog	0600Z	35.2	75.5	Cape Hatteras, NC	35*	-----	-----	-----	-----	-----
9/5/1950- Easy	1700Z	29.1	82.8	Cedar Key, FL	105	105	958	1009	325	15
9/6/1950- Easy	0400Z	28.5	82.7	Brooksville, FL	90	85	965	1008	300	-----
10/18/1950- King	0500Z	25.7	80.2	Miami, FL	115	95	955	1005	200	5
10/21/1950- Love	1000Z	29.5	83.4	Cross City, FL	60	60	-----	-----	-----	-----
5/17/1951- Able	2100Z	25.8	80.2	Miami, FL	40*	-----	-----	-----	-----	-----
10/2/1951- How	1000Z	26.7	82.3	Fort Myers, FL	55	55	-----	-----	-----	-----
10/5/1951- How	0800Z	36.0	76.0	Cape Henry, VA	45*	-----	-----	-----	-----	-----
2/3/1952- Storm 1	0400Z	25.4	81.1	Cape Sable, FL	55	45	-----	-----	-----	-----
8/31/1952- Able	0300Z	32.3	80.6	Beaufort, SC	85	90	980	1011	175	-----
8/28/1952- Storm 3	0200Z	33.7	78.7	N. Myrtle Beach, SC	50	-----	-----	-----	-----	-----
6/6/1953- Alice	1700Z	30.3	85.9	Panama City, FL	40	35	-----	-----	-----	-----
8/14/1953- Barbara	0200Z	34.9	76.3	Ocracoke Is., NC	80	90	975	1015	150	-----
8/14/1953- Barbara	0500Z	35.4	76.1	Nebraska, NC	75	70	978	1015	150	-----
8/14/1953- Barbara	0900Z	36.1	75.7	Kitty Hawk, NC	75	70	978	1015	150	-----
9/1/1953- Storm 3	0800Z	31.6	81.1	N of Brunswick, GA	35	30	-----	-----	-----	-----
9/7/1953- Carol	1200Z	41.2	70.2	Nantucket, MA	50*	-----	-----	-----	-----	-----
9/7/1953- Carol	1800Z	44.9	67.0	Eastport, ME	45*	-----	-----	-----	-----	-----
9/20/1953- Storm 7	1700Z	29.0	82.8	Crystal River, FL	35	40	-----	-----	-----	-----
9/26/1953- Florence	1600Z	30.3	86.2	Panama City, FL	80	80	975	1009	225	-----

10/4/1953- Storm 10	0000Z	25.3	80.3	Ocean Reef, FL	35*	-----	-----	-----	-----	-----
10/9/1953- Hazel	1500Z	26.6	82.3	Captiva, FL	65	60	987	1011	300	-----
10/9/1953- Hazel	1600Z	26.7	82.1	Ft. Myers, FL	65	60	987	1011	300	-----

Table 6. Tropical cyclones that affected the United States from 1944-1953. (1944 Storm #7, 1945 Storms #5 and #9, and 1947 Storm #4 were reanalyzed prior to this thesis). Many TCs made multiple U.S. landfalls. Direct landfalls are included as well as close approaches of hurricanes and tropical storms that caused at least tropical storm conditions on land. \* indicates a close approach (not a direct landfall), and the wind speed value listed is the analyzed maximum wind experienced on land (therefore the original HURDAT intensity value is left blank for those cases). The original HURDAT intensity column is left blank elsewhere for new storms and new analyzed landfalls. For all hurricane impacts, max wind, central pressure, OCI, and ROCI are required. For all tropical storm impacts, max wind is the only value required to be provided. RMW is provided for hurricane impacts only if the value is known.

### **Saffir-Simpson Category Changes to U.S. Landfalling Hurricanes**

Table 7 shows that there are 16 U.S. landfalling hurricanes (1944-1953) for which changes are made to the SSHWS category that impacted one or more states/regions. However, changes are only made to the maximum U.S. landfall category for nine of these 16 hurricanes.

Storm 8 of 1948 (previously Storm 7), which made landfall just southeast of Everglades City, FL on September 22 at 05Z, is upgraded from a Category 3 to a Category 4 at landfall. Everglades City reported a pressure of less than 948 mb with simultaneous winds of at least 85 kt. The maximum estimated wind at Everglades City was in excess of 105 kt, but the city was positioned on the left (typically weaker) side of the storm. Analyzed intensities are 115 kt at 00Z, landfall and 06Z. Previous HURDAT intensities were 100 kt at 00Z and 85 kt at 06Z.

Storm 2 of 1949, which made landfall in Palm Beach County, FL between Boynton Beach and Lake Worth on August 26 at 23Z, is upgraded from a Category 3 to a Category 4 at landfall. However, the wind speed in HURDAT is lowered from 130 to 120 kt at 18Z on the 26<sup>th</sup> and 00Z on the 27<sup>th</sup>. This is a classic example of the reason why landfall parameters are specified in the reanalyzed HURDAT for U.S. landfalling hurricanes. The highest official 1-min, 10 m wind was 110 kt at Lake Worth. The lowest pressure recorded was a 954 mb central pressure (with calm) at West Palm Beach. A 1-min, elevated wind of 133 kt was recorded at Jupiter Light, FL. This value reduces to 120 kt at 10 m.

### Changes to U.S. Landfalling Hurricanes (1944-1953)

Year/Storm	Original	Revised	Cat/state changes
1944 Storm 3	NC1	NC1	none
1944 Storm 7	<b>NC<sup>3</sup></b> VA3 NY3 CT3 RI3 MA2	<b>NC<sup>2</sup></b> VA2 NY2 CT1 RI2 MA1	NC <b>-1</b> ; VA -1; NY -1; CT -2; RI -1; MA -1
1944 Storm 13	BFL3 DFL2	BFL3 DFL1 AFL1	NE FL -1; add NW FL
1945 Storm 1	AFL1	AFL1	none
1945 Storm 5	BTX2	ATX2 BTX2 CTX1	add S TX (+2); add N TX
1945 Storm 9	CFL <sup>3</sup>	CFL <sup>4</sup> BFL2 AFL1 SC1	SE FL <b>+1</b> ; add SW FL (+2), NW FL, SC
1946 Storm 6	BFL1	BFL1	none
1947 Storm 3	CTX1	CTX1	none
1947 Storm 4	CFL4 LA3 MS3 BFL2	CFL4 LA2 MS2 BFL2	LA -1; MS -1
1947 Storm 9	GA2 SC2 CFL1	GA2 SC2 BFL1 CFL1	add SW FL
1948 Storm 5	LA1	LA1	none
1948 Storm 8	BFL <sup>3</sup> CFL2	BFL <sup>4</sup> CFL2	SW FL <b>+1</b>
1948 Storm 9	CFL2	BFL2 CFL2	add SW FL
1949 Storm 1	NC1	NC1	none
1949 Storm 2	CFL <sup>3</sup>	CFL <sup>4</sup> BFL1 AFL1 DFL1 GA1	SE FL <b>+1</b> ; add SW FL, NW FL, NE FL, GA
1949 Storm 11	CTX <sup>2</sup>	CTX <sup>3</sup> BTX1	N TX <b>+1</b> ; add C TX
1950 Baker	AL1	AL1 AFL1	add NW FL
1950 Easy	AFL3	AFL3 BFL1	add SW FL
1950 King	CFL <sup>3</sup>	CFL <sup>4</sup> DFL1	SE FL <b>+1</b> ; add NE FL
1952 Able	SC <sup>1</sup>	SC <sup>2</sup>	SC <b>+1</b>
1953 Barbara	NC1	NC1	none
1953 Carol	ME <sup>1</sup>	<b>TS</b>	<b>remove ME</b>
1953 Florence	AFL1	AFL1	none
1953 Hazel	<b>TS</b>	BFL <sup>1</sup>	SW FL <b>+1</b>

Table 7. Original vs. revised hurricane impacts for U.S. states by Saffir-Simpson category. (1944 Storm #7, 1945 Storms #5 and #9, and 1947 Storm #4 were analyzed by other students prior to this thesis). ATX- South Texas, BTX-Central Texas, CTX-North Texas, LA- Louisiana, MS- Mississippi, AL-Alabama, AFL-Northwest Florida, BFL-Southwest Florida, CFL-Southeast Florida, DFL-Northeast Florida, GA-Georgia, SC-South Carolina, NC- North Carolina, VA- Virginia, NY- New York, CT- Connecticut, RI- Rhode Island, MA- Massachusetts, ME- Maine. Changes to maximum U.S. landfall category are indicated in underline and bold.

Storm 11 of 1949 (previously Storm 10), which made landfall near Freeport, TX on October 4, 1949 at 05Z, is upgraded from a Category 2 to a Category 3 at landfall, but the intensity at the point before landfall is reduced from 115 to 100 kt. This is another example of how the previously unavailable landfall parameters indicate the disparity between the HURDAT winds and the landfall category in HURDAT. The highest official 1-min 10 m wind was 87 kt at Freeport. The highest unofficial wind was 115 kt estimated at a location about five nmi away from Freeport. This was reported simultaneously with the lowest official land pressure observation of 978 mb. The RMW was 15 nmi and the analyzed landfall central pressure is 960 mb.

Hurricane King of 1950, which made landfall at Miami, FL on October 18 at 05Z, is upgraded from a Category 3 to a Category 4 at landfall. A central pressure of 955 mb was observed in Miami. The maximum recorded 1-min wind at the Downtown Miami Weather Bureau Office was 106 kt (elevated) and 70 kt was the highest 1-min wind experienced at the airport. The RMW was a tiny 5 nmi. A central pressure of 955 mb equals 108 and 105 kt according to the intensifying subsets of the Brown et al. (2006) pressure-wind relationships for south and north of 25N latitude respectively. The climatological RMW value from Vickery et al. (2000) for this latitude and central pressure is 17 nmi (more than three times larger than the analyzed RMW of 5 nmi). Reanalysis methodology from Landsea et al. (2008) states that for landfalling U.S. tropical storms and hurricanes for which the RMW is significantly smaller (>50%) than the climatological value, 10 kt should be added to the pressure-wind relationship. A 115 kt landfall intensity is analyzed. King deepened by 33 mb during the 14 hr immediately prior to landfall at Miami (max 1-min wind is analyzed to have increased 45 kt in 12 hr).

Hurricane Able of 1952, which made landfall near Beaufort, SC on 31 August, is upgraded from a Category 1 to a Category 2 hurricane at landfall on the Saffir-Simpson Hurricane Wind Scale. The maximum winds are, however, are reduced from 90 to 85 kt in HURDAT. A highest measured wind of ~75-80 kt was recorded at Beaufort when the left RMW passed overhead, but the strongest winds likely occurred over the uninhabited swampy marshlands between Beaufort and Charleston and were not recorded. Available observations indicate the central pressure at landfall was near 980 mb, which yields 76 kt according to the intensifying subset of the north of 25N pressure-wind relationship from Brown et al. Evidence from radar aircraft reconnaissance indicates that the eye was contracting prior to landfall, and the RMW was smaller than the climatological RMW value for that central pressure and latitude from Vickery et al (2000). Due to this information combined with the analysis that the wind observation occurred on the left side of the storm, 85 kt is the analyzed landfall intensity.

Hurricane Carol of 1953, which was originally listed as a Category 1 impact for Maine, is found to have only produced a tropical storm impact there. The highest recorded 1-minute wind in Maine was 42 kt at Eastport. Although Carol is analyzed to have still been a Category 1 hurricane when it passed a few dozen nmi east of Eastport, ME, the winds on the east side were much stronger than the winds on the west side. The strongest wind recorded on the U.S. coastline in association with Carol was 49 kt at Nantucket.

Tropical Storm Hazel of 1953 (now Hurricane Hazel) is upgraded from a 60 kt tropical storm to a 65 kt hurricane at landfall between Fort Myers and Punta Gorda, FL. A 987 mb minimum pressure was recorded at Okeechobee City, FL, and this value is the

analyzed landfall central pressure. A 987 mb central pressure equals 66 kt according to the intensifying subset of the Brown et al. (2006) north of 25N pressure-wind relationship. Although the environmental pressure was low (in terms of ROCI, which was about 300 nmi), that effect is counteracted by the fast speed of the storm, which was 20 kt. A 65 kt landfall intensity is chosen based on that data. A Category 1 landfall is also supported by commentary, which describes damage indicative of a Category 1.

### **Hurricane Impacts Outside of the Continental U.S.**

Table 8 lists all hurricane landfalls and impacts (1944-1953) for land areas outside of the continental U.S. Many of these hurricanes made direct landfalls; however, several others passed close enough to islands or countries for hurricane force winds to be experienced on land without making direct landfalls. Those hurricanes are included in this list as well and contain the value of maximum intensity likely experienced on land as calculated by the Schwerdt et al. (1979) model in the absence of information that contrarily indicates a higher or lower intensity. There were no landfalling Category 5 hurricanes analyzed, but countries that experienced one or more major hurricane impacts during the decade include Cuba (3 major hurricanes), The Bahamas (3), Jamaica (2), Mexico (2), and Antigua and Barbuda (1). Bermuda experienced a Category 2 impact four times during the ten-year period.

Landfalling Hurricanes Outside of Continental U.S. (1944-1953)

Date/Storm #	Landfall time	Location	Lat (°N)	Lon (°W)	Category	Wind	Revised	Original
8/20/1944- Storm 4	1600Z	Jamaica	18.2	76.3	3	105	105	105
8/22/1944- Storm 4	1100Z	Mexico	20.0	87.5	1	80	80	80
9/20/1944- Storm 8	1000Z	Mexico	21.1	86.8	1	70	70	70
9/21/1944- Storm 8	2000Z	Mexico	18.4	93.4	1	70	70	70
10/16/1944 Storm 13	0600Z	Cayman Is.	19.3	81.4	2	85*	90	80
10/18/1944- Storm 13	0000Z	Cuba	21.4	82.9	4	115	115	105
10/18/1944- Storm 13	0800Z	Cuba	22.5	82.9	4	120	120	105
9/14/1945- Storm 9	0600Z	Turks & Caicos	21.3	71.7	2	85	85	105
9/15/1945- Storm 9	0800Z	Bahamas	23.7	77.7	3	110	110	110
10/4/1945- Storm 10	1300Z	Belize	16.2	88.8	1	75	75	60
10/12/1945- Storm 11	1200Z	Cuba	21.6	79.3	1	80	80	85
9/13/1946- Storm 4	0000Z	Bahamas	25.9	77.3	1	65	65	65
10/4/1946- Storm 5	1800Z	Azores	38.5	28.5	1	70	70	----
8/15/1947- Storm 2	1100Z	Mexico	21.9	97.6	3	100	100	95
9/17/1947- Storm 4	0600Z	Bahamas	26.5	78.7	3	110	110	140
10/20/1947- Storm 10	1500Z	Bermuda	32.3	64.8	2	90*	105	105
9/13/1948- Storm 6	1800Z	Bermuda	32.3	64.9	2	95*	110	110
9/19/1948- Storm 8	1200Z	Cayman Is.	19.3	81.4	2	85*	90	75
9/20/1948- Storm 8	2200Z	Cuba	22.3	82.1	3	110	110	95
9/21/1948- Storm 8	0100Z	Cuba	22.7	82.1	3	110	110	100
10/5/1948- Storm 9	0700Z	Cuba	22.4	83.2	3	110	110	105
10/6/1948- Storm 9	0800Z	Bahamas	26.8	75.6	2	85*	85	85
10/7/1948- Storm 9	2200Z	Bermuda	32.3	64.8	2	90	90	90
8/26/1949- Storm 2	1000Z	Bahamas	25.0	77.3	3	100	100	100
9/21/1949- Storm 10	1200Z	St. Croix	17.7	64.9	1	65*	65	65
9/21/1949- Storm 10	2100Z	Puerto Rico	18.0	67.2	1	65*	70	70
8/21/1950- Able	1600Z	Nova Scotia	44.5	63.7	1	65	65	35
8/22/1950- Baker	0400Z	Antigua	17.0	61.7	2	85*	90	90
9/1/1950- Dog	0600Z	Antigua	17.2	61.8	4	125*	125	90
9/3/1950- Easy	0100Z	Cuba	21.5	82.7	1	70	70	70

9/3/1950- Easy	0700Z	Cuba	22.7	82.4	1	80	80	70
10/11/1950- Item	0400Z	Mexico	18.8	95.9	1	80	80	----
10/16/1950-King	2200Z	Cuba	20.9	78.3	1	80	80	95
5/18/1951- Able	0900Z	Bahamas	26.9	78.0	1	75	75	70
8/18/1951- Charlie	0300Z	Jamaica	17.9	76.9	3	110	110	95
8/20/1951- Charlie	0300Z	Mexico	20.4	87.3	4	115	115	115
8/22/1951- Charlie	1900Z	Mexico	22.2	97.8	3	100	100	110
9/2/1951- Dog	1200Z	Martinique	14.4	60.9	1	80*	80	100
9/2/1951- Dog	1200Z	St. Lucia	14.1	60.9	1	65*	80	100
10/24/1952- Fox	1600Z	Cuba	21.7	81.0	4	125	125	130
10/24/1952- Fox	1800Z	Cuba	22.0	80.9	4	125	125	130
10/26/1952- Fox	0800Z	Bahamas	24.7	76.3	1	75	75	100
9/7/1953- Carol	2000Z	Canada	44.2	66.4	1	75	75	65
9/7/1953- Carol	2200Z	Canada	45.3	65.8	1	70	70	65
9/18/1953- Edna	0200Z	Bermuda	32.3	64.8	2	90*	100	100

Table 8. Landfalling hurricanes outside of the continental U.S. (1944-1953). Wind is estimated maximum sustained (1 min) surface (10 m) winds to occur at the coast at landfall/closest approach. Revised winds are the winds in the revised HURDAT at the point just prior to landfall or point of closest approach. Original winds are the winds in HURDAT that were originally provided at the point just prior to landfall or point of closest approach. Non-landfalls are denoted by a “\*” symbol.

### Aircraft Central Pressures

To justify the methodology for the Category 5 study and to give a sense of how often low pressures were measured by aircraft reconnaissance, Figure 10 and Table 9 list the frequency of reported available aircraft central pressures. One central pressure observation represents one aircraft penetration for which a central pressure is reported. There were a few occasions for which two penetrations and two central pressures were reported on the same flight, but usually no more than one central pressure would be reported per flight. There were many flights for which no central pressure value was reported. Sometimes, a center fix was reported with a minimum pressure encountered but with no information as to whether the plane flew in the eye. Careful interpretation with enough evidence is necessary before a “minimum” pressure value is considered to be a central pressure. It is likely that there are a few cases for which the crew believed they were in the eye, but it was in fact a local calm/clear area encountered in the periphery. Sometimes this was reported as the eye with a pressure 10 mb higher than the “minimum” pressure encountered by the aircraft. Pre-satellite aircraft reconnaissance undoubtedly had a more difficult time locating the center especially for weaker TCs. For cases when there is uncertainty as to whether the minimum pressure reported is a central pressure, the reanalysis leans toward not making a significant change to the original HURDAT intensity. All aircraft observations of less than 960 mb for the entire decade regardless of whether they are a central pressure are listed in Table 9. The reason why 960 mb is chosen for this table is because 960 mb is about the general cutoff for major hurricane intensity according to the Brown et al. pressure-wind relationships. These pressure-wind relationships also indicate that a value near 945 mb is the borderline

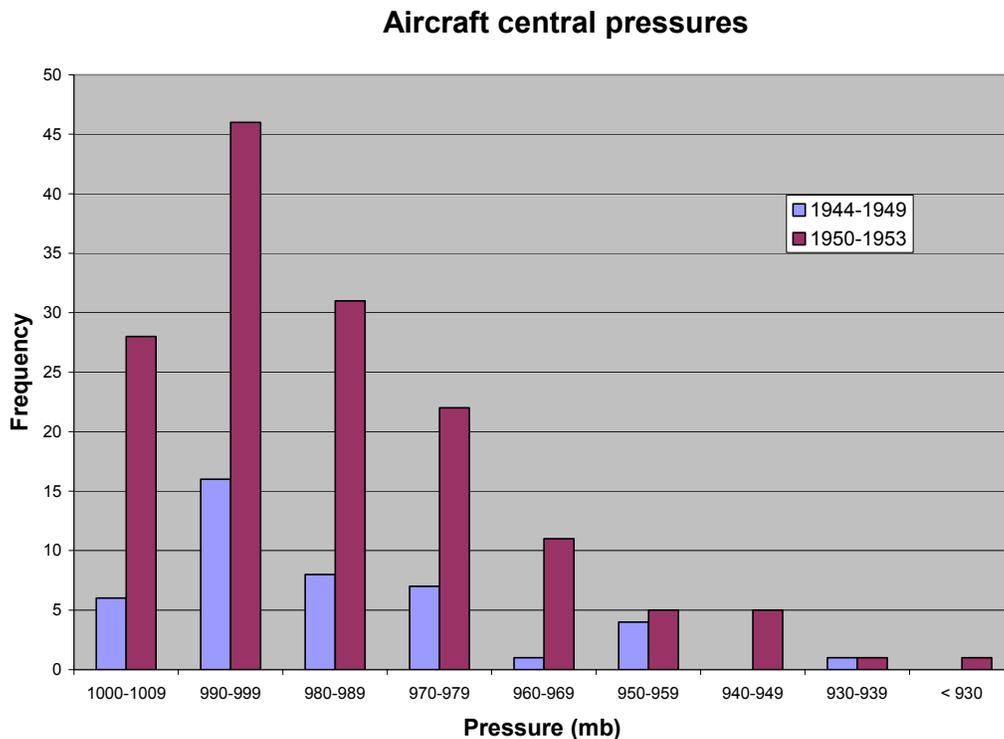


Figure 10. Total number of aircraft central pressures reported during the 6 years from 1944-49 vs. the 4 years from 1950-53.

between Category 3 and 4 intensity. A 920 mb central pressure is a good approximation for the borderline of Category 4 and 5 intensity. There were very few pressure readings indicative of major hurricanes compared to the number of major hurricanes that existed previously in the original HURDAT database during this decade. From 1944-1953, there were five hurricanes for which a Category 4 intensity was confirmed by an aircraft pressure measurement. This number compares with 16 Category 4 or greater hurricanes listed in HURDAT originally and 14 shown in the reanalyzed HURDAT for this ten year period. There was one hurricane for which a Category 5 intensity was confirmed by an aircraft pressure measurement from 1944-1953 (1953 Hurricane Carol- 929 mb). This number compares with three Category 5 hurricanes listed in HURDAT originally and one shown in the reanalyzed HURDAT for the ten year period. For two of the TCs

previously listed as Category 5 hurricanes (1950 Hurricane Dog and 1951 Hurricane Easy), aircraft pressure information indicated wind speeds below the Category 5 threshold at the time HURDAT originally listed Category 5 intensity. Category 5 wind speeds were placed into the original HURDAT database due to maximum wind speed guesses by the onboard aerologist for those two hurricanes. For 1947 Storm 4 (reanalyzed by Donna Strahan- Landsea et al. 2007), Category 5 wind speeds were placed into the original HURDAT database due to a 160 mph surface observation in the Bahamas that was found in the reanalysis to be too high based on aircraft central pressure

#### Lowest Aircraft Pressure Observations (1944-1953)

Lowest Aircraft Pressure (mb)	Central pressure?	Storm	Revised intensity (kt) at time of observation	HURDAT original intensity (kt)
929	yes	1953 Hurricane Carol	140	130
937	yes	1951 Hurricane Easy	125	140
938	yes	1947 Storm 4	125	125
940	yes	1952 Hurricane Fox	120	125
942	yes	1953 Hurricane Carol	115	125
942	yes	1952 Hurricane Fox	110	95
943	maybe	1950 Hurricane Dog	125	145
944	yes	1953 Hurricane Carol	120	75
944	maybe	1950 Hurricane Dog	120	160
945	yes	1953 Hurricane Carol	110	105
951	yes	1948 Storm 8	105	80
951	yes	1947 Storm 4	110	135
952	yes	1947 Storm 4	115	115
953	yes	1950 Hurricane Able	105	120
953	yes	1950 Hurricane Dog	110	75
953	maybe	1950 Hurricane Dog	110	75
956	yes	1947 Storm 4	105	140
957	yes	1951 Hurricane Easy	95	120
958	yes	1950 Hurricane Able	100	120
958	yes	1952 Hurricane Charlie	100	100

Table 9. All available aircraft pressure observations of less than 960 mb for first ten years of aircraft reconnaissance. “Maybe” in three of the above cases indicates the surface pressure was measured by dropsonde.

measurements made on the same day. Whenever there was not a central pressure measurement to justify an intensity change, no change would be made to the HURDAT intensity, but several of the major hurricanes were eliminated due to central pressure information that indicated a weaker intensity.

The original HURDAT database contains central pressure values in 92 of the 6-hourly time slots during the ten years of 1944-53. The reanalyzed HURDAT contains central pressure values in 301 of the 6-hourly time slots. Aircraft central pressures are responsible for 23 of the 92 central pressures that were listed in the original HURDAT. Aircraft reconnaissance is found to have been responsible for 201 of the 301 central pressures in the revised HURDAT. Other types of central pressures are measured when the center of a tropical cyclone passes over a ship or a land station, but some of the central pressures in the revised HURDAT are calculated from peripheral observations using aforementioned methodology.

### **Changes by year**

The revised track maps for each year (1944-1953 inclusive) are shown in this section. Tables summarizing the highlighted changes for each cyclone are shown. A major track revision is defined as greater than or equal to a two degree latitude/longitude (~120 nmi) change. All track changes less than two degrees are considered minor track revisions. A major intensity revision is defined as a change of greater than or equal to 20 kt. All intensity revisions of 5 to 15 kt are considered minor revisions. The precision of the positions are to the nearest 0.1 degree latitude/longitude, and the precision of intensities are to the nearest 5 kt. A track change is only made to HURDAT if the

position requires adjusting of at least 0.2 degrees latitude/longitude. Several individual changes of only 0.1 degree are shown in the metadata, but these were due to the smoothing of the track between points when there was more available data. For the reanalysis methodology prior to the aircraft reconnaissance era, intensity changes are only made to HURDAT if observations suggest a 10 kt or greater change needs to be made (Landsea et al. 2008). That guideline was followed in most cases for the reanalysis of 1944-1953, but there were instances when a 5 kt change would be made if there was sufficient available data to support such a minor revision. A 5 kt change is only made when applicable and when both the central pressure and the RMW are known. Other 5 kt changes shown in the metadata are due to interpolation of revised intensity between times of sufficient data availability. The tables for each year also show changes that were analyzed to the genesis, extratropical transition, and dissipation of the TCs.

### The 1944 Hurricane Season

The reanalysis of 1944 contains several noteworthy changes and additions, depicted in Figure 11 and Table 10. The original HURDAT lists 11 tropical storms, seven of which reached hurricane intensity, and three of which were listed as major hurricanes. Three missing tropical storms are added to HURDAT during 1944, and none were removed, increasing the total number of storms to 14. One of the three new storms is found to have been a hurricane that occurred near the Azores in October and made landfall in Portugal as a tropical storm. If accepted by the NHCBTCC, this will be the only recorded tropical storm in the entire HURDAT database from 1851-present to have ever made landfall in the Iberian Peninsula. However, there is some precedence for

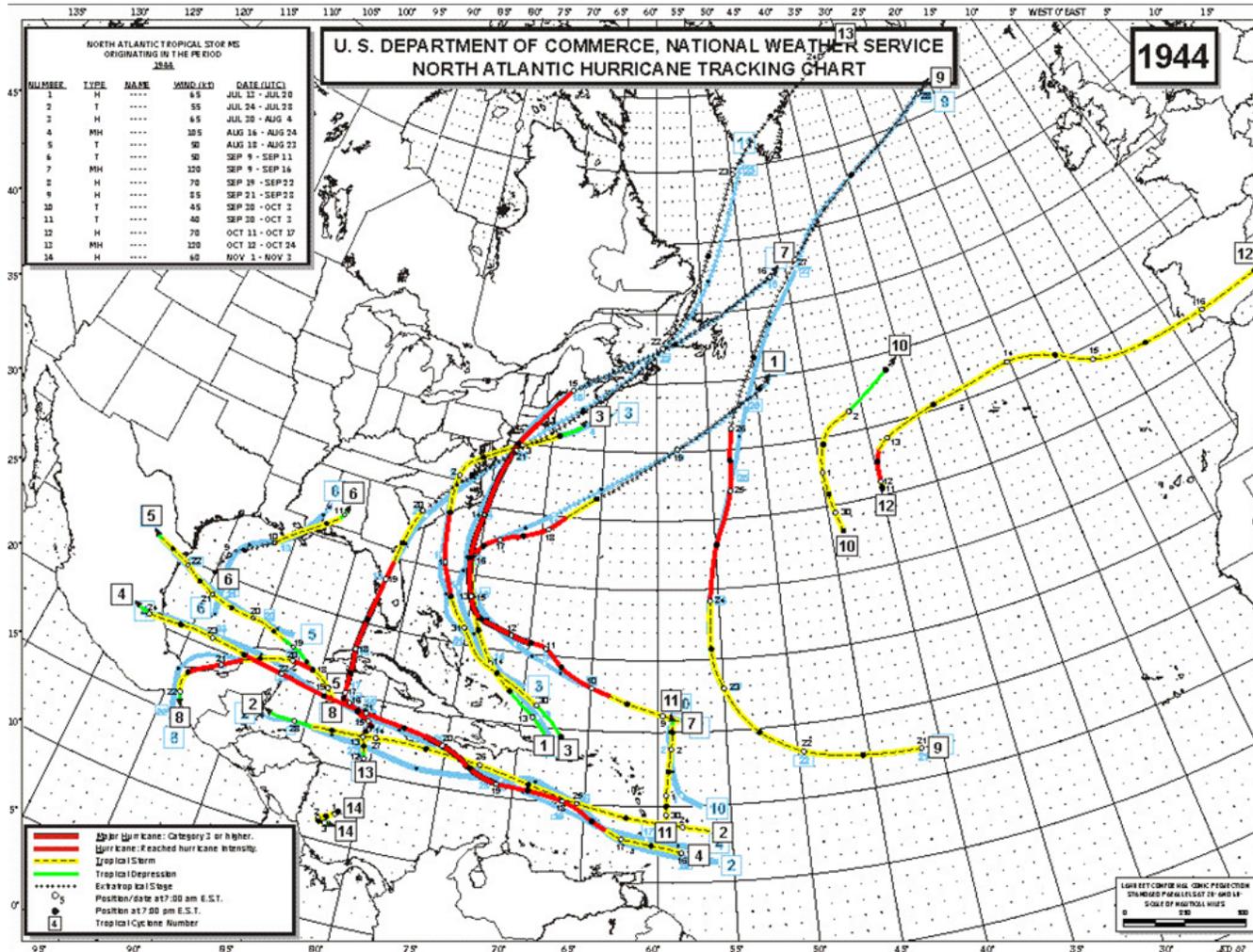


Figure 11. 1944 revised-comparison track map. Faded light blue lines correspond to the original HURDAT tracks.

Revisions for the 1944 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	7/13 - 7/20	80	65	minor	minor	ET 12 hr later
2	2	7/24 - 7/28	55	55	major	minor	None
3	3	7/30 - 8/4	80	65	minor	minor	Genesis 18 hr earlier, Decay 12 hr earlier
4	4	8/16 - 8/24	105	105	major	minor	Genesis 6 hr earlier, Decay 6 hr later
5	5	8/18 - 8/23	50	50	minor	none	Genesis 30 hr earlier
6	6	9/9 - 9/11	45	50	major	minor	added ET 1st 36 hr; Decay 12 hr later
7	7	9/9 - 9/16	120	120	minor	major	None
8	8	9/19 - 9/22	70	70	minor	major	None
9	9	9/21 - 9/28	85	85	major	minor	ET 24 hr earlier
10	----	9/30 - 10/3	----	45	----	----	New storm
11	10	9/30 - 10/3	40	40	major	none	Genesis 24 hr earlier
12	----	10/11-10/17	----	70	----	----	New storm
13	11	10/12-10/24	105	120	minor	major	Genesis 6 hr earlier, ET 12 hr earlier, Decay 24 hr later
14	----	11/1 - 11/3	----	60	----	----	New storm

Table 10. 1944 revisions.

## 1944 New Hurricane- October 12 12Z



Figure 12. 1944 Storm 12 (new to HURDAT) on October 12 at 12Z. Center is analyzed at 36.0N, 40.0W (depicted by the tropical cyclone symbol) as a 70 kt hurricane. Highest observed wind was 70 kt. Lowest observed pressure was 996 mb.

tropical cyclones affecting the Iberian Peninsula. Vaquero et al. (2008) documents a possible tropical storm or hurricane that impacted the region in late October, 1842. Also, Hurricane Vince of 2005 weakened to a tropical depression before making landfall in the Iberian Peninsula. A synoptic map from this new hurricane of October 12, 1944 is shown in Figure 12. This new hurricane increases the number of hurricanes in 1944 from seven to eight. The number of major hurricanes in 1944 is unchanged. Of note is that 1944 Storm 13 (originally listed as Storm 11) is analyzed to have impacted Cuba with a Category 4 intensity, while HURDAT originally shows only Category 3 winds for Cuba. The reanalysis of 1944 resulted in an increase of the ACE from 96 to 104.

### The 1945 Hurricane Season

For the 1945 hurricane season, HURDAT originally listed 11 tropical storms, 5 of which were listed to have reached hurricane intensity, 3 of which were listed as major hurricanes. 1945 was the only year of this study for which no missing tropical cyclones were discovered and added to HURDAT. No storms were removed in 1945 either, so the total number of storms is unchanged. One tropical storm (Storm 4), which was originally listed with a peak intensity of 60 kt, is reanalyzed with a peak intensity of 65 kt- a hurricane. This is responsible for increasing the total number of hurricanes from five to six for the year. The number of major hurricanes is decreased from three to one. Storm 1 was found to have attained a peak intensity of only 85 kt instead of 100 kt. The 100 kt intensity was placed into HURDAT originally likely due to a 100 kt reported aircraft wind, but an abundance of other data for this storm shows that this wind estimate was too high. Storm 10 is an interesting case in 1945 in that the dissipation of this storm is analyzed to have occurred two days later than originally indicated. After making landfall in Belize as a 75 kt hurricane (up from a 60 kt tropical storm originally), the cyclone crossed central America and entered the Pacific Ocean intact as a tropical depression, as shown in Figure 13. The cyclone is analyzed to have restrengthened to a tropical storm over the Pacific just off the Mexican coast. Then it made landfall on the Pacific Coast of Mexico as a 40 kt tropical storm and dissipated shortly thereafter. These revisions and others for 1945 are summarized in Table 11. The reanalysis of 1945 results in a decrease in ACE from 67 to 60.

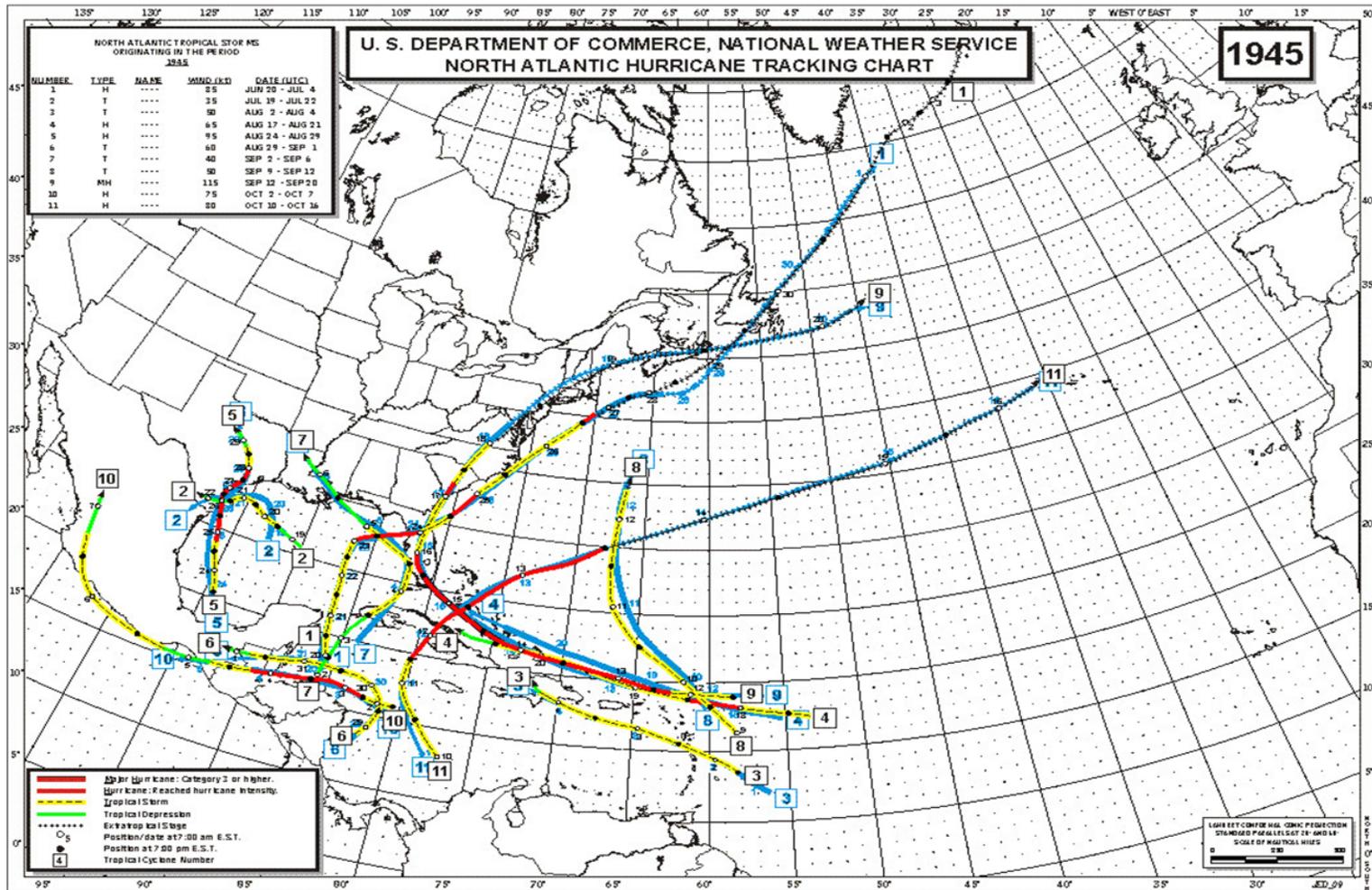


Figure 13. 1945 revised-comparison track map.

Revisions for the 1945 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	6/20 - 7/4	100	85	minor	major	ET 24 hr earlier, Decay 72 hr later
2	2	7/19 - 7/22	45	35	major	minor	Decay 6 hr later
3	3	8/2 - 8/4	50	50	minor	minor	Genesis 18 hr later
4	4	8/17 - 8/21	60	65	minor	minor	none
5	5	8/24 - 8/29	120	95	minor	major	Genesis 6 hr earlier
6	6	8/29 - 9/1	50	60	minor	major	Decay 12 hr later
7	7	9/2 - 9/6	35	40	minor	minor	Genesis 30 hr earlier
8	8	9/9 - 9/12	50	50	minor	minor	ET included at end
9	9	9/12 - 9/20	120	115	minor	major	ET 6 hr earlier
10	10	10/2 - 10/7	85	75	major	major	Decay 48 hr later
11	11	10/10-10/16	85	80	minor	minor	none

Table 11. 1945 revisions.

### The 1946 Hurricane Season

1946 was the least active year of tropical cyclone activity during the ten year period of study. Changes for 1946 are summarized in Figure 14 and Table 12. HURDAT originally listed six tropical storms for the year, three of which were hurricanes and one of which was listed as a major hurricane. Two missing storms are identified and added to HURDAT in 1946, increasing the total number of tropical storms from six to eight. One of these storms is found to have attained hurricane intensity before making a direct landfall in the Azores as a 70 kt hurricane, so the total number of hurricanes in 1946 is increased from three to four. This hurricane destroyed an American built air base in the Azores. A short-lived 35-kt tropical storm that made landfall on the Outer Banks of North Carolina is the other new storm that is added. It is analyzed that this system was a tropical storm for 12 hours and made landfall near Ocracoke Island, NC. The major hurricane listed in HURDAT originally (1946 Storm 5- now Storm 6) is reanalyzed with a major downward intensity revision and is no longer shown to have been a major hurricane, so the number of major hurricanes in 1946 is decreased from one to zero. The downward intensity revision of this storm is based on a 979 mb central pressure measurement (which yields a wind speed of 76 to 79 kt). The measurement occurred just four hours after an aircraft wind estimate of 115 kt. HURDAT previously listed this cyclone as having weakened from 115 kt to 65 kt during a 6-hour period while the cyclone was still over water. The revised intensity shows a weakening from 80 kt to 75 kt during that 6-hour period. This major intensity error in the original HURDAT database is almost certainly due to the wind overestimate by aircraft reconnaissance since the value shown in HURDAT is an exact match of the intensity reported from the aircraft.

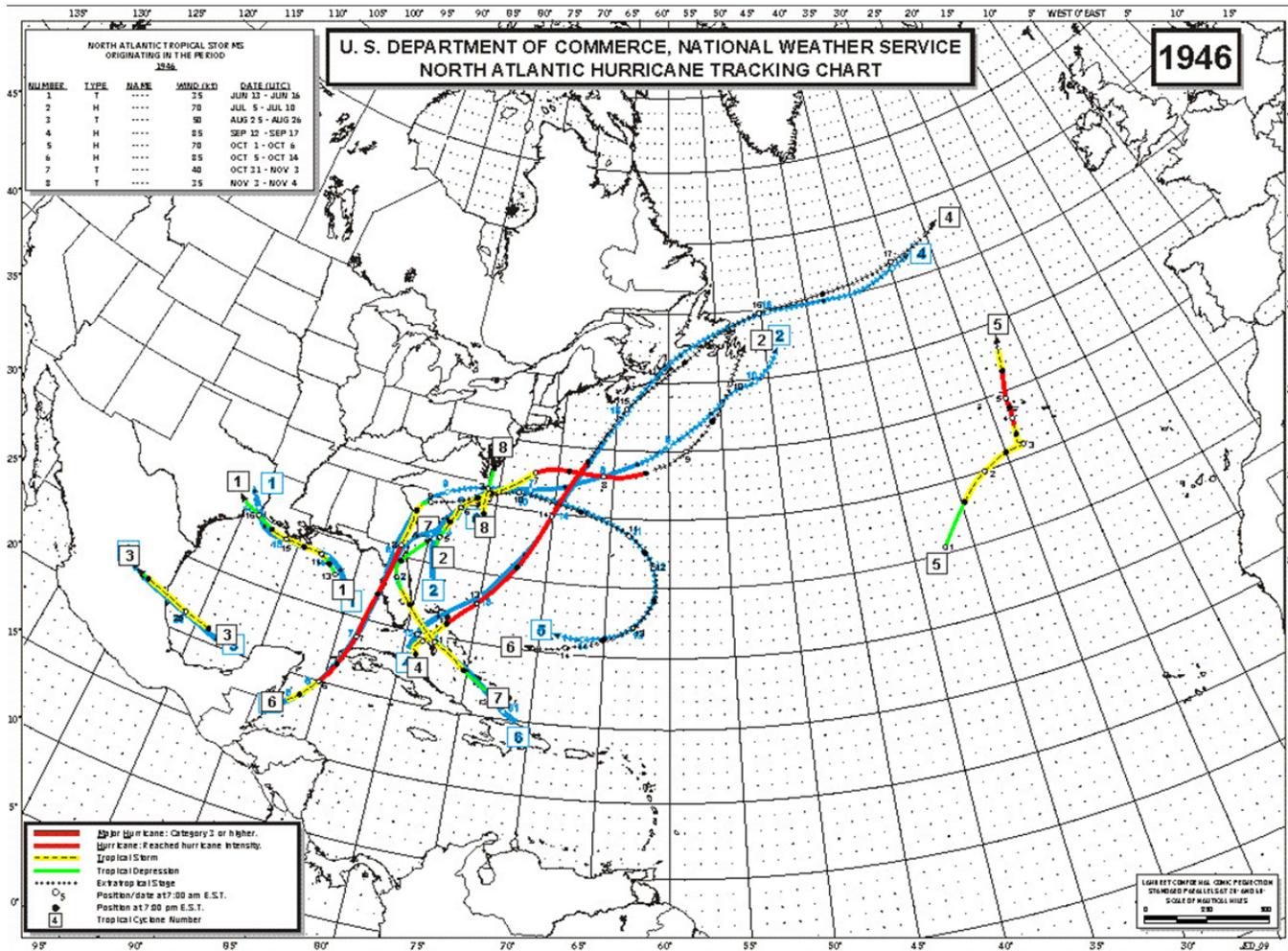


Figure 14. 1946 revised-comparison track map

Revisions for the 1946 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	6/13 - 6/16	35	35	minor	minor	Genesis 6 hr earlier
2	2	7/5 - 7/10	70	70	major	minor	none
3	3	8/25 - 8/26	35	50	minor	minor	none
4	4	9/12 - 9/17	85	85	minor	minor	Genesis 6 hr earlier, ET 12 hr earlier, Decay 6 hr later
5	-----	10/1 - 10/6	-----	70	-----	-----	New storm
6	5	10/5-10/14	115	85	minor	major	Genesis 12 hr later
7	6	10/31-11/1	40	40	major	minor	Genesis 12 hr later, Decay 6 hr earlier
8	-----	11/3 - 11/4	-----	35	-----	-----	New storm

Table 12. 1946 revisions.

These aircraft winds were usually interpreted by the forecasters as truth (Neumann personal communication). The reanalysis of 1946 results in an increase in the ACE index for the year from 22 to 24.

### The 1947 Hurricane Season

In 1947, the original HURDAT lists nine tropical storms, five of which were thought to have been hurricanes, and two of which were listed as major hurricanes. The changes for 1947 are summarized in Figure 15 and Table 13. One storm is added to the database in 1947- a tropical storm in the northeastern Atlantic during October that attained a peak intensity of 50 kt. This new storm increases the 1947 total from nine to ten since no storms were removed. No changes are made to the number of hurricanes in 1947, which remains at five. One hurricane which was previously listed with a peak intensity of Category 2 strength- Storm 2- is reanalyzed to have been a Category 3 hurricane at landfall in Mexico, which made landfall about 30 nmi south-southeast of Tampico. This increase in intensity is justified by wind speed observations from the station at Tampico. This adjustment increases the number of major hurricanes for 1947 from two to three.

There were some other noteworthy changes made during 1947. Major track and intensity revisions are analyzed for Storm 3, which is originally shown in HURDAT to have moved on a slow, straight path through the Gulf of Mexico from the Florida Straits to Galveston. This storm was weak in the eastern Gulf of Mexico, and is analyzed to have undergone a center reformation to the north. The cyclone is analyzed to have made a brief landfall in southern Louisiana as a 40 kt tropical storm before dipping

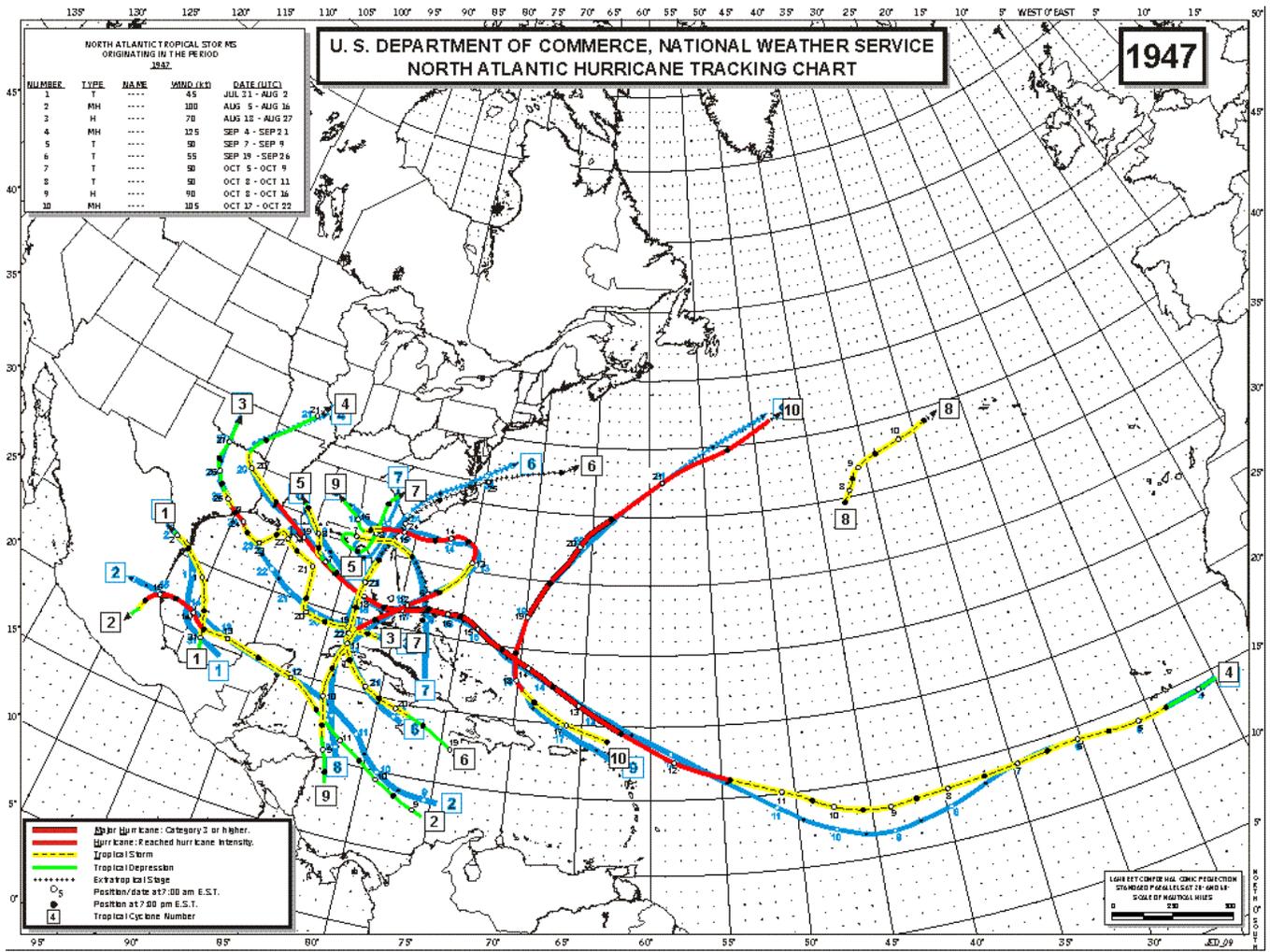


Figure 15. 1947 revised-comparison track map.

Revisions for the 1947 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	7/31 - 8/2	40	45	minor	minor	none
2	2	8/9 - 8/16	95	100	minor	major	none
3	3	8/18 - 8/27	70	70	major	major	none
4	4	9/4 - 9/21	140	125	minor	major	ET 24 hr later
5	5	9/7 - 9/9	40	50	major	minor	Genesis 18 hr earlier, Decay 6 hr later
6	6	9/19 - 9/26	50	55	minor	major	Genesis 18 hr earlier, ET 12 hr earlier, Decay 6 hr later
7	7	10/5 - 10/9	45	50	major	minor	Genesis 12 hr earlier, ET 1st 30 hr, Decay 12 hr later
8	-----	10/8-10/11	-----	50	-----	-----	New Storm
9	8	10/8-10/16	75	90	minor	minor	Genesis 12 hr earlier
10	9	10/17-10/22	105	105	minor	major	Genesis 6 hr later, ET 12 hr later

Table 13. 1947 Revisions.

southwestward back over the Gulf of Mexico on the 23<sup>rd</sup>. The Category 1 landfall near Galveston is unchanged. Storm 7 underwent some significant alterations as well. An extratropical phase is added for the first day of this cyclone and the position at 06Z on October 6 is shifted 5 degrees north of the previous HURDAT position. This is one of the many examples of unrealistic accelerations and decelerations at the beginning and end of cyclone tracks in the original HURDAT database. The first ever TC cloud seeding experiment was conducted during Storm 9 (originally Storm 8). This cyclone formed in the western Caribbean in October, made Category 1 landfalls in Cuba and Florida, and was located 350 miles east of Jacksonville on a northeast course when *Project Cirrus* was conducted. An aircraft dropped dry ice into the hurricane that appeared headed out to sea (Barnes 1998). Shortly afterward, the cyclone slowed down and then turned sharply toward the west, making landfall at Savannah, GA as a 90 kt hurricane where extensive damage occurred. Some people blamed the westward turn on the cloud seeding experiment (though this was not the case) (Barnes 2001, Dorst 2007). The reanalysis of 1947 results in a decrease of the ACE index from 112 to 90.

#### The 1948 Hurricane Season

A similar amount of tropical cyclone activity occurred in the Atlantic Basin during 1948 as in 1947. Revisions for 1948 are summarized in Figure 16 and Table 14. Originally, HURDAT listed nine storms, six of which were hurricanes. Four of the six hurricanes were listed to have become major hurricanes. A 55 kt tropical storm, previously undocumented in HURDAT, was found in the western Atlantic in September. This is the lone storm added to HURDAT for 1948, which increases the number of

storms from nine to ten. The number of hurricanes and major hurricanes in 1948 is unaltered. Despite this, there were some noteworthy changes. Storm 6 of 1948 underwent very large intensity revisions for several days. This storm originated from an African easterly wave. HURDAT started this as a tropical storm right away and listed this storm as having attained hurricane intensity by the time it reached 23W longitude. The previous HURDAT brought it to a Category 2 on September 8 by the time it reached 38W and a major hurricane at 00Z on the 11<sup>th</sup> at 20N, 54W. Major downward intensity revisions ( $\geq 20$  kt) are implemented at all times from 18Z on September 4 to 12Z on September 11. The intensity was lowered by 45 kt from the previous HURDAT intensity from 06Z on the 10<sup>th</sup> through 00Z on the 11<sup>th</sup>. The first aircraft reconnaissance flight, which reached the cyclone on the 9<sup>th</sup> near 19.0N, 48.4W found maximum winds of only 35-40 kt. Text from the Weather Bureau operational advisories describes it as a tropical storm of moderate intensity. The first reconnaissance flight to notice any increase in intensity occurred on the 11<sup>th</sup>. Before that time, it is analyzed that this storm was a weak tropical storm on its journey across the Atlantic rather than a hurricane since the plane on the 9<sup>th</sup> found a weak tropical storm. Storm 6 went on to give Bermuda its 2<sup>nd</sup> Category 2 hurricane impact in as many years (1947 Storm 9). Later in 1948, two hurricanes struck southern Florida within a span of two weeks, and many of the same locations were impacted. The results from the 1948 reanalysis have decreased the ACE for the year from 106 to 93.

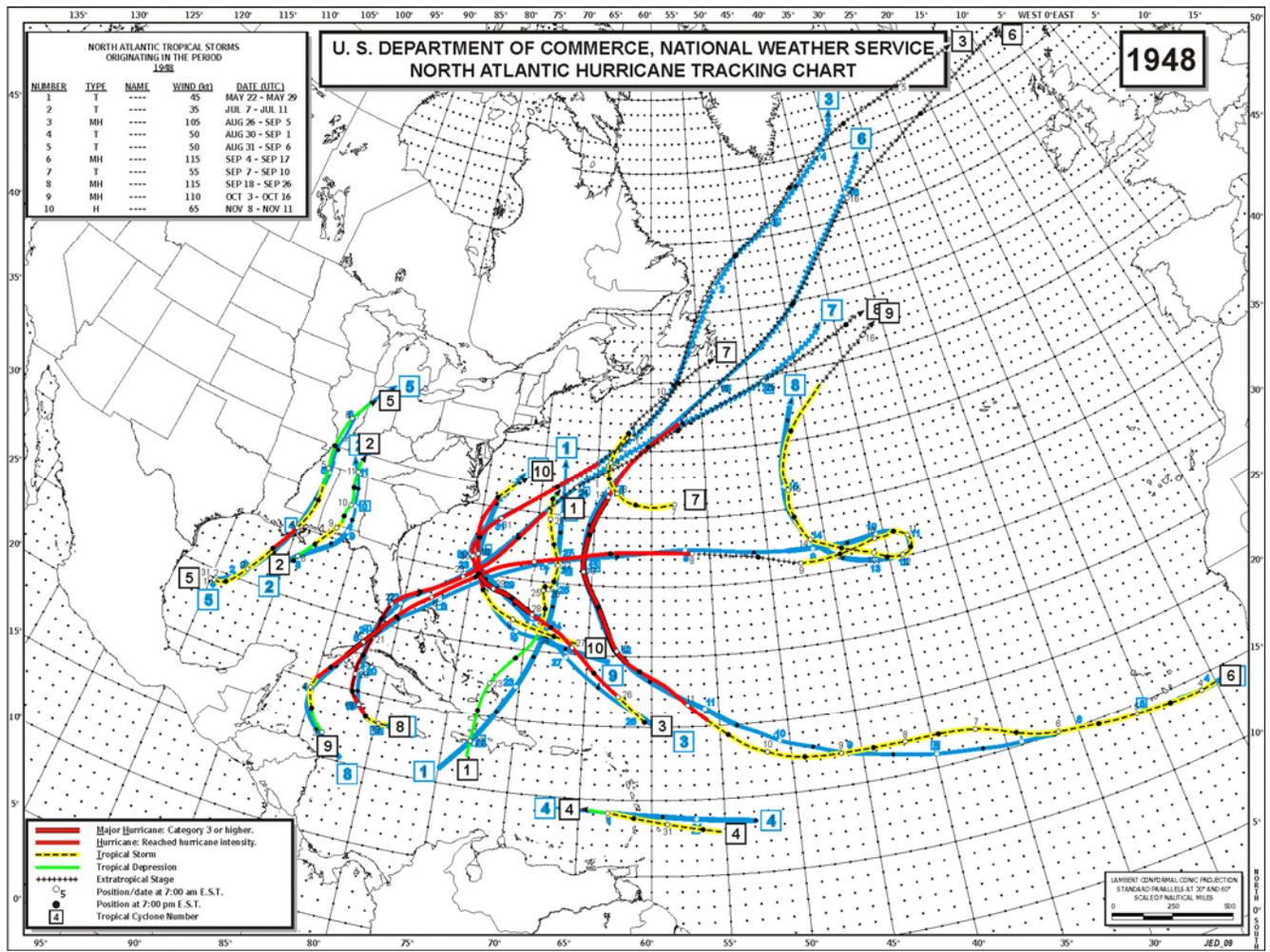


Figure 16. 1948 revised-comparison track map.

Revisions for the 1948 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	5/22 - 5/29	45	45	major	minor	Decay 6 hr later
2	2	7/7 - 7/11	35	35	minor	minor	none
3	3	8/26 - 9/5	105	105	major	minor	Genesis 6 hr earlier, ET 6 hr later, Decay 24 hr later
4	4	8/30 - 9/1	50	50	major	none	Genesis 6 hr earlier
5	5	8/31 - 9/6	70	65	minor	major	Genesis 30 hr earlier, Decay 6 hr earlier
6	6	9/4 - 9/17	115	115	major	major	ET 12 hr earlier, Decay 18 hr later
7	-----	9/7 - 9/10	-----	55	-----	-----	New storm
8	7	9/18 - 9/26	105	115	minor	major	ET 6 hr earlier, Decay 6 hr later
9	8	10/3-10/16	115	110	major	major	Genesis 6 hr earlier, Decay 12 hr later, ET added twice
10	9	11/8-11/11	70	65	major	minor	ET 6 hr later

Table 14. 1948 revisions.

### The 1949 Hurricane Season

Revisions for 1949 are summarized in Figure 17 and Table 15. The number of tropical storms during the 1949 Atlantic hurricane season was well above the 1944-1953 average, but the number of hurricanes and major hurricanes were near the ten-year averages. HURDAT originally listed 13 tropical storms, seven of which were listed as hurricanes. Three of these hurricanes were listed as major hurricanes. Three new tropical storms are identified and added into HURDAT for 1949. The first new storm identified was a tropical storm during September that attained a peak intensity of 45 kt and made landfall near Wrightsville Beach, NC as a 35 kt tropical storm. This is the second tropical storm to make a U.S. landfall that was previously unlisted in HURDAT during the period of this study. The second previously unlisted storm that was identified in 1949 occurred in the central Atlantic in early October and moved northeastward, attaining a peak intensity of 50 kt. The third system identified moved westward in the central Atlantic south of 25N latitude in early November, attaining a peak intensity of 45 kt. These three storms increase the total number of tropical storms in 1949 from 13 to 16. The number of hurricanes and major hurricanes in 1949 are both not changed. Major intensity revisions in 1949 are only analyzed for two of the TCs, which is less than most of the other years. As a result, the ACE is only changed slightly from 98 to 99.

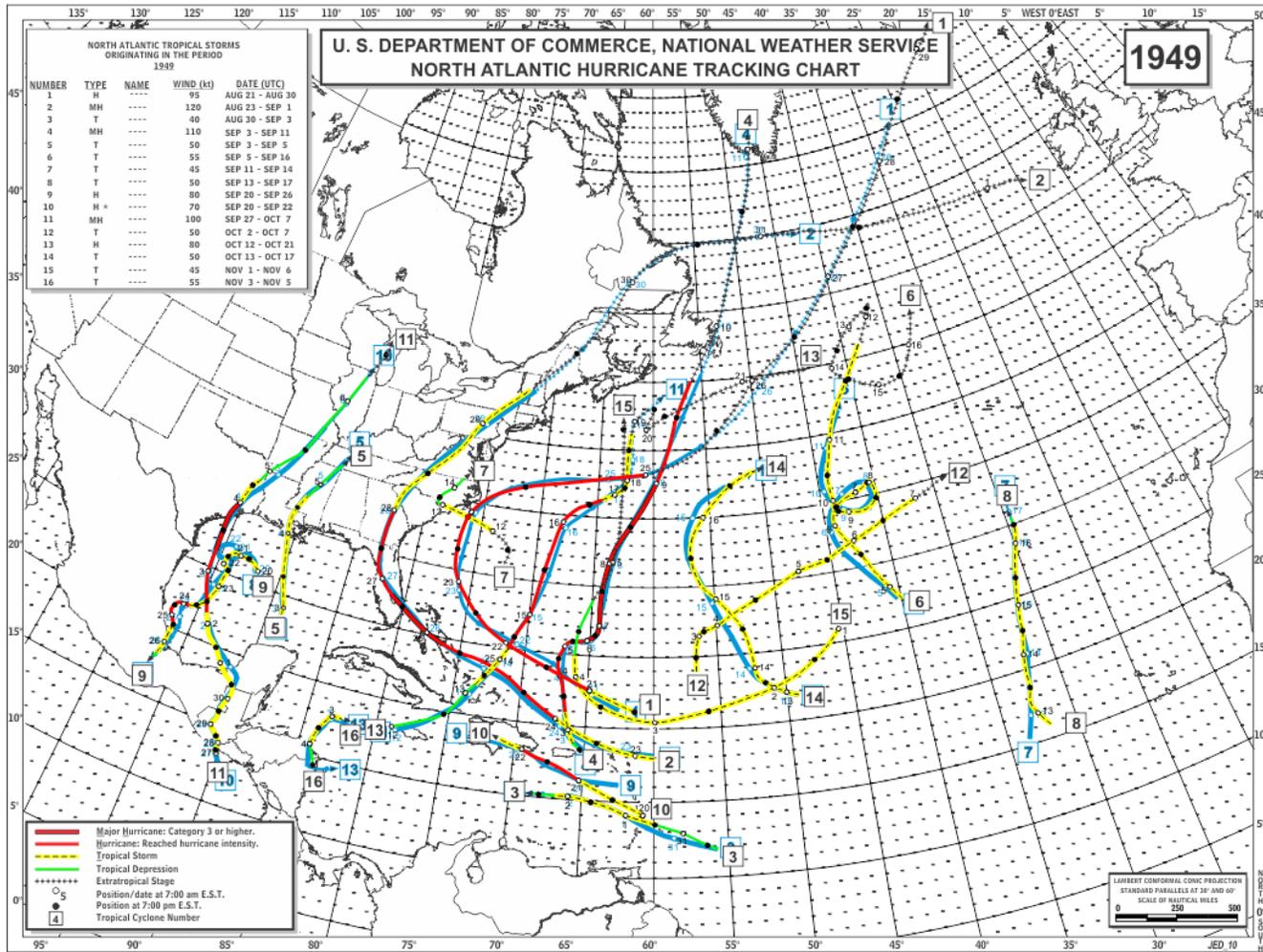


Figure 17. 1949 revised-comparison track map

Revisions for the 1949 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	8/21 - 8/30	95	95	major	minor	Genesis 6 hr earlier, ET 12 hr earlier, Decay 30 hr later
2	2	8/23 - 9/1	130	120	minor	major	Decay 24 hr later
3	3	8/30 - 9/3	45	40	minor	minor	Decay 6 hr earlier
4	4	9/3 - 9/11	110	110	minor	major	Genesis 6 hr earlier
5	5	9/3 - 9/5	40	50	minor	minor	none
6	6	9/5 - 9/16	40	55	minor	minor	Decay 5 days later
7	-----	9/11 - 9/14	-----	45	-----	-----	New storm
8	7	9/13 - 9/17	50	50	minor	minor	Decay 18 hr earlier
9	8	9/20 - 9/26	85	80	minor	minor	none
10	9	9/20 - 9/22	70	70	minor	minor	Genesis 18 hr earlier
11	10	9/27 - 10/7	115	100	minor	minor	Added ET last 12 hr, Decay 6 hr later
12	-----	10/2 - 10/7	-----	50	-----	-----	New storm
13	11	10/12-10/21	90	80	minor	minor	ET 24 hr later, Decay 48 hr later
14	12	10/13-10/17	50	50	minor	minor	none
15	-----	11/1 - 11/6	-----	45	-----	-----	New storm
16	13	11/3 - 11/5	50	55	minor	minor	none

Table 15. 1949 revisions.

### The 1950 Hurricane Season

The most active hurricane season during the first decade of aircraft reconnaissance was 1950, and the results are shown in Figure 18 and Table 16. Originally, HURDAT listed 13 tropical storms, 11 of which were listed as hurricanes. Eight of these 11 hurricanes were listed as major hurricanes. Three new tropical storms are identified and added for 1950, bringing the total number of tropical storms to 16. All three of the new storms added did not attain hurricane intensity, and all of them occurred in late October or November. One of these storms that was previously unlisted in HURDAT was given a name by the Air Weather Service in their post-season tropical cyclone review (AWS 1951). The storm, named Mike, occurred from 25-29 October in the central Atlantic. That storm along with both of the two other storms added to HURDAT did not threaten any land areas. The number of hurricanes for 1950 is not changed. However, two of the cyclones previously listed as major hurricanes are revised down to minor hurricanes, which lowers the major hurricane total for 1950 from eight to six. The peak intensity of Hurricane Baker is reduced from 105 kt to 90 kt, and the peak intensity of Charlie is reduced from 100 kt to 95 kt. Additionally, since there were more available aircraft central pressure observations beginning in 1950 compared with the 1940s, numerous downward intensity adjustments were made because the high-biased wind speeds reported by aircraft reconnaissance became more obvious when central pressures confirmed these biases. Hurricane Dog, which was previously listed as having maintained a Category 5 intensity for several days, is reanalyzed to have only attained

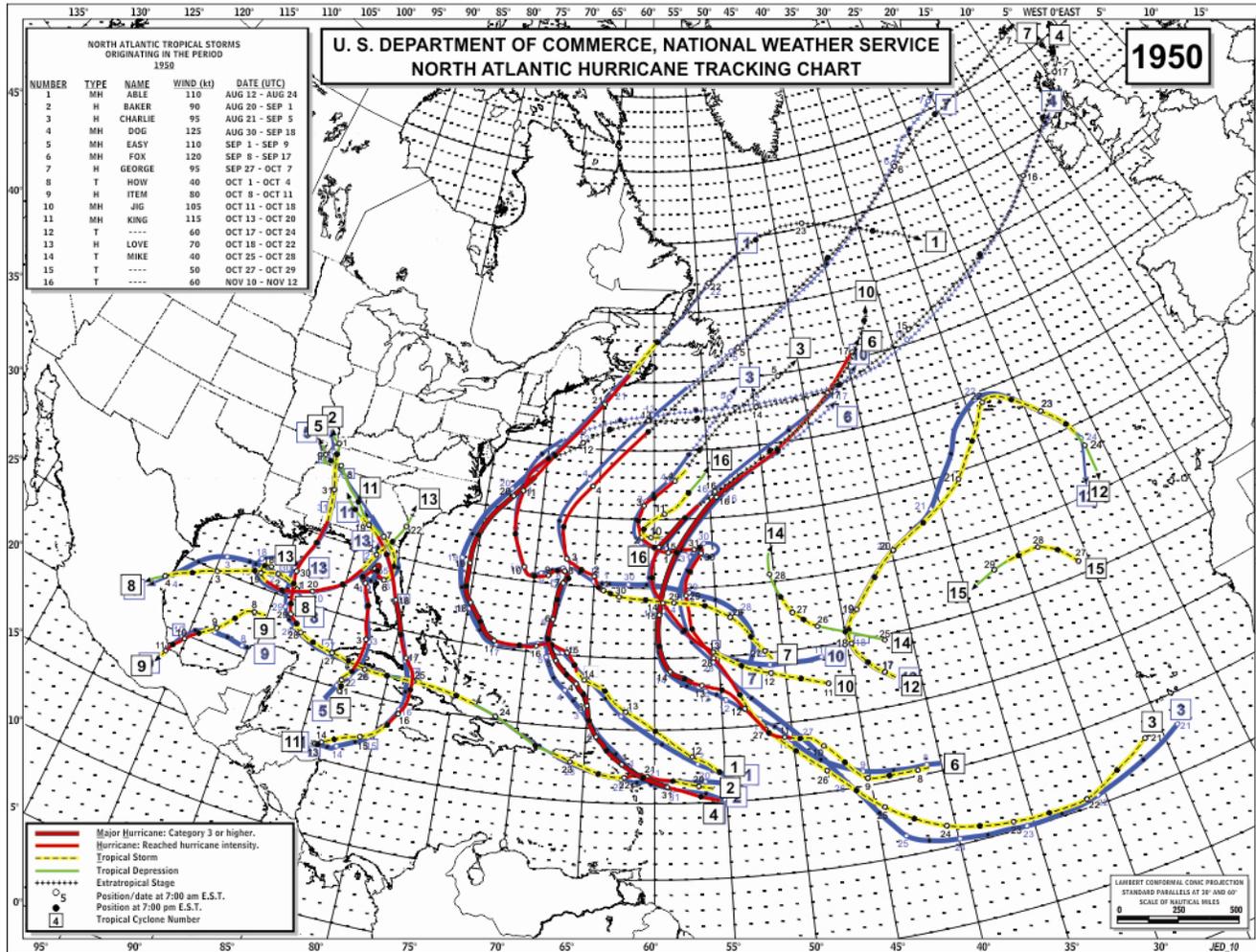


Figure 18. 1950 revised-comparison track map.

Revisions for the 1950 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1 (Able)	8/12 - 8/24	120	110	minor	major	Added ET last 60 hr, Decay 36 hr later
2	2 (Baker)	8/20 - 9/1	105	90	minor	major	none
3	3 (Charlie)	8/21 - 9/5	100	95	major	major	ET 6 hr earlier
4	4 (Dog)	8/30 - 9/18	160	125	minor	major	ET 6 hr earlier, Decay 24 hr later
5	5 (Easy)	9/1 - 9/9	110	110	minor	major	none
6	6 (Fox)	9/8 - 9/17	120	120	major	minor	ET 12 hr later, Decay 6 hr later
7	7 (George)	9/27 - 10/7	95	95	major	minor	ET 6 hr later
8	8 (How)	10/1 - 10/4	50	40	minor	minor	none
9	9 (Item)	10/8 - 10/11	95	80	major	major	Decay 18 hr later
10	10 (Jig)	10/11-10/18	105	105	major	minor	ET 30 hr earlier, Decay 6 hr later
11	11 (King)	10/13-10/20	105	115	minor	major	Decay 18 hr later
12	12 (Unnamed)	10/17-10/24	60	60	major	none	none
13	13 (Love)	10/18-10/22	80	70	minor	major	Genesis 12 hr later, Decay 24 hr later, ET at end
14	(Mike)	10/25-10/29	----	40	----	----	New storm
15	----	10/27-10/29	----	45	----	----	New storm
16	----	11/10-11/13	----	60	----	----	New storm

Table 16. 1950 revisions.

Category 4 intensity. The ACE in 1950 was lowered from 243 to 211 as a result of the many downward intensity revisions. One reason for the decrease is due to better knowledge of pressure-wind relationships.

There were several interesting recording errors in HURDAT during 1950. For Hurricane King, the intensities in HURDAT on the 17<sup>th</sup> and 18<sup>th</sup> of October were mixed up and placed on the incorrect day. This resulted in the original HURDAT listing King as too intense for the Cuba landfall and too weak for the Miami, FL landfall. Hurricane Item was originally listed to have dissipated after 18Z on October 10. The reanalysis reveals that Item did not make landfall until the 11<sup>th</sup> at 04Z just east of Veracruz, Mexico as a hurricane. The track is thus extended for 18 hours. There were other instances when central pressures were previously placed in the incorrect time slots, such as during Hurricane Easy when the central pressure of 958 mb, which was observed at Cedar Keys, FL, was listed 12 hours too early.

### The 1951 Hurricane Season

For the 1951 hurricane season, HURDAT originally listed ten tropical storms, eight of which were listed to have become hurricanes. Five of these hurricanes were listed to have attained major hurricane intensity. Two new out-of-season tropical cyclones were identified and added to HURDAT in 1951, as shown in Figure 19. One was a tropical storm in January (now 1951 Storm 1) that attained a peak intensity of 55 kt, and the other was a hurricane in December (now 1951 Storm 12) with a peak intensity of 70 kt, as shown in Table 17. The January tropical storm originated as an eastward moving frontal wave in the western Atlantic. It then separated from the front and moved southward. It

attained tropical characteristics, strengthened, and turned west just in time before it would have made landfall in Puerto Rico. A couple of days later, the cyclone turned north and became extratropical as the next front approached. The December hurricane, which occurred over the north-central and northeastern Atlantic, would likely have been considered to have been a subtropical cyclone throughout its lifetime by the designation techniques of today, but for the purposes of the reanalysis, these cyclones are considered to be tropical cyclones (since there are no satellite pictures to confirm the convective structure). The two new cyclones in 1951 increases the number of tropical storms from ten to 12. Although one new hurricane was added, the number of hurricanes in 1951 did not change because Hurricane Item is analyzed to have only attained tropical storm strength. The peak intensity of Item is reduced from 70 to 55 kt. As a result of the reanalysis, the number of major hurricanes in 1951 is decreased from five to three. The peak intensity of Hurricane Able, which occurred from May 16-24 in the western Atlantic off the east coast of the U.S., is reduced from 100 kt to 80 kt, and the peak intensity for Hurricane Dog is also reduced from 100 kt to 80 kt. The former is the result of overestimation of winds by aircraft reconnaissance while the latter is the result of an elevated or estimated wind mistakenly being considered an official wind measurement operationally, which unfortunately was included in the HURDAT database originally. Other observations show that this wind was biased too high. Hurricane Easy, previously listed as a Category 5 hurricane, is lowered to Category 4 status. The ACE for 1951 was decreased from 137 units to 126 units.

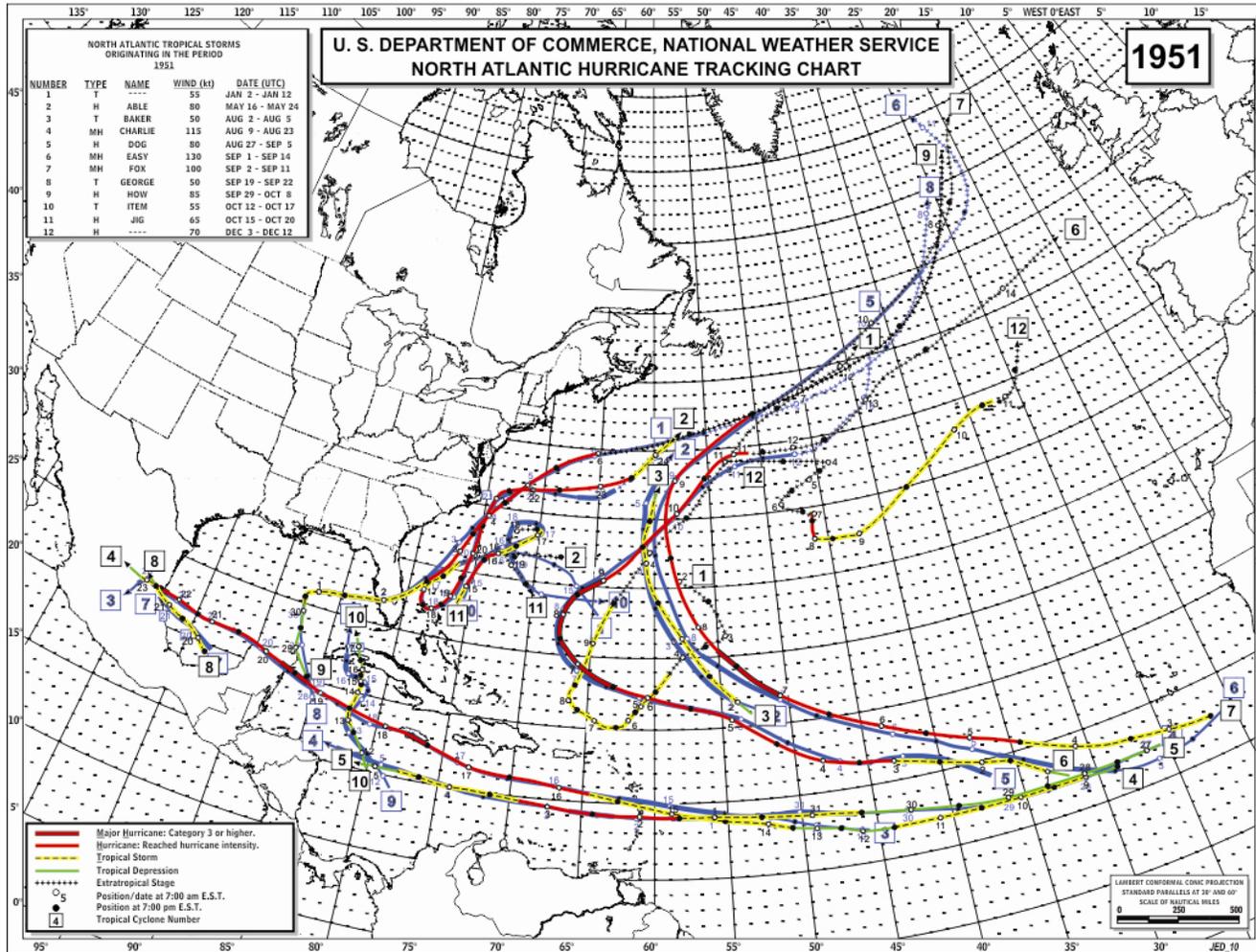


Figure 19. 1951 revised-comparison track map.

Revisions for the 1951 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	----	1/2 - 1/12	----	55	----	----	New storm
2	1 (Able)	5/16 - 5/24	100	80	minor	major	Genesis 18 hr later, Eliminated ET
3	2 (Baker)	8/2 - 8/5	50	50	minor	minor	Decay 12 hr earlier
4	3 (Charlie)	8/9 - 8/23	115	115	minor	major	Genesis 78 hr earlier
5	4 (Dog)	8/27 - 9/5	100	80	minor	major	Decay 6 hr earlier
6	5 (Easy)	9/1 - 9/14	140	130	major	major	Genesis 36 hr earlier, ET 18 hr earlier, Decay 24 hr later
7	6 (Fox)	9/2 - 9/11	100	100	major	major	ET 18 hr earlier, Decay 6 hr earlier
8	7 (George)	9/19 - 9/22	50	50	minor	minor	Genesis 12 hr earlier, Decay 6 hr later
9	8 (How)	9/29 - 10/8	95	85	minor	major	Genesis 18 hr later, Et 12 hr earlier, Decay 6 hr later
10	9 (Item)	10/12-10/17	70	55	major	major	none
11	10 (Jig)	10/15-10/20	70	65	minor	minor	Decay 18 hr earlier, added ET last 2 days
12	----	12/3 - 12/12	----	70	----	----	New storm

Table 17. 1951 revisions.

### The 1952 Hurricane Season

Revisions for the 1952 season are summarized in Table 18. Originally, HURDAT listed seven tropical storms in 1952. Six of these were originally listed as hurricanes and three of the hurricanes were originally listed as major hurricanes. Four new storms were added to HURDAT in 1952 (the most storms added for any single year of this study). None of these new storms were hurricanes. Perhaps the most interesting of the four new storms added is the one that made landfall near North Myrtle Beach, SC as a 50 kt tropical storm early on 28 August. A frontal boundary, which was dissipating on the 26<sup>th</sup> left behind an area favorable for the development of a tropical cyclone. This tropical storm formed less than 12 hours prior to landfall and no advisories or warnings were issued. This is the third tropical storm previously unlisted in HURDAT to have made a U.S. landfall during these ten years. The other two had 35 kt intensities at landfall, but this tropical storm occurred with a 50 kt landfall intensity. Although the statistics shown in Landsea (2007) are computed under the assumption that no landfalling tropical cyclones were missed post-1900, that study also acknowledges the possibility that some short-lived, relatively weak landfalling tropical storms could have been missed. Of the 21 new TCs added to HURDAT for this study (1944-1953), 16 of these did not impact any land areas or islands in the Atlantic Basin. Three of these impacted portions of the Carolinas with tropical storm impacts. The other two impacted the Azores- one with only tropical storm conditions (this TC also impacted the Iberian Peninsula with tropical storm conditions), and the other with hurricane conditions. Although there were likely no U.S. hurricanes that were missed and very few hurricanes missed that impacted other countries or islands post-1900, the statistics in the Landsea (2007) study may have to be adjusted

Revisions for the 1952 hurricane season

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1	2/3 - 2/5	50	60	minor	minor	Genesis 18 hr later, ET 6 hr later
2	2 (Able)	8/18 - 9/3	90	85	major	major	Decay 12 hr later
3	-----	8/27 - 8/28	-----	50	-----	-----	New storm
4	3 (Baker)	8/30 - 9/10	105	95	major	major	Genesis 12 hr earlier, ET 12 hr earlier, Decay 12 hr later
5	-----	9/8 - 9/14	-----	50	-----	-----	New storm
6	4 (Charlie)	9/23 - 10/1	105	105	minor	major	Genesis 18 hr later, ET 24 hr earlier, Decay 12 hr earlier
7	5 (Dog)	9/24 - 9/30	75	55	minor	major	Genesis 18 hr earlier, Decay 30 hr later
8	-----	9/25 - 9/28	-----	40	-----	-----	New storm
9	6 (Easy)	10/6 - 10/11	95	85	minor	minor	none
10	7 (Fox)	10/20-10/28	130	125	major	major	Added ET at end
11	-----	11/24-11/30	-----	50	-----	-----	New storm

Table 18. 1952 revisions.

slightly after the completion of the reanalysis. Perhaps minimal 35 kt tropical storms were so inconsequential, that even if a Weather Bureau forecaster realized of the existence of a closed tropical cyclone prior to landfall, the intensity would not have impressed them enough to begin issuing advisories. It is likely that the 50 kt tropical storm of 1952 formed and moved inland so quickly that there was not enough time to issue an advisory. Based on data available, the earliest that Weather Bureau forecasters would have been able to issue an advisory would have been six hours before landfall, but they may not even have considered the system to have been a TC by that time as it still contained some hybrid characteristics. It appears that storms like this were sometimes ignored and not included in HURDAT. The other three new tropical storms in 1952 did not impact any land areas. The total number of tropical storms in 1952 is increased from seven to 11. The number of hurricanes is reduced from six to five. Hurricane Dog was previously listed with a 75 kt peak intensity, but this is reduced to a 55 kt peak intensity. The peak intensity of Hurricane Baker is decreased from 105 kt to 95 kt, which lowers the number of major hurricanes for 1952 from three to two. The ACE for 1952 decreased from 87 to 71 as a result of the reanalysis.

#### The 1953 Hurricane Season

Originally, HURDAT listed 14 tropical storms in 1953, six of which were listed as hurricanes. Four of these hurricanes were originally listed as major hurricanes. One of the 14 tropical storms was removed. It was found that Storm 11 was a continuation of Hurricane Gail. The cyclone previously listed as Storm 11 is removed from HURDAT, but several days are added on to the end of Gail. Two new tropical cyclones are added in

1953 – a July tropical storm that paralleled the east coast of the U.S. a couple hundred nmi offshore and a short-lived tropical storm found to have occurred in the north-central Atlantic in September. This increases the total number of tropical storms in 1953 from 14 to 15, as shown in Table 19. Tropical Storm Hazel was previously listed with a 60 kt peak intensity, but it is reanalyzed to have been a hurricane at its Florida landfall. This increases the number of hurricanes for 1953 from six to seven. Hazel, which was previously not listed on the U.S. landfalling hurricanes list, is upgraded to a Category 1 hurricane at landfall as mentioned earlier in the U.S. landfalling hurricanes section. Hurricanes Dolly and Florence, which were originally listed as major hurricanes, are downgraded to minor hurricanes. The number of major hurricanes in 1953 is thus decreased from four to two. Hurricane Carol, which was originally listed with a Category 4 peak intensity, is upgraded to a Category 5 on 3 September while over the open ocean due to a 929 mb aircraft central pressure observation. This 929 mb aircraft observation was the lowest central pressure recorded by aircraft reconnaissance during the first ten years of aircraft reconnaissance. Carol is now listed as the only Category 5 hurricane in HURDAT from 1944-1953. Carol later made landfall in Canada as a Category 1 hurricane. Carol was originally listed as having impacted Maine with Category 1 conditions, but it was found that Maine only experienced tropical storm conditions, and Carol is removed from the U.S. hurricane list. The ACE for 1953 is revised downward from 104 to 96 units as a result of the reanalysis.

Storm #	Previous Storm #	Date	Orig. Peak Intensity (kt)	Revised Peak Intensity (kt)	Major/Minor Track Change	Major/Minor Intensity Change	Genesis/Decay Change
1	1 (Alice)	5/25 - 6-7	60	60	minor	major	Decay 12 hr later
2	----	7/11 - 7/16	----	40	----	----	New storm
3	2 (Barbara)	8/11 - 8/16	95	80	minor	major	ET 6 hr earlier, Decay 6 hr later
4	3	8/28 - 9/1	50	35	minor	minor	Decay 30 hr earlier
5	4 (Carol)	8/28 - 9/9	130	140	major	major	ET 6 hr later
6	5 (Dolly)	9/8 - 9/16	100	65	major	major	ET 6 hr later, Decay 30 hr earlier
7	----	9/10 - 9/11	----	50	----	----	New storm
8	6 (Edna)	9/15 - 9/22	110	100	minor	major	Genesis 18 hr later, Decay 48 hr later
9	7	9/15 - 9/21	60	40	major	major	Genesis 30 hr later
10	8 (Florence)	9/23 - 9/27	110	90	minor	major	ET 6 hr later, Decay 24 hr earlier
11	9 (Gail)	10/2-10/12	70	70	major	major	Decay 6.5 days later
12	10	10/3 - 10/8	40	40	major	minor	Decay 60 hr earlier
----	11	----	60	----	----	----	Storm was removed from HURDAT
13	12 (Hazel)	10/7-10/14	60	65	minor	minor	ET 6 hr earlier, Decay 48 hr later
14	13	11/23-11/26	45	45	major	minor	none
15	14	12/7 - 12/9	35	55	major	major	none

Table 19. 1953 revisions.

### **Reanalysis discussion and HURDAT uncertainty estimates**

There are many potential sources of error in the reanalysis of the first decade of aircraft reconnaissance. Sometimes, two different sources contained contradictory information regarding the same observation. For example, one source would claim that a land-based reported wind observation was an estimate while another source would indicate that the wind was recorded by an instrument. In other cases, sources conflicted on the averaging time of a land-based wind observation. Conflicting information from different sources is not the only problem that can lead to uncertainty. A significant amount of uncertainty exists in the numerous cases for which there is not enough information or clarity provided to know important information. Sometimes, it could not be determined whether a reported aircraft wind was a surface wind, flight level wind, or maximum storm intensity estimate. It was also often difficult to determine the method by which the aircraft wind was estimated or measured unless explicitly mentioned in a message or in the military coding messages. Some aircraft reports did not specify whether the report was of the most intense part of the storm (though one can safely assume that nearly always the most intense part of the TC was not measured). Sometimes when aircraft reported the minimum pressure encountered, it was uncertain whether the value was the pressure in the center (or eye). The pressure value cannot be treated as a central pressure in the reanalysis unless there is near certainty that the pressure value reported is a central pressure rather than a peripheral pressure reading.

Estimates of the average position and intensity errors for HURDAT for the first decade of aircraft reconnaissance are shown in Tables 20 and 21 along with estimates for the period 1851-1920 provided in Landsea et al. (2008). For position, open ocean cases

without aircraft showed only slight improvements from the early decades of the HURDAT era. This increase is solely due to an increase in ship traffic from the 1800s to the mid-20<sup>th</sup> century. The position improvement is not very significant because widespread monitoring of the whole basin provided by geostationary satellites was not yet available. The average position error for open ocean cases for which aircraft reconnaissance provided a center fix is estimated to have been about 30 nmi.

#### HURDAT Position Error Estimates

Year	US Landfalling (settled)	Open ocean w/ AC	Open ocean w/ no AC
1851-85	60 nmi	N/A	120 nmi
1886-1920	60 nmi	N/A	100 nmi
1944-1953	20 nmi	35 nmi	80 nmi
Late 1990s	12 nmi	15 nmi	25 nmi
Late 2000s	12 nmi	15 nmi	25 nmi

Table 20. Average track error estimates in the reanalyzed HURDAT for different time periods stratified by using different observation methods. “AC” = aircraft reconnaissance. (References: Landsea et al. 2008; Landsea, 2011, personal communication.)

#### HURDAT Intensity Error Estimates

Year	US Landfalling (settled)	Open ocean w/ AC cp	Open ocean w/ AC; no cp	Open ocean w/ no AC
1851-85	15 kt	N/A	N/A	25 kt
1886-1920	12 kt	N/A	N/A	20 kt
1944-1953	11 kt	13 kt	15 kt	20 kt
Late 1990s	10 kt	12 kt	N/A	15 kt
Late 2000s	9 kt	10 kt	N/A	12 kt

Table 21. Average intensity error estimates in the reanalyzed HURDAT for different time periods stratified using different observation methods. “CP” = central pressure. (References: Landsea et al. 2008; Landsea, 2011, personal communication.)

There were some flights for which no center fix was provided (such as when circumnavigation was conducted), and it is estimated that the position error averaged over all times when there was reconnaissance data available is about 35 nmi. Average position error for settled areas of the coastline for U.S. landfalling hurricanes showed significant improvement from the 19<sup>th</sup> century. This is largely due to the numerous (sometimes hourly) aircraft center fixes that were usually provided during the last day or so leading up to a U.S. landfall. Also, the coastal radar network was beginning to be developed during the late 1940s, and by 1950, there were at least four land-based radars operation along the coastal areas between Texas and Virginia (NHC microfilm). These radars were located at Boca Chica (NAS), FL, first utilized for 1947 Storm 9 (originally Storm 8), Freeport, TX, first utilized for 1949 Storm 11 (originally Storm 10), Norfolk, VA, first utilized for 1950 Hurricane Able, and Gainesville, FL, first utilized for 1950 Hurricane Easy. The last two rows in Tables 20 and 21 are unpublished subjective error estimates from an average of the NHC hurricane specialists for recent time periods (Landsea, 2011, personal communication).

The intensity errors in HURDAT are stratified similarly to the track errors except the aircraft reconnaissance group is divided into two groups- one for which central pressures were measured, and the other for when they were not measured. There was a significant difference in the average absolute error between the two groups. The wind speeds in the original HURDAT contain similar errors for when central pressures were measured compared to when central pressures were not measured. The improvement as a result of the reanalysis is due to greatly increased knowledge of pressure-wind relationships. The HURDAT intensity biases are shown in Table 22. Intensities are

### HURDAT Intensity Error Biases

Year	1851-85	1886-1920	1944-53	Late 2000s
US Landfalling (settled)	0 kt	0 kt	0 kt	0 kt
Open ocean w/ AC cp	N/A	N/A	0 kt	0 kt
Open ocean w/ AC; no cp (30-60 kt)	N/A	N/A	+3 kt	N/A
Open ocean w/ AC; no cp (65-95 kt)	N/A	N/A	+5 kt	N/A
Open ocean w/ AC; no cp (100-115 kt)	N/A	N/A	0 kt	N/A
Open ocean w/ AC; no cp (120+ kt)	N/A	N/A	-12 kt*	N/A
Open ocean w/ no AC	-15 kt	-10 kt	-10 kt	0 kt

Table 22. Average intensity bias estimates in the reanalyzed HURDAT for different time periods stratified using different observation methods and by *actual* storm intensity only for when aircraft reconnaissance flights did not report central pressure values. (References: Landsea et al. 2008; Landsea, 2011, personal communication.)

likely underestimated in HURDAT for open ocean cases when aircraft reconnaissance was not present. For cases when aircraft central pressures were measured there is little, if any, bias in the HURDAT intensity. However, for the cases when the aircraft estimated the maximum winds but did not provide a central pressure, there were larger biases. TCs that were Category 1 and 2 hurricanes in reality are likely overestimated in intensity by around 5 kt on average in the reanalyzed HURDAT during times when aircraft provided wind estimates with no central pressure measurement (they were likely overestimated by around 10 kt on average in HURDAT originally). This is because the intensity can only be reduced if there is enough observational evidence to lower the HURDAT intensity. There are likely many cases for which aircraft reconnaissance overestimated the intensity and did not measure or report a central pressure, but the HURDAT intensity cannot be fully corrected for these cases unless there is enough evidence. TCs that were actually 120 kt and higher are likely underestimated in intensity since the most intense part of the storm was not sampled for these intense hurricanes. To test this hypothesis, statistics from the Category 5 study were utilized. For all times during which hurricanes between

1992-2007 utilized for this study were at or above a 120 kt intensity, the NHC best track intensity (kt) is subtracted from the late 1940s intensity value. During the late 1940s, the intensity averaged over all 6-hourly cases is 12 kt lower than the intensities listed in the NHC best track, and that value is shown in Table 22.

Figure 20 is similar to Figure 9 except that all central pressures listed in the revised HURDAT are utilized (from aircraft, ship, and station data). Central pressures listed in HURDAT for overland cases after landfall are excluded because the Brown et al. pressure-wind relationships are for over water exposure only. The raw data that pertains to Figure 20 is listed in Appendix B.

### Central pressures (all) - (1944-1953)

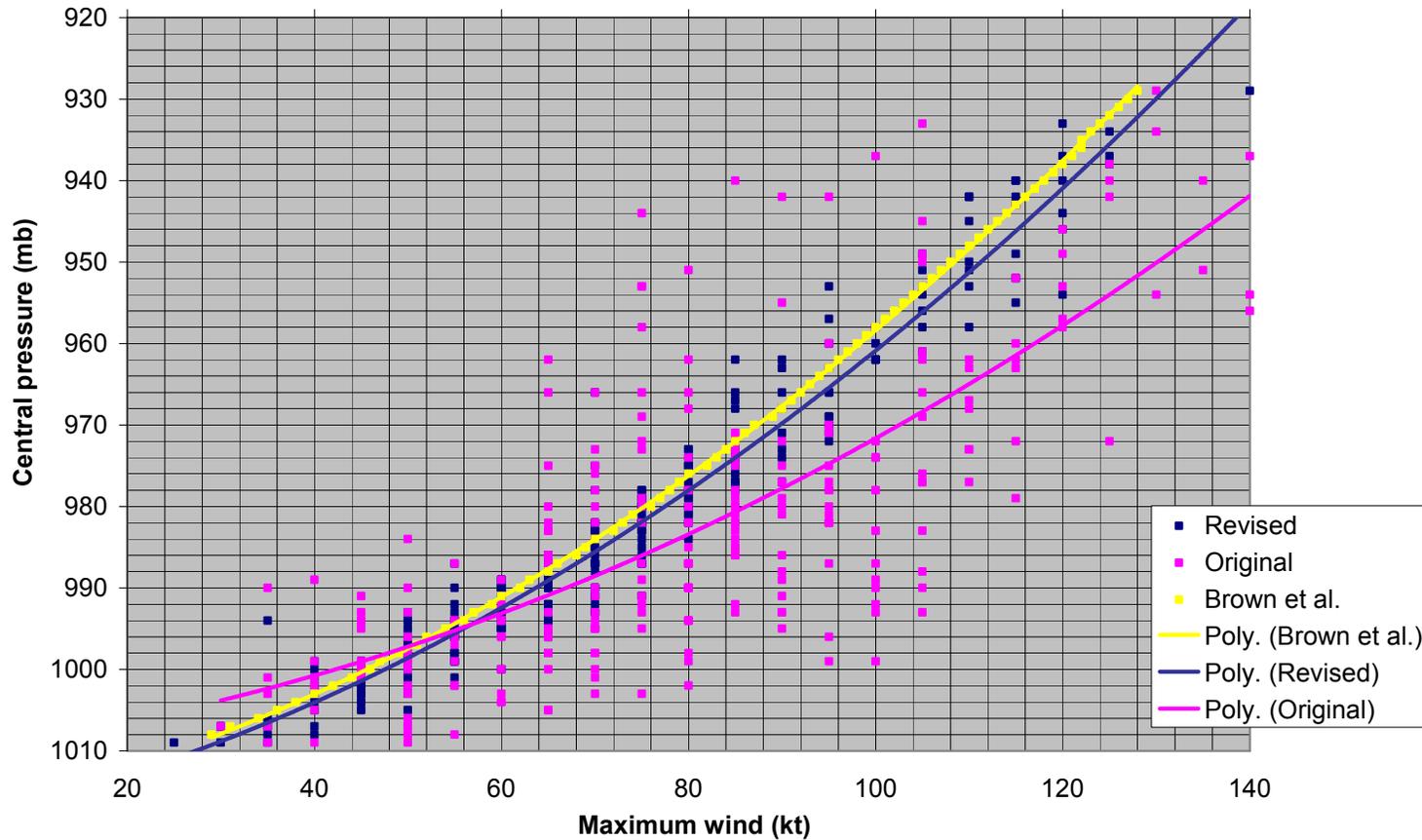


Figure 20. Comparison plot of original HURDAT winds vs. revised HURDAT winds with all central pressures listed in the revised HURDAT. Data taken from Table 25 (does not include rows high-lighted in yellow, which are over-land cases).

## CHAPTER 6

### CATEGORY 5 STUDY RESULTS AND DISCUSSION

Best track intensity graphs are drawn for the entire lifetime of all ten of the Category 5 hurricanes using the methodology for this study described above in the methodology section. The actual intensities from the NHC best track are compared to the best track intensity that would have been listed if these hurricanes had occurred during the late 1940s. The following subsections detail how the questions were answered for the individual ten Category 5 hurricanes.

#### **Hurricane Andrew (1992)**

Hurricane Andrew (1992), the most damaging hurricane in the history of the United States at the time (not adjusted for population and wealth increases) (Pielke et al. 2008), is listed in the revised NHC Best Track (Landsea et al. 2004b, Rappaport 1993) as a Category 5 on August 23 at 12 and 18Z as well as August 24 at the 09Z landfall south of Miami, FL. The results of this study suggest that Hurricane Andrew would have also been listed as a Category 5 if it had occurred during the late 1940s. Two barometers in Homestead recorded central pressures of about 922 mb at landfall. A central pressure of 922 mb yields wind speeds of 137 and 130 kt, respectively, according to the southern and north of 25N pressure-wind relationships, respectively. The 922 mb central pressure also yields 139 and 137 kt according to the intensifying subsets of the aforementioned pressure-wind relationships respectively. A number between these values of 136 kt is chosen. Taking into account the small size of Andrew, 10 kt is added to the pressure-wind relationship. A 145 kt intensity is chosen as the landfall intensity and the intensity

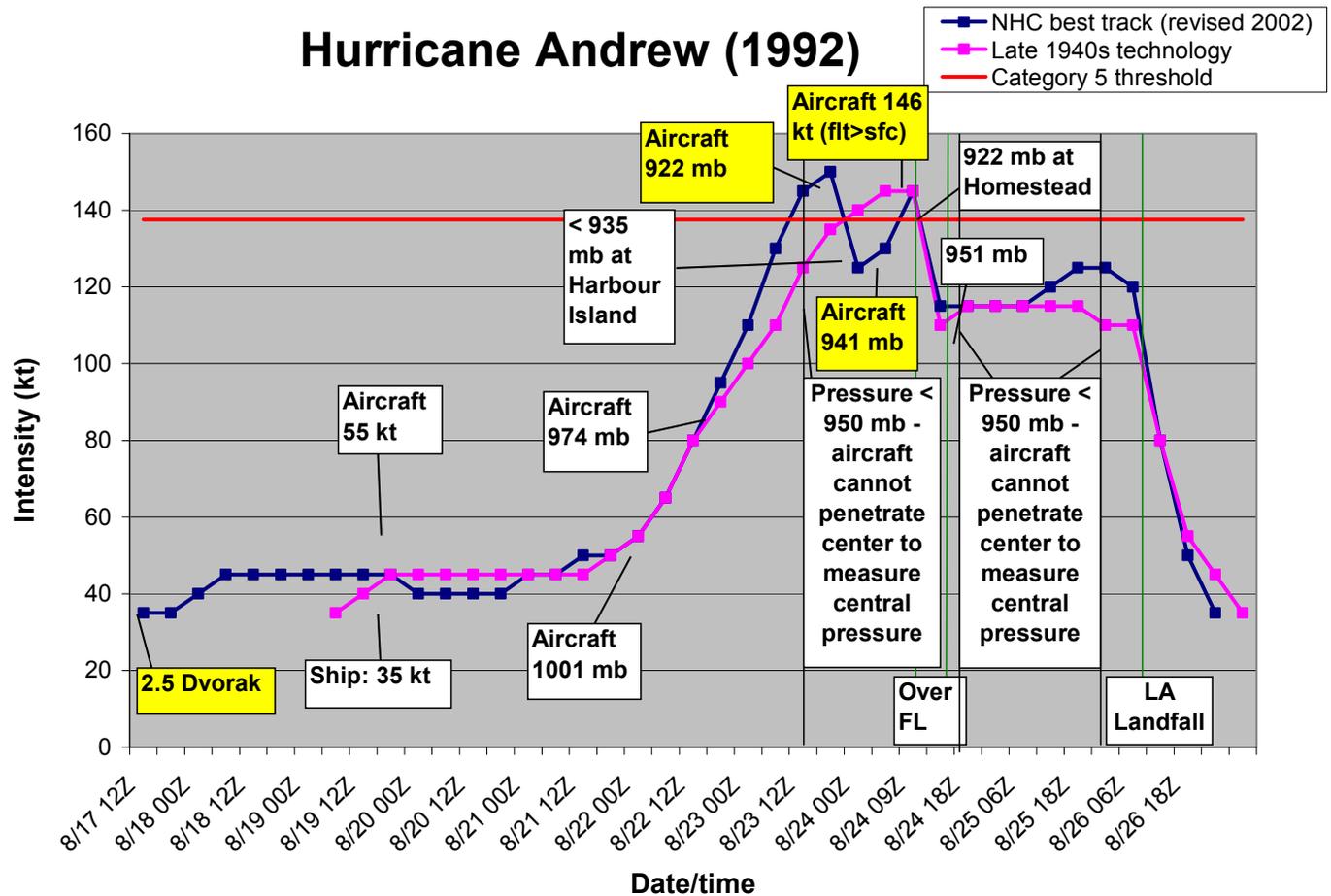


Figure 21. Best Track comparison graph for Hurricane Andrew (1992). Dark blue line is the NHC Best Track intensity and pink line is what the intensity would have likely been if only observations that would have been available during the late 1940s are used. Yellow boxes indicate observations that would only be available with recent technology and white boxes indicate observations that were available during both the late 1940s and today.

at 06Z on August 24<sup>th</sup> (three hours prior to landfall), as shown in Figure 21. During the time when Andrew is listed as a Category 5 on August 23, intensities of 125 and 135 kt would have been chosen at 12 and 18Z if Andrew had occurred during the late 1940s (145 and 150 kt in the revised NHC Best Track). On August 22 at 1705Z, aircraft measured a central pressure of 974 mb which yields about 82 kt, and 90 kt is chosen for 18Z due to speed/size considerations. On August 23 at 1224Z, aircraft flew to the system again and would have not been able to penetrate the center. A central pressure of less than 950 mb yields a wind speed of greater than 111 kt in this case. Adding 10 kt for speed/size yields a wind speed of greater than 120 kt. A 125 kt intensity is chosen for August 23 at 12Z. On August 23 at 21Z, a pressure of 935 mb was recorded at Harbor Island, Bahamas. Although this was not a central pressure in reality, there may have been some uncertainty as to whether it was a central pressure if Andrew had occurred during the late 1940s. A central pressure of less than 935 mb yields a wind speed of greater than 126 kt in this case. A 5 to 10 kt addition is made for speed/size. A 135 kt intensity is chosen due to the uncertainty regarding whether this is a central pressure, but one could argue that 140 kt should be chosen for August 23 at 18Z after factoring in the possibility that the 935 mb observation may not have been treated as a central pressure during the late 1940s. In general, the double peak intensity for Andrew would not have been identified back in the 1940s. Instead, it is likely that the first Category 5 peak would have been underestimated and the second would have been recorded. The ACE of Hurricane Andrew would have been shown as 25 instead of the value of 28 indicated from the revised NHC Best Track.

### **Hurricane Mitch (1998)**

Hurricane Mitch (1998) presents a different type of scenario, dissimilar from the other nine Category 5 hurricanes. Hurricane Mitch passed directly over Swan Island as a Category 5 hurricane. There used to be a full weather station on the island, but it was abandoned sometime during the 1980s. If Mitch occurred during the late 1940s, it would have been possible that the Category 5 conditions experienced there would have been recorded by the barometer or anemometer. A more likely scenario is that these instruments would have been blown away or destroyed by the storm, or a human would not have been there to monitor the instantaneous pressure trace for fear of his or her life. Nevertheless, due to the conservative methodologies applied for this study, it is assumed that the Category 5 conditions would have been recorded during the late 1940s. Mitch is listed in the NHC Best Track (Guiney and Lawrence 1999) as a Category 5 from October 26 12Z through October 28 00Z. The following values (kt) are the analyzed intensities for late 1940s values compared with the NHC Best Track values in parenthesis for the time when Mitch is listed as a Category 5 in the NHC Best Track: 135 (145); 140 (155); 140 (155); 140 (150); 135 (150); 130 (145); 125 (140). These values are shown in Figure 22 on the Best Track comparison graph for Hurricane Mitch. On October 25 at 1326Z, aircraft would not have been able to penetrate the center because the pressure was less than 950 mb. The Brown et al. southern pressure-wind relationship for intensifying systems is used at this time. It would have been known that the system was intensifying because the central pressure deepened by at least 31 mb during the previous 20 hours. This yields a wind speed of at least 113 kt. A 120 kt intensity is chosen from October 25 12Z through October 25 18Z. Thereafter, a 5 kt intensity increase every six hours is

# Hurricane Mitch (1998)

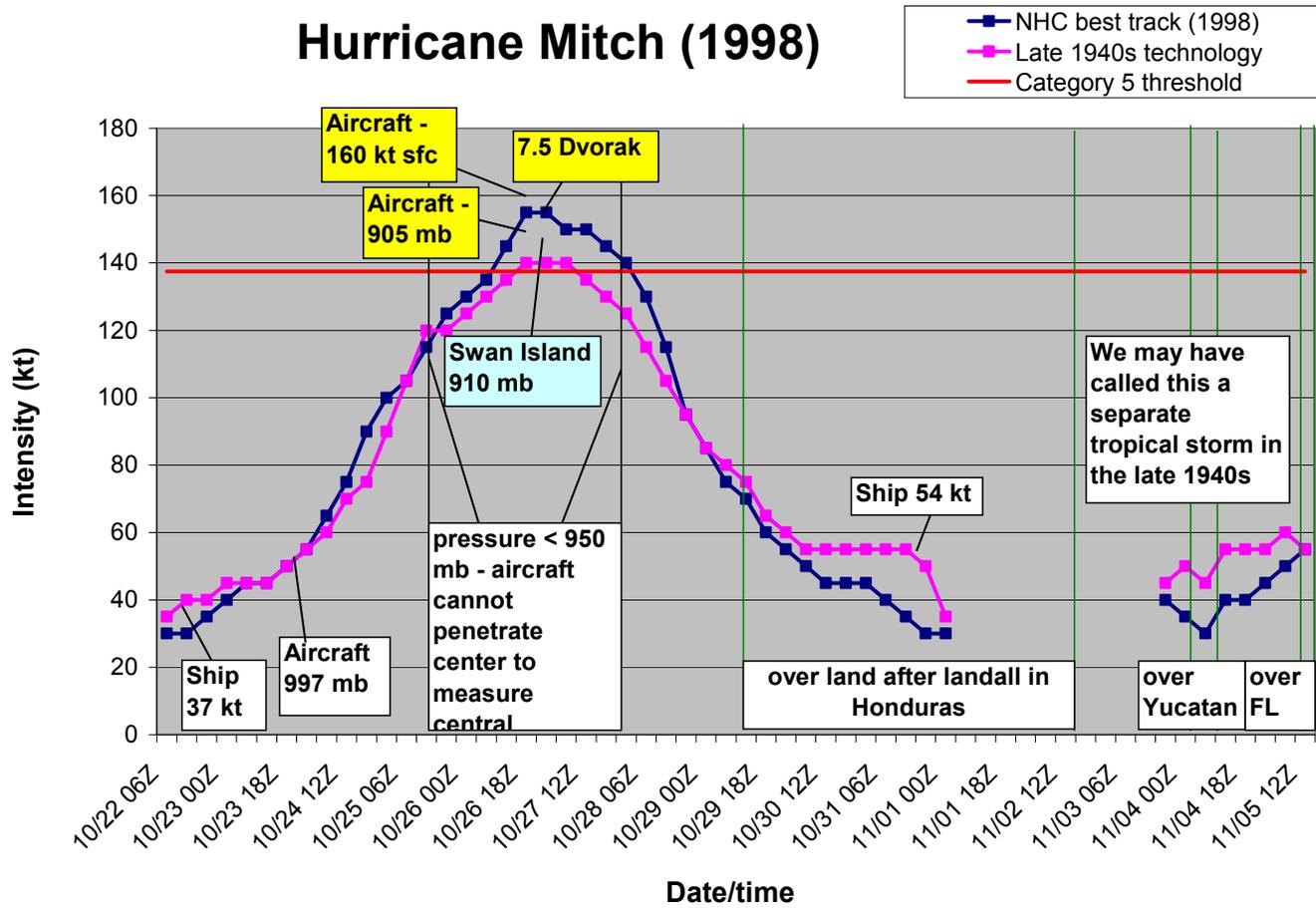


Figure 22. Best Track comparison graph for Hurricane Mitch (1998).

applied until October 27 00Z, when Mitch passed over Swan Island, where a 910 mb central pressure could have been recorded. A central pressure of 910 mb equals 147 kt according to the Brown et al. southern pressure-wind relationship. A 140 kt intensity is chosen because 5 kt is subtracted for a slow speed. On the 27<sup>th</sup> at 2340Z, the central pressure of Mitch was still less than 950 mb. By midday on the 28<sup>th</sup>, aircraft measured central pressures of 959 and 960 mb, which yield intensities around 95 kt after taking into account speed/size. A 125 kt intensity is chosen for October 28 at 00Z because analysis would have shown that the pressure would have still likely been below 950 mb at that time. The U.S. landfall intensity for Mitch would have been listed as 60 kt instead of 55 kt for the November 5<sup>th</sup> landfall at Naples, FL. The ACE for Mitch would have been listed as 34 instead of the value of 36 from the NHC Best Track.

### **Hurricane Isabel (2003)**

Hurricane Isabel (2003) was a particularly interesting case with a distinct and important difference from all of the other nine cases- it was out of range of aircraft reconnaissance during part of the time when it was a Category 5 hurricane. Isabel originated from an African easterly wave. Satellite images and associated Dvorak classifications showed it became a tropical storm on September 6 at 06Z in the far eastern Atlantic. It strengthened into a hurricane at 12Z on the 7<sup>th</sup>. Satellite images indicated that Isabel became a Category 3 hurricane by September 8 at 12Z. A 7.0 Dvorak classification on September 11 indicated that Isabel had reached Category 5 strength on that day while moving westward near 45 degrees W longitude- still too far east for aircraft reconnaissance. The range of aircraft reconnaissance in the 1940s was to 50W

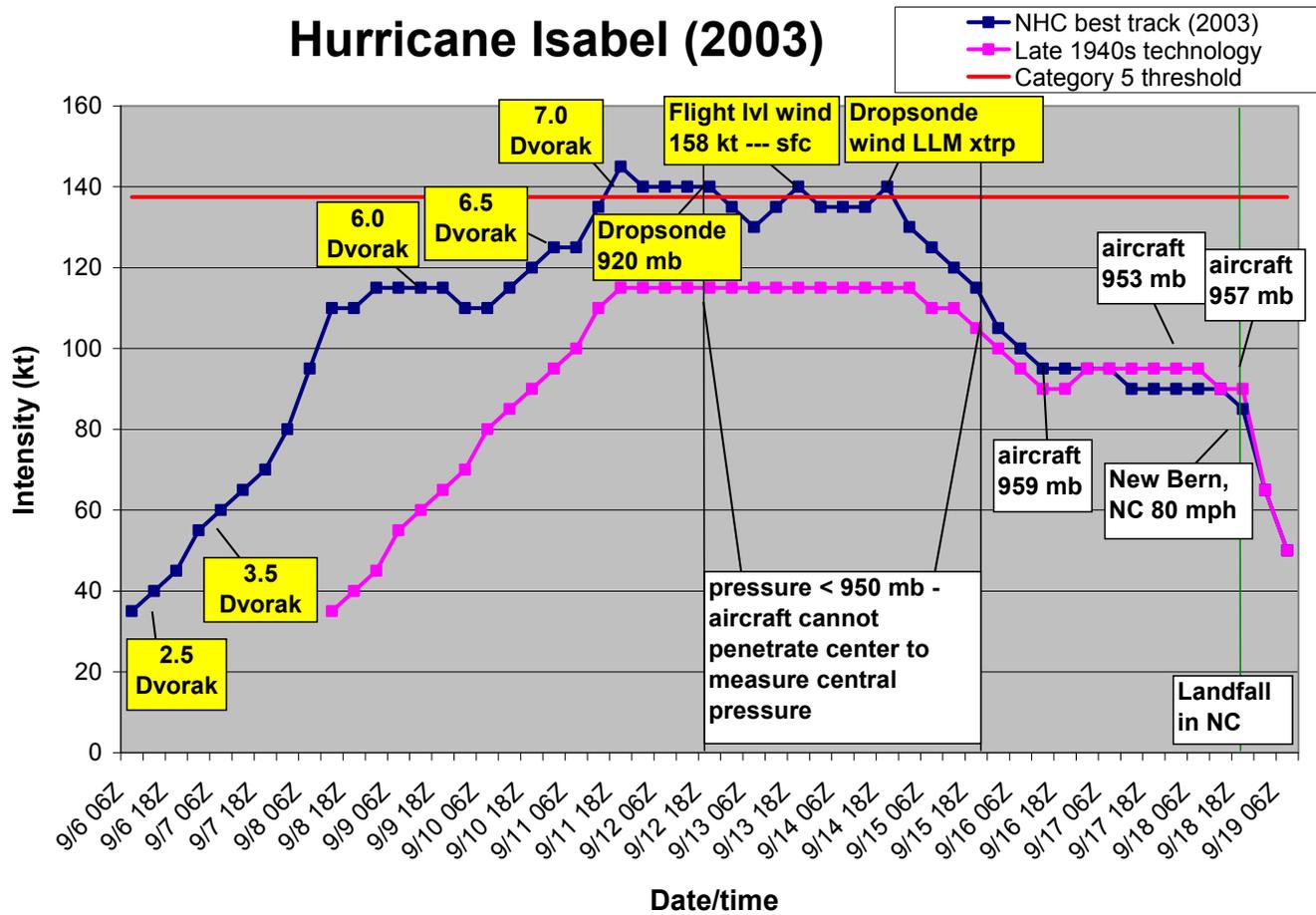


Figure 23. Best Track comparison graph for Hurricane Isabel (2003).

longitude. No ships traveled close enough to Isabel to measure winds of gale force during the time from genesis to the first aircraft flight on the 12<sup>th</sup>. Therefore, for the first day when Isabel was a Category 5 hurricane, it likely would not have been known that a tropical storm even existed if Isabel occurred during the late 1940s. The methodology of this study does not take into account the fact that since there were no warnings for unknown storms, ships would have run into them if they happened to have been on a collision course with a TC. However, experience with the reanalysis as well as published papers such as the one by Vecchi and Knutson (2008) indicate that ship traffic in the region between 5-25N, 25-55W was sparse, even during the 1940s compared with other regions of the Atlantic Basin. In fact, ship density in this region remains rather sparse today. When aircraft reconnaissance first reached Isabel on the 12<sup>th</sup> of September, the aircraft would not have been able to penetrate the center because the central pressure was less than 950 mb, as shown in Figure 23. A central pressure of less than 950 mb yields a wind speed of greater than 111 kt according to the southern pressure wind relationship. Using the rule to choose an intensity 5 kt above the what the 950 mb value would suggest if it was a central pressure, 115 kt is chosen. Even though the pressure remained less than 950 mb through at least 1936Z on the 15<sup>th</sup>, the 115 kt intensity is lowered to 110 kt at 06Z on the 15<sup>th</sup>. On the 15<sup>th</sup>, the storm began to approach 25N latitude and it also slowed down slightly from the previous days. On September 15 at 1936Z, the central pressure was still below 950 mb. Using a combination of the southern and north of 25N pressure-wind relationships, and then subtracting by 5 kt because of a below average speed and an above average size, a wind speed of greater than 102 kt is obtained. On September 16 at 1231Z, aircraft measured a central pressure of 959 mb which yields an

intensity of 96 kt according to the north of 25N pressure-wind relationship. Subtracting 5 kt for a slow speed and large size rounds to 90 kt. To allow for a steady intensity decrease from the previous day, the 110 kt intensity chosen for 12Z on September 15 is brought down to 105 kt on September 15 at 18Z, 100 kt on September 16 at 00Z, 95 kt at 06Z, and 90 kt at 12Z. The central pressure then deepened again from 959 mb to 953 mb between September 16 at 1231Z and September 17 at 2344Z. The 90 kt intensity on September 16 at 18Z is brought up to 95 kt for 00Z on the 17<sup>th</sup>. On September 17 at 1925Z, the 955 mb central pressure yields an intensity of 100 kt (subtracting 5 kt for speed/size yields 95 kt). Although the pressure of 953 mb at 2344Z on the 17<sup>th</sup> yields 102 kt, after subtracting by 5 kt for speed/size, it would produce an intensity of 97 kt. That was the last observation for the day, and the next observation at 9/18 1302Z yields an intensity of 94 kt. The 953 mb observation could have been transitory, and 95 kt is maintained from September 17 06Z through landfall.

Isabel would have been listed with a 95 kt landfall intensity instead of the 90 kt intensity shown in the NHC Best Track (Beven and Cobb 2003). A 957 mb aircraft central pressure recorded just as the center was moving onshore yields 98 kt according to the Brown et al. north of 25N pressure wind relationship and 92 kt according to the north of 35N pressure-wind relationship. Averaging the two values yields 95 kt, which would be chosen according to reanalysis methodology.

Hurricane Isabel has by far the largest ACE disparity between the late 1940s value and the NHC Best Track value. The ACE for Isabel would have been 40.6 instead of 63.3. But this is using a very conservative methodology. When Isabel would have been first discovered in the late 1940s (September 12<sup>th</sup> around 18Z), the analyzed 115 kt

intensity at that time was flat-lined back for 24 hours due to the fact that aircraft reconnaissance could have reached Isabel on the 11<sup>th</sup> since it reached 50W by that day. From the point on the 11<sup>th</sup> of September, the intensity is decreased by 25 kt per day until a 35 kt intensity is shown back on the 8<sup>th</sup> of September. If these conservative methodologies are not applied, the late 1940s ACE of Isabel would have been 29.3 instead of 63.3 if counting begins on September 12 at 12Z.

### **Hurricane Ivan (2004)**

Hurricane Ivan (2004) fluctuated between Category 4 and 5 intensity three different times during its lifetime according to the NHC Best Track (Stewart 2004). Ivan was a long-lived hurricane that traveled westward through the Caribbean Sea, passed through the Cayman Islands when it was at borderline Category 4/5 intensity, moved northwestward into the Gulf of Mexico and then northward and made a U.S. Landfall in Alabama after having weakened to a Category 3 hurricane. Hurricane Ivan also would not have been listed as a Category 5 if the cyclone had occurred during the late 1940s. The Best Track comparison graph for Hurricane Ivan is shown in Figure 24. Hurricane Ivan is listed as a Category 5 in the NHC Best Track for the 12 hours including 06-12Z on September 9, the 12 hours including September 11 18Z – September 12 00Z, and the 36 hours including September 13 00Z to September 14 06Z. Intensities of 140 kt were attained during the first and last of these three periods and 145 kt was attained during the middle period.

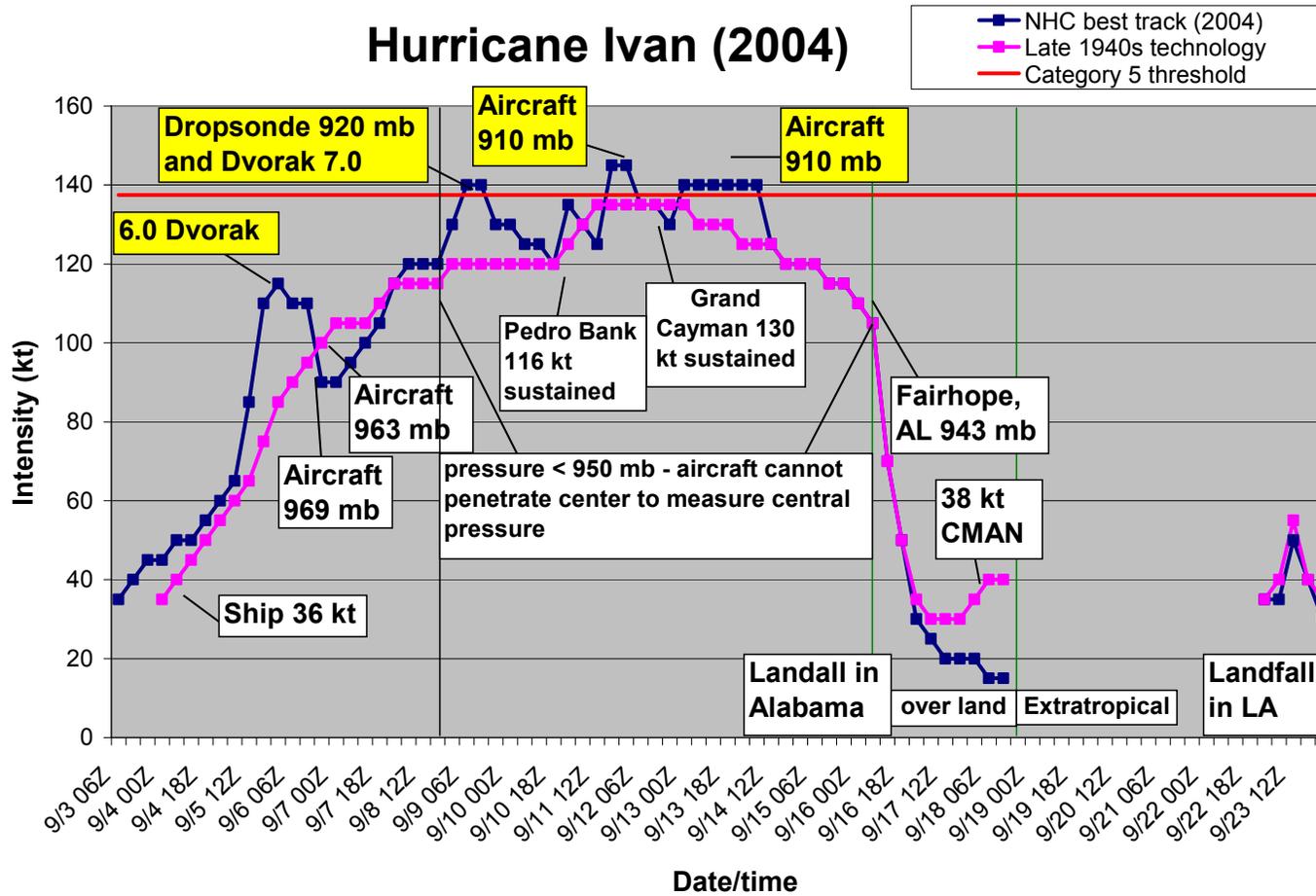


Figure 24. Best Track comparison graph for Hurricane Ivan (2004).

For the first of those three periods, intensities of 120 kt would have been chosen instead of 140 kt on September 9 from 06 – 12Z. On September 7 at 2043, 2208, and 2312Z, aircraft reconnaissance measured central pressures of 952, 950, and 951 mb respectively. These pressures yield 110 kt (southern- intensifying), 113 kt (southern, intensifying), and 110 kt (southern) respectively. The intensifying subset was used for the first two because the cyclone is analyzed to have been intensifying steadily since a 963 mb central pressure was recorded 24 hours earlier. But when the 951 mb reading was recorded, it appeared to signal the end of that intensification process. Adding 5 kt to each of these for a smaller than average storm and a faster than average forward motion yields an average of about 115 kt among the three observations. A 115 kt intensity is chosen for Ivan from September 8 00Z to September 8 18Z. On September 8 at 1748Z, aircraft measured a central pressure of 951 mb, which yields 110 kt according to the southern pressure-wind relationship. The speed and size of the cyclone were becoming closer to average. However, two hours later, at 1928Z on the 8<sup>th</sup>, aircraft would not have been able to penetrate the center because the pressure was below 950 mb. The pressure remained below 950 mb from September 8 1928Z through at least September 15 at 2255Z. At September 8 1928Z, a pressure of less than 950 mb yields a wind speed of greater than 111 kt. After adding 5 kt for speed/size plus adding 5 kt since the central pressure would have been some unknown value less than 950 mb, 120 kt is chosen from September 9 00Z through September 10 18Z. This time includes the first period when Ivan was a Category 5.

For the second Category 5 period for Ivan, during the morning of the 11<sup>th</sup>, when the cyclone was passing near Jamaica, Pedro Bank recorded winds of 116 kt (on the left side of the storm). More than 24 hours later, Grand Cayman recorded a sustained wind of 130 kt on September 12 at 15Z. Grand Cayman was located on the right side of the storm and within three-tenths of a degree lat/lon of the center. A 135 kt intensity is chosen using the reanalysis methodology to choose an intensity 5 kt above the highest available reliable wind observation. It is important to note that if a station is located on the left side of the storm, an intensity 10 kt above that observation can be chosen due to the effects of translational velocity. Therefore, at the time of the Pedro Bank observation of 116 kt, a 125 kt intensity is chosen. At the time of the Grand Cayman observation of 130 kt, a 135 kt intensity is chosen. A 130 kt intensity is chosen for 06Z on the 11<sup>th</sup>, so 125 kt is chosen for 00Z on the 11<sup>th</sup>. The intensity is increased to 135 kt at 12Z on September 11 and held there through September 13 00Z. After the Cayman Islands observation of 130 kt at 15Z on the 12<sup>th</sup>, there is no more information regarding the peak intensity of the hurricane until landfall near the Alabama/Florida border when a 105 kt intensity is chosen based on a 943 mb central pressure observation (after applying an adjustment factor of +5 kt to the pressure-wind relationship). A gradual decrease in intensity from 130 kt on the 12<sup>th</sup> to 105 kt on the 16<sup>th</sup> is implemented starting at 9/13 06Z. Between the time of the 130 kt at Grand Cayman and the 943 mb observation at Fairhope, AL, the central pressure was below 950 mb the entire time, so aircraft reconnaissance would not have been able to penetrate the center. No other surface observations recorded near Category 5 conditions.

According to the NHC Best Track, Hurricane Ivan made landfall on the coast of Alabama as a 105 kt hurricane. If Ivan had occurred during the 1940s, the analyzed intensity would likely have been about the same value. A central pressure of 943 mb at Fairhope, AL yields 112 kt according to the north of 25N pressure wind relationship. There is no evidence that the cyclone was weakening prior to landfall. After subtracting 5 kt due to a rather low OCI of 1006 or 1007 mb, a 107 kt intensity is obtained, which rounds to 105 kt (the same value as listed in the NHC Best Track). The ACE for Ivan is analyzed to have been 64 (late 1940s) compared with the NHC Best Track value of 70.

### **Hurricane Emily (2005)**

Hurricane Emily (2005) would have been listed with a peak intensity of 125 kt (as depicted in Figure 25) instead of the 140 kt peak intensity shown in the NHC Best Track (Franklin and Brown 2006). Hurricane Emily is listed as having only been at Category 5 strength for six hours (at July 17 00Z). The peak observations available during the late 1940s that would have been used to determine the peak intensity of Emily are as follows. From July 16 at 1328Z until at least July 17 at 1715Z, the central pressure was less than 950 mb and the aircraft would not have been able to penetrate the center. A central pressure of less than 950 mb yields a wind speed of greater than 113 kt from the intensifying subset of the Brown et al. southern pressure- wind relationship. Adding 5 kt to the pressure-wind relationship for a small size and a fast speed rounds to greater than 120 kt. A 125 kt intensity is chosen from July 16 12Z to July 17 18Z.

Choosing intensities on July 18 for 00Z and 06Z were problematic because the first Mexican landfall would have been analyzed to have occurred within 6 nmi of Tulum, Mexico, where a minimum pressure of 978 mb was recorded. However, in reality, aircraft measured 955 mb just before landfall (at night). A 978 mb central pressure yields 79 kt and 955 mb yields 106 kt. A 5 kt addition is applied to both for a small size. This yields 85 and 110 kt respectively. But even if the 978 mb observation was believed to be close to the central pressure value, it would not have been treated as a central pressure, so the 85 kt could therefore be raised to 95 kt. However, since it would have been known that the pressure was less than 950 mb just 13 hours prior to landfall, it seems unrealistic that the hurricane would fill 28 mb over water in 13 hours. Therefore, a solution about halfway between the two possibilities is analyzed, and 100 kt is chosen for the first landfall. For the second landfall, the Ho et al. inland pressure decay model is used to obtain a landfall pressure of 949 mb which yields 110 kt (unchanged). This pressure is obtained from an observation of a 965 mb pressure four hours after landfall and 60 km inland. Emily did not make a U.S. landfall. The ACE for Hurricane Emily would have been 30 instead of 33.

### **Hurricane Katrina (2005)**

Hurricane Katrina (2005) likely would not have been listed in HURDAT as a Category 5 hurricane if it would have occurred during the late 1940s, as depicted by the Best Track comparison graph in Figure 26. During the 18 hour time when Katrina was a Category 5 (August 28 12Z – August 29 00Z), intensities of about 115, 120, and 120 kt would have been assigned instead of 145, 150, and 140 kt. On August 27 at 1514Z, the

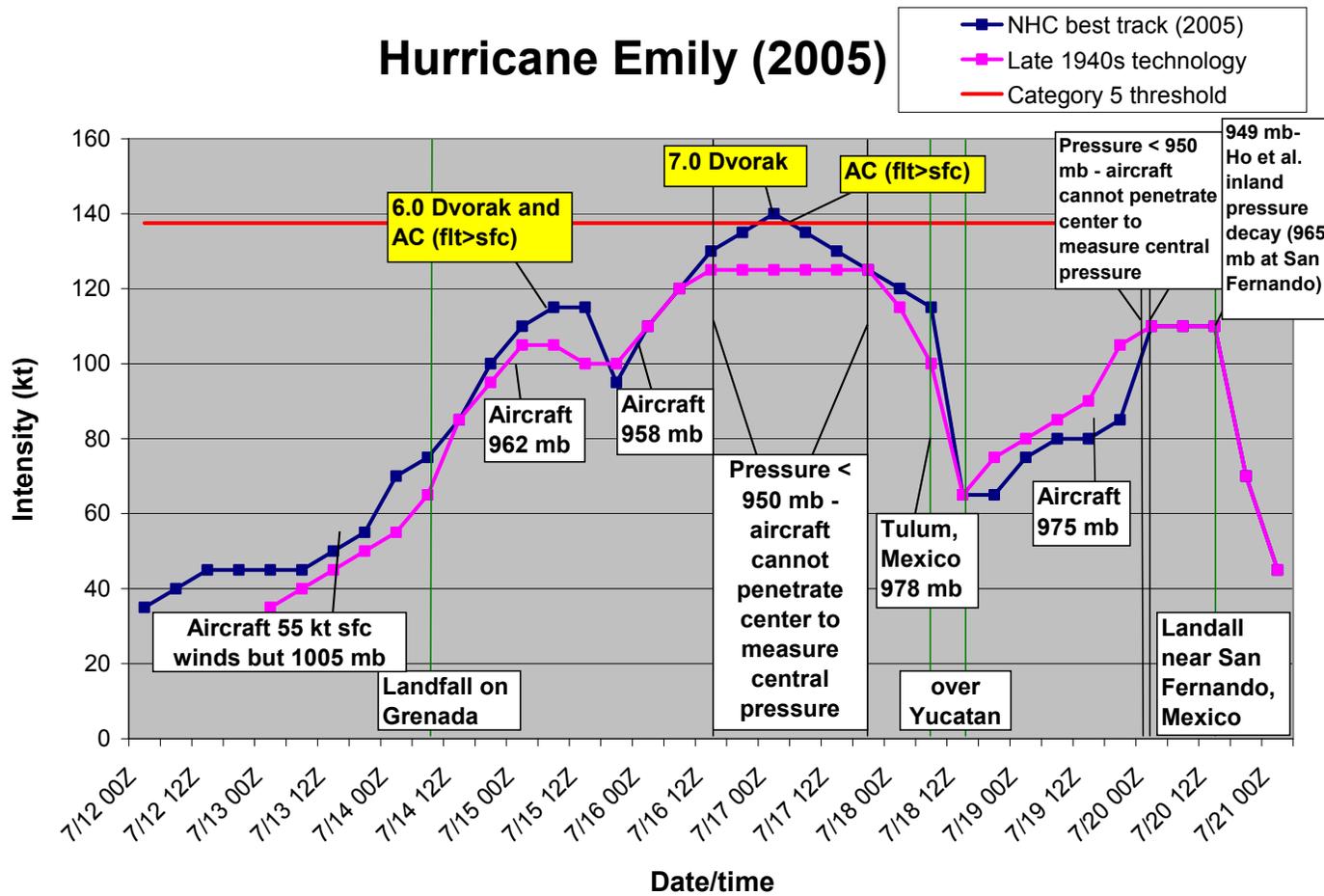


Figure 25. Best Track comparison graph for Hurricane Emily (2005).

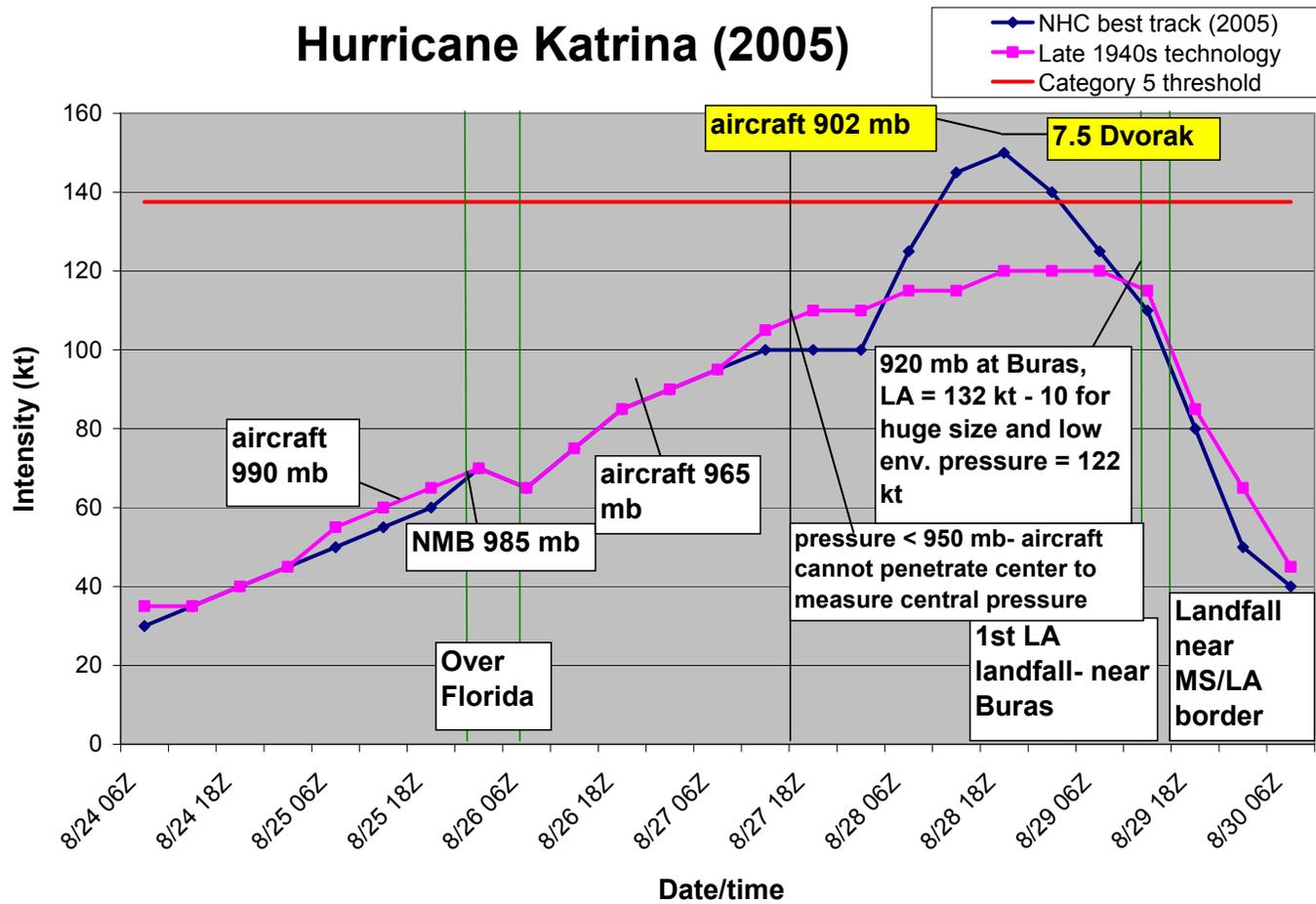


Figure 26. Best Track comparison graph for Hurricane Katrina (2005).

aircraft would not have been able to penetrate the center because the pressure was less than 950 mb. This continued with every aircraft fix through landfall. A pressure of less than 950 mb yields wind speeds of at least 113 and at least 110 kt according to the Brown et al. pressure-wind relationships for intensifying systems south and north of 25N respectively. A 115 kt intensity would have been chosen for a TC with a normal size and forward speed due to the methodology to choose an intensity 5 kt higher than a peripheral pressure. After subtracting 5 kt for the large size of Katrina, 110 kt is chosen for the intensity on August 27<sup>th</sup> at 18Z. On August 29 at 0948Z, an National Ocean Service (NOS) station recorded a pressure of 922 mb, and then a 920 mb central pressure was measured at Buras, LA on August 29 at 1116Z. A central pressure of 920 mb equals 132 kt according to the pressure-wind relationship for north of 25N. A 120 kt peak lifetime intensity is chosen (after subtracting 10 kt for the very large size of Katrina) from August 28 18Z through the first Louisiana landfall, which occurred at August 29 11Z. The intensity is analyzed to have reached 115 kt by August 28 at 06Z and 120 kt by August 28 at 18Z. The rapid intensification and subsequent rapid weakening that occurred in the Gulf of Mexico would not have been captured with the observational platforms of the late 1940s.

The 70 kt intensity for Katrina's Florida landfall would be unchanged. The highest observed wind was 63 kt at Virginia Key in Miami-Dade County, FL. The lowest observed pressure was 983 mb (central pressure) at the WFO/NWS/NHC/TPC in Miami, FL. A central pressure of 983 mb yields 72 and 68 kt according to the southern and north of 25N pressure-wind relationships respectively. The size of Katrina was smaller than average, but the speed was slower than average, so no adjustment is necessary. Taking

an average of the 72 and 68 kt values yields 70 kt. Multiplying by 0.85 to account for surface friction (Vickery et al. 2009) because the observation was slightly inland yields 60 kt. However, this observation was taken more than two hours after landfall. The lowest pressure on the coast at landfall was 985 mb at North Miami Beach. A central pressure of 985 mb yields 71 and 66 kt according to the southern and north of 25N pressure-wind relationships respectively. Taking an average yields 68 kt, which rounds to 70 kt. Katrina made its second U.S. landfall at Buras, LA. A 120 kt intensity would have been chosen for landfall (reasoning already explained above) instead of the 110 kt landfall intensity listed in the NHC Best Track (Knabb et al. 2005). The central pressure of Katrina was so low, a 120 kt Category 4 landfall intensity would have been analyzed even after subtracting 10 kt from the Brown et al. pressure-wind relationship. Katrina made its third and final landfall a few hours later near the Louisiana/Mississippi border. A 115 kt intensity would have been analyzed compared with a 105 kt intensity listed in the NHC Best Track. Within ten minutes of the time of this 2<sup>nd</sup> landfall, a buoy recorded a pressure of 927 mb (would have been uncertain whether this was a central pressure value). Assuming it is a central pressure, 927 mb equals 126 kt for north of 25N, but then reduces to 115 kt after taking into account the size of the storm.

The ACE for the entire lifetime of Katrina would have been about 18.8 instead of 20.0 if Katrina had occurred during the late 1940s instead of in 2005. During the 30 hour period including the intensities from August 28 at 06Z through August 29 at 06Z, the actual intensity of Katrina was much higher than the intensity that would have been listed

in the Best Track if Katrina had occurred during the late 1940s. It would have been assumed that Katrina slowly intensified until reaching its peak intensity at Louisiana landfall.

### **Hurricane Rita (2005)**

Hurricane Rita (2005) also would not have been considered to have been a Category 5 if only late 1940s technology was available for observing the cyclone. The Best Track comparison graph for Hurricane Rita is shown in Figure 27. Hurricane Rita was a Category 5 for 24 hours (according to the NHC Best Track) from 18Z on September 21 through 12Z on September 22. Intensities of 145, 150, 155, and 140 kt are listed in the Best Track for Hurricane Rita from September 21, 2005 at 18Z through September 22 at 12Z. If Rita had occurred during the late 1940s, intensities of 120, 125, 125, and 130 kt would have likely been listed in HURDAT during the time it was a Category 5. On September 21 at 1517Z, aircraft would not have been able to penetrate the hurricane because the central pressure was less than 950 mb. A central pressure of less than 950 mb yields wind speeds of greater than 113 kt and greater than 110 kt according to the intensifying subsets of the Brown et al. southern and north of 25N pressure-wind relationships respectively. No adjustment is implemented because the size and the forward speed of Rita were near average on the 21<sup>st</sup>. Beginning on the 22<sup>nd</sup> at 06Z, Rita slowed slightly and the size increased, so an adjustment of -5 kt is implemented on the 22<sup>nd</sup>. Late on the 22<sup>nd</sup>, at 2250Z, a buoy in the Gulf of Mexico recorded a 926 mb pressure, which would have been the peak intensity observation for the entire lifetime of Rita available during the late 1940s. If the assumption is made that 926 mb observation

# Hurricane Rita (2005)

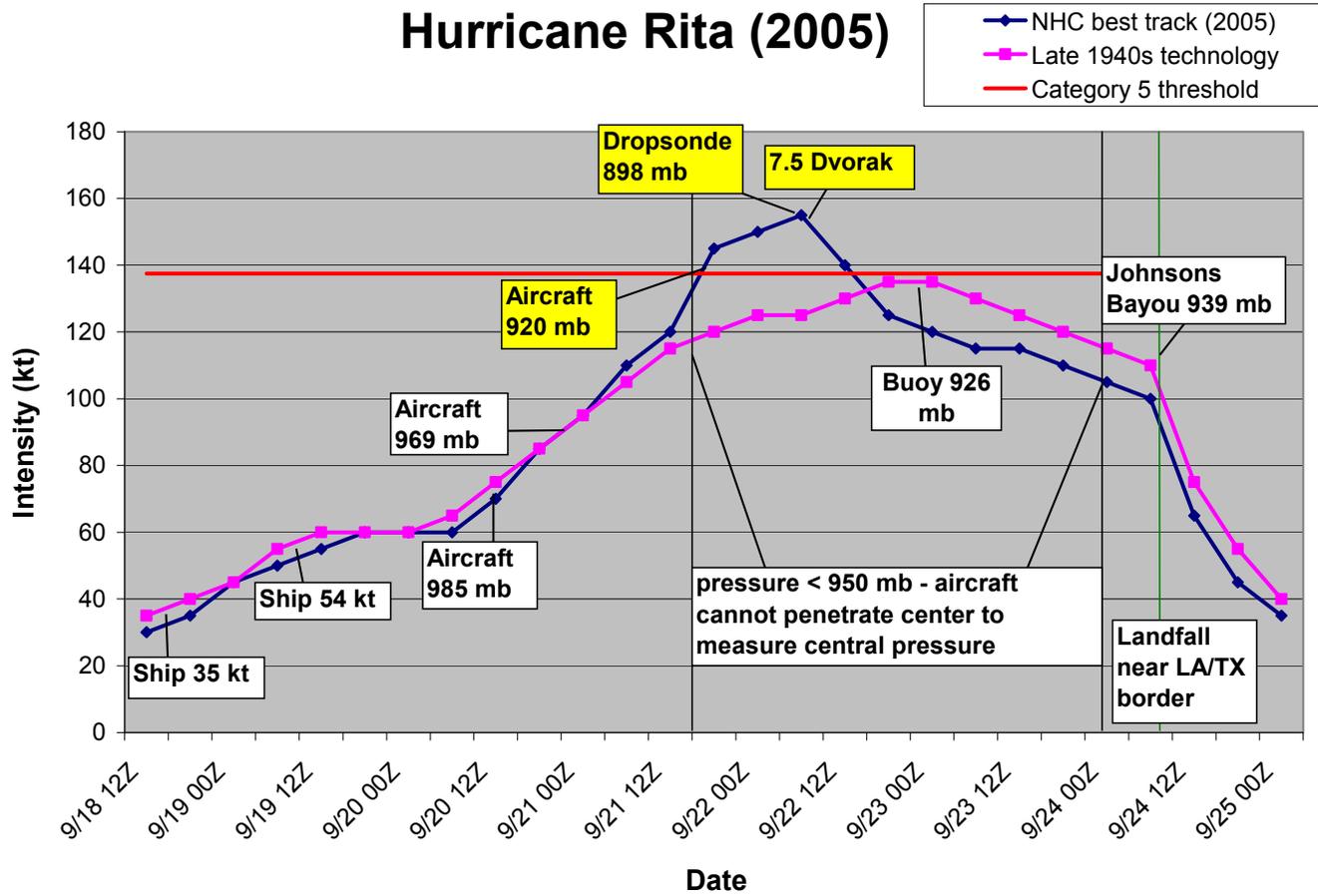


Figure 27. Best Track comparison graph for Hurricane Rita (2005).

is a central pressure value, the pressure-wind relationship yields 133, 127, 136, and 133 kt for south of 25N, north of 25N, south of 25N and intensifying, and north of 25N and intensifying subsets, respectively. A 133 kt intensity is chosen from this blend. Subtracting by 5 kt for speed/size yields 128 kt, which rounds to 130 kt. 130 kt is chosen at Sep 22 12Z. Winds are gradually ramped up to this value from the preceding 24 hr. Since it would not have been certain in the late 1940s whether the 926 mb observation was a central pressure, 135 kt is chosen from 9/22 18Z to 9/23 00Z. The peak intensity of Rita would have been analyzed to have occurred later and have only been a 135 kt Category 4 if observations of recent technology were not available. Some observations due to recent technology that provided evidence of the Category 5 intensity include an 898 mb dropsonde pressure in the eye and a 7.5 satellite Dvorak classification. An intensity of either 150 or 155 kt would have been chosen in the reanalysis if the 898 mb pressure would have been available if Rita had occurred during the late 1940s. A 7.5 Dvorak classification corresponds to a 155 kt intensity. Hurricane Rita made landfall near the Texas/Louisiana border on September 24 at 07Z. A 110 kt intensity would have analyzed with reanalysis methodology compared to the 100 kt shown in the NHC Best Track (Knabb et al. 2006) because a 939 mb pressure was recorded at Johnsons Bayou. This would have been assumed to have been a central pressure since it was at the exact location of landfall. A central pressure of 939 mb equals 116 kt according to the pressure-wind relationship for north of 25N, and 110 kt for its weakening subset. At that time, 33 hours had passed since the 926 mb buoy observation. The rate of weakening was greater than or equal to 13 mb during the previous 33 hours. No adjustment factor for speed/size is necessary. A 110 kt intensity is chosen for the landfall intensity. The

ACE for Hurricane Rita would have not been very different if Rita had occurred during the late 1940s- about 25.1 units of ACE for both scenarios. Although the analyzed intensity (late 1940s) for Rita would have been lower during the time it was a Category 5, the inclusion of all surface observations, both official and unofficial as well as reanalysis methodology are both partially responsible for an analyzed intensity above the actual intensity on the 23<sup>rd</sup> and 24<sup>th</sup> of September.

### **Hurricane Wilma (2005)**

Hurricane Wilma (2005) also would not have been known to have attained a Category 5 intensity if it had occurred during the late 1940s, as depicted in Figure 28. According the NHC Best Track (Pasch et al. 2005), Hurricane Wilma rapidly intensified from 75 kt to 160 kt in a period of 18 hours. This rapid intensification was observed via satellite intensity estimates and aircraft observations including a dropsonde which indicated a central pressure of 882 mb, the lowest pressure ever recorded in the Atlantic Basin. Wilma was a Category 5 hurricane for only 18 hours on October 19 from 06Z through 18Z with intensities of 150, 160 and 140 kt at 06, 12 and 18Z on the 19<sup>th</sup>. If only the technology and observational capabilities of the late 1940s were available to observe Wilma, the intensity at these time would be listed in HURDAT as about 115, 120, and 120 kt for 06, 12, and 18Z on the 19<sup>th</sup> of October, respectively. On October 18<sup>th</sup> at 2309Z, aircraft recorded a central pressure of 954 mb. This pressure yields 109 kt according to the intensifying subset of the Brown et al. southern pressure-wind relationship. Subtracting by 5 kt for a slow speed yields a value of about 105 kt. The next aircraft flight occurred at night, and no intensity information was available during

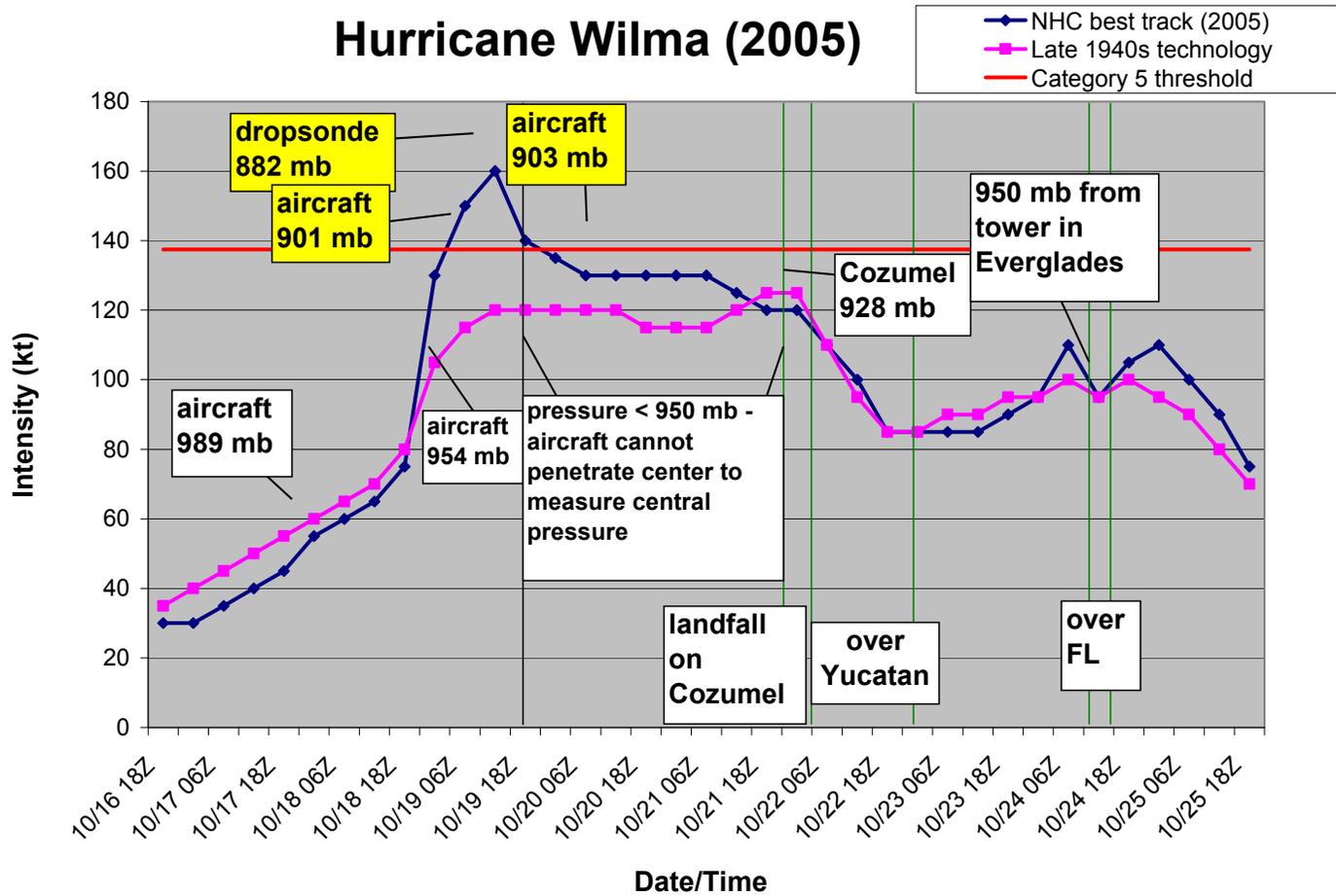


Figure 28. Best Track comparison graph for Hurricane Wilma (2005).

the late 1940s at night. The first fix during daylight on the 19<sup>th</sup> occurred at 1806Z. Aircraft in the 1940s would not have been able to penetrate the center since the central pressure was below 950 mb. A pressure of less than 950 mb yields a wind speed of greater than 111 kt making use of the southern pressure-wind relationship. Subtracting by 5 kt for the slow speed of the storm yields an intensity of greater than 106 kt. It would not have been known whether Wilma was significantly strengthening at the time, but if it was, the intensifying subset would yield a value of greater than 108 kt after subtracting by 5 kt at 18Z on the 19<sup>th</sup>. According to the methodology for this study, a value of either 110 or 115 kt would be chosen in this situation. However, with late 1940s technology, a rapid intensification would have been noted to have occurred between the 18<sup>th</sup> at 12Z (70 kt) and the 19<sup>th</sup> at 00Z (105 kt) (65 to 130 kt in the NHC best track). According to reanalysis methodology, a gradual leveling off of the intensification rate may have been applied in this situation if Wilma was being reanalyzed today as a storm that occurred during the 1940s. Therefore, a 120 kt intensity is chosen for 18Z on the 19<sup>th</sup>. It is important to note that the peak intensity in the NHC Best Track is 160 kt at 12Z. There would have been no information in the late 1940s between the 954 mb central pressure observation on the 18<sup>th</sup> and the aircraft not being able to penetrate the center on the 19<sup>th</sup> to indicate a hurricane with such intensity.

A 928 mb pressure was recorded from the station at Cozumel Mexico on October 21 at 21Z. It would have been known that this observation occurred inside the RMW, with light (but not calm) winds. Assuming a central pressure of 927 mb, this value equals 133 kt according to the Brown et al. southern pressure-wind relationship. Subtracting 10 kt for a very slow speed and a large storm yields 123 kt, which rounds to 125 kt, and 125

kt is chosen as the peak intensity from October 21 18Z through landfall near Puerto Morelos, Mexico on October 22 at 03Z. A 120 kt intensity is shown for these times in the NHC Best Track. For the portion of the Best Track intensity chosen on October 22, Wilma was over Mexico on the 22<sup>nd</sup> from 03Z to 22Z. Runs of the Kaplan and DeMaria inland decay model yield 98 kt for 06Z, 71 kt for 12Z, and 58 kt for 18Z. Intensities of 110, 95, and 85 kt are chosen for those times because at 10/22 1930Z, Isla Mujeres reported a minimum pressure of 968 mb. Isla Mujeres is an island just off the northeastern tip of Yucatan. The cyclone was located inland on the mainland at this time, so the 968 mb observation is not a central pressure. Also, the center of the storm was within 10 nm of the coastline at this time. A peripheral pressure of 968 mb yields a wind speed of greater than 90 kt according to the weakening subset of the southern pressure-wind relationship. Subtracting 10 kt for speed/size yields a wind speed of greater than 80 kt. No 0.85 multiplication factor (Vickery et al. 2009) is applied for over-land friction because the front-right RMW could have been over water by that time. A wind speed of 85 kt is chosen for 18Z, using the rule to choose an intensity 5 kt above the pressure-wind relationship for peripheral pressures. Wilma made a U.S. landfall in southwest Florida near Naples. A 100 kt intensity would have been chosen for landfall (105 kt in the NHC best track). A 950 mb central pressure was recorded from a tower in the Everglades.

The ACE for Wilma would have been about 33.8 instead of 38.9 if Wilma had occurred during the late 1940s. The time when Wilma was a Category 5 is mostly responsible for this disparity as shown in the Best Track intensity graph for Wilma.

### **Hurricane Dean (2007)**

Hurricane Dean (2007) also would not have been listed as a Category 5 if it had occurred during the 1940s even though it made landfall in Mexico as a Category 5. The Best Track comparison graph for Hurricane Dean is shown in Figure 29. The eye passed within 17 nmi of a coastal station, but the station stopped reporting as the storm approached. Dean is listed a Category 5 from August 18 06Z-12Z and again from August 21 00Z to the 0830Z landfall. During the time it was a Category 5 on the 18<sup>th</sup>, analyzed intensities during the late 1940s would have been 130 kt at 06 and 12Z instead of the 145 kt shown in the NHC best track (Franklin 2008). The 130 kt on the 18<sup>th</sup> would have been listed as the peak intensity for Dean. Aircraft would not have been able to penetrate the center from August 17 2332Z until landfall because the central pressure was less than 950 mb. For the intensity on August 18 at 00Z, a pressure of less than 950 mb yields a wind speed of greater than 113 kt using the Brown et al. southern pressure-wind relationship for intensifying systems. Adding 10 kt for a small storm and a fast speed rounds to greater than 125 kt. A 130 kt intensity is therefore chosen from August 18 00Z to August 18 18Z. During the time when Dean was a Category 5 on August 21, analyzed intensities during the late 1940s would have been 125 kt instead of the 145-150 kt listed in the NHC Best Track from August 21 00Z through the 0830Z landfall. From August 19 at 00Z until August 21 at 00Z, it would not have been known whether the hurricane was strengthening, and the speed and size of the storm suggest an adjustment factor of only +5 kt above the pressure-wind relationship. These combined factors yield an intensity of greater than 115 kt, and 125 kt is chosen for the time period, except 120 kt is analyzed from 8/19 18Z to 8/20 12Z. There are no more peak observations between Aug 21 00Z

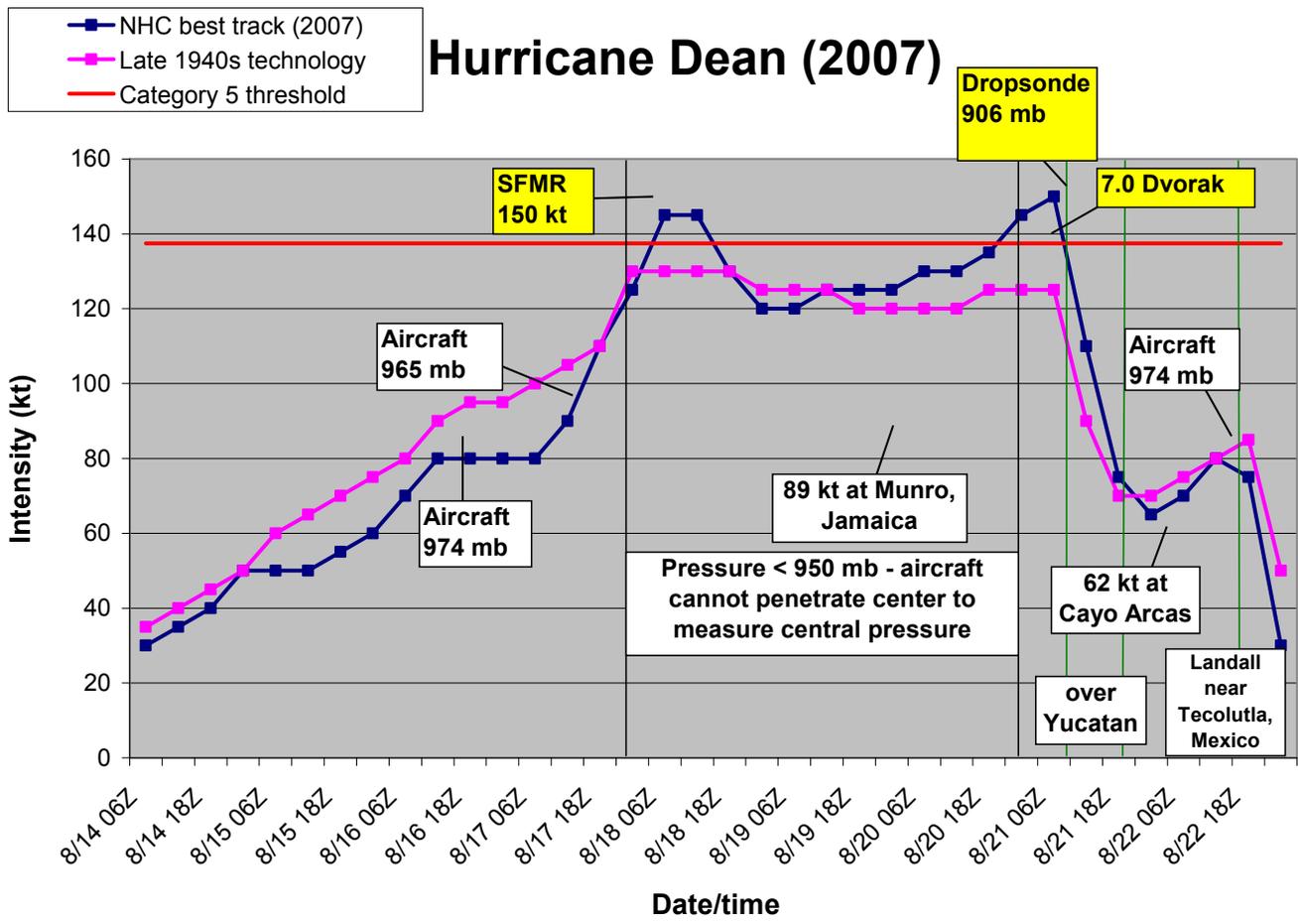


Figure 29. Best Track comparison graph for Hurricane Dean (2007).

and the first Mexican landfall at Aug 21 0830Z, so 125 kt is carried until landfall. For Dean's final landfall in Mexico on August 22 at 1630Z, an intensity of 95 kt is chosen (up from 85 kt in the NHC Best Track). On August 22 at 18Z, Tuxpan, Mexico recorded a pressure of 974 mb along with 27 kt of wind at the same time. A 971 mb landfall central pressure is analyzed. A central pressure of 971 mb equals 90 kt according to the intensifying subset of the southern pressure-wind relationship. Adding 5 kt for above average speed and below average size yields 95 kt. For the 18Z intensity, the NHC Best Track shows 75 kt. Using a 95 kt landfall intensity, a run of the Kaplan and DeMaria inland decay model yields 80 kt for 18Z. At 18Z, the central pressure was still 971 mb, and the center of the hurricane was only 11 miles inland. A 971 mb central pressure yields 87 kt according to the southern pressure-wind relationship for weakening systems. An 85 kt intensity is chosen for 18Z. For the intensity on August 23 at 00Z, the NHC Best Track lists a 30 kt intensity. The Kaplan and DeMaria run yields 54 kt for that time. A 50 kt intensity is chosen because the center had just reached rugged terrain and Dean was a small system. NHC already dissipated the system by 06Z on the 23<sup>rd</sup>. The Kaplan and DeMaria run yields a 38 kt intensity for that time. A 30 kt intensity is chosen. The ACE of Dean would have been about 35 for both the late 1940s and present day.

### **Hurricane Felix (2007)**

Figure 30 shows that Hurricane Felix (2007) would not have been listed as a Category 5 if it had occurred during the late 1940s. However, Felix did make landfall in Nicaragua as a Category 5. There was a coastal station about 17 nm from the center, but the station's barometer and anemometer stopped working before the peak of the storm.

Hurricane Felix is listed as a Category 5 in the NHC Best Track (Beven 2008) from September 3 00Z-12Z and again on September 4 at 12Z (the point right at landfall). On September 3 at 00 and 06Z, 130 kt would have been the intensity instead of the 150 kt listed in the NHC Best Track with the technology of the late 1940s, and at 12Z on the 3<sup>rd</sup>, 125 kt is chosen instead of the 145 kt listed in the NHC Best Track. The observations that support this analysis are as follows. On September 2 at 2307Z, the aircraft would have found that they could not penetrate the center since the central pressure was below 950 mb, and this continued through at least September 3 at 1227Z. For September 3 at 00Z, a pressure of less than 950 mb yields a wind speed of greater than 113 kt according to the intensifying subset of the Brown et al. southern pressure-wind relationship. At that time, the cyclone's forward motion was a fast 17 kt, its ROCI was a small 125 nmi, and its OCI was a near average 1011 mb so 10 kt is added to the pressure-wind relationship. This yields an intensity of greater than 125 kt after rounding to the nearest 5 kt value. Therefore, 130 kt is chosen from September 3 00Z through September 3 06Z. On September 3 at 1723Z, aircraft measured a central pressure of 953 mb, which yields 108 kt according to the southern pressure-wind relationship. Adding 10 kt for speed/size yields 120 kt after rounding, and this value is chosen for the 18Z intensity on the 3<sup>rd</sup>. On September 3 at 12Z, 125 kt is chosen even though it would have been known that the pressure was still less than 950 mb (since the aircraft could not penetrate the center) because the system is likely no longer intensifying at 12Z. For the time on September 4 at 12Z when HURDAT lists a Category 5 intensity of 140 kt, a late 1940s intensity of 120 kt is chosen. After the aircraft central pressures of 953 mb on September 3 from 1723Z – 2041Z, there would have been no more data for the remainder of the lifetime of Felix.

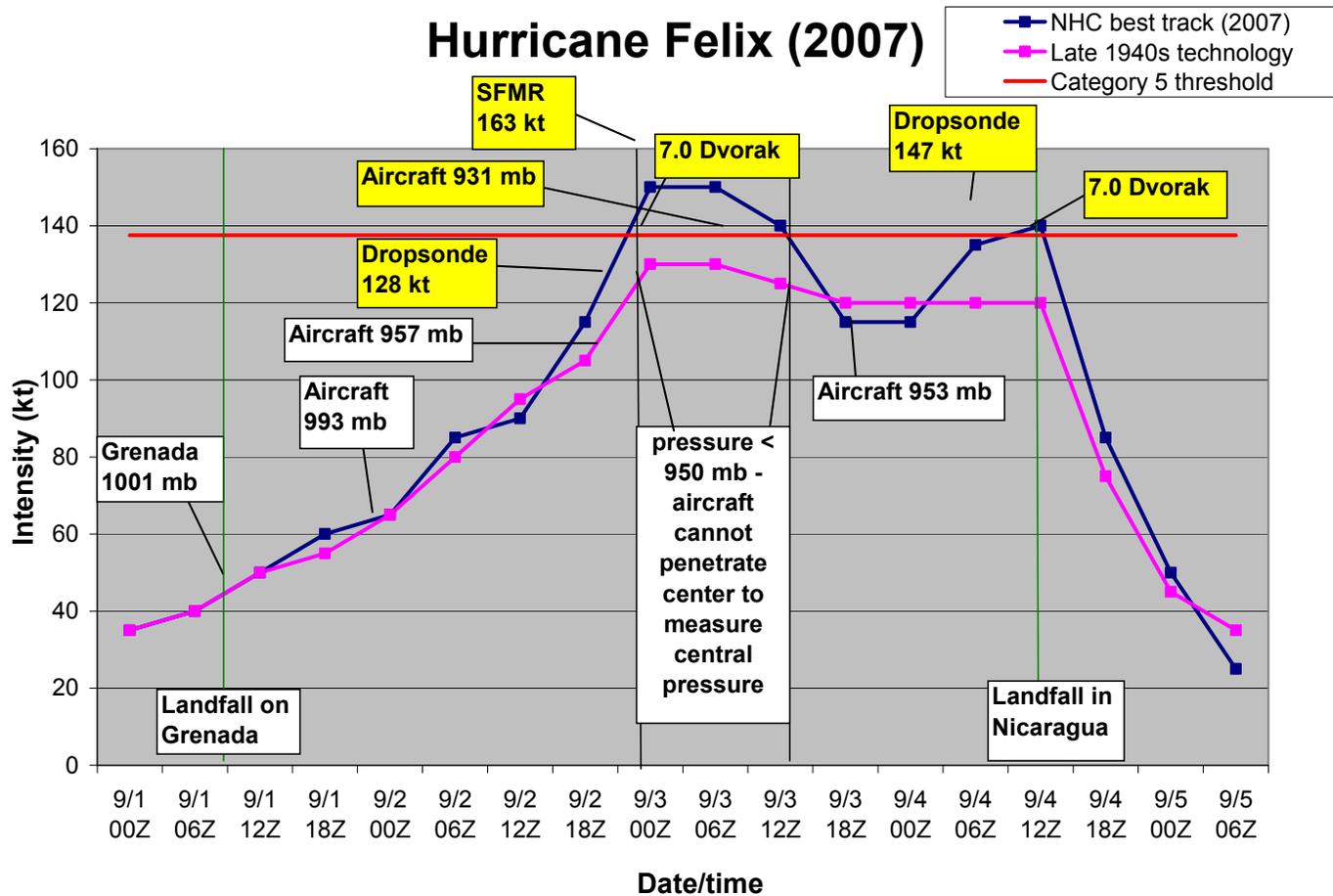


Figure 30. Best Track comparison graph for Hurricane Felix (2007).

Therefore, the 120 kt intensity chosen for September 3 18Z is maintained until landfall. Using a 120 kt landfall intensity, runs of the Kaplan and DeMaria inland decay model yield 73 kt for 18Z on the 4<sup>th</sup>, 52 kt for the 5<sup>th</sup> at 00Z, and 43 kt for 06Z. Intensities of 75, 45, and 35 kt are chosen because the storm was traveling over some high terrain. The NHC Best Track (using a landfall intensity of 140 kt) shows 85, 50, and 25 kt respectively. The ACE of Felix would have been 16 instead of 18.

### **Overall results of Category 5 Study**

The results show that Category 5 conditions would not have been observed for eight of these ten Category 5 hurricanes (including Katrina and Wilma of 2005) if these storms occurred during the late 1940s. On average, there were much fewer observations of the peak intensity of TCs during the late 1940s, especially because there were no satellites and because aircraft would not fly into the eye of strong hurricanes. During the lifetimes of eight of the ten hurricanes, there were land stations or ships that measured Category 5 winds or pressures indicative of a Category 5. It is known that these cyclones were Category 5 hurricanes due to observations from satellites, aircraft, dropsondes, and SFMR surface wind measurements. Table 23 (the overall results of the Category 5 study) shows that eight of the ten recent Category 5 hurricanes likely would not have been classified as such during the late 1940s. All of the observations that measured Category 5 conditions during those eight hurricanes were from observational technologies or practices that did not exist during the late 1940s. The two hurricanes that likely would have been classified as Category 5s if they occurred during the late 1940s are Andrew (1992) and Mitch (1998). For Andrew, surface pressures of 921 and 923 mb were

## Category 5 Study Results

Recent Category 5 Hurricane	Best Track Peak (kt)	Duration as Cat 5 (days)	1940s Peak (kt)	Best Track ACE ( $10^4$ kt <sup>2</sup> )	1940s ACE ( $10^4$ kt <sup>2</sup> )
Andrew - 1992	150	0.62	145 – Cat 5	28	25
Mitch – 1998	155	1.75	140 – Cat 5	36	34
Isabel – 2003	145	1.75	115 – Cat 4	63	41
Ivan – 2004	145	2.5	135 – Cat 4	70	64
Emily – 2005	140	0.25	125 – Cat 4	33	30
Katrina - 2005	150	0.75	120 – Cat 4	20	19
Rita – 2005	155	1	135 – Cat 4	25	25
Wilma – 2005	160	0.75	125 – Cat 4	39	34
Dean – 2007	150	1	130 – Cat 4	35	35
Felix - 2007	150	1	130 – Cat 4	18	16
<b>Average</b>	<b>150</b>	<b>1.37</b>	<b>130 – Cat 4</b>	<b>37</b>	<b>32</b>

Table 23. Summary of results of Category 5 study. Best Track Peak is the peak intensity of the hurricane listed in the official NHC best track database, and 1940s Peak is the value that the peak intensity would have likely been analyzed as if the hurricane would have occurred during the late 1940s.

measured from barometers in Homestead, FL. Given the tiny size of the RMW, Andrew would be classified as a Category 5 hurricane at landfall with the observational capabilities of the 1940s and of the reanalysis techniques of today. Mitch passed directly over Swan Island at its peak Category 5 intensity. Today, there is no weather station on that island, but during the late 1940s, a full weather station was in operation on the island.

Therefore, for the purposes of this study, it is assumed that Category 5 conditions would have been recorded explicitly from an anemometer or indirectly through a central pressure measurement.

Table 23 shows that eight of the ten cyclones would not have been listed as Category 5 hurricanes if they had occurred during the late 1940s. However, the analyses performed indicate that the other eight would have been classified with a Category 4 peak strength. The reader is reminded that many conservative methodologies have been employed for this study. For example, many times during the late 1940s the aircraft reconnaissance did not penetrate the center of hurricanes below 960 mb. If this criteria were utilized, it is likely that some of these cyclones would have been listed with a peak intensity of only Category 3 strength.

### **Discussion and Error Analysis for Category 5 Study**

The average errors for the best track intensity graphs are similar to the average errors in the revised HURDAT for the period 1944-1953 (about 10 to 15 kt) since aircraft reconnaissance was utilized on nearly all of the days for most of the cases. However, more importantly, using the given set of observations that would have been available during the late 1940s, the range of intensity values that would have been chosen based on available data and reanalysis methodology is more standardized. For the purposes of debating the chosen intensity values, a range of plus/minus 5 kt on average from the values chosen should be considered (since an intensity 5 kt lower or higher could have been chosen for many of the 6-hourly values for many of the storms). If this 5 kt flexibility range is used for the intensity values chosen, then the number of storms that

would not have been considered Category 5 hurricanes is in the range of six to nine (out of the ten). If all of the peak intensities in Table 23 are increased by 5 kt, then six of the ten cyclones would not have been considered Category 5s. If all of the peak intensities in Table 23 are decreased by 5 kt, then nine of the ten cyclones would not have been considered Category 5s. In a deterministic sense, using the peak intensity values chosen, eight of the ten would not have been considered Category 5s.

Hurricane Andrew would have been observed to be a Category 5 hurricane only under the assumption that the meteorological instrumentation that measured the Category 5 conditions would have been present in the same location in the late 1940s, which is reasonable, as Homestead has had barometer readings to the 1940s and earlier. Both Hurricane Andrew and Hurricane Mitch would have been observed to be a Category 5 only if the instrumentation was not blown away or destroyed before the Category 5 conditions were recorded. Therefore, it could have been possible that all ten of these Category 5s would not have been categorized as Category 5s during the late 1940s period. On the other hand, before satellites, ships may have been slightly more prone to run into hurricanes than more recently (though none would purposely steer into the eye of a major hurricane simply to observe the central pressure). All of these questions add uncertainty to the Category 5 study.

The observation network that existed during the late 1940s was much more sparse than it is today. Therefore, it is very likely that most of the peak intensity observations during these storms would have been missed. With the observational capabilities, density, and practices of the late 1940s, very few peak intensity observations in Category 4 and 5 hurricanes would have been observed.

## CHAPTER 7

### OVERALL SUMMARY AND CONCLUSIONS

The first decade of aircraft reconnaissance was an active period for Atlantic hurricanes, especially with respect to U.S. and Caribbean hurricanes. The number of TCs was significantly increased as a result of the reanalysis as 21 TCs were added during the decade. However, the number of major hurricanes and ACE were decreased as a result of the reanalysis, due in large part to overestimation of winds in TCs from aircraft reconnaissance.

HURDAT position and intensity estimates from 1944-1953 are significantly better than the HURDAT estimates for the period 1851-1920 due largely to aircraft reconnaissance. The most significant bias that existed during the first decade of aircraft reconnaissance was the tendency for aircraft to overestimate the wind speeds in many TCs. For flights during which a central pressure was measured, this bias is eliminated. Ship traffic was more dense in many areas of the basin during the 1940s and 50s compared with the 2<sup>nd</sup> half of the 19<sup>th</sup> century. This assisted in having a more complete record of TC frequency, but not necessarily TC intensity as ships did their best to avoid sampling the most intense portion of TCs. Although there likely have been some storms that were missed (even after this reanalysis), the intensity accuracy in HURDAT is perhaps a more alarming issue than the number of TCs that remain unaccounted for. Several missed TCs were found in this reanalysis, but the average absolute error for intensity was likely improved only slightly due to the low number of aircraft central pressures observed along with the limitations of the Brown et al. pressure-wind relationship.

Hundreds of track and intensity changes to HURDAT are recommended to the NHCBTCC. Although a significant percentage of these recommendations call for major track and intensity alterations, the overwhelming majority of the recommendations are for minor revisions to HURDAT. However, there were numerous cases for which no changes or minor changes were analyzed due to a lack of available observations since changes to HURDAT cannot be made unless there is enough evidence to make a change. These cases likely contain errors larger than the average error estimates in HURDAT for the decade.

The metadata from the reanalysis of the 1944 to 1953 hurricane seasons are listed in Appendix C. The metadata explains the analysis and the reasoning behind the major changes that are introduced to HURDAT.

In conclusion, the goals of this thesis are to provide documentation of the Atlantic Hurricane Reanalysis Project for the first decade of aircraft reconnaissance (1944-1953). A discussion of aircraft reconnaissance equipment, techniques, procedures, and limitations has been provided. A results summary as well as detailed error estimates for the reanalyzed positions and intensities have been provided. An important point of this thesis is to demonstrate the limitations of the HURDAT database, especially with regards to TC intensity analysis accuracy, and the Category 5 study helps to illustrate this point. This research suggests that for many cases, the intensities listed in HURDAT (at least through 1953, and likely beyond that year) are not nearly as reliable as intensity estimates today.

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## APPENDIX A

### PRESSURE-WIND RELATIONSHIP TABLE

The different types of pressure-wind relationships utilized for the reanalysis of the first decade of aircraft reconnaissance are listed in Table 24. The winds in Table 24 are listed in kt and central pressures are in mb. All pressure-wind conversions in the reanalysis were based on one of the seven conversions. For TCs south of 35N latitude, all pressure-wind relationship derivations come from Brown et al. (2006). For TCs north of 35N latitude, all pressure-wind relationship observations are from the Landsea et al. (2004a) pressure-wind relationships. The six types of pressure-wind relationships from the Brown et al. study are: 1) southern; 2) north of 25N (used for 25-35N latitude); 3) southern/intensifying; 4) southern/weakening; 5) north of 25N/intensifying; and 6) north of 25N/weakening.

Central	Brown	Brown	Brown	Brown	Brown	Brown	Landsea
Pressure	S 25 N	N 25 N	S 25 N In	S 25 N We	N 25 N In	N 25 N We	N 35 N
1008	30	28	28	32	29	27	32
1007	32	30	31	35	31	29	35
1006	35	32	34	37	33	32	37
1005	37	34	36	39	36	33	40
1004	39	36	38	41	38	35	42
1003	41	38	41	43	40	37	44
1002	43	40	43	45	42	39	45
1001	45	42	45	47	44	41	47
1000	47	44	47	48	45	42	49
999	49	45	48	50	47	44	50
998	51	47	50	52	49	45	52
997	53	49	52	54	51	47	53
996	54	50	54	55	52	48	55
995	56	52	56	57	54	50	56
994	58	53	58	58	56	51	58
993	59	55	59	60	57	53	59
992	61	56	61	61	59	54	60
991	62	58	62	63	60	56	61
990	64	59	64	64	62	57	63

989	65	61	65	65	63	58	64
988	67	62	67	67	65	60	65
987	68	64	68	68	66	61	66
986	70	65	70	69	68	62	67
985	71	66	71	71	69	63	68
984	72	68	73	72	70	65	69
983	74	69	74	73	72	66	70
982	75	70	76	74	73	67	71
981	76	71	77	76	74	68	72
980	78	73	78	77	76	69	73
979	79	74	80	78	77	71	74
978	80	75	81	79	78	72	75
977	81	76	82	80	80	73	76
976	83	77	84	81	81	74	77
975	84	79	85	83	82	75	78
974	85	80	86	84	83	76	79
973	86	81	87	85	85	77	80
972	88	82	89	86	86	78	80
971	89	83	90	87	87	80	81
970	90	84	91	88	88	81	82
969	91	86	92	89	89	82	83
968	92	87	93	90	91	83	84
967	93	88	95	91	92	84	85
966	94	89	96	92	93	85	85
965	96	90	97	93	94	86	86
964	97	91	98	94	95	87	87
963	98	92	99	95	96	88	88
962	99	93	100	96	97	89	88
961	100	94	101	97	98	90	89
960	101	95	102	98	100	91	90
959	102	96	104	99	101	92	91
958	103	97	105	100	102	93	91
957	104	98	106	101	103	94	92
956	105	99	107	102	104	95	93
955	106	100	108	103	105	96	93
954	107	101	109	104	106	97	94
953	108	102	110	105	107	98	95
952	109	103	111	106	108	99	96
951	110	104	112	107	109	100	96
950	111	105	113	108	110	101	97
949	112	106	114	108	111	101	98
948	113	107	115	109	112	102	98
947	114	108	116	110	113	103	99
946	115	109	117	111	114	104	99
945	116	110	118	112	115	105	100
944	117	111	119	113	116	106	101
943	118	112	120	114	117	107	101
942	119	113	121	115	118	108	102
941	120	114	122	115	119	109	103
940	121	115	123	116	120	110	103

939	122	116	124	117	121	110	104
938	123	116	125	118	122	111	104
937	124	117	126	119	123	112	105
936	125	118	127	120	124	113	106
935	125	119	128	120	125	114	106
934	126	120	129	121	126	115	107
933	127	121	130	122	127	116	107
932	128	122	130	123	128	116	108
931	129	123	131	124	128	117	109
930	130	124	132	124	129	118	109
929	131	124	133	125	130	119	110
928	132	125	134	126	131	120	110
927	133	126	135	127	132	121	111
926	133	127	136	128	133	121	111
925	134	128	137	128	134	122	112
924	135	129	138	129	135	123	112
923	136	130	139	130	136	124	113
922	137	130	139	131	137	125	114
921	138	131	140	132	138	125	114
920	139	132	141	132	138	126	115
919	139	133	142	133	139	127	115
918	140	134	143	134	140	128	116
917	141	135	144	135	141	129	116
916	142	135	145	135	142	129	117
915	143	136	146	136	143	130	117
914	144	137	146	137	144	131	118
913	144	138	147	138	144	132	118
912	145	139	148	138	145	133	119
911	146	139	149	139	146	133	119
910	147	140	150	140	147	134	120
909	148	141	151	140	148	135	120
908	148	142	151	141	149	136	121
907	149	143	152	142	150	136	121
906	150	143	153	143	150	137	122
905	151	144	154	143	151	138	122
904	152	145	155	144	152	139	123
903	152	146	156	145	153	139	123
902	153	147	156	145	154	140	124
901	154	147	157	146	155	141	124
900	155	148	158	147	155	142	125
899	155	149	159	148	156	142	125
898	156	150	160	148	157	143	126
897	157	150	160	149	158	144	126
896	158	151	161	150	159	145	127
895	159	152	162	150	159	145	127
894	159	153	163	151	160	146	128
893	160	153	163	152	161	147	128
892	161	154	164	152	162	148	129
891	162	155	165	153	163	148	129
890	162	156	166	154	163	149	129

889	163	156	167	154	164	150	130
888	164	157	167	155	165	150	130
887	165	158	168	156	166	151	131
886	165	159	169	156	166	152	131
885	166	159	170	157	167	153	132
884	167	160	170	158	168	153	132
883	168	161	171	158	169	154	133
882	168	162	172	159	170	155	133
881	169	162	173	160	170	155	133
880	170	163	173	160	171	156	134
879	170	164	174	161	172	157	134
878	171	164	175	162	173	157	135
877	172	165	176	162	173	158	135
876	173	166	176	163	174	159	136

Table 24. Empirically derived pressure-wind relationship from Brown et al. (2006) and Landsea et al. (2004a).

## APPENDIX B

### CENTRAL PRESSURES

Appendix B is a list containing all of the central pressures in the original and the revised HURDAT database from 1944-1953. For the 6-hourly time slot for which these central pressures are listed, the analyzed maximum wind speeds from both the original HURDAT and the revised HURDAT are shown. The column on the left is the revised storm number, and the column on the right is the observation type by which the central pressure was obtained. Observations in yellow highlight pertain to analyzed central pressures after landfall for inland TCs (i.e. these cannot be compared against the Brown et al. pressure-wind relationship since that relationship is for over-water exposure only). It is important to note that not all central pressures listed in the revised HURDAT are obtained by direct pressure measurements. Some central pressures are estimated, but only when there are enough peripheral observations close enough to the center to obtain a reliable central pressure estimate. Nearly all (greater than 90%) of the revised central pressures are taken from direct measurements. Some methods for estimating central pressure from peripheral pressure measurements are: 1) The 10 kt per mb rule for a observation inside the RMW; 2) The Schloemer equation; 3) the averaging of two or more close off-time central pressure measurements (e.g. a 989 mb central pressure measured at 16Z and a 985 mb central pressure measured at 20Z would yield an analyzed central pressure of 987 mb for 18Z). Central pressures at the time of landfall have been estimated in many previous studies for many landfalling hurricanes. If the estimates from these studies appear correct, and if there is no contradictory data, then these central

pressures will sometimes be chosen for landfall, but only for cases for which there was no explicit central pressure measured. The data contained in Figures 9 and 20 come from Table 25.

Revised Storm #	Original HURDAT		Revised HURDAT		Ob type
	central p	max w	central p	max w	
194403	990	80	990	55	land
194404	973	75	973	90	ship
194406	none	35	1001	50	land
194407	943	115	943	115	unknown
194407	none	105	933	120	ship
194407	none	90	942	110	land
194407	none	75	953	95	land
194407	966	65	966	70	land
194413	none	70	976	80	ship
194413	none	100	937	120	land
194413	none	105	949	105	land
194413	none	65	962	90	land
194413	978	60	976	60	land
194413	983	50	983	55	land
194413	987	45	985	50	land
194505	963	115	963	95	land
194505	966	120	966	90	land
194505	968	120	none	75	
194505	980	65	980	65	land
194505	987	50	987	50	land
194505	993	40	993	40	land
194505	1002	25	1002	25	land
194505	1006	20	1006	20	land
194506	993	35	990	60	land
194508	none	none	1009	45	aircraft
194509	none	100	972	95	aircraft
194509	977	105	977	85	land
194509	none	120	949	115	land
194509	951	115	954	100	land
194509	963	85	963	75	land
194509	974	65	974	70	land
194509	987	55	987	65	land
194509	990	50	990	70	land
194509	991	45	991	75	land
194509	996	40	996	50	land
194509	1000	40	1000	50	land
194509	1006	35	1006	45	land
194510	none	80	987	70	aircraft
194510	982	85	982	75	aircraft
194511	1000	85	980	80	land

194511	982	65	982	75	land
194602	1006	40	none	30	
194602	none	40	1005	40	land
194604	994	75	none	75	
194604	975	85	975	85	aircraft
194606	1005	45	none	35	
194606	993	65	993	65	ships
194606	979	115	979	80	aircraft
194606	none	65	980	75	land
194607	none	40	1002	40	ship & land
194702	none	90	977	90	aircraft
194703	none	70	984	70	land
194704	none	95	999	50	aircraft
194704	none	105	977	85	aircraft
194704	none	115	952	115	aircraft
194704	none	125	938	125	aircraft
194704	none	135	951	110	aircraft
194704	none	140	956	105	aircraft
194704	none	140	954	105	land
194704	947	135	940	115	land
194704	966	80	966	95	land
194704	970	75	970	70	land
194704	984	60	984	55	land
194704	987	35	987	45	land
194706	none	45	993	50	ship & AC
194706	none	45	994	50	ship & land
194709	none	50	1000	50	aircraft
194709	none	65	983	75	aircraft
194709	none	70	978	80	land
194709	991	75	none	70	
194709	none	70	982	70	aircraft
194709	none	65	975	80	aircraft
194709	none	70	966	85	ship
194709	973	75	966	90	land
194710	none	65	1000	45	aircraft
194710	none	80	990	70	aircraft
194710	none	85	981	80	aircraft
194710	none	105	961	105	aircraft
194804	1009	50	none	50	
194804	1007	30	1007	30	aircraft
194805	none	65	998	50	aircraft
194805	none	70	990	60	aircraft
194805	990	70	none	65	
194805	989	65	986	65	land
194805	none	55	988	60	land
194808	none	60	994	60	aircraft
194808	none	80	951	105	aircraft
194808	963	105	950	110	land
194808	none	85	940	115	land
194808	964	75	none	85	land

194808	965	80	965	80	land
194809	none	75	991	70	ship & AC
194809	975	110	963	90	land
194809	979	90	979	80	land
194809	none	85	971	90	land
194809	none	40	989	60	ship
194810	none	60	996	50	ship
194810	none	70	994	60	aircraft
194810	none	70	990	65	aircraft
194810	none	55	994	55	aircraft
194901	none	70	993	70	aircraft
194901	none	85	984	80	aircraft
194901	none	85	974	85	ship
194901	977	95	977	90	land
194902	954	130	954	120	land
194902	965	100	965	85	land
194902	974	65	974	70	land
194902	982	55	980	70	land
194902	987	50	984	65	land
194902	992	45	988	65	land
194902	996	40	996	55	land
194902	1000	40	1000	50	land
194902	1002	40	1002	50	land
194902	1000	40	1000	50	land
194902	1000	35	998	50	land
194904	none	65	987	70	aircraft
194904	none	75	995	65	ship
194904	none	80	994	65	aircraft
194904	none	80	994	65	aircraft
194904	none	95	982	80	aircraft
194904	none	100	974	90	aircraft
194905	1008	40	none	50	
194906	none	none	996	55	ship
194911	none	95	970	95	aircraft
194911	none	115	960	100	land
194911	none	60	982	60	land
194911	none	50	998	35	land
194913	none	70	995	65	aircraft
194913	none	90	981	80	aircraft
194916	none	50	993	55	aircraft
195001	none	70	995	60	ship & AC
195001	none	70	995	60	ship
195001	none	70	995	60	aircraft
195001	none	75	989	65	aircraft
195001	none	80	987	70	aircraft
195001	none	90	980	80	aircraft
195001	none	110	962	100	aircraft
195001	none	120	958	100	aircraft
195001	none	120	953	105	aircraft
195002	none	105	990	70	aircraft

195002	none	100	987	75	aircraft
195002	none	60	1003	45	aircraft
195002	none	55	996	55	aircraft
195002	none	65	998	55	aircraft
195002	none	65	996	55	aircraft
195002	979	90	none	90	
195002	none	75	979	75	land
195003	none	85	985	70	aircraft
195003	none	100	974	85	aircraft
195003	none	85	980	75	aircraft
195004	none	75	953	110	aircraft
195004	none	115	962	100	aircraft
195004	none	125	972	85	aircraft
195004	none	80	987	65	aircraft
195004	none	85	986	65	aircraft
195004	none	85	986	65	aircraft
195004	none	85	982	70	aircraft
195004	none	85	978	75	aircraft
195004	none	80	974	80	aircraft
195004	none	75	972	85	aircraft
195005	none	65	996	55	aircraft
195005	none	65	995	55	aircraft
195005	none	70	980	75	aircraft
195005	none	75	980	75	aircraft
195005	none	110	973	85	aircraft
195005	none	110	973	85	aircraft
195005	958	105	none	105	
195005	none	100	958	105	land
195006	none	70	995	55	aircraft
195006	none	90	986	75	aircraft
195006	none	90	977	85	aircraft
195006	none	120	946	120	aircraft
195007	none	80	978	70	aircraft
195007	none	95	960	95	aircraft
195008	none	50	1009	35	aircraft
195008	none	50	1007	35	aircraft
195009	none	50	1002	45	aircraft
195009	none	80	990	65	aircraft
195009	none	95	980	75	aircraft
195011	none	60	992	55	aircraft
195011	none	85	985	75	aircraft
195011	955	105	none	65	
195011	none	105	988	70	aircraft
195011	none	90	955	115	land
195011	none	75	975	80	land
195011	none	65	983	70	land
195011	none	35	989	65	land
195011	none	25	992	45	land
195011	none	25	996	35	land
195011	none	none	999	30	land

195011	none	none	1000	35	land
195011	none	none	1002	20	land
195013	none	80	990	60	aircraft
195013	none	80	990	65	aircraft
195013	none	80	987	70	ship
195013	none	70	991	70	aircraft
195102	none	65	983	70	aircraft
195102	none	75	982	75	aircraft
195102	none	80	985	70	aircraft
195102	none	80	982	75	aircraft
195102	none	80	980	75	aircraft
195102	none	90	979	75	aircraft
195102	none	100	978	75	aircraft
195102	none	85	973	80	aircraft
195102	none	50	984	75	aircraft
195102	none	45	994	35	aircraft
195103	none	45	999	45	aircraft
195104	none	50	999	55	aircraft
195104	none	75	992	65	aircraft
195104	none	95	978	85	aircraft
195104	964	95	971	95	aircraft
195104	none	75	958	110	land
195104	none	95	982	80	aircraft
195104	none	105	976	85	aircraft
195104	none	90	989	65	aircraft
195104	none	90	988	65	aircraft
195104	none	95	982	70	aircraft
195104	none	115	972	85	aircraft
195105	none	100	992	70	aircraft
195105	none	85	993	60	aircraft
195105	none	60	1004	45	aircraft
195106	none	110	967	85	aircraft
195106	none	120	957	95	aircraft
195106	none	140	937	125	aircraft
195108	none	50	999	50	aircraft
195109	none	35	1003	40	aircraft
195109	none	80	982	75	aircraft
195109	none	85	979	80	aircraft
195109	none	95	975	80	aircraft
195109	none	90	972	85	aircraft
195110	none	70	1000	50	aircraft
195110	none	50	998	50	aircraft
195110	none	40	1009	25	aircraft
195111	none	70	998	65	aircraft
195111	none	60	1000	60	aircraft
195111	none	55	999	55	aircraft
195202	1006	50	1006	35	aircraft
195202	none	50	1007	40	aircraft
195202	none	55	1008	40	aircraft
195202	1003	70	1003	45	aircraft

195202	998	70	998	50	aircraft
195202	none	75	1003	50	aircraft
195202	none	80	999	55	aircraft
195202	none	80	998	55	aircraft
195202	none	85	992	65	aircraft
195202	none	85	983	75	aircraft
195204	1003	70	none	60	aircraft
195204	1003	80	none	65	aircraft
195204	none	90	993	70	aircraft
195204	none	95	996	65	aircraft
195204	993	100	993	65	aircraft
195204	none	105	993	65	aircraft
195204	none	105	983	70	aircraft
195204	none	100	983	70	aircraft
195204	981	95	981	75	aircraft
195204	none	95	978	80	aircraft
195204	969	75	969	95	aircraft
195206	993	90	993	65	aircraft
195206	none	105	969	95	aircraft
195206	none	100	958	100	aircraft
195207	998	70	998	55	aircraft
195207	none	55	1002	45	aircraft
195207	none	45	1001	45	aircraft
195207	none	45	1001	45	aircraft
195207	none	35	1009	30	aircraft
195207	none	none	1008	30	aircraft
195209	995	45	995	50	aircraft
195209	968	80	968	85	aircraft
195209	1001	40	1001	40	aircraft
195210	993	75	993	60	aircraft
195210	none	95	942	110	aircraft
195210	none	125	940	120	aircraft
195210	934	130	934	125	land
195210	991	90	991	60	aircraft
195210	none	80	994	55	aircraft
195301	none	45	1000	40	aircraft
195301	none	50	1003	40	aircraft
195301	none	55	997	50	aircraft
195301	none	50	996	50	aircraft
195301	none	40	999	40	aircraft
195301	997	60	994	55	aircraft
195303	none	65	1005	50	aircraft
195303	none	80	1002	50	aircraft
195303	none	90	995	60	aircraft
195303	none	95	987	70	aircraft
195303	987	90	975	80	land
195303	none	70	973	80	aircraft
195304	985	45	none	30	
195304	none	35	1007	30	aircraft
195304	none	50	1008	35	aircraft

195305	none	75	944	120	aircraft
195305	929	130	929	140	aircraft
195305	none	125	942	115	aircraft
195305	none	105	945	110	aircraft
195305	none	80	962	85	aircraft
195306	none	65	1005	45	aircraft
195306	none	100	999	55	SHIP
195306	995	100	990	60	aircraft
195306	none	100	989	65	aircraft
195306	none	60	996	55	land
195306	none	55	994	55	aircraft
195308	none	65	995	65	aircraft
195308	none	75	987	75	aircraft
195308	none	110	977	80	aircraft
195308	none	105	966	95	AC & ship
195308	none	105	962	100	aircraft
195309	none	60	1004	40	aircraft
195310	none	70	1001	55	AC & ship
195310	968	110	968	90	aircraft
195310	985	70	975	70	land
195311	none	65	986	70	SHIP
195311	none	none	997	50	aircraft
195313	none	55	1002	45	aircraft
195313	994	55	987	55	land
195313	none	60	989	60	aircraft
195314	none	45	999	45	aircraft

Table 25. List of central pressures both in the original HURDAT (2<sup>nd</sup> column) and the revised HURDAT (4<sup>th</sup> column). Original HURDAT wind speed (3<sup>rd</sup> column) is the original HURDAT wind speed listed in the time slot of the central pressure in the revised HURDAT.

APPENDIX C  
REANALYSIS METADATA

**1944**

1944 Storm 1

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31500 07/13/1944 M= 8 1 SNBR= 697 NOT NAMED XING=0
31505 07/13* 0 0 0 0*196 679 35 0*207 688 35 0*217 698 40 0*
31505 07/13* 0 0 0 0*196 682 30 0*207 692 30 0*215 702 30 0*
          *** **          *** **          *** **
          *** **          *** **          *** **

31510 07/14*226 708 40 0*234 718 45 0*243 728 45 0*251 737 50 0*
31510 07/14*223 711 35 0*231 720 35 0*240 728 35 0*251 735 35 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31515 07/15*259 744 50 0*274 755 55 0*289 762 60 0*296 762 60 0*
31515 07/15*262 741 40 0*274 746 45 0*285 750 50 0*294 753 55 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31520 07/16*302 761 65 0*309 758 70 0*314 755 70 0*318 752 75 0*
31520 07/16*302 755 60 0*309 756 65 0*314 755 65 0*318 752 65 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31525 07/17*321 748 80 0*324 744 80 0*328 738 80 0*333 727 80 0*
31525 07/17*322 748 65 0*325 743 65 0*328 735 65 0*331 726 65 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31530 07/18*339 715 70 0*345 703 70 0E351 692 65 0E360 676 60 0*
31530 07/18*333 716 65 0*336 706 65 0*340 695 65 0*350 680 60 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31535 07/19E372 651 55 0E386 620 55 0E402 582 50 0E421 540 50 0*
31535 07/19E365 655 60 0E382 622 60 0E402 582 60 0E422 540 50 0*
          *** **          *** **          *** **          *** **
          *** **          *** **          *** **          *** **

31540 07/20E442 498 45 0* 0 0 0 0* 0 0 0 0* 0 0 0 0 0*
31545 HR

```

Minor track changes and minor changes to intensity were made on most days of this storm. Evidence for these alterations comes from the Historical Weather Maps series, the COADS ship database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

July 12:

HURDAT does not list a storm on this day, and HWM shows a possible wave axis between 62 and 65W, but no closed low. Microfilm indicates a spot low near 15N, 65.5W. No gales or low pressures.

July 13:

HWM analyzes a spot low in an open trough near 22N, 63.8W. HURDAT lists this as a 35 kt tropical storm at 20.7N, 68.8W. The MWR post-season track map shows a 00Z center near 17.2N, 67W and a 12Z center near 20.5N, 69.3W. Microfilm shows a closed low analyzed near 20.7N, 69.1W. Aircraft highlights: 35 kt SE at 22.9N, 66.1W at 1230Z (micro); 35 kt SE at 23.0N, 67.9W at 13Z (micro).

July 14:

HWM shows a tropical storm of at most 1015 mb centered near 25.6N, 67.3W. HURDAT lists this as a 45 kt tropical storm at 24.3N, 72.8W. The MWR post-season track map shows a 00Z center near 22.2N, 71.4W and a 12Z center near 24.2N, 73.3W. Microfilm shows a low of at most 1015 mb centered near 23.5N, 73.2W. No gales or low pressures.

July 15:

HWM shows a tropical storm of at most 1010 mb centered near 28.8N, 73.1W. HURDAT lists this as a 60 kt tropical storm at 28.9N, 76.2W. The MWR tracks of centers of cyclones shows a center near 27.2N, 73.8W. The MWR post-season track map shows a 00Z position near 26N, 74.3W and a 12Z position near 28.6N, 76.2W. Microfilm shows a low of at most 1005 mb centered near 28.1N, 74.4W. Aircraft highlights: 50 kt ESE at 29.0N, 74.0W at 0930Z (micro); 40 kt SSW at 28.0N, 75.0W at 14Z (micro); 40 kt SE at 29.8N, 73.8W at 1550Z (micro). Seven additional observations of gale force winds were found.

July 16:

HWM shows a tropical storm of at most 1010 mb centered near 31.7N, 76.1W. HURDAT lists this as a 70 kt hurricane at 31.4N, 75.5W. The MWR tracks of centers of cyclones shows a center near 29N, 75W at 00Z and 31.2N, 75.5W at 12Z. The MWR post-season track map shows a 00Z position near 30.3N, 76.1W and a 12Z position near 31.1N, 75.5W. Microfilm shows a low of at most 1002 mb centered near 31.6N, 76.3W. Ship highlight: 35 kt SSE and 996 mb at 30.8N, 73.8W near ~00Z (micro). Aircraft highlights: 45 kt SSE at 31.1N, 75.1W at 1410Z (micro); 45 kt WNW at 29.7N, 76.0W at 15Z (micro); 35 kt NE at 31.2N, 78.3W at 1610Z (micro).

July 17:

HWM shows a tropical storm of at most 1010 mb centered near 32.2N, 72.3W with a dissipating cold front a few hundred nm northwest of the cyclone. HURDAT lists this as an 80 kt hurricane at 32.8N, 73.8W. The MWR tracks of centers of cyclones shows a 00Z position near 32.2N, 74.8W and a 12Z position near 33N, 73W. The MWR post-season track map shows a 00Z position near 31.9N, 75W and a 12Z position near 32.4N, 73.9W. Microfilm shows a low of at most 999 mb centered near 32.8N, 73.1W. Aircraft highlights: 60 kt at ~32N 71W at 19Z (micro); 35 kt SW at 29.9N, 70.3W at 14Z (micro); 35 kt NW at 32.0N, 73.3W at ~14Z (micro); 35 kt S at 33.5N, 70.0W at 19Z (micro). "Pireps wind shift at 1840Z with drift change from 8 right to 15 left on 90 degree course at 32N, 71W. Max wind estimated 70 mph. Sea relatively flat near center with spray in fine parallel bands. Rvcd from WVI (Parrish)" (micro).

July 18:

HWM shows a tropical storm of at most 1010 mb centered near 35.4N, 69.1W with stationary fronts indicated to the southwest and northeast of the cyclone, but neither analyzed to be extending into the cyclone. HURDAT lists this as a 65 kt extratropical cyclone at 35.1N, 69.2W. The MWR tracks of centers of cyclones shows a 00Z position near 33.8N, 70.5W and a 12Z position near 34N, 68.2W. The MWR post-season track

map shows a 00Z position near 33.5N, 71.5W and a 12Z position near 34.7N, 69W. Microfilm shows a low of at most 996 mb centered near 33.3N, 68.8W. Ship highlights: 35 kt SE and 1013 mb at 35.5N, 68.5W at 1Z (COA); 45 kt SW and 1001 mb at 32.1N, 69.0W at 1045Z (micro); 45 kt S and 1014 mb at 33.5N, 65.5W at 12Z (COA); 45 kt S and 1017 mb at 33.5N, 65.5W at 16Z (COA); 35 kt NE at 40.5N, 66.5W at 20Z (COA). Land highlight: 35 kt at Bermuda (MWR). Aircraft highlight: 40 kt WSW at 32.0N, 70.0W at ~1830Z (micro) Regarding the position..."Bermuda reported winds of approximately 40 miles per hour as the center passed about 250 miles to the northwest of that station" (MWR).

July 19:

HWM shows a tropical storm of at most 1005 mb centered near 42N, 56W with a warm front indicated to the northeast of the cyclone and a cold front southwest of the cyclone, but neither analyzed to be extending into the cyclone. HURDAT lists this as a 50 kt extratropical storm at 40.2N, 58.2W. The MWR post-season track map shows a 00Z position near 36.6N, 65.3W and a 12Z position near 40.2N, 58.2W. Microfilm shows a center near 39.7N, 57.7W at 12Z with Beaufort wind force 11 (60 kt) analyzed to be near the center at 17Z. Ship highlight: 35 kt NW and 992 mb at 39.0N, 59.0W at ~1830Z (micro).

A low pressure area associated with a tropical wave apparently moved northwestward from the eastern Caribbean Sea and became a tropical depression just north of the Dominican Republic at 06Z on the 13<sup>th</sup> (no change to genesis). Minor track changes to HURDAT are introduced on everyday of the cyclone's lifetime and are largest on the 15<sup>th</sup> and 18<sup>th</sup> as the position was adjusted over a degree on these days. Continuing northwestward, it became a tropical storm at 00Z on the 14<sup>th</sup>, 18 hours later than in the original HURDAT. Late on the 15<sup>th</sup> the tropical storm's forward motion slowed down and turned toward the north-northwest, but strengthening continued. It became a hurricane at 06Z on the 16<sup>th</sup> (six hours later than originally) and recurved on this date with a position a few hundred miles east of Georgia. It remained a hurricane on the 17<sup>th</sup> and the 18<sup>th</sup> as it moved slowly off to the northeast. Early on the 18<sup>th</sup>, the hurricane began to accelerate, and by 18Z on the 18<sup>th</sup> the intensity had weakened to a 60 kt tropical storm. The intensity is reduced every day from the 13<sup>th</sup> to the 17<sup>th</sup> as observational data indicates that the cyclone was weaker than originally shown in HURDAT. While there are no explicit observations of hurricane intensity, a peak intensity of 65 kt from the 16<sup>th</sup> to the 18<sup>th</sup> (down from 80 kt originally) is retained as aircraft reconnaissance did estimated surface winds of 60 kt on the 17<sup>th</sup>. The cyclone became extratropical at 00Z on the 19<sup>th</sup> (12 hours later than originally) a few hundred miles south of Halifax, Canada. On the 19<sup>th</sup>, the 50 kt intensity of the extratropical cyclone is raised to 60 kt due to Weather Bureau analysis of Beaufort force 11 near the center. It was absorbed by a larger extratropical low around 06Z on the 20<sup>th</sup>.

This hurricane is historic in that these were the very first planned aircraft reconnaissance missions to occur with the flights from the 13<sup>th</sup> to the 17<sup>th</sup> of July.

## 1944 Storm 2

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31550 07/24/1944 M= 5 2 SNBR= 698 NOT NAMED XING=0
31555 07/24* 0 0 0 0*114 561 35 0*117 584 40 0*123 610 45 0*
31555 07/24* 0 0 0 0*134 566 35 0*137 584 40 0*140 604 45 0*
          *** ***          ***
31560 07/25*130 630 50 0*141 643 55 0*151 656 55 0*158 671 55 0*
31560 07/25*143 622 50 0*147 639 55 0*151 656 55 0*156 673 55 0*
          *** ***          *** ***
31565 07/26*162 686 55 0*163 702 55 0*162 721 55 0*161 744 50 0*
31565 07/26*161 690 55 0*166 707 55 0*170 725 55 0*173 744 50 0*
          *** ***          *** ***
31570 07/27*161 768 50 0*165 791 45 0*169 812 45 0*169 822 40 0*
31570 07/27*175 764 45 0*176 783 40 0*175 800 35 0*174 816 35 0*
          *** *** **          *** *** **          *** *** **
31575 07/28*170 830 35 0*171 844 30 0*172 858 25 0*169 872 25 0*
31575 07/28*173 831 35 0*172 845 30 0*172 858 25 0*172 872 25 0*
          *** ***          *** ***          ***
31580 TS

```

Major track changes and minor intensity changes were made to this tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

## July 23:

HWM analyzes a spot low in an open wave near 11.4N, 57.6W. HURDAT does not list a system on this day. There were no gales or low pressures

## July 24:

HWM analyzes a spot low in an open wave near 13.5N, 62W. HURDAT lists this as a 40 kt tropical storm at 11.7N, 58.4W. Microfilm shows a low approaching the southern Windward Islands by their 18Z map. No gales or low pressures.

## July 25:

HWM analyzes a spot low in an open wave near 15N, 65.5W. HURDAT lists this as a 55 kt tropical storm at 15.1N, 65.6W. The MWR post-season track map shows a center near 14.6N, 65.4W. Microfilm shows a small tropical storm at 00Z centered at 14.5N, 61.7W. At 12Z, microfilm shows a low of at most 1011 mb centered near 15.2N, 65.4W. Land highlight: 48 kt at Fort de France at 00Z (MWR). Aircraft highlights: 40 kt E at 16.0N, 65.8W at 17Z (micro); 40 kt E at 16.9N, 67.0W at 18Z (micro); 35 kt SE at 15.0N, 65.8W at 19Z (micro); 45 kt SE at 17.0N, 65.8W at 20Z (micro).

## July 26:

HWM analyzes a spot low near 16.7N, 72.2W. HURDAT lists this as a 55 kt tropical storm near 16.2N, 72.1W. The MWR post-season track map shows a 00Z position near 16N, 68.8W and a 12Z position near 17.5N, 73W. Microfilm shows a low of at most 999 mb centered near 17.4N, 73.1W. No concrete gales or low pressures. Regarding the intensity, "...There were positive evidences that it was near the coast of Haiti not far

south of Port Au Prince on the morning of the 26<sup>th</sup>. A wind of 70 knots was encountered by an airplane near this point (exact location and elevation unknown), and the Port Au Prince soundings showed winds aloft of hurricane force, with squalls of 35 miles per hour at the surface. Considerable damage was reported from the town of Jacmel on the coast south of Port Au Prince. Indications are that the small center struck the high mountains of the Haitian Peninsula and were broken up. It is not believed that winds of hurricane force accompanied the storm at the surface, but that velocities of about 60 miles per hour marked its entire course” (MWR).

July 27:

HWM analyzes a closed low of at most 1010 mb centered near 17N, 79.6W. HURDAT lists this as a 45 kt tropical storm at 16.9N, 81.2W. Microfilm analyzes a low in an open wave near 17.7N, 80.8W. No gales or low pressures.

July 28:

HWM analyzes a tiny tropical storm near 17.7N, 85.1W. HURDAT lists this as a 25 kt tropical depression at 17.2N, 85.8W. Microfilm analyzes a spot low near 17.2N, 84.5W. Microfilm showed a low over Honduras at 18Z. No gales or low pressures.

July 29: HWM does not contain any evidence of a tropical cyclone. HURDAT ended the storm at 18Z on July 28. No gales or low pressures.

This tropical storm formed east of the southern Windward Islands on the 24<sup>th</sup> apparently originating from a tropical wave. It is possible that the cyclone was in existence farther east, but the very sparse observations do not allow for this determination. Significant track changes – 2 degrees farther north – were made on the 24<sup>th</sup> at the genesis of this storm. On the 26<sup>th</sup> and 27<sup>th</sup> the storm tracked closer to Hispaniola and Jamaica than in the original HURDAT. These more northerly positions are in agreement with microfilm and the MWR post-season track map, as well as available observations. It reached a maximum intensity of 55 kt (unchanged from original HURDAT) in the eastern and central Caribbean on the 25<sup>th</sup> and 26<sup>th</sup>. On the 26<sup>th</sup> and 27<sup>th</sup>, the tropical storm came very close to the south coast of Hispaniola and the south coast of Jamaica. The high mountains on these islands, particularly Hispaniola, likely contributed to weakening of the storm, and by July 27<sup>th</sup>, the storm had weakened to 35 knots (revised downward from 45 kt) at 17.5N, 80W. On the 28<sup>th</sup> with the cyclone center apparently north of Honduras, there is no evidence of tropical storm force winds, so HURDAT’s intensity of 25 kt is maintained on this day. The depression dissipated by 00Z on the 29<sup>th</sup>, which is unchanged from the original HURDAT.

### 1944 Storm 3

31585	07/30/1944	M=	6	3	SNBR=	699	NOT	NAMED	XING=1	SSS=1			
31590	07/30*	0	0	0	0*	0	0	0	0*	0	0	0	0*
31590	07/30*	195	670	25	0*205	678	30		0*215	690	35	0*225	705
		***	***	**	***	***	**		***	***	**	***	***
31595	07/31*	237	725	50	0*246	737	55		0*256	749	65	0*269	767
31595	07/31*	234	722	45	0*243	738	50		0*262	752	55	0*272	761
		***	***	**	***	***	**		***	***	**	***	***

31600	08/01*283	771	75	0*296	779	75	0*310	781	80	0*326	782	80	990*
31600	08/01*282	767	65	0*293	772	65	0*305	777	65	0*320	780	65	0*
	***	***	**	***	***	**	***	***	**	***	***	**	***
31605	08/02*342	783	60	0*357	782	55	0*369	780	45	0*378	774	40	0*
31605	08/02*341	782	55	990*357	782	45	0*369	780	35	0*378	774	35	0*
	***	***	**	***	***	**			**			**	
31610	08/03*385	762	35	0*392	745	35	0*398	728	35	0*403	710	35	0*
31615	08/04*408	694	35	0*413	679	35	0*419	665	30	0*423	654	30	0*
31615	08/04*408	694	30	0*413	679	30	0*	0	0	0*	0	0	0*
			**			**	***	***	**	***	***	**	

31620 HR NC1

#### U.S. Landfall:

8/1/1944 2300Z 33.9N 78.1W 65 kt 990 mb 12 nmi RMW 1014 mb OCI 175 nmi ROCI

Minor changes to track and intensity were made. Genesis is begun 18 hours earlier and dissipation occurs 12 hours earlier than originally indicated. Evidence for these alterations comes from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Dunn and Miller (1960), Jarrell et al. (1992), and Barnes (2001).

#### July 27:

HWM does not analyze a closed low. HURDAT does not list the system on this day. No gales or low pressures.

#### July 28:

HWM does not analyze a close low. HURDAT does not list the system on this day. No gales or low pressures.

#### July 29:

HWM analyzes a low, not closed, near 16N, 66.5W located in a trough of low pressure. HURDAT does not list the system on this day. No gales or low pressures.

#### July 30:

HWM analyzes an open wave containing a spot low near 21.5N, 69.5W. HURDAT firsts lists this system at 18Z as a 40 kt tropical storm at 22.7N, 70.0W. The MWR tracks of centers of cyclones shows a position near 24N, 74W. No gales or low pressures.

#### July 31:

HWM analyzes a tropical storm of at most 1010 mb centered near 26.4N, 75.1W. HURDAT lists this as a 65 kt hurricane at 25.6N, 74.9W. The MWR tracks of centers of cyclones shows a 00Z position near 27N, 77W. The MWR post-season track map shows a position near 26.3N, 75.4W. Microfilm shows a low of at most 1011 mb centered near 26.7N, 75.6W. Aircraft highlights: 45 kt S at 26.6N, 74.5W at 11Z (micro); 45 kt SE at 28.0N, 74.2W at 1205Z (micro); 35 kt S at 28.8N, 73.6W at 19Z (micro); 40 kt SE at 27.9N, 76.0W at 20Z (micro). There were four additional gale observations. Regarding

the position... “The center was definitely located by reconnaissance about 175 miles northeast of Nassau at about 7 a.m. on the 31st” (MWR).

August 1:

HWM analyzes a tropical storm of at most 1010 mb centered near 30.8N, 77.4W. HURDAT lists this as a 80 kt hurricane at 31N, 78.1W. The MWR tracks of centers of cyclones shows a position near 29.8N, 77.8W. The MWR post-season track map shows a 00Z position near 28N, 76.8W and a 12Z position near 30.6N, 78.2W. Microfilm shows a center in the vicinity of 30.4N, 77.8W. Land highlights: 51 kt at ~21Z and 990 mb at 2330Z at Oak Island, NC (MWR). There was one other land gale and three other land low pressures. Aircraft highlights: 50 kt SE at 30.5N, 75.9W at 14Z (micro); 35 kt SW at 30.7N, 76.5W at 1520Z (micro). Four other aircraft gales. “The storm approached the North Carolina coast with slowly increasing intensity and moved inland south of Southport at about 7 p.m. on August 1. The diameter of the storm was small but reports indicate that winds were of hurricane force” (MWR). “A tropical disturbance of moderate energy passed over the Wilmington area on the 1<sup>st</sup>. The center of the storm reached the coast about 30 miles south of Wilmington in the vicinity of Southport about 7:00 pm. The wind at Wilmington reached an extreme velocity (1-min) of 52 miles per hour at 7:41 p.m., with velocity in gusts estimated as high as 72 miles per hour. At the Wilmington station the barometer fell rapidly through the afternoon and early evening reaching the lowest point, 29.41 inches (sea level) at 6:55 pm. Damage at Carolina Beach, 15 miles south of Wilmington, was extensive and due chiefly to the unusually high tide and heavy seas washing over the beach and battering to pieces many of the dwelling houses and business places. Two fishing piers were demolished. Damage at Wrightsville Beach was less extensive than at Carolina Beach, but here also two fishing piers were partly wrecked and many roofs damaged. In the city of Wilmington many roofs were damaged, power and communication lines broken down, several plate glass windows smashed, and a few hundred large trees (up to at least 24 inches in diameter) uprooted. Total damage to the city and beach property and crops in four surrounding counties has been estimated at \$1,600,000. No fatalities resulted from this storm. Several persons were injured, but only a few seriously” (OMR). Regarding the damage... “On the beaches, particularly at Carolina and Wrightsville, many houses and cottages were destroyed or had their foundations undermined by high tides and extremely high seas. Substantially built structures not subject to undermining by water action went through the storm without damage” (MWR). Regarding the position...from the Wilmington OMR...”Cloud observations during the passage of the hurricane on the 1<sup>st</sup>: At 6:00 am (10Z 1<sup>st</sup>) cloud arc indicated center of disturbance to lie slightly east of south. At 6:00 pm center of arc apparently slightly west of south. 7:00 pm, stratus from east, center of cloud arc southwest of station. 8:30 pm, cloud arc indicates center slightly north of west” (OMR). Regarding the damage... “The most extensive damage occurred at Carolina Beach. Thirty-foot waves reportedly pounded the beachfront and totally destroyed the town’s famed boardwalk. According to the *Wilmington Morning Star*, oceanfront homes were washed from their foundations. At Wrightsville, the greatest damage occurred to the new sewage project, which was under construction and was left completely covered by sand. Police officers who remained at Wrightsville through the storm reported that ‘at one time, the water measured 18 feet by the City Hall.’ The total

damage from the storm exceeded \$2 million” (Barnes). “3.14 inches of precipitation fell at Myrtle Beach, SC on the 1<sup>st</sup>” (08/1944 SC Climatological Data). “Tropical Cyclones in the South Atlantic States – Carolinas and Georgia: Aug 1 – N.C. – Minimal – Damage \$2,000,000” (Dunn and Miller – “Minimal” has maximum winds of 74 to 100 mph and central pressure 983 to 996 mb). “1944 Aug – NC1 – 990 mb pressure” (Jarrell et al.).

#### August 2:

HWM analyzes a tropical storm of at most 1010 mb centered inland over southeastern Virginia near 37.5N, 77.5W. HURDAT lists this as a 45 kt tropical storm at 36.9N, 78W. The MWR tracks of centers of cyclones shows a 00Z position near 34.0N, 77.8W and a 12Z position near 37.5N, 77.7W with a 1007 mb pressure. The MWR post-season track map shows a 00Z position near 33.5N, 78.4W and a 12Z position near 36.2N, 78.2W. Microfilm shows a low of at most 1008 mb centered near 37.2N, 77.8W. Land highlights: 37 kt SE at Wilmington, NC at 00Z (OMR); 45 kt (1-min) at Wilmington, NC at 0041Z (OMR); 42 kt S at Wilmington, NC at 1Z (OMR); 33 kt (1-min) E at Atlantic City, NJ at ~20Z (MWR, OMR). “The center began a recurve to the northeastward, passed near Richmond and Washington about noon of the 2nd, and moved out to sea near Atlantic City where an extreme wind (1-min) of 38 miles per hour was recorded during the afternoon of the same day. At Washington, 6.15 inches of rain fell during a 24-hour period as the storm center passed east of that city” (MWR).

#### August 3:

HWM analyzes a tropical storm of at most 1010 mb centered near 39.8N, 73.2W. HURDAT lists this as a 35 kt tropical storm at 39.8N, 72.8W. The MWR tracks of centers of cyclones shows a 00Z position near 38.9N, 75.5W and a 12Z position near 39.8N, 72W with a 1010 mb pressure. The MWR post-season track map shows a 00Z position near 38.9N, 75.2W and a 12Z position near 39.8N, 72.4W. Microfilm shows a low of at most 1008 mb near 39.8N, 72.8W. No gales or low pressures. However, there were two 30-kt ship obs, both within ~150 nm of the HURDAT position.

#### August 4:

HWM no longer shows a closed low but instead analyses a NE-SW trough axis from 42N, 68W to 37N, 77W. HURDAT lists this as a 30 kt tropical depression at 41.9N, 66.5W. The MWR tracks of centers of cyclones shows a 00Z position near 41N, 69.4W and a 12Z position near 42.5N, 65.7W with a 1011 mb pressure. The MWR post-season track map has a 00Z position near 41N, 70.2W and a 12Z position near 42.4N, 66.9W. No gales or low pressures. Two obs of 30 kt and 1010 mb are in the general vicinity of the HURDAT position.

Genesis of this cyclone is estimated to have occurred around 00Z on the 30<sup>th</sup>, 18 hours earlier than originally indicated in HURDAT. Only minor track changes are made from genesis through the beginning of 2<sup>nd</sup>. Thereafter, no track changes to HURDAT are made. This system formed from a vigorous tropical wave evident as early as 27 July east of the Lesser Antilles. A tropical depression formed around 00Z on the 30<sup>th</sup> just north of the Mona Passage, and it became a tropical storm at 18Z the same day, six hours earlier than indicated in HURDAT. By the 31<sup>st</sup>, there were numerous reports from aircraft of

gale force winds near the center, but the system most likely attained hurricane status around 00Z August 1<sup>st</sup> (12 hours later than original HURDAT) once it was north of 30N.

The hurricane made landfall on Oak Island, North Carolina at 23Z where a 990 mb central pressure was reported (MWR). Peak observed sustained winds were 51 kt from Oak Island. The 990 mb pressure suggests winds of 59 kt from the Brown et al. (2006) north of 25N pressure-wind relationship. Given the small (12 nmi) RMW compared with climatology for this pressure and landfall latitude (Vickery et al. 2000), winds at landfall are estimated to be 65 kt – Category 1. This is a downgrade from the 80 kt in HURDAT originally just before landfall. Category 1 at landfall in North Carolina is consistent with damage reports. (It is noted that both Schwerdt et al. 1979 and Ho et al. (1987) did not list this system in their US landfalling hurricanes, implying that the cyclone had central pressure of 982 mb or greater.) Using the Inland Decay Model from Kaplan and DeMaria (1995), the hurricane weakened to a 57 kt tropical storm one hour after it made landfall (00Z 2<sup>nd</sup>). The inland decay model weakens the storm to 43 kt at 6Z and 33 kt at 12Z. Peak observed winds within two hours of synoptic times were 42 kt at 00Z and 36 kt at 06Z. Given the sparse reports available, winds close to the Kaplan and DeMaria model were chosen for the reanalyzed HURDAT: 55 kt at 00Z (down from 60 kt), 45 kt at 06Z (down from 55 kt), and 35 kt at 12Z (down from 45 kt). Since the storm reemerges over the Atlantic near Atlantic City, NJ around 06Z on the 3<sup>rd</sup>, and a 33 kt 1-minute sustained wind was observed at Atlantic City at 20Z on the 2<sup>nd</sup>, tropical storm status is maintained for the entire duration that this storm was over the US. It is analyzed to have weakened to a tropical depression over the open Atlantic at 00Z on the 4<sup>th</sup> and it dissipated by 12Z a few hundred miles east of Cape Cod as a closed low was no longer evident. This storm was tropical throughout its lifetime. The final two 6-hour points are eliminated from HURDAT because the system is analyzed to have been dissipated by 12Z on the 4<sup>th</sup>.

#### 1944 Storm 4

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31625 08/16/1944 M= 9 4 SNBR= 700 NOT NAMED XING=0
31630 08/16* 0 0 0 0* 0 0 0 0* 0 0 0 0*123 570 40 0*
31630 08/16* 0 0 0 0* 0 0 0 0*120 585 40 0*123 595 45 0*
          *** **
31635 08/17*125 587 45 0*127 598 45 0*129 608 50 0*132 622 55 0*
31635 08/17*125 605 50 0*127 615 55 0*129 625 60 0*134 635 65 0*
          *** **          *** **          *** **          *** **
31640 08/18*136 638 60 0*142 652 65 0*147 666 75 973*152 680 80 0*
31640 08/18*140 645 70 0*147 655 80 0*152 666 90 973*155 678 90 0*
          *** **          *** **          *** **          *** **
31645 08/19*156 693 90 0*160 702 95 0*162 709 100 0*166 722 105 0*
31645 08/19*157 690 90 0*158 701 95 0*159 712 100 0*162 722 105 0*
          *** **          *** **          *** **          ***
31650 08/20*170 733 105 0*174 744 105 0*178 756 105 0*181 771 105 0*
31650 08/20*167 732 105 0*174 742 105 0*179 753 105 0*183 766 90 0*
          *** **          ***          *** **          *** **
31655 08/21*184 785 70 0*186 798 70 0*188 811 75 0*191 827 75 0*
31655 08/21*186 782 75 0*188 797 75 0*190 811 75 0*192 827 75 0*
          *** **          *** **          ***          ***

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31660	08/22*194	843	80	0*199	859	80	0*204	875	80	0*206	885	65	0*
31660	08/22*194	843	80	0*197	860	80	0*200	877	80	0*202	893	65	0*
				***	***		***	***		***	***		
31665	08/23*208	895	55	0*209	911	50	0*209	928	45	0*209	942	45	0*
31665	08/23*204	907	55	0*206	920	50	0*207	933	45	0*208	946	45	0*
				***	***		***	***		***	***		
31670	08/24*209	953	40	0*208	971	35	0*	0	0	0	0	0	0*
31670	08/24*207	958	40	0*206	970	35	0*205	982	25	0*	0	0	0*
				***	***		***	***	**				

31675 HR

Major track changes and minor intensity changes were implemented with this storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, NHC microfilm of synoptic weather maps, Connor (1956), and the Jamaican Meteorological Office (1945).

#### August 16:

HWM analyzes a wave axis between 55-60W, and a low at the southern end of the wave axis near 11.7N, 56.8W. HURDAT first lists this at 18Z as a 40 kt tropical storm at 12.3N, 57.0W. "This small intense hurricane was first noted east of Barbados on the 16th (MWR)." No gales or low pressures.

#### August 17:

HWM analyzes two lows, both of at most 1010 mb. The one near 14N, 64.2W shows a large area of below 1010 mb pressure extending from 11N, 68W northeastward to 17N, 63W where a wave axis, which extends northeastward to 22N, 59W, is plotted attached to the low. The low is very small and located near 11.2N, 59.7W. HURDAT lists this as a 50 kt tropical storm at 12.9N, 60.8W. The MWR post-season track map shows a 00Z position near 12.3N, 58.9W and a 12Z position near 12.5N, 62W. Microfilm shows a low of at most 1002 mb near 13.2N, 62.7W. Aircraft highlights: center fix at 1140Z at 13N, 62.5W (micro); 40 kt ESE at 14.4N, 62.9W at 1430Z (micro); 35 kt SSW at 12.3N, 62.0W at 1630Z (micro). Two other aircraft gales. "Passing south of Barbados and over the Grenada Islands during the night, it entered the Caribbean not far from St. Vincent about 8:30 am on the 17th" (MWR).

#### August 18:

HWM analyzes a low in a trough with a wave axis extending from the low north-northeastward for several hundred kilometers. The position of the plotted low is near 14N, 67.8W. HURDAT lists this as a 75 kt hurricane at 14.7N, 66.6W. The MWR post-season track map shows a 00Z position near 13.3N, 64.6W and a 12Z position near 14.3N, 67.3W. Microfilm shows a center near 14.5N, 67.5W. Ship highlight: center fix at 15.2N, 66.7W with 973 mb central pressure and calm (MWR). Aircraft highlights: 35 kt N at 15.2N, 68.3W, possibly at 1330Z (micro); 40 kt S at 14.3N, 67.0W at 1350Z (micro); 35 kt SE at 14.1N, 65.7W at 16Z (micro). Three other aircraft gales.

#### August 19:

HWM analyzes a tropical storm of at most 1010 mb near 16.8N, 72.3W. HURDAT lists this as a 100 kt hurricane at 16.2N, 70.9W. The MWR post-season track map shows a 00Z position near 14.8N, 69.3W, and a 12Z position near 15.8N, 71.3W. Microfilm shows a center near 15.9N, 71.3W. Aircraft highlights: 35 kt SSE at 16.5N, 70.8W at 18Z (micro); 45 kt SSW at 16.1N, 72.1W at 1830Z (micro); 35 kt N at 16.7N, 73.7W at 2340Z. One other aircraft gale.

August 20:

HWM analyzes a tropical storm approaching Jamaica near 17.6N, 75.2W. HURDAT lists this as a 105 kt hurricane at 17.8N, 75.6W. The MWR post-season track map shows a 00Z position near 16.4N, 73.3W and a 12Z position near 17.3N, 75.5W. Microfilm shows a center near 17.7N, 75.4W. Land highlights: 987 mb (min p) at 1530Z at Morant Point (17.9N, 76.2W) (Jamaica); 52 kt (max wind) WSW around 18Z at Kingston, Jamaica (MWR); 999 mb (min p) around 18Z at Kingston, Jamaica (MWR); 45 kt W and 1000 mb at Kingston, Jamaica at ~1830Z (micro); 980 mb (min p) around 21Z at Harmony Hall, Duncans, Trelawny, Jamaica (18.5N, 77.5W) (Jamaica); 984 mb (min p) around 2240Z at Montego Bay (18.5N, 77.9W) (Jamaica); 1001 mb (min p) at 2345Z at Nergil (18.2N, 78.4W) (Jamaica). Aircraft highlights: 50 kt S at 17.5N, 74.3W at 15Z (micro); 50 kt ESE at 18.3N, 73.6W at 1530Z (micro); 40 kt SSW at 17.3N, 75.4W at 1610Z. Three other aircraft gales. "The hurricane swept inland over the southeast coast of Jamaica, in the Boston Bay area, shortly before noon on the 20<sup>th</sup> and passed off the western coast near Montego Bay some hours later. The storm lost much of its intensity as it crossed the island, for winds fell from an estimated 100 to 120 miles per hour on the east coast to 80 miles per hour in the vicinity of Montego Bay where damage was not serious. Press photos show that on some of the large coconut plantations, in the more seriously affected areas, not a tree was left standing" (MWR). Regarding the course over Jamaica... "It first struck the coast at Boston at about 11:30 am EST (1630 GMT) and moved in a west northwesterly direction, which took it along the coast to Annotto Bay, and then overland to some point between Falmouth and Montego Bay from whence it passed out to sea some time between 5:30 and 6:00 pm (2230 and 2300 Z). Its average speed over Jamaica was 18 mph, a high speed for such a destructive storm; but there is some evidence that its speed over the eastern half of the island was of the order of 15 mph, gradually increasing to 20-22 mph in the western half. The exact track of the center over the western parishes is rather difficult to determine" (Jamaica). Regarding pressure observations in Jamaica during the storm... "No sequence of barometer readings from a station in the path of the storm is available, but the minimum pressure at one point on the path, Harmony Hall, Duncans, Trelawny was approximately 980 mb (28.84 inches). A barograph record made at Montego Bay showed a minimum pressure of about 984 mb. The center passed 2-3 miles north of Montego Bay, but the town appears to have experienced the outer part of the eye of the storm as a definite lull was reliably reported" (Jamaica). Regarding the pressure recorded at Morant Point versus an estimation of the central pressure of the storm at 1530Z... "From 3 am (8Z), the pressure (at Morant Point) fell with increasing rapidity until after 9 am (14Z) the graph became almost a straight line, indicating a uniform rate of fall of 0.9 millibars per mile distance from the center (Morant being approximately 27 and 12.5 miles from the center at 9 (14Z) and 10:30 (1530Z) respectively). Assuming that this rate of fall was maintained to the boundary of

the eye, that the eye was about 5 miles in diameter, and that the isobars were circular, the pressure at the boundary of the eye at 10:30 am (1530Z) would be  $10 * 0.9 = 9.0$  mb less than at Morant where a minimum pressure of 987 mb was recorded at about 10:30 am (1530Z). It can be assumed that there was no great change in pressure within the eye and that therefore the (central pressure) at this time was of the order of 978 mb” (Jamaica). “From the above readings (and other readings not included) and remarks the following points may be noted: (a) The area of excessively large pressure gradient on the south side of the hurricane was comparatively small, being of the order of 30-35 miles radius. The area was probably slightly greater on the north side. (b) The minimum pressure at Vernam Field and Nergil are evidence in favor of the theory that filling up occurred in the western section of the landtrack, but that deepening was renewed once the hurricane passed out to sea. (It had been over the sea some 1.5-2 hours when the Nergil minimum was recorded)” (Jamaica). Regarding the wind speed... “No instrumental observations of wind force or direction are available from places in the path of the hurricane, but it is possible to make one fairly reliable estimate of the speed at Annotto Bay (18.3N, 76.8W) shortly before the center passed that town, and after the hurricane had traveled along the coast for some two hours. Two railway vans, weighing 14.5 tons each, situated approximately 90 degrees to the wind direction, were overturned, from which fact it may be deduced that the wind speed was of the order of 100-120 mph. The strongest winds occurred between Manchioneal (18.0N, 76.3W) and western St. Mary (18.4N, 76.9W)” (Jamaica). Regarding the state of the sea... “Very heavy swell on the open seas was noted at Palisadoes (essentially Kingston) when the center was still 70 miles distant, and appeared to be unchanged 2 hours later when the center was about 35 miles nearer. Morant Point Lighthouse reported very heavy swell from an ENE direction when the center was over 50 miles distant” (Jamaica). Regarding the damage... “Well over 30 people were killed (mostly due to the wind). The main damage to buildings occurred in Portland, St. Mary, St. Ann, northern Trelawny, northern St. James, northern St. Andrews, northern St. Catherine and eastern St. Thomas, the first three suffering heavy destruction, and fourth one considerable damage to large buildings. Small single or double roomed dwellings of light construction were either blown down or crushed by falling trees. Larger dwellings, which were damaged, mostly remained intact until a shutter or window was blown open, after which the roof was easy prey for the wind. In some cases, where the wind was able to get beneath a building, it was lifted bodily several yards. Several large buildings, particularly churches, had their roofs completely removed and suffered much internal damage” (Jamaica). Regarding the diameter of the eye... “The dimensions of the eye of the storm are of interest. It has been assumed that the diameter was 5 miles before it struck the Island. This was based on reports that the lull was of the order of 15-20 minutes in the extreme eastern districts. East of Anotto Bay all the available reports come from coastal stations, and without exception report a lull. West of Anotto Bay lulls of duration varying from 15 to 30 minutes are reported from the places situated in a belt 8-10 miles wide. It therefore appears that the eye was increasing in diameter in the west of the Island, and that this factor may be connected with the weakening of the storm” (Jamaica).

August 21:

HWM analyzes a low of at most 1005 mb near 19.3N, 81.1W. HURDAT lists this as a 75 kt hurricane at 18.8N, 81.1W. The MWR post-season track map shows a 00Z position near the western tip of Jamaica near 18.2N, 78.4W and a 12Z position near 18.7N, 81.1W. Microfilm shows a low centered near 19.2N, 81.1W of at most 1002 mb claiming that the maximum gusts reported by a source were 85 mph out of the ENE. It is unclear whether this report is the maximum gusts encountered by a ship or plane, or whether it is the estimated maximum gusts of the storm. Land highlights: 40 kt ENE and 1003 mb at Cayman Islands at 12Z (micro); 40 kt ENE with maximum gusts to 78 kt and 1004 mb at Cayman Islands at 13Z (micro); 45 kt E and 1003 mb at Cayman Islands at 14Z (micro); 40 kt E and 1008 mb at Cayman Islands at 15Z (micro). Aircraft highlights: 45 kt ENE at 19.5N, 81.5W at 1330Z (micro); 35 kt E at 20.2N, 80.7W at 14Z (micro); 35 kt NE at 19.5N, 83.8W at 14Z (micro). “The hurricane center passed near Grand Cayman Island on the 21<sup>st</sup> with winds of 80 to 90 miles per hour, in gusts” (MWR).

August 22:

HWM analyzes a tropical storm inland over western Belize near 17.8N, 88.9W. HURDAT lists this as a 80 kt hurricane at 20.4N, 87.5W. The MWR post-season track map shows a 00Z position near 19.1N, 83.8W and a 12Z position near 20.1N, 87.6W. Microfilm shows a low centered near 20.1N, 87.6W. Ship highlight: 40 kt SSE and 108 mb 20.1N, 86.1W (micro). Two other gales of 40 kt and one low pressure of 1005 mb. Regarding the track...”On the morning of the 22<sup>nd</sup>, the center moved inland on the coast of Yucatan a short distance south of Cozumel Island, and while it lost force in passing over the Peninsula, it emerged into the Gulf of Mexico intact and moved westward into Mexico a short distance south of Tuxpan. According to press reports at least 12 deaths were caused inland in Mexico as a result of floods that accompanied dissipation of the storm” (MWR).

August 23:

HWM analyzes a tropical storm of at most 1005 mb near 20.2N, 94.1W. HURDAT lists this as a 45 kt tropical storm at 20.9N, 92.8W. The MWR post-season track map shows a 00Z position near 20.6N, 90.4W and a 12Z position near 20.7N, 93W. Microfilm shows a low of at most 1002 mb centered near 20.8N, 93.7W. Land highlights: 35 kt E and 1007 mb at 1Z at Merida (21.0N, 89.7W) (micro); 35 kt E and 1008 mb at 2Z at Merida (micro).

August 24:

HURDAT last lists this at 06Z as a 35 kt tropical storm at 20.8N, 97.1W. The MWR post-season track map shows a 00Z position near 20.7N, 95.6W moving just south of due west at about 265 degrees. Microfilm shows a low at 12Z centered near 20N, 98.2W. “A conservative estimate of fatalities resulting from this hurricane, taken from incomplete statistics, places loss of life at 216” (MWR). Regarding the damage...”Estimates of property damage are incomplete but will total several million dollars. Extremely heavy crop losses were suffered on Jamaica, where a crippling blow was dealt growers, exporters, and industrialists dependent upon the highly important banana and coconut yields. The most authoritative estimate of the number of coconut trees destroyed on the

whole island is 41 percent, while banana trees which were concentrated in the stricken zone, were about 90 percent destroyed” (MWR).

This tropical storm was first noticed east of Barbados, and the analysis indicates that it passed south of Barbados. HURDAT started this storm at 18Z on the 16<sup>th</sup>, though the analysis indicates that it was a tropical storm by 12Z. It is possible that the cyclone existed east of the Lesser Antilles, but observations are very sparse over the open Atlantic. The largest track change is late on the 16<sup>th</sup> and early on the 17<sup>th</sup>, when the storm is analyzed to be substantially farther west than in the original HURDAT. All other track changes are minor and were introduced throughout the lifetime of the cyclone. It moved west-northwestward through the Caribbean Sea and apparently rapidly intensified on the 17<sup>th</sup>. The central pressure observation of 973 mb reported by a ship and reported by Monthly Weather Review the morning of the 18<sup>th</sup> is crucial in determining the intensity changes made to HURDAT. The pressure of 973 mb equals 88 kt according to the Brown et al. southern pressure-wind relationship. The size of the storm is believed to be average or smaller than average at this time, because at this ship, the pressure fell 40 mb in 3 hours and then after the calm period, the pressure rose 40 mb in 3 hours. So an intensity of 90 kt is chosen for 12Z on the 18<sup>th</sup>, upgraded from 75 kt in the previous HRUDAT. Since 90 kt is chosen for 12Z on the 18<sup>th</sup>, the intensity at 12Z on the 17<sup>th</sup> is raised from 50 to 60 kt. By the 18<sup>th</sup>, the cyclone became a major hurricane with 100 kt winds by 12Z on the 19<sup>th</sup> (unchanged) near 16N, 71W. It struck Jamaica directly around 16Z on the 20<sup>th</sup>, as a 105 kt category 3 hurricane- consistent with the impacts described in the report by the Jamaican Meteorological Office, and the storm weakened to a category 1 before emerging back over water. (Note that the 978 mb central pressure estimated based upon a 987 mb peripheral pressure measurement discussed in the report is likely substantially underestimated in intensity because of the small size of the hurricane.) Winds are reduced at 18Z on the 20<sup>th</sup> (from 105 to 90 kt), as the hurricane had been over Jamaica for a couple of hours at that point and no weakening had previously been indicated in HURDAT. The hurricane continued traveling towards the WNW passing south of the Cayman Islands, where hurricane force gusts were reported. The hurricane struck the Yucatan Peninsula on the 22<sup>nd</sup> at as category 1 hurricane. It weakened to a tropical storm while over the Yucatan Peninsula, and it emerged into the Bay of Campeche intact. The storm did not regain any strength over the Bay of Campeche and made its 2<sup>nd</sup> Mexico landfall as a tropical storm early on the 24<sup>th</sup>. There were no changes to the intensity from late on the 21<sup>st</sup> until early on the 24<sup>th</sup>. Dissipation of the cyclone likely occurred around 18Z on the 24<sup>th</sup> – six hours later than originally indicated, as observations show that the system retained a closed circulation at 12Z.

## 1944 Storm 5

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31680 08/19/1944 M= 5 5 SNBR= 701 NOT NAMED XING=0
31680 08/18/1944 M= 6 5 SNBR= 701 NOT NAMED XING=0
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(The 18<sup>th</sup> is new to HURDAT.)

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31682 08/18* 0 0 0 0* 0 0 0 0*205 850 25 0*209 856 25 0*
31685 08/19* 0 0 0 0* 0 0 0 0* 0 0 0 0*228 877 35 0*
31685 08/19*213 862 30 0*217 868 30 0*220 875 30 0*223 883 35 0*
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31690	08/20*228	890	35	0*229	895	40	0*230	900	40	0*230	906	45	0*
31690	08/20*226	892	35	0*229	901	40	0*230	910	40	0*230	919	45	0*
	***	***		***	***		***	***		***	***		
31695	08/21*231	914	50	0*233	926	50	0*235	938	50	0*238	946	50	0*
31695	08/21*231	928	50	0*233	937	50	0*235	945	50	0*238	952	50	0*
	***	***		***	***		***	***		***	***		
31700	08/22*240	954	50	0*243	964	50	0*247	973	45	0*250	982	45	0*
31700	08/22*240	958	50	0*243	964	50	0*247	971	45	0*250	978	45	0*
	***	***		***	***		***	***		***	***		
31705	08/23*253	989	35	0*256	998	25	0*	0	0	0*	0	0	0*
31705	08/23*253	987	35	0*256	998	25	0*	0	0	0*	0	0	0*
	***	***		***	***		***	***		***	***		
31710	TS												

Minor track changes but no intensity alterations were made to this tropical storm in the Gulf of Mexico. Genesis is begun 30 hours earlier than originally indicated. Evidence for these changes comes from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, NHC microfilm of synoptic weather maps and the Original Monthly Records from NCDC.

#### August 13:

HWM analyzes a tropical wave axis from 12N, 61W to 18N, 55W in a trough of low pressure. HURDAT does not list a system on this day. No gales or low pressures.

#### August 14:

HWM analyzes a tropical wave axis from 13N, 64W to 22N, 57W in a trough of low pressure. HURDAT does not list a system on this day. No gales or low pressures.

#### August 15:

HWM analyzes a tropical wave axis from 16N, 68W to 23N, 62W in a trough of low pressure. HURDAT does not list a system on this day. Microfilm shows a closed low of at most 1011 mb centered near 17.5N, 68.2W. No gales or low pressures.

#### August 16:

HWM analyzes a spot low near 14.5N, 74W with a tropical wave axis extending from the low north-northeastward to 24N, 70W. HURDAT does not list a system on this day. No gales or low pressures.

#### August 17:

HWM analyzes a tropical wave axis from 17N, 82W to 24N, 76W located in a sharp trough of low pressure that indicates the low is three-fourths closed. HURDAT does not list a system on this day. No gales or low pressures.

#### August 18:

HWM analyzes a tropical wave axis from 15N, 85W to 26N, 83W in a sharp trough of low pressure. HURDAT does not list a system on this day. Microfilm shows a low in a trough located near 20.3N, 84.4W. No gales or low pressures.

August 19:

HWM does not analyze any features of interest on this day. HURDAT initiates this storm at 18Z at 22.8N, 87.7W with an intensity of 35 kt. No gales or low pressures. "Development of a circulation and an increase in intensity was noted north of the Yucatan Peninsula, in an isallobaric wave that for some time had been moving westward through the Caribbean" (MWR).

August 20:

HWM does not analyze any features of interest on this day. HURDAT lists this as a 40 kt tropical storm at 23.0N, 90.0W. The MWR post-season track map shows a 00Z position near 22.4N, 88.7W and a 12Z position near 22.5N, 90.3W. Microfilm does not show a closed low. Ship highlight: 35 kt ENE and 1014 mb at 24.7N, 86.8W at 0030Z (micro).

August 21:

HWM analyzes a spot low near 24.7N, 95.5W. HURDAT lists this as a 50 kt tropical storm at 23.5N, 93.8W. The MWR post-season track map shows a 00Z position near 22.7N, 92.1W and a 12Z position near 23.1N, 93.8W. Microfilm shows a closed low of at most 1011 mb centered near 23N, 94.5W. Aircraft highlight: 35 kt E at 24.5N, 95.2W at 19Z (micro).

August 22:

HWM analyzes a tiny closed low of at most 1010 mb centered near 25.3N, 96.6W just offshore of the Texas-Mexico border. HURDAT lists this as a 45 kt tropical storm at 24.7N, 97.3W. The MWR post-season track map shows a 00Z position near 24N, 95.7W and a 12Z position near 24.6N, 97.3W. Microfilm shows a low of at most 1008 mb centered near 24.7N, 97.3W. Land highlight: 39 kt (1-min) NE at Brownsville at ~1730Z (OMR). "The disturbance continued a westward or west-northwestward movement and crossed the Mexican coast south of Brownsville about noon of the 22nd" (MWR).

August 23:

HWM does not show any features of interest over Texas or Mexico on this day. HURDAT last lists this storm at 06Z inland at 25.6N, 99.8W as a 25 kt tropical depression. At 06Z, microfilm shows a low of at most 1008 mb centered near 25.7N, 99.6W. There was an inland observation of 1007 mb and 15 kt from the ESE at 26.0N, 99.2W at ~0630Z (micro). "The disturbance did not develop winds of more than moderate gale force" (MWR).

This storm formed from a strong tropical wave that can be tracked back to the eastern Caribbean Sea on 13 August. It attained a closed circulation around 12Z on the 18<sup>th</sup> as it was passing between Cuba and the Yucatan Peninsula. Thus a change was made to begin this system as a tropical depression 30 hours earlier than originally in HURDAT. Minor track changes were introduced for every day in its lifetime. It then strengthened to a 50 kt tropical storm (unchanged from original HURDAT) as it moved west-northwestward through the Gulf of Mexico. The storm weakened to 45 kt before making landfall around 18Z on the 22<sup>nd</sup> in Mexico about 70 miles south of Brownsville. The peak observed

winds for this tropical cyclone were the 39 kt 1-minute winds in Brownsville, which is consistent with the 45 kt landfall intensity originally analyzed. It then weakened to a tropical depression over land and dissipated about 18 hours after landfall. No changes were made to the dissipation phase of this tropical cyclone.

#### 1944 Storm 6

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31715 09/09/1944 M= 3 6 SNBR= 702 NOT NAMED XING=1
31720 09/09*223 938 35 0*239 940 40 0*254 942 45 0*267 941 45 0*
31720 09/09E250 950 25 0E258 948 30 0E265 945 35 0E270 941 40 0*
      **** ** **          **** ** **          **** ** **          **** **
31725 09/10*277 933 45 0*283 921 40 0*289 908 40 0*300 896 35 0*
31725 09/10E272 935 45 0E277 926 45 0*285 915 50 0*294 897 50 1001*
      **** ** **          **** ** **          *** ** **          *** ** **
31730 09/11*315 885 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0 0*
31730 09/11*306 880 40 0*314 870 30 0*320 868 25 0* 0 0 0 0 0*
      *** ** **          *** ** **          *** ** **          *** ** **
31735 TS

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#### U.S. landfalls:

9/10/1944 1600Z 29.1N, 90.4W 1001 mb 50 kt  
 9/10/1944 2300Z 30.3N, 88.3W 1001 mb 50 kt

Major changes to the track and minor alterations to intensity were made for this tropical storm. Significant changes were also made with regards to the structure of the cyclone (extratropical) during the first 36 hours of its existence. Evidence of these changes comes from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Dunn and Miller (1960), and Conner (1956).

#### September 8:

HWM does not analyze a closed low on this day, but it does indicate a stationary front lying across the northwestern Gulf of Mexico. HURDAT does not list a system on this day. Microfilm shows a low of at most 1011 mb attached to a WSW-ENE frontal boundary centered near 27.4N, 95.5W. No gales or low pressures. "A partial wind circulation, evident early in the afternoon on September 7, developed and within the next 36 hours isobars with cyclonic curvature covered the entire western Gulf, and suggested a complete wind circulation with center near latitude 23N, longitude 94W" (MWR).

#### September 9:

HWM analyzes a low near 25.5N, 94.3W at the southwest end of a SW-NE warm front, both of which lie in a pressure trough. HURDAT lists this as a 45 kt tropical storm at 25.4N, 94.2W. The MWR tracks of centers of cyclones shows a 00Z position near 23.5N, 94.1W and a 12Z position near 25.5N, 94.5W. The MWR post-season track map shows a 00Z position near 22.5N, 94.1W and a 12Z position near 25.5N, 94.6W. Microfilm has a tropical storm symbol plotted on the 00Z map near 23N, 94W, and on the 12Z map microfilm shows a low of at most 1005 mb near 27N, 94.5W with two boundaries extending from the low. One boundary extends from the low east-

northeastward, and the other boundary extends from the low south-southwestward. Both of these boundaries lie in pressure troughs. No gales or low pressures.

#### September 10:

HWM analyzes a closed low of at most 1005 mb just south of Louisiana near 28.7N, 92.3W at the west end of a W-E warm front. HURDAT lists this as a 40 kt tropical storm at 28.9N, 90.8W. The MWR tracks of centers of cyclones shows a 00Z position near 27.3N, 93.8W and a 12Z position near 29N, 92W. The MWR post-season track map shows a 00Z position near 27.7N, 93.7W and a 12Z position near 28.8N, 91.2W. Microfilm shows a low of at most 1005 mb near 29N, 92.5W with the same 2 boundaries analyzed as on the previous day. Ship highlights: 35 kt SSE at 27.5N, 88.5W at 18Z (COA); 30 kt WSW and 1004 mb at 29.0N, 89.4W at 1830Z (micro). Land highlights: 47 kt at Pensacola, FL (MWR); 41 kt S at Pensacola, FL at ~21Z (OMR); 1003 mb at Pensacola, FL at 2120Z (OMR). Two other land low pressures- Mobile (1003 mb) and New Orleans (OMR). "The tide in the Mobile River reached a height of 3.8 ft above sea level, which was the highest tide since September 1, 1932. The high tide occurred shortly before the regularly computed time of low tide under normal conditions" (OMR). The station with the greatest monthly total precipitation for September of all the stations in Louisiana was Paradis, LA, which is located very close to the path the storm took in southeastern Louisiana. This station recorded 11.29 inches of precipitation during September. 5.30 of the 11.29 inches fell on the 9<sup>th</sup> and 10<sup>th</sup> of the month (09/1944 LA Climatological Data). "Sep. 10, Landfall near Grand Isle, Estimated Minimum Central Pressure 999 mb" (Connor). "Tropical cyclones in Louisiana, Mississippi, and Alabama – Sept. 10 – Mobile – Minor – 7 to 11 in. rain" ("Minor" – winds less than 74 mph, pressure greater than 996 mb- Dunn and Miller).

#### September 11:

HWM analyzes no features of interest over the southeast United States or over the northern Gulf of Mexico. HURDAT last lists this system at 00Z at 31.5N, 88.5W as a 30 kt tropical depression. The MWR tracks of centers of cyclones shows a 00Z position near 31N, 87W. The MWR post-season track map shows a 00Z position just southeast of Mobile, AL near 30.8N, 87.9W. Microfilm shows a low of at most 1005 mb near 00Z near 31N, 87.5W with a boundary extending eastward from the low. Land highlight: 35 kt S at Pensacola, FL at ~00Z (micro).

This system started in the west-central Gulf of Mexico as part of a frontal boundary. HURDAT listed this originally as being tropical throughout its lifetime. The original HURDAT starts this system as a tropical storm at 00Z on 9 September. However, a significant temperature gradient across the storm indicates that it was extratropical for the first 30 hours of HURDAT positions, until 06Z on the 10<sup>th</sup>. It is estimated that – despite the analysis from HWM and the microfilm maps – the system did not break its frontal structure and became a tropical storm around 12Z on the 10<sup>th</sup>. The major track changes early on the 9<sup>th</sup> point to positions significantly northwest of the original HURDAT positions. On the 10<sup>th</sup>, observations indicate positions slightly south and west of the previous HURDAT positions for all synoptic times on that day. For intensity, HURDAT starts this as a 35 kt tropical storm, but it is reanalyzed to have started as a 25 kt

extratropical low at 00Z on the 9<sup>th</sup>, becoming 35 kt by 12Z on the 9<sup>th</sup> (revised down from 45 kt), based upon numerous ship and coastal observations. The cyclone was moving northeastwards, towards the north Gulf Coast. The transition to a tropical storm occurred just hours before landfall on the southeast Louisiana coastline. The tropical storm made two landfalls, both as a 50 kt tropical storm (the intensity was revised upwards from the original HURDAT). The first landfall occurred in southeastern Louisiana at 29.1N, 90.4W around 16Z on the 10<sup>th</sup>, and the second landfall was at the Mississippi/Alabama border around 23Z on the 10<sup>th</sup>. A few peripheral pressure readings suggest a central pressure around the time of landfall of 1001 mb. This would support winds of 42 kt from the Brown et al. north of 25N pressure-wind relationship. However, an observation at Pensacola of a 5-minute wind of 47 kt late on the 10<sup>th</sup> suggests a maximum sustained wind of about 50 kt at both landfalls. Winds are boosted to 50 kt at 12Z and 18Z on the 10<sup>th</sup> (from 40 and 35 kt originally). HURDAT's original last point was at 00Z on the 11<sup>th</sup> as a 30 kt depression. Observations indicate it was still a 40 kt tropical storm at 00Z on the 11<sup>th</sup>. Available data maintains a tropical, closed circulation for an additional 12 hours after HURDAT's last position at 00Z. The storm is analyzed to have weakened to a depression by 06Z on the 11<sup>th</sup> while over Alabama. The last point in the revised HURDAT is a 25 kt tropical depression at 12Z.

1944 Storm 7 (note: this storm was reanalyzed prior to my work, so I did not write the metadata for this storm)

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31740 09/09/1944 M= 8 7 SNBR= 703 NOT NAMED XING=1 SSS=3
31740 09/09/1944 M= 8 7 SNBR= 703 NOT NAMED XING=1 SSS=2
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31745 09/09* 0 0 0 0*208 580 65 0*212 597 70 0*216 610 70 0*
31745 09/09* 0 0 0 0*208 585 45 0*212 597 50 0*216 610 55 0*
*** ** **

31750 09/10*220 623 75 0*225 636 75 0*230 650 75 0*234 663 80 0*
31750 09/10*220 623 60 0*225 636 65 0*230 650 70 0*236 663 75 0*
** ** **

31755 09/11*239 674 85 0*242 681 90 0*245 687 90 0*247 692 95 0*
31755 09/11*243 674 80 0*250 681 85 0*255 687 90 0*257 692 95 0*
*** ** *** ** ***

31760 09/12*249 697 105 0*252 703 110 0*256 711 115 943*263 723 120 0*
31760 09/12*258 699 105 0*259 706 110 0*262 715 115 943*266 728 120 0*
*** *** *** *** ***

31765 09/13*271 735 120 0*278 742 115 0*285 748 110 0*297 755 105 0*
31765 09/13*270 740 120 0*276 747 120 0*285 751 120 0*297 755 120 933*
*** *** *** *** *** **

31770 09/14*312 760 100 0*327 761 95 0*344 757 90 0*371 747 85 0*
31770 09/14*312 757 115 0*327 756 110 0*344 752 110 942*371 745 105 0*
*** *** *** *** *** ***

31775 09/15*399 732 75 0*421 715 65 966E442 685 35 0E460 637 35 982*
31775 09/15*399 732 95 953*421 710 70 966E442 685 55 982E460 637 50 *
** *** *** ** ***

31780 09/16E478 582 30 0E499 526 30 0E520 470 30 0* 0 0 0 0*
31780 09/16E478 582 40 0E499 526 35 0E520 470 30 0* 0 0 0 0*
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31785 HR NC3 VA3 NY3 CT3 RI3 MA2  
 31785 HR NC2 VA2 NY2 CT1 RI2 MA1  
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#### U.S. Landfalls:

9/14/1944 1300Z 35.2N 75.0W 90kt 2 17nmi 942mb  
 (Note: hurricane passed just east of NC as 110 kt Cat 3, 90 kt are peak  
 winds estimated to have impacted the NC coast)  
 9/15/1944 0300Z 40.9N 72.3W 95kt 2 29nmi 953mb  
 9/15/1944 0345Z 41.3N 71.5W 95kt 2 29nmi 955mb

Minor changes to the track and major alterations to the intensity shown in Neumann et al. (1999). Evidence for these alterations comes from the Historical Weather Map series, Monthly Weather Review, Original Monthly Records from NCDC, the COADS ship database, Tannehill (1952), Dunn and Miller (1960), Harris (1963), Schwerdt et al. (1979), Ho et al. (1987), Jarrell et al. (1992), Boose et al. (2001), and Cobb (2004).

#### September 9:

HWM analyzes a closed low of at most 1010 mb centered near 20.0N, 61.0W. HURDAT listed this as a 70 kt category 1 hurricane at 21.2N, 59.7W. The MWR Tracks of Centers of Cyclones for September 1944 (Chart IX) places the center at 20.5N, 59.5W at 12 UTC on this day. The center of the storm according to a reconnaissance flight reported in the Monthly Weather Review indicated a center located at approximately 21.0N, 60.0W sometime on the 9th. Available observations suggest that the 50 kt tropical storm was centered at 21.2N, 59.7W due to a lack of data in the vicinity of the storm. The intensity of the storm on this day is based on the following quote taken from the 1944 Monthly Weather Review, "strong disturbance existed in the vicinity." Ship highlights: No gales or low pressures present on this day. (An attempt was made to extend the record for this storm before September 9, but due to a lack of data due to World War II, it could not be done.)

#### September 10:

HWM analyzes a closed low of at most 1000 mb centered at 24.0N, 64.8W. HURDAT listed this as a 75 kt category 1 hurricane at 23.0N, 65.0W. The MWR Tracks of Centers of Cyclones for September 1944 (Chart IX) places the center at 21.5N, 61.5W at 0 UTC on this day. The MWR Tracks of Centers of Cyclones (Chart IX) places the center at 22.5N, 64.5W at 12 UTC on this day. Available observations suggest that the 70 kt category 1 hurricane was centered at 23.0N, 65.0W due to a lack of data in the vicinity of the storm. Ship highlights: No gales or low pressures on this day.

#### September 11:

HWM analyzes a closed low of at most 995 mb centered at 25.2N, 68.2W. HURDAT listed this as a 95 kt category 2 hurricane at 24.5N, 69.0W. The MWR Tracks of Centers of Cyclones (Chart IX) places the center at 23.5N, 67.5W at 0 UTC on this day. The MWR Tracks of Centers of Cyclones (Chart IX) places the center at 25.2N, 68.2W at 12 UTC on this day. Available observations suggest that the 90 kt category 2 hurricane was centered at 25.5N, 68.7W. Ship highlights: 1001 mb and 20kt WNW at 12 UTC at 24.5N, 70.5W (COA); 20 kt WSW and 1002 mb at 17 UTC at 23.5N, 69.5W (COA).

## September 12:

HWM analyzes a closed low of at most 995 mb centered at 26.0N, 71.5W. HURDAT listed this as a 115 kt category 4 hurricane with 943 mb central pressure at 25.6N, 71.1W. The MWR Tracks of Centers of Cyclones (Chart IX) places the center at 25.0N, 70.3W at 0 UTC on this day. The MWR Tracks of Centers of Cyclones (Chart IX) places the center at 25.5N, 71.0W at 12 UTC on this day. Available observations suggest that the 115 kt category 4 hurricane was centered at 26.2N, 71.5W. Ship observations: 1001 mb and 15 kt NW at 13 UTC at 24.5N, 73.5W (COA); 1000 mb and 35 kt W at 13 UTC at 24.5N, 73.5W (COA); 999 mb and 45 kt SW winds at 17 UTC at 25.5N, 73.5W (COA); 1002 mb and 15 kt winds at 17 UTC at 25.5N, 73.5W (COA). Regarding the intensity: unable to track down a source for the 943 mb documented in HURDAT for 12 UTC on this day.

## September 13:

HWM analyzes a closed low of at most 990 mb centered at 29.5N, 76.0W. HURDAT listed this as a 110 kt category 3 hurricane at 28.5N, 74.8W. The Tracks of Centers of Cyclones (Chart IX) places the center at 27.5N, 73.5W at 0 UTC on this day. The Tracks of Centers of Cyclones (Chart IX) places the center at 28.0N, 74.5W at 12 UTC on this day. Available observations suggest that the 120 kt category 4 hurricane was centered at 28.5N, 75.1W. Ship observations: 1008 mb and 35 kt NE at 00 UTC at 28.5N, 76.5W (Hugh Cobb); 1000 mb and 35 kt SSW at 01 UTC at 25.5N, 73.5W (COA); 1000 mb at 26.5N, 73.5W (COA); 1005 mb and 17 kt NW at 12 UTC at 25.5N, 77.1W (HWM); 952 mb at 13 UTC at 29.5N, 75.5W (COA); 933 mb at 17 UTC at 29.5N, 75.5W (COA); 1013 mb and 35 kt SE at 17 UTC at 27.5N, 72.5W (COA); 1013 mb and 35 kt SE at 18 UTC at 27.5N, 72.5W (Hugh Cobb). Regarding the intensity: 952 mb central pressure at 12 UTC on this day; 933 mb central pressure at 18 UTC for this day. September 1944 MWR: "At about 9 pm [02 UTC] of the 12th, the storm was centered near the 75th meridian and the expected recurve to the northward became apparent." "It was one of the most violent hurricanes of history; in fact, there is no definite proof of a more violent hurricane in the records. As it approached the northern Bahamas its central pressure was certainly below 27.00 inches [914 mb] (very probably about 26.85 inches [909 mb]) and it was at that time a hurricane of large diameter" (Tannehill).

## September 14:

HWM analyzes a closed low of at most 985 mb centered at 35.5N, 75.5W. HURDAT listed this as a 90 kt category 2 hurricane at 34.4N, 75.7W. The Tracks of Centers of Cyclones (Chart IX) places the center at 31.0N, 75.5W at 0 UTC on this day. The Tracks of Centers of Cyclones (Chart IX) places the center at 35.0N, 75.5W at 12 UTC on this day. Available observations suggest that the 110 kt category 3 hurricane was centered at 34.4N, 75.2W. Ship observations: 75 kt SW at 00 UTC at 29.5N, 75.5W (Hugh Cobb); 986 mb and 60 kt N at 17 UTC at 37.5N, 76.5W (COA); 997 mb and 40 kt NW at 21 UTC at 37.5N, 76.5W (COA) Land observations: 964 mb at 1230 UTC at 35.2N, 75.7W (OMR Hatteras, NC); 947 mb at 1320 UTC at 35.2N, 75.7W; 35 kt N (OMR Hatteras, NC); 74 kt NW at 1722 UTC at 36.9N, 76.0 W (Cape Henry, VA) (September 1944 MWR); 75 kt NW at 1745 UTC at 36.9N, 76.0W (September 1944 MWR Cape Henry,

VA). Edenton, NC: "A hurricane centered 100 miles south of Beaufort, NC at 0400 [0900 UTC], passed along the Eastern coast causing gusts up to 72 knots over this station. Pressure reached a low of 985 mb." Harvey Point, NC: "Light rain began near 0400 [0900 UTC] and increased in intensity during height of storm, and gradually diminished in early afternoon after center passed. Barometer fell sharply as center approached; became unsteady as it passed close to eastward. Lowest pressure recorded at 1130 [1630 UTC] with mercurial barometer of 981.5 mb. Winds increased steadily from NE to become 60-70 knots, gusty, during forenoon. Highest 30 sec. buzzer reading 66 knots, with higher gusts estimated to 80 knots." Wilmington, NC: "A tropical disturbance of great energy moved northward over the Atlantic Ocean some distance east of the North Carolina coast on the 14th. The center of the storm passed about 100 miles east of this station. The lowest barometer reading during the passage of the storm was 29.36 inches [995 mb] at 4:50 am [0950 UTC], and the highest wind velocity 27 miles per hour [23 kt] at 4:35 am [0935 UTC]." Weeksville, Elizabeth City, NC: "Hurricane passed station before noon [17 UTC]. Rain preceding hurricane. Winds reached highest gust of 79 knots from NNE, and averaged 45 to 50 knots during passage." Richmond, VA: "A tropical hurricane which passed along the coast of Virginia caused heavy rains and fresh winds at Richmond but no damage resulted on this immediate vicinity." Norfolk, VA: "One of the most severe tropical hurricanes in the history of the Norfolk Weather Bureau Office, the records of which go back to 1871, struck this city and the entire coastal area of Virginia, on September 14, 1944. Warnings regarding this storm were issued by the Weather Bureau as much as four days in advance. Its path was carefully charted and its westward and northwestward course plotted and closely followed throughout its journey from the time of its inception in the tropical waters of the Atlantic Ocean until it passed northward along the coast of the United States on September 14th, causing widespread disaster over all areas coming under its influence. Definite effects of the approach of the storm were noticeable in the gentle to moderate easterly winds during the early morning hours. These shifted to northeasterly, with velocity increasing to 20 miles for the hour 6-7 am [11-12 UTC]. The direction continued northeast for four hours, with velocities up to 36 miles an hour. This was followed by a further backing of the wind, which was mostly north until 1 pm, then north west until 4 pm [21 UTC], finally becoming west and southwest. Velocities continued to increase rapidly until a sustained velocity of 56 miles an hour [49 kt] from the NW, for five minutes, occurred from 11:50 am [1650 UTC] to 11:55 am [1655 UTC]. During this interval the fastest single mile passed at the rate of 73 miles an hour [63 kt], from the north, beginning at 11:51 am [1651 UTC]. Velocities of 50 miles an hour [43 kt] continued during the early afternoon but decreased rapidly thereafter to only 11 miles per hour [10 kt] at 6:00 pm [23 UTC]. The barometric pressure fell rapidly during the forenoon, reaching the lowest point at 11:45 am [1645 UTC], when a sea level reading of 29.11 inches [986 mb] was recorded. The center of this storm did not pass directly over Norfolk, but was doubtless a few miles off the coast. Virginia Beach and Cape Henry were doubtless not far from the center as it passed northward. Winds were much stronger at the Cape Henry Weather Bureau Office where a velocity of 85 miles an hour [74 kt] was sustained for a period of five minutes, beginning at 12:22 pm [1722 UTC]. This wind was from the NW. The fastest single mile of wind registered at the Cape Henry Office was at the rate of 134 miles an hour [117 kt], from the NW at 1:13 pm [1813

UTC]. There were gusts for a moment's duration, with velocities estimated to be as high as 150 miles an hour. These velocities exceeded all previous records at the Cape Henry Station. The lowest pressure, reduced to sea level, recorded at the Cape Henry Station during the hurricane was 28.86 inches, at 12:10 pm [1710 UTC]. Fortunately for Norfolk and the entire Hampton Roads area, the peak of this hurricane came at low tide. In spite of all the advance notice and warnings given by the Weather Bureau regarding this storm, considerable damage could not be avoided. Many buildings were unroofed, hundreds of signs were blown down, and thousands of trees were uprooted. Plate glass windows of many stores were blown in or broken by flying debris, and many chimneys were toppled. Crops on thousands of acres of land were seriously injured. Some were washed or blown completely out of the ground. The damage to crops alone, throughout this area was estimated at \$1,000,000. Other property damage was estimated to reach a figure of about equal proportions. There was no loss of life in this immediate vicinity, but two U.S. Coast Guard cutters dispatched from Norfolk in spite of the warnings, to aid another vessel in distress were sunk. Other vessels caught in the storm, including a minesweeper, a destroyer and a lightship, also went to the bottom. A total of 344 men lost their lives. The estimates of the value of property saved as a result of the Bureaus warnings run as high as \$20,000,000, due largely to the removal of many extremely valuable airplanes, as well as other property to points of safety. Doubtless hundreds of lives would have been lost, in addition to those mentioned in the foregoing, had there been no warnings of the approach of this hurricane." Washington, DC: "A tropical hurricane in its northerly course passed near to the Virginia Capes on the 14th and caused great damage along the Atlantic coast and in eastern sections of New England. The barometer at this station fell from 29.83 inches at 10:30 pm [1530 UTC] of the 13th to 29.50 inches at 3:00 pm [18 UTC], 14th. The greatest velocities of the wind during the passage of the hurricane were as follows: 5-minute period: 17 NW at 1:43 pm [1843 UTC]; extreme velocity 18-NW at 1:43 pm [1843 UTC]; Dines anemometer velocity 26-NW at 4:27 pm [2327 UTC]." New York, NY: "The hurricane of September 14, 1944 will long be remembered for its violence, and takes its place among historic storms of the Northeastern States such as the hurricane of September 21, 1938 and the blizzard of March 12, 1888. With an extreme wind velocity of 99 mph [86 kt] and a maximum velocity of 81 mph [70 kt] the all-time wind records of New York City are broken. Damage estimated at \$183,613.00 occurred in New York Harbor and \$830,640.00 on the Long Island and New Jersey Shores. Twenty deaths in New York City and vicinity were attributed to the storm. Trees damaged or lost estimated at 30,000 Due to timely warnings losses were greatly minimized." September 1944 MWR: "Moving almost due north, at a rate of 25-30 miles per hour, the center passed just east of Hatteras at about 9:20 am [1420 UTC] on the 14th." "Tropical Cyclones in the South Atlantic States - Carolinas and Georgia - 1944 Sep 14 - Cape Hatteras - Major [equivalent to Saffir-Simpson Hurricane Scale 2 or 3] - Barometer 27.97 inches at Cape Hatteras" (Dunn and Miller). "108 kt maximum sustained [1 min equivalent] for winds at North Carolina impact. 1009 mb peripheral pressure in North Carolina" (Schwerdt et al.). "944 mb central pressure at time of closest bypass of North Carolina - 17 nmi RMW" (Ho et al.). "1944 - Sep - NC3, VA3 - 947 mb central pressure" (Jarrell et al.).

September 15:

HWM analyzes a closed low of at most 985 mb centered at 44.5N, 68.0W. HURDAT listed this as a 35 kt extratropical storm at 44.2N, 68.5W. The Tracks of Centers of Cyclones (Chart IX) places the center at 39.0N, 75.0W at 0 UTC on this day. The Tracks of Centers of Cyclones (Chart IX) places the center at 44.5N, 68.5W at 12 UTC on this day. Available observations suggest the 60 kt extratropical storm with 982 central pressure was centered at 44.2N, 68.5W. Ship observations: 969 mb and 80 kt SE at 39.5N, 72.5W (COA); 990 mb at 12 UTC at 45.5N, 66.0W (HWM). Land observations: 70 kt N at 0030 UTC at 40.7N, 74.0W (September 1944 MWR New York, NY); 960 mb at 35 SW at 0310 UTC at 41.2N, 71.6W (OMR Block Island, RI); 962 mb at 0245 UTC at 41.3N, 72.0W (September 1944 MWR Fishers Island, NY); 71 kt SE at 0230 UTC at 41.2N, 71.6W (September 1944 MWR Block Island, RI); 959 mb at Point Judith, Rhode Island (Ho et al.). September 1944 MWR: "Then turning slightly to the northeastward it moved up the coast, at an accelerated speed of about 40 miles per hour, and crossed over eastern Long Island at about 10 pm [03 UTC on the 15th] of the same date. Moving inland about an hour later near Point Judith, RI, the center crossed the State of Rhode Island and Massachusetts, passing a short distance southeast of Boston, and moved into Massachusetts Bay shortly after 1 am [06 UTC on the 15th]." Hartford, CT: "Weather of September 1944 was outstandingly marked by the passage of a hurricane along the North Atlantic Coast and across Southeastern New England on September 14th and 15th. Nevertheless, considerable damage was reported, due to hurricane winds and heavy rain of Thursday night, September 14, particularly to power lines, telephone lines, trees, fruit, tobacco and corn for Hartford and vicinity and throughout Connecticut. Southeastern coastal areas of Connecticut, Rhode Island and Cape Cod were reported severely damaged by tidal waves and hurricane winds. Eight known deaths due to the hurricane were reported in Connecticut as of September 22, 1944. At 10:07 pm [0307 UTC on 15th] of the 14th gusts were clocked for 4 seconds duration at a rate of 109 mph [95 kt]. The lowest barometer reading had preceded this very shortly, being 28.94 inches [980 mb] (reduced to sea level) at 9:50 pm [0250 UTC]." "Tropical Cyclones in the Middle Atlantic States - 1944 Sep 14-15 - Coast - Major [Saffir-Simpson Hurricane Scale 2-3 equivalent] - 63 killed, damage \$22,500,000. Tropical Cyclones in New England - 1944 Sep 14-15 - Coastal areas - Extreme - [Saffir-Simpson Hurricane Scale 4-5 equivalent] - 390 killed - \$100,000,000" (Tannehill). "95 kt maximum sustained [1 min equivalent] winds at New England landfall. 1011 mb peripheral pressure at New England landfall" (Schwerdt et al.). "F2 structural damage [Saffir-Simpson Hurricane Scale 2 equivalent]" (Boose et al.). "Sep 15 - 955 mb central pressure at landfall - 29 nmi RMW - Landfall point 40.9N, 72.3W - Storm becoming extratropical" (Ho et al.). "The storm surge associated with this hurricane was similar to that of the September 21-22, 1938 storm. The peak surges associated with this storm (1944) coincided very nearly with the normal low tide, and the peak surges of the 1938 storm coincided very nearly with the normal high tide. Thus the observed tides of this storm were lower and produced less damage" (Harris). "1944 - Sep - NY3, CT3, RI3, MA2" (Jarrell et al. 1992).

#### September 16:

HWM analyzes a closed low of at most 985 mb centered at 50.2N, 45.8W. HURDAT listed this as a 30 kt extratropical storm at 52.0N, 47.0W. The Tracks of Centers of Cyclones (Chart IX) places the center at 48.0N, 58.0W at 0 UTC on this day. The Tracks

of Centers of Cyclones (Chart IX) does not list a location for 12 UTC on this day. Available observations suggest the 30 kt extratropical storm was centered at 52.0N, 47.0W. Ship observations: 1003 mb at 00 UTC at 50.5N, 54.5W (COA); 1004 mb at 00 UTC at 47.5N, 54.5W (COA); 993 mb at 11 UTC at 53.5N, 44.5W (COA); 998 and 35 kt SSW mb at 14 UTC at 52.5N, 35.5W (COA); 994 mb at 15 UTC at 53.5N, 44.5W (COA); 1000 mb at 22 UTC at 51.5N, 36.5W (COA). Providence, RI: "The Atlantic Hurricane passed over Rhode Island during the evening of September 14, 1944, causing great damage in various parts of the state. Numerous houses were washed away along the beaches, but no loss of life resulted from the storm. Total damage to the entire state was between \$2,000,000 and \$2,500,000. During the height of the storm winds attained a maximum velocity at WBAS of 43 mph [37 kt] for 5 minutes. Extreme velocity of 49 SE for 1 mile, with gusts estimated up to 90 mph [78 kt]. Lowest barometer at WBAS was 28.48 inches [964 mb], while at WBO the lowest reading was 28.56 inches [967 mb] at 11:20 pm [0420 UTC on the 15th]." Nantucket, MA: "The hurricane of September 14-15 was the most severe at Nantucket in recent years. The maximum wind velocity for five minutes was 57-SW at 11:47 pm [0447 UTC on the 15th] on the 14th; extreme velocity was 79-SW at 12:46 am [0546 UTC] of the 15th. Gust velocities were estimated at 90 mph. The hurricane of September 21, 1938 produced a maximum velocity of 52-SE and an extreme velocity of 57-SE. The severity of this storm exceeded that of the hurricane of September 21, 1938 at Nantucket except in relation to high [sic] tides. Damage from this month's storm was principally the result of high winds and tusts [sic], while unusually high tides, accompanying the 1938 hurricane, accounted for the greatest damage in that storm. The tide did not rise to unusual heights during this month's storm and the resulting water damage was not great." East Boston, MA: "At Boston, lowest pressure occurred at 12:25 am [0525 UTC] on September 15, when the barometer reached a low point of 28.592 inches, station reading, 28.62 [969 mb] inches S.L. Winds reached a maximum (5 min.) velocity of 60 mph [52 kt] at 10:24 pm EST [0324 UTC], direction was NE. Peak gusts of 98 mph [85 kt] were observed (60th mile contact) by buzzer, 10:18 pm [0318 UTC] to 11 pm EST [0400 UTC]. Extreme velocity recorded was 72 mph [63 kt] at 10:28 pm, EST, [0328 UTC] direction was NE." Concord, NH: "The hurricane of September 14-15 caused little damage in the vicinity of the Concord, NH station. A few small trees, and branches of large trees were blown down. The only real property damage of any importance was done to blown down apples, especially the McIntosh variety. Portland, ME: The maximum at the airport was 40 NE with an extreme of 50 NE at 1:08 am [0608 UTC] on the morning of the 15th. Observers noted the eye of the storm at 4:20 am [0920 UTC] when the wind dropped to moderate and the stars were visible. Then the wind shifted to NW from NE. Some places along the coast, notably Ogunquit the NW wind was an estimated velocity of about 70 and many trees were blown down and minor damage." September 1944 MWR: "A total of 390 lives were lost as a result of the 1944 hurricane, a large proportion of them as a result of marine casualties. The 46 deaths listed as occurring along the coastal areas of the United States is less than 10 percent of the 494 fatalities resulting from the storm of 1938. Heavy marine casualties were directly related to intensified patrol work and other exigencies resulting from war conditions. Property damage has been estimated at approximately \$100,000,000 or about one-third that estimated for the 1938 hurricane."

For genesis of this hurricane, the first position at 06 UTC on the 9<sup>th</sup> was adjusted to the west for a more realistic initial speed. Originally, HURDAT started this system at genesis as a 65 kt hurricane. Intensity began as a 45 kt tropical storm and reduced on the 9<sup>th</sup> and 10<sup>th</sup>. Evidence for this alteration is based primarily upon the 1944's Monthly Weather Review assessment. The changes at 06 and 12Z on the 9<sup>th</sup> are major (20 kt) revisions downward. The actual genesis point for this hurricane likely occurred farther east before the 9<sup>th</sup>, but lack of ship observations do not allow for an accurate genesis assessment. Minor track changes were introduced from the 11<sup>th</sup> through the 14<sup>th</sup>. No changes made to the intensity from the 11<sup>th</sup> and 12<sup>th</sup>, though observations near the center were sparse. There was a 943 mb central pressure listed for 12 UTC on the 12<sup>th</sup>, which could not be confirmed through available sources. Given observations on the 13<sup>th</sup>, this central pressure value is likely valid. A 943 mb central pressure suggests winds of 118 kt from the Brown et al. south of 25N pressure-wind relationship and 112 kt from the north of 25N pressure-wind relationship - 115 kt retained in HURDAT. At 17 UTC on the 13<sup>th</sup>, a 933 mb ship observation (possible central pressure) was recorded. 933 mb suggests winds of 121 kt from the subtropical pressure-wind relationship. 120 kt is chosen for HURDAT at 18 UTC on the 13<sup>th</sup>, up from 105 kt originally. (It is noted that Tannehill suggests a much more intensity hurricane - possibly Category 5 - given the pressure estimated near the Bahamas. However, such an intensity could not be substantiated from available observations.)

On the 14<sup>th</sup>, the hurricane turned to the north and clipped the North Carolina coast. The original HURDAT took the center of the hurricane over the Outer Banks, but observations from Hatteras suggest that instead the hurricane passed just offshore around 13 UTC on the 14<sup>th</sup>. This agrees with Ho et al.'s assessment that the hurricane did not make a North Carolina landfall. Given the 49 kt wind reported at the time of the 947 mb pressure at Hatteras, it is estimated that the central pressure was around 942 mb. This is just slightly lower than the Ho et al. value of 944 mb. 942 mb suggests winds of 113 kt from the Brown et al. north of 25N pressure-wind relationship and 102 kt from the high latitude (north of 35n) pressure-wind relationship. Given the small size of the RMW (estimated 17 nmi) given the climatological average of 25 nmi for that latitude and central pressure (Vickery et al. 2000), winds are estimated to be 110 kt during its close bypass of North Carolina and Virginia (up from 90 kt in HURDAT originally). Peak 5 min observed winds for North Carolina and Virginia were 74 kt (Hatteras) and 75 kt (Cape Henry), which are equivalent to about 80 kt 1 min winds. It is estimated that both North Carolina and Virginia experienced Category 2 sustained winds, which is a downgrade from Category 3 analyzed officially originally. The downgrade from Category 3 to 2 for Virginia matches the assessment of Cobb (2004).

The hurricane accelerated to the north-northeast and made landfall at the eastern tip of Long Island, New York around 0300 UTC on the 15<sup>th</sup> near 40.9N, 72.3W. The hurricane made a second landfall around 0345 UTC on the 15<sup>th</sup> on the Rhode Island coast near 41.4N, 71.6W. Lowest observed pressures were 959 mb at Point Judith, Rhode Island, 960 mb with 35 kt SW wind at Block Island, Rhode Island, and 962 mb at Fishers Island, New York. Central pressure at landfall in Rhode Island is estimated to be 955 mb (in

agreement with Ho et al.). Landfall pressure in New York is estimated to be 953 mb, slightly deeper than at Rhode Island. Highest observed 5 min winds at landfall were 70 kt N in New York City and 71 kt in Block Island. These convert to about 75 kt 1 min peak winds. A 953 mb central pressure suggests wind of 95 kt from the north of 35N pressure-wind relationship. (955 mb gives 93 kt.) Given the near climatological RMW (29 nmi RMW versus 32 nmi climo) and forward speed (30 kt), 95 kt is estimated as the maximum sustained winds at landfall. Thus 95 kt and 953 mb are entered into HURDAT for 00 UTC on the 15th, the last synoptic time before landfall. This is a significant increase compared to 75 kt originally. (Winds from 12Z on the 14<sup>th</sup> to 00Z on the 15<sup>th</sup> had a major increase of 20 kt compared to HURDAT originally.) New York, Connecticut, and Rhode Island are each analyzed as to having been impacted by Category 2 wind conditions, which is a downgrade from Category 3 originally in HURDAT. Massachusetts is analyzed as being impacted by Category 1 winds, which is a downgrade from Category 2 originally. Peak observed winds after landfall (within two hours of the synoptic time) were 61 kt at 06 UTC and 50 kt at 12 UTC. A run of the New England wind-decay model (Kaplan and DeMaria 2001) gives 65 kt and 41 kt at 06 and 12 UTC, respectively. 70 and 55 kt were chosen for HURDAT, because of the latter observation and because the system went back out over the Atlantic after crossing Massachusetts. Thus winds are substantially higher at 12 UTC on the 15th (55 kt) than originally indicated in HURDAT (35 kt). The 982 mb central pressure originally listed as being an 18 UTC reading apparently comes from the 12 UTC Eastport, Maine observation. This is now shifted to correctly being indicated at 12 UTC. No change was made to the assessment that extratropical transition occurred around 12 UTC on the 16th, near the coast of Maine. No change was made in the dissipation of this system.

#### 1944 Storm 8

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31790 09/19/1944 M= 4 8 SNBR= 704 NOT NAMED XING=0
31795 09/19* 0 0 0 0*193 838 60 0*200 842 65 0*206 849 70 0*
31795 09/19* 0 0 0 0*193 836 40 0*200 842 50 0*206 849 60 0*
          *** **          **          **
31800 09/20*209 856 70 0*210 863 70 0*211 872 70 0*209 883 70 0*
31800 09/20*209 856 70 0*210 863 70 0*211 872 60 0*209 883 55 0*
          **          **          **          **
31805 09/21*205 895 65 0*200 909 70 0*198 922 70 0*191 939 70 0*
31805 09/21*205 895 50 0*200 907 65 0*192 920 70 0*185 932 70 0*
          **          *** **          *** **          *** **
31810 09/22*179 947 60 0*166 944 35 0*151 940 20 0* 0 0 0 0*
31810 09/22*179 940 60 0*172 942 45 0*165 940 30 0* 0 0 0 0*
          ***          *** *** **          *** **
31815 HR

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Minor track changes and major intensity changes were made to this hurricane. Evidence for these changes arises from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, Mexican station observations, and NHC microfilm of synoptic weather maps.

September 18:

HWM shows a closed low of at most 1010 mb near 18N, 81.7W. HURDAT does not list a system on this day. No gales or low pressures.

September 19:

HWM analyzes a tropical storm of at most 1005 mb centered near 19.3N, 83.9W. HURDAT lists this as a 65 kt hurricane at 20.0N, 84.2W. The MWR post-season track map shows a center near 20.3N, 84.4W. No gales or low pressures.

September 20:

HWM analyzes a tropical storm of at most 995 mb centered near 22.1N, 87W. HURDAT lists this as a 70 kt hurricane at 21.1N, 87.2W. The MWR tracks of centers of cyclones has a 00Z position near 20.7N, 84W and a 12Z position near 21N, 86.2W. The MWR post-season track map shows a 00Z position near 21N, 85.6W and a 12Z position near 21.2N, 87.7W. Microfilm shows a low of at most 999 mb centered near 21.8N, 87.4W. Land highlights: 50 kt W and 1000 mb at Cozumel, Mexico at 08Z (micro); 45 kt WSW and 996 mb at Cozumel, Mexico at 10Z (micro); 35 kt SE at 21.3N, 88.2W at 18Z (micro); 19 kt E and 1002 mb at 20Z at Merida (Mexico). Three other gales and four other low pressures at Cozumel. "Forming from a wave in the Caribbean Sea near the Yucatan Channel, this storm quickly developed a small center with winds of about hurricane force and moved into northern Yucatan on the 20th" (MWR).

September 21:

HWM analyzes a tropical storm near 18.9N, 92.7W. HURDAT lists this as a 70 kt hurricane at 19.8N, 92.2W. The MWR tracks for centers of cyclones has a 00Z position near 21.2N, 88.9W and a 12Z position near 19.2N, 92W. The MWR post-season track map shows a 00Z position near 20.6N, 89.1W and a 12Z position near 19N, 91.7W. Microfilm shows a low of at most 999 mb centered near 19.2N, 92W. Land highlights: 44 kt N and 1006 mb at 13Z and 61 kt N and 1007 mb at 20Z at Coatzacoalcos (Mexico); 40 kt NE and 1002 mb at Merida at 0Z (micro); 65 kt at Campeche, Mexico at ~5Z (MWR); 1001 mb at Campeche, Mexico at ~5Z (MWR); 25 kt S and 998 mb at Carmen, Mexico at 1230Z (micro). Seven other land gales and six other land low pressures. Aircraft highlights: 55 kt E at 19.5N, 92.3W at 1450Z (micro); 40 kt NW at 18.5N, 93.5W at 1520Z (micro); 45 kt NE at 20.6N, 94.2W at 16Z (micro). "Curving toward the southwest and passing south of Merida, it entered the Gulf of Mexico at Campeche about midnight of the 20<sup>th</sup>-21<sup>st</sup>. Traversing a small extent of the Gulf the center reentered Mexico between Coatzacoalcos and Ciudad del Carmen in the late afternoon of the 21<sup>st</sup>. Reports received from Yucatan and from aircraft indicate a very small center with winds of 75 miles per hour throughout the life of this storm" (MWR).

September 22:

HWM analyzes a tropical storm well inland of at most 1000 mb 16.8N, 93.2W. HURDAT lists this as a 20 kt tropical depression 15.1N, 94.0W. Land highlights: 51 kt E and 1001 mb at 03Z at Coatzacoalcos (Mexico); 35 kt N and 1007 mb at Veracruz, Mexico at 0030Z (micro). "Press reports indicate that 200-300 persons drowned in floods that occurred in the Isthmus of Tehuanepec" (MWR).

A tropical storm developed on the 19<sup>th</sup> between the Cayman Islands and Cozumel, Mexico. No changes were made to the genesis of this cyclone, as – despite from the HWM and microfilm analyses of a closed low on the 18<sup>th</sup> – observations do not support the formation of the system on that date. Aside from a change to the initial position for a more realistic translational velocity, no changes are necessary to the HURDAT positions for the first two days of the storm. Minor changes to the track were introduced on the 21<sup>st</sup> and 22<sup>nd</sup>. The most significant track change to HURDAT is the very last point on the 22<sup>nd</sup>. HURDAT has a position well into the Pacific Ocean away from the coast. Although observations are sparse and it is not out of the question that HURDAT could be correct, the few observations available indicate that the depression could be further north at the time. Furthermore, HWM and MWR both do not show this system traveling into the Pacific. A position was chosen near the HWM position that also fits persistence. For intensity revisions, HURDAT started this storm as 60 kt at 06Z on the 19<sup>th</sup>. The highest available wind observation on the 19<sup>th</sup> is 30 kt, with a fair amount of data available. Therefore, the tropical cyclone is started as 40 kt (a major 20 kt decrease). The intensity catches back up with HURDAT 24 hours later with the analysis agreeing with HURDAT with a 70 kt intensity for the first Mexican landfall. Highest observed winds in the Yucatan were 50 kt and lowest pressure was 996 mb (with 45 kt winds). This pressure suggests winds of at least 54 kt using the Brown et al. south of 25N pressure-wind relationship. No change is made to the 70 kt intensity at the 10Z/20<sup>th</sup> landfall in the Yucatan Peninsula of Mexico, in agreement with what was described in MWR. HURDAT previously only had the hurricane weakening by 5 kt while traveling over the Yucatan Peninsula, but there are no available observations to support this lack of weakening. Runs of the Kaplan and DeMaria inland decay model suggest winds of 57 kt at 12Z/20<sup>th</sup>, 48 kt at 18Z, and 38 kt at 00Z/21<sup>st</sup>. Peak available winds within 2 hr of synoptic times were 45, 35, and 40 kt respectively. Winds are reanalyzed to be 60 kt at 12Z/20<sup>th</sup> (down from 70 kt), 55 kt at 18Z (down from 70 kt) and 50 kt at 00Z/21<sup>st</sup> (down from 65 kt). By 04Z on the 21<sup>st</sup>, the storm emerged in the Bay of Campeche. During the next 14 hours, it strengthened back to a 70 kt hurricane while it turned to the southwest. While there were no specific observations of hurricane force (peak winds observed were 61 kt at Coatzacoalcos, Mexico), 70 kt is retained in HURDAT as the second landfall in mainland Mexico around 20Z on the 21<sup>st</sup>. Like the first Mexican landfall, hurricane intensity is supported by the description in the MWR. Runs of the Kaplan and DeMaria inland decay model suggest winds of 56 kt at 00Z/22<sup>nd</sup>, 43 kt at 06Z, and 40 kt at 12Z. Highest observed winds were 35 kt (at 00Z), 51 kt (at 03Z), and no observed gales at 06Z and 12Z. Winds are reanalyzed to be 60 kt at 00Z (unchanged), 45 kt at 06Z (up from 35 kt originally), and 30 kt at 12Z (up from 20 kt originally). The circulation likely weakened more than suggested by Kaplan and DeMaria at 12Z because of the impacts of the elevated terrain across Mexico. No changes were made to the dissipation of this cyclone.

#### 1944 Storm 9

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31820 09/21/1944 M= 8 9 SNBR= 705 NOT NAMED XING=0
31825 09/21* 0 0 0 0* 0 0 0 0*171 415 35 0*172 435 35 0*
31830 09/22*174 456 35 0*177 477 35 0*182 497 40 0*190 514 40 0*
31835 09/23*198 527 45 0*213 541 45 0*230 551 50 0*244 557 55 0*

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31840	09/24*258	559	55	0*274	559	60	0*292	558	65	0*311	555	70	0*
31840	09/24*258	559	55	0*274	559	60	0*292	558	65	0*312	555	70	0*
										***			
31845	09/25*332	550	75	0*356	541	80	0*380	532	85	0*395	526	85	0*
31845	09/25*332	550	75	0*352	541	80	0*370	535	85	0*382	533	80	0*
				***			***	***		***	***	**	
31850	09/26*409	522	85	0*422	516	80	0*432	512	75	0*459	498	70	0*
31850	09/26*392	533	75	0*402	532	70	0E415	530	60	0E435	520	55	0*
		***	***	**	***	***	**	****	***	**	****	***	**
31855	09/27*487	479	70	0*500	465	65	0E523	439	60	0E552	411	55	0*
31855	09/27E465	500	55	0E500	472	50	0E530	439	50	0E555	400	45	0*
		****	***	**	*	***	**	***	**	***	***	**	
31860	09/28E578	347	55	0E596	285	50	0E614	224	45	0*	0	0	0*
31860	09/28E578	347	45	0E596	285	40	0E614	224	40	0*	0	0	0*
			**			**		**	**				

31865 HR

Major track changes along with minor intensity changes were made to this recurring hurricane. A major change was made to the structure as extratropical transition is analyzed to have occurred 24 hours earlier than previously listed in HURDAT. Evidence for these changes comes from the Historical Weather Map series and the COADS ship database.

#### September 20:

HWM analyzes an open wave with a spot low plotted near 15.5N, 32.6W. HURDAT does not list a system on this day. No gales or low pressures.

#### September 21:

HWM analyzes a closed low of at most 1010 mb centered near 17N, 41.3W. HURDAT lists this as a 35 kt tropical storm at 17.1N, 41.5W. No available observations in vicinity.

#### September 22:

HWM analyzes a tropical storm of at most 1010 mb centered near 18.4N, 49.8W. HURDAT lists this as a 40 kt tropical storm at 18.2N, 49.7W. No available observations in vicinity.

#### September 23:

HWM analyzes a tropical storm of at most 1005 mb near 23.1N, 55.1W. HURDAT lists this as a 50 kt tropical storm at 23.0N, 55.1W. No gales or low pressures.

#### September 24:

HWM analyzes a hurricane of at most 995 mb centered near 29.3N, 55.7W, with a dissipating stationary front indicated a couple hundred nm to the hurricane's northwest. HURDAT lists this as a 65 kt hurricane at 29.2N, 55.8W. No gales or low pressures.

#### September 25:

HWM analyzes a hurricane of at most 995 mb centered near 38.2N, 53.1W. HURDAT lists this as an 85 kt hurricane at 38.0N, 53.2W. No gales or low pressures.

## September 26:

HWM analyzes a hurricane of at most 1000 mb centered near 43.3N, 51.2W, with a cold front beginning a couple hundred nm southwest of the hurricane and extending southwestward. HURDAT lists this as a 75 kt hurricane at 43.2N, 51.2W. Ship highlights: 35 kt SE at 40.5N, 48.5W at 11Z (COA); 35 kt SSE at 39.5N, 48.5W at 15Z (COA). Two other gales.

## September 27:

HWM analyzes a low of at most 1000 mb near 53N, 43.5W with a warm front north of the low extending eastward and a cold front south of the low extending south-southwestward. HURDAT lists this as an extratropical cyclone with 60 kt winds at 52.3N, 43.9W. Ship highlights: 25 kt NE and 999 mb at 53.5N, 44.0W (HWM); 25 kt W and 995 mb at 54.5N, 45.5W at 15Z (COA).

## September 28:

HWM analyzes a low of at most 995 mb with a cold front and a warm front intersecting at the low near 61.7N, 18.0W. HURDAT lists this as a 45 kt extratropical low at 61.4N, 22.4W. All six available observations in vicinity are not gales but have pressures between 999-1004 mb.

A low, perhaps associated with a tropical wave that came off of Africa, is listed in HURDAT as becoming a tropical storm on the 21<sup>st</sup>. There are no available observations anywhere remotely near this storm between the 21<sup>st</sup> and 24<sup>th</sup>, so no changes are made to the genesis, track or intensity in HURDAT during this time. The cyclone moved west-northwest and then northwest through the Atlantic recurving around 56W longitude on the 24<sup>th</sup>. The largest track changes are on the 25<sup>th</sup> and 26<sup>th</sup>. The storm is analyzed to be slower and slightly to the left of the HURDAT track. These changes are based on available observations from the two sources available for this storm. As it turned towards the north-northeast, it intensified into a hurricane with a peak intensity of 85 kt on the 25<sup>th</sup> and 26<sup>th</sup>. There are no observations near the inner core of this cyclone so it is difficult to confirm (or reject) this intensity maxima. No changes are made to when it became a hurricane and to the peak intensity reached. Based upon the increased temperature gradient and asymmetric structure of the pressure field, the cyclone is reanalyzed to have become extratropical around 12Z on the 26<sup>th</sup> – 24 hours earlier than originally shown in HURDAT. The only intensity changes are made after this storm is extratropical. The maximum winds are analyzed to be slightly weaker than in the previous HURDAT on the 27<sup>th</sup> and 28<sup>th</sup>. These changes are made based on the location and magnitude of the wind observations relative to the center for an extratropical cyclone. The cyclone was absorbed by a larger extratropical cyclone late on the 28<sup>th</sup> near Iceland.

## 1944 Storm 10 (new to HURDAT)

31895	09/30/1944	M= 4	10	SNBR= 707	NOT NAMED	XING=0							
31896	09/30*331	441	35	0*338	443	35	0*345	445	40	0*352	447	40	0*
31897	10/01*359	448	45	0*367	449	45	0*375	450	45	0*385	449	45	0*
31898	10/02*395	445	40	0*405	435	35	0*415	415	30	0*426	393	30	0*

31899 10/03E438 370 30 0\* 0 0 0 0\* 0 0 0 0\* 0 0 0 0\*  
31960 TS

HWM and COADS indicate that a tropical storm, previously undocumented in HURDAT, occurred in the north-central Atlantic from 30 September to 3 October.

#### September 29:

HWM indicates a broad closed low of at most 1015 mb near 31.5N, 42W with a dissipating NNE-SSW warm front a few hundred nmi off to the northwest. HURDAT does not list this system. No gales or low pressures.

#### September 30:

HWM indicates a low of at most 1010 mb near 33N, 47.5W. Ship highlights: 30 kt SW and 1004 mb at 34.5N, 44.5W at 15Z (COA); 35 kt SW and 1003 mb at 34.5N, 45.5W at 23Z (COA).

#### October 1:

HWM indicates a low of at most 1005 mb near 36.5N, 44.5W, with a warm front analyzed a few hundred nmi northwest of the cyclone. Ship highlights: 25 kt NW and 1005 mb at 39.5N, 46.5W at 15Z (COA).

#### October 2:

HWM indicates a trough in the general vicinity of 41N, 41W with an approaching mid-latitude cyclone a few hundred nmi to the west. Ship highlights: No gales or low pressures.

#### October 3:

HWM indicates that the mid-latitude cyclone (which was approaching on the 2<sup>nd</sup>) is the only dominant feature.

On 29 September, a broad area of low pressure developed, possibly from a dissipating front. Temperatures were warm around the low, but the circulation was too broad on this day to be considered a tropical cyclone. By 30 September, the low had consolidated, and a ship with a 35 kt SW wind and 1003 mb pressure was observed at 23Z. This peripheral pressure suggests winds of at least 38 kt from the north of 35N pressure-wind relationship. The tropical cyclone is started at 00Z on the 30<sup>th</sup> as a 35 kt tropical storm. The cyclone is analyzed to have reached a peak intensity of 45 kt on the 1<sup>st</sup>. The system moved slowly north-northwestward after formation. While there was only one observed gale for this cyclone, there were also three low pressures that suggest gale force winds existed. This storm then made a turn to the northeast on the 2<sup>nd</sup>. It is analyzed that the system weakened to a depression by 12Z on the 2<sup>nd</sup> and was absorbed by an approaching extratropical cyclone from the west around 00Z on 3 October.

#### 1944 Storm 11 (originally Storm 10)

31870 10/01/1944 M= 3 10 SNBR= 706 NOT NAMED XING=0  
31870 09/30/1944 M= 4 11 SNBR= 706 NOT NAMED XING=0

\*\* \*\*                      \* \*\*

(The 30<sup>th</sup> of September is new to HURDAT.)

31872	09/30*	0	0	0	0*142	595	35	0*145	595	40	0*148	595	40	0*
31875	10/01*	0	0	0	0*150	570	40	0*158	584	40	0*166	588	40	0*
31875	10/01*151	595	40		0*154	595	40	0*158	595	40	0*164	594	40	0*
		***	***	**	***	***		***			***	***		
31880	10/02*174	590	40		0*182	591	40	0*189	591	40	0*195	592	35	0*
31880	10/02*174	593	40		0*182	592	40	0*189	591	40	0*195	590	35	0*
		***			***						***			
31885	10/03*201	592	35		0*205	591	30	0*	0	0	0	0	0	0*
31885	10/03*201	590	35		0*205	590	30	0*	0	0	0	0	0	0*
		***			***									

31890 TS

Major track changes with no intensity changes were made for this tropical storm. Genesis is begun 24 hours earlier than the original HURDAT. Evidence for these changes comes from the Historical Weather Map series, the COADS ship database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### September 30:

HWM does not analyze a closed low on this day. HURDAT does not list a storm on this day. Microfilm shows a closed low east of the Lesser Antilles. Ship highlights: 40 kt at 14.0N, 59.6W at 18Z (micro).

#### October 1:

HWM analyzes a low of at most 1010 mb centered near 15.5N, 60.5W. HURDAT lists this as a 40 kt tropical storm at 15.8N, 58.4W. The MWR post-season track map shows a position near 16N, 58.5W. Microfilm shows a possible low with a center in the vicinity of 15.7N, 59.8W. Aircraft highlights: 45 kt SSW at 16.0N, 58.8W at ~17Z (micro); 40 kt WSW at 14.6N, 59.2W at 1720Z (micro).

#### October 2:

HWM analyzes a small low of at most 1010 mb centered near 16.3N, 60W. HURDAT lists this as a 40 kt tropical storm at 18.9N, 59.1W. The MWR post-season track map shows a 00Z position near 17.2N 58.9W and a 12Z position near 18.5N, 59W. No gales or low pressures. "Developing from disturbed and squally conditions that had been noted east of the Lesser Antilles, during the several days previous, this disturbance moved northward near the 60<sup>th</sup> meridian into a strong trough that existed east of Bermuda. The storm did not develop hurricane winds and no reports of damage to shipping have been received" (MWR).

#### October 3:

HWM shows no features of interest near or north of the Lesser Antilles. HURDAT lists this at 06Z as a 30 kt tropical depression at 20.5N, 59.1W. No gales or low pressures.

A tropical storm formed east of the Lesser Antilles at 06Z on September 30<sup>th</sup> near 14.5N, 59.5W based upon numerous ship and island observations. This is 24 hours earlier than

indicated originally in HURDAT. At the time of the first HURDAT position (06Z on October 1<sup>st</sup>), available observations suggest that the storm was located more than two degrees to the west of the HURDAT position. The tropical cyclone moved northward for three days, weakened to a tropical depression at 06Z on October 3<sup>rd</sup>, and dissipated six hours later (unchanged from original HURDAT). However, it is possible that the system continued northward as a tropical cyclone into the open Atlantic Ocean, given the very sparse observations available.

#### 1944 storm 12 (new to HURDAT)

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31895 10/11/1944 M= 7 12 SNBR= 707 NOT NAMED XING=0
31896 10/11*355 400 35 0*355 400 35 0*355 400 40 0*355 400 45 0*
31897 10/12*356 400 50 0*357 400 60 0*360 400 70 0*366 400 70 0*
31898 10/13*375 399 70 0*383 395 60 0*390 385 50 0*397 365 50 0*
31899 10/14*404 335 45 0*410 295 45 0*415 255 45 0*412 230 45 0*
31899 10/15*405 210 45 0*397 195 50 0*390 180 55 0*385 160 55 0*
31899 10/16*382 130 50 0*381 100 50 0*380 70 45 0*380 40 35 0*
31899 10/17*380 10 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0 0*
31960 HR

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HWM and COADS indicate that a hurricane, undocumented in HURDAT, existed in the eastern north Atlantic during October 1944. This system made landfall in Portugal and Spain as a tropical storm, which is the first such system identified in HURDAT.

#### October 9:

HWM analyzes a low of at most 1015 mb near 37N, 41.5W at the intersection of a warm front, which extends to the ENE and a cold front which extends to the SSW. HURDAT does not list this system. No gales or low pressures.

#### October 10:

HWM analyzes an elongated low of at most 1010 mb near 35.5N, 40.5W with a dissipating cold front through the low and another cold front north of the low. No gales or low pressures.

#### October 11:

HWM analyzes a low of at most 1005 mb centered near 35.5N, 39.5W with a warm front extending from the low towards the ENE and a dissipating cold front extending from the low towards the SW and then W. Ship highlights: 35 kt N and 1016 mb at 11Z at 36.5N, 42.5W (COA); 40 kt NNE and 1011 mb at 19Z at 36.5N, 40.5W (COA); 45 kt N at 23Z at 36.5N, 41.5W (COA). Three other gales.

#### October 12:

HWM analyzes a low of at most 995 mb centered near 35.8N, 38.6W with the closest front located 4 degrees north of the center extending eastward from there. Ship highlights: 65 kt S and 1000 mb at 10Z at 35.5N, 37.5W (COA); 45 kt SE and 998 mb at 11Z at 36.5N, 39.5W (COA); 70 kt S and 1010 mb at 14Z at 35.5N, 37.5W (COA). Four other gales and a few other low pressures.

#### October 13:

HWM analyzes a low of at most 1000 mb centered near 39.5N, 35.7W with the west end of a dissipating warm front located a few degrees to the ENE of the low center. No gales or low pressures.

October 14:

HWM analyzes a low of at most 1005 mb centered north of the Azores near 40.5N, 26W with a trough plotted extending from the low towards the south, then curving west. No gales or low pressures.

October 15:

HWM analyzes a low of at most 1005 mb centered near 37.5N, 18.3W with a trough plotted extending from the low SW and then W. Ship highlights: 50 kt SSW and 1003 mb at 09Z at 38.5N, 20.5W (COA); 50 kt NNW and 1008 mb at 13Z at 39.5N, 20.5W (COA). One other low pressure.

October 16:

HWM analyzes a small low of at most 1005 mb centered inland near the border of Portugal and Spain near 38.2N, 7W with a trough plotted extending towards the SW and mid-latitude fronts just a few degrees to the north. Land highlights: 40 kt SW and 1010 mb at 12Z at Seville, Spain at 37.4N, 6.0W (HWM).

A broad low pressure area which formerly may have been associated with a frontal zone became evident on 9 October near 37N, 41.5W. On the 9<sup>th</sup> and 10<sup>th</sup> the system began to acquire tropical characteristics as it appears that the frontal boundaries had dissipated, but there is no evidence of a closed circulation on these days. There are also no gales or low pressures on these days. By 11 October, the circulation began to consolidate and the first observed gale was at 11Z this day. Genesis occurred for this system around 00Z on the 11<sup>th</sup> as a 35 kt tropical storm. On the 12<sup>th</sup>, there are seven observations of gale force winds, two of them being hurricane force winds. Low pressures (down to 998 mb) are observed with these high winds, and these observations are all in close proximity of the cyclone's center. Peak intensity of a 70 kt hurricane is analyzed from 12Z on the 12<sup>th</sup> to 00Z on the 13<sup>th</sup>. Very little movement of the cyclone was indicated on the 11<sup>th</sup> and 12<sup>th</sup>. On the 13<sup>th</sup> and 14<sup>th</sup> observations indicate that the system weakened below hurricane force (down to 45 kt on the 14<sup>th</sup>), and the cyclone is analyzed to move quickly towards the east. The cyclone apparently reintensified as two 50 kt gale observations were recorded on the 15<sup>th</sup> and 55 kt is chosen for the intensity at 12 and 18Z for this day. At this point, the storm was moving quickly towards the east, but maintained its tropical characteristics. The system made landfall in southern Portugal around 08Z on the 16<sup>th</sup> with winds estimated to be 50 kt. 40 kt sustained winds were recorded at Seville, Spain at 12Z on the 16<sup>th</sup>. The cyclone weakened to a tropical depression around 00Z on the 17<sup>th</sup> with dissipation six hours later. In summary, this new hurricane, which occurred farther north and farther east than nearly all Atlantic Basin tropical cyclones, is analyzed to have been tropical throughout its lifetime. This produced the only known tropical storm strike in Portugal/Spain in the HURDAT era.

## 1944 Storm 13 (originally Storm 11)

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31895 10/12/1944 M=12 11 SNBR= 707 NOT NAMED XING=1 SSS=3 L
31895 10/12/1944 M=13 13 SNBR= 707 NOT NAMED XING=1 SSS=3 *
      ** **
31900 10/12* 0 0 0 0* 0 0 0 0* 0 0 0 0*150 803 35 0*
31900 10/12* 0 0 0 0* 0 0 0 0*160 805 30 0*164 806 35 0*
      *** **
31905 10/13*161 808 65 0*168 809 65 0*174 809 70 0*177 809 70 0*
31905 10/13*168 807 40 0*171 808 50 0*174 809 60 0*176 809 70 0*
      *** **
31910 10/14*179 808 70 0*182 807 70 0*185 806 75 0*188 806 75 0*
31910 10/14*178 808 80 976*179 807 80 0*180 806 80 0*181 806 80 0*
      *** **
31915 10/15*190 805 75 0*192 805 75 0*193 808 75 0*192 813 80 0*
31915 10/15*182 805 80 0*183 805 80 0*185 808 85 0*187 813 85 0*
      *** **
31920 10/16*192 817 80 0*193 821 80 0*194 824 85 0*196 827 85 0*
31920 10/16*190 817 90 0*192 821 90 0*194 824 90 0*195 827 90 0*
      *** **
31925 10/17*199 829 90 0*202 829 95 0*206 829 95 0*212 829 100 0*
31925 10/17*196 829 90 0*197 829 95 0*200 829 95 0*206 829 105 0*
      *** **
31930 10/18*219 829 105 0*225 829 105 0*231 830 100 0*240 829 105 0*
31930 10/18*214 829 115 0*222 829 120 0*231 830 120 937*240 829 105 949*
      *** **
31935 10/19*253 827 105 0*268 824 65 0*284 821 65 968*298 817 60 978*
31935 10/19*253 827 100 0*269 826 90 962*284 822 75 968*298 818 60 976*
      *** **
31940 10/20*312 812 50 983*323 808 45 987*335 801 40 992*352 785 35 996*
31940 10/20*312 815 55 983*325 811 50 985E338 805 50 988E354 790 45 0*
      *** **
31945 10/21E369 766 35 998E381 750 40 997E394 733 45 0E411 708 45 0*
31945 10/21E371 769 40 997E383 750 40 0E394 733 45 0E407 708 45 0*
      *** **
31950 10/22E429 674 45 0E449 637 45 0E470 602 40 0E492 571 40 0*
31950 10/22E427 674 45 0E449 635 45 0E475 595 40 0E505 565 40 0*
      *** **
31955 10/23E522 542 40 0E561 515 35 0E600 488 35 0* 0 0 0 0*
31955 10/23E540 540 45 0E570 520 45 0E595 500 50 0E615 470 50 0*
      *** **
(The 24th is new to HURDAT.)
31957 10/24E630 435 45 0E645 390 40 0E660 340 30 0* 0 0 0 0*

31960 HRBFL3DFL2
31960 HRBFL3DFL1AFL1
      *****

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## U.S. Landfalls:

10/18/1944 2000Z 24.6N 82.9W (Dry Tortugas) 105 kt 949 mb 1010 mb OCI 350 nmi  
 ROCI 29 nmi RMW 9 kt forward motion

10/19/1944 0700Z 27.2N 82.5W 90 kt 962 mb 1011 mb OCI 375 nmi ROCI 34 nmi  
RMW 15 kt forward motion

Minor track changes and major intensity changes are made to this powerful hurricane. Dissipation is analyzed to have occurred 24 hours later than in the original HURDAT. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Summer (1944a), Connor (1956), Dunn and Miller (1960), Harris (1963), Schwerdt et al. (1979), Ho et al. (1987), Jarrell et al. (1992), and Perez et al. (2000).

October 11:

HWM analyzes an open wave containing a spot low near 16.7N, 79.7W. HURDAT does not list this storm on this day. Microfilm shows a very broad closed low of at most 1008 mb in the western Caribbean Sea. No gales or low pressures.

October 12:

HWM analyzes a tropical storm centered near 16.7N, 81.7W. HURDAT first lists this system at 18Z as a 35 kt tropical storm at 15.0N, 80.3W. No gales or low pressures. Regarding the genesis, "First indications that this tropical storm was developing in the Caribbean Sea came when the motorship *Silver Arrow*, en route from Jamaica to Belize, stopped at Swan Island about 6:30 pm on October 12, and reported rough seas encountered about 100 miles to the eastward" (MWR).

October 13:

HWM analyzes a tropical storm located near 17.9N, 82.1W. HURDAT lists this as a 70 kt hurricane at 17.4N, 80.9W. The MWR post-season track map shows a 00Z position near 16.3N, 80.9W and a 12Z position near 17.4N, 80.9W. Microfilm shows a hurricane symbol on the 0030Z map located near 17.1N, 80.5W. On the 1230Z microfilm map, the hurricane symbol is vacant, but it shows a low of at most 1005 mb centered near 17.2N, 80.5W. Ship highlights: 35 kt E and 1005 mb at 17.2N, 80.5W at ~0030Z (micro); ~40 kt and 1005 mb at 17.0N, 80.0W at ~1230Z (micro); 40 kt SE and 1004 mb at 17.6N, 79.8W at ~1530Z (micro); 45 kt SSW and (996 mb?) at 17.6N, 80.7W at ~1830Z (micro); 50 kt SW at 21Z at 18.2N, 80.6W (micro); 50 kt SW and 981 mb at ~23Z at 18.2N, 80.6W (micro). One other ship low pressure of 1005 mb. Aircraft highlights: 40 kt SSE at 17.7N, 79.3W at 1530Z (micro); 40 kt S at 17.5N, 81.1W at 16Z (micro). Regarding the first signs of the storm at Grand Cayman Island, "At Grand Cayman Island, the first signs of the storm were noted during the forenoon of October 13. Rain was continuous on Grand Cayman throughout the remainder of the day" (MWR).

October 14:

HWM analyzes a tropical storm of at most 1005 mb centered near 19.2N, 80.6W. HURDAT lists this as a 75 kt hurricane at 18.5N, 80.6W. The MWR post-season track map shows a 00Z position near 18.0N, 80.8W, and a 12Z position near 18.5N, 80.6W. Microfilm shows a broad circulation in the general vicinity of the other sources' locations. Ship highlights: 30 kt SW and 979 mb at 00Z at 18.2N, 80.6W (micro); 35 kt

SSE at 17.4N, 79.4W at ~0030Z (micro). Land highlights: 30 kt NNE and 1005 mb at Cayman at 12Z (micro). Aircraft highlights: 35 kt N at 17.8N, 81.8W at 1320Z (micro); 40 kt E at 18.9N, 81.1W at 1330Z (micro); 40 kt W at 16.5N, 80.6W at 1350Z (micro). Three other aircraft gales. Regarding the conditions on Grand Cayman, "On the 14<sup>th</sup> surface winds had increased and the highest gust recorded was 58 mph. At about 5 pm on the 14<sup>th</sup> rapidly changing conditions evidenced the existence of a heavy individual squall within the main storm area. At that time the wind changed suddenly without pause from moderate NNE to strong SE, and the heaviest rainfall of the entire storm period occurred. After about 20 minutes the wind returned to NNE and lost much of its force. A record 24-hour rainfall for the island, 16.04 inches, fell on the 14<sup>th</sup>" (MWR).

October 15:

HWM analyzes a hurricane of at most 995 mb centered near 18.7N, 80.9W. HURDAT lists this as a 75 kt hurricane at 19.3N, 80.8W. The MWR post-season track map shows a 00Z position near 18.9N, 80.7 and a 12Z position near 19.2N, 81.0W. Microfilm shows a low of at most 993 mb centered near 19.1N, 80.9W. Ship highlights: 40 kt E and 990 mb at 18.8N, 80.4W at ~0030Z (micro); 35 kt ESE and 992 mb at 18.6N, 79.8W at 1324Z (micro); 25 kt SE and 994 mb at 18.3N, 79.3W at 1715Z (micro). Land highlights: 30 kt NW gust 52 kt and 1008 mb at Swan Island at 4Z (micro); 25 kt ENE gust 57 kt and 997 mb at Grand Cayman at ~1530Z (micro); 35 kt NNW and 1010 mb at Cozumel at 17Z (micro); 48 kt E and 984 mb at Grand Cayman at 2230Z (MWR); 40 kt ESE gust 83 kt and 986 mb at Grand Cayman at 23Z (micro); 83 kt sustained at Grand Cayman (MWR). Aircraft highlights: 45 kt N at 17.8N, 82.2W at 1530Z. Seven other aircraft gales. Regarding the conditions on Grand Cayman, "On the next day, October 15, shortly after 6:30 pm, the pressure at Grand Cayman Island reached its lowest point 29.06 inches (984 mb). The extreme gust for that station, 118 mph from the east, was registered at about the same time" (MWR).

October 16:

HWM analyzes a hurricane of at most 995 mb centered near 19.2N, 82.8W. HURDAT lists this as a 85 kt hurricane at 19.4N, 82.4W. The MWR post-season track map shows a 00Z position near 19.2N, 81.8W and a 12Z position near 19.4N, 82.7W. Microfilm shows a hurricane of at most 987 mb centered near 19.2N, 82.6W. Ship highlight: 35 kt NE and 1016 mb at 25.5N, 80.5W (COA). Land highlights: 40 kt ESE gust 103 kt and 988 mb at Grand Cayman at 00Z (micro); 40 kt ESE gust 90 kt and 991 mb at Grand Cayman at 2Z (micro); 30 kt NW gust 42 kt and 1001 mb at Swan Island at 8Z (micro). Six more gales and low pressures at Grand Cayman with two more hurricane force wind gusts. One more low pressure at Swan Island with a gale force wind gust. Aircraft highlights: 50 kt N at 19.1N, 83.0W at 1340Z (micro); 50 kt W at 18.3N, 82.8W at 1350Z (micro); 50 kt S at 18.2N, 82.0W at 1410Z (micro). Four other aircraft gales. Regarding the damage from surge in Grand Cayman, "The hurricane center passed westward, south of the island and turned rather abruptly to the north along the 83<sup>rd</sup> meridian. As the storm moved northward, hurricane winds on the right of the center sent a destructive storm tide lashing at docks, piers, and other shore installations on the south coast (of Grand Cayman), reducing many of the wooden structures to kindling" (MWR). "Storm

warnings were ordered for the Keys the morning of the 16<sup>th</sup> (10/1944 FL Climatological Data).

#### October 17:

HWM analyzes a hurricane of at most 990 mb located near 19.6N, 82.9W. HURDAT lists this as a 95 kt hurricane at 20.6N, 82.9W. The MWR post-season track map shows a 00Z position near 19.8N, 83W and a 12Z position near 20.5N, 83.2W. Microfilm shows a low of at most 987 mb centered near 20N, 82.8W. Ship highlight: 35 kt S at 19.8N, 80.2W at 16Z (micro). Land highlights: 40 kt NW gust 50 kt and 1001 mb at Swan Island at 3Z (micro); 35 kt SSE and 997 mb at Cayman at 12Z (micro); 35 kt NE and 1008 mb at Dry Tortugas (24.6N, 82.9W) at 1230Z (micro); 45 kt NE at Isle of Pines (21.8N, 82.8W) at 1830Z (micro). A few other gales and a few other low pressures. Aircraft highlights: 45 kt N at 20.1N, 83.9W at 14Z (micro); 50 kt W at 19.2N, 83.2W at 1430Z (micro); 45 kt S at 20.4N, 81.8W at 1530Z (micro); 45 kt E at 21.7N, 81.2W at 16Z (micro). Eight other aircraft gales. Regarding the track, "During the late afternoon of the 17<sup>th</sup> the storm center crossed the Isle of Pines" (MWR).

#### October 18:

HWM analyzes a hurricane of at most 980 mb centered near 23.1N, 83.6W, on the northwest coast of Cuba. HURDAT lists this as a 100 kt hurricane at 23.1N, 83.0W. The MWR tracks of centers of cyclones shows a 00Z position near 21N, 82.3W and a 12Z position near 22.3N, 82.2W. The MWR post season track map shows a 00Z position near 21.7N, 83.1W and a 12Z position near 22.9N, 83W. Microfilm at 6Z shows a low of at most 981 mb centered near 22.3N, 82.8W, but the 12Z microfilm map is not available. Ship highlights: 44 kt NE and 1006 mb at 23.3N, 85.8W at 2Z (micro); 35 kt NNE and 995 mb at 25.5N, 85.5W at 18Z (COA); 964 mb at 23.9N, 83.0W at 2130Z (MWR). Three other low pressures and three other gales. Land highlights: 70 kt SSE and 960 mb at Havana at 12Z (MWR); 122 kt (30-second averaged wind) at Havana at 15Z (MWR); 104 kt E at Dry Tortugas (elevated) at ~1830Z (MWR); 33 kt SE and 986 mb (min p) at Key West at 1950Z (MWR); 96 kt SE and 990 mb at Sombrero Light at 21Z (MWR); center fix at Dry Tortugas at 22Z with 949 mb central pressure (uncorrected aneroid barometer) (MWR); 45 kt S gust 74 kt and 988 mb at Key West at 23Z (micro); 100 kt SE at Sombrero Light (elevated) at ~2330Z (MWR). Several other gale force winds. Five other pressures below 1000 mb. Regarding the storm at the Dry Tortugas, "At the Dry Tortugas, 58 miles west of Key West, where an airway-type anemometer and windvane were exposed on top of the lighthouse, a wind velocity of 120 mph was recorded at 1500 (19Z) of the 18<sup>th</sup> before the anemometer was blown away. The lowest pressure there was 28.02 inches (949 mb) at 1800 (22Z), with a calm period from 1600 to 1800 (20-22Z). All times EWT (Zulu minus 4 hours). The wind direction was east immediately before the lull, and west after the center passed" (OMR). Regarding the track, "Approaching Cuba from the south, the storm center crossed the island a short distance west of the Mariel-Majana line, the narrowest part of Cuba, and about 10 or 15 miles west of Havana. On the 18<sup>th</sup>, at a point about midway between the north coast of Cuba and Dry Tortugas, a vessel heavily involved with the storm reported passing through the eye of the hurricane where calm airs were observed for an hour between 1:40 and 2:40 pm (EST) (1840-1940Z). Except during through the center, hurricane winds

(Beaufort force 12) were encountered from noon to about 4 pm (17-21Z)” (MWR). “Hurricane warnings issued from Miami to Tampa the morning of the 18<sup>th</sup>” (10/1944 FL Climatological Data). “The storm was preceded by several tornadoes on the afternoon of the 18<sup>th</sup>, near Wauchula and Arcadia and in southeastern Polk County” (10/1944 FL Climatological Data). “El Huracan de 1944- October 17-18 – Category 4 – 937 mb central pressure, peak observed gust of 141 kt, estimated 1-min maximum sustained wind of 121 kt – 5.5 m storm surge – 300 deaths” (Perez et al.). “Oct. 18 – 949 mb central pressure from Dry Tortugas observation, RMW- 29 nm, Speed - 13 kt” (Ho et al.)

October 19:

HWM analyzes a hurricane of at most 980 mb centered just east of Tampa, or near 28.2N, 82.2W, with a warm front extending from the northeast periphery of the cyclone east-southeastward. HURDAT lists this as a 65 kt hurricane at 28.4N, 82.1W. The MWR tracks of centers of cyclones shows a 00Z position between Key West and the Dry Tortugas near 24.6N, 82.1W and a 12Z position just northeast of Tampa near 28.2N, 82W. The MWR post-season track map shows a 00Z position near 25N, 83W and a 12Z position near 28.2N, 82.5W. Microfilm shows a center in the vicinity of 28.2N, 81.8W. Ship highlights: 986 mb at 26.5N, 85.5W at 02Z (COA); 60 kt SE and 998 mb at 13Z at 28.5N, 80.5W (COA); 50 kt NW and 998 mb at 14Z at 26.5N, 85.5W (COA). Two other gales and three other low pressures. Land highlights: 52 kt S and 993 mb at Key West at 0030Z (OMR); 50 kt ENE gust 74 kt and 993 mb at Naples at 1Z (micro); 60 kt (1-min) at Miami at 0504Z (MWR); 87 kt S and 981 mb at Sanibel Light at 0530Z (MWR); 57 kt ESE and 984 mb at Fort Myers at 0530Z (MWR); 50 kt N gust 90 kt and 968 mb at St. Petersburg, FL at 920Z (micro); 37 kt NE and 967 mb at Tampa at 10Z (MWR, OMR); 70 kt E at Lakeland (MWR); 969 mb at Lakeland (MWR); 54 kt ESE and 980 mb at Orlando at 1230Z (MWR); 71 kt (1-min) SSE at Orlando at 1405Z (MWR); 5 kt SE and 980 mb at Jacksonville at 1944Z (MWR); 37 kt NE at Savannah at 2130Z (OMR). Many other gales and low pressures. Regarding the track, “The storm moved northward with the center passing inland south of Sarasota, near Nokomis, about 3 am EST on October 19. A pressure of 28.42 inches (962 mb) was recorded at Sarasota. Taking a course north-northeastward across Florida, the storm center skirted the east side of Tampa Bay, moved over Dade City and Ocala, and passed seaward a short distance south of Jacksonville” (MWR). Regarding the storm structure, “Although the storm was traveling at 20 mph, the “eye” was reported to have lasted from 11:30 am to 5:00 pm (at Jacksonville). This exceptionally long period of time required for conditions characteristic of the “eye” of the hurricane to pass Jacksonville indicates an unusually large central core. This central portion of the storm was apparently an elongated oval with its principal axis along the line of advance. The central core extended at one time almost from Jacksonville to Ocala, a distance of about 70 air line miles” (MWR). “The hurricane itself was very large, with the central core or area of light shifting winds from from 40 to 60 miles in diameter, requiring 2 to 4 hours to pass over towns directly in its path. Dangerous winds extended fully 200 miles to the right or east of the center, and about 100 miles to the left or west, thus affecting all of Peninsular Florida. Winds of hurricane or near hurricane velocity surrounded the central core, with gusts up to 100 miles per hour at Tampa and Orlando. Warnings for winds and tides were ample and well distributed, and exposed beaches were generally evacuated on both coasts. Tides

were high from Sarasota southward on the Gulf, and from Melbourne northward on the Atlantic. Everglades City reported 8.2 ft, Naples 12 ft, Jacksonville Beach 12 ft., Mayport 7.8 ft, Fernandina 10.6 ft above mean low water. Property damage in the state (Florida) totaled probably 10 to 13 million dollars...but the total crop losses were nearly \$50,000,000. Loss of life (for Florida), as reported by the Red Cross, totaled 18. Systematic evacuation of all dangerously exposed beaches doubtless saved many lives” (10/1944 FL Climatological Data). From the Georgia Climatological Data, “The important feature of the month was the movement up the Georgia coast of a tropical hurricane from which the winds and excessive rainfall caused moderate to severe damage on the coast and over other areas as far inland as Augusta, Dublin, and Alapaha, beyond which conditions were much more moderate. Brunswick Airport received 11.38 inches of precipitation during a 24 hour period of the 18-19<sup>th</sup>” (10/1944 GA Climatological Data). Regarding the damage in Georgia, “A severe hurricane, after sweeping across the northern part of Florida on the morning of October 19, 1944, moved up the Georgia coast and crossed into South Carolina a short distance north of Savannah at about midnight of the same date (~20<sup>th</sup> 5Z). Georgia was probably saved from enormous losses for two reasons: (1) the storm undoubtedly lost some of its violence in crossing the land surface of Florida, (2) the storm skirted the Georgia coast rather than following a more direct course through the state. As a whole, property and other losses amounted to \$250,000, possibly as much as \$500,000. The most important losses included a large amount of timber, a shipyard at Brunswick, and damages to building roofs. Most of the losses were sustained well in advance of the approach of the storm center, with only negligible losses after its passage. High winds and heavy rainfall affected an area 50-100 miles inland, and unusually high and destructive tides occurred along all the immediate coastal area. More detailed descriptions (of damage in Georgia) follow:

-St. George: Greatest damage was to roads and bridges, making them impassible.

-St. Marys: Large number of trees blown down or stripped of limbs; considerable damage from tide water, which flowed in and beyond several businesses near the water front; shingles blown from roofs of buildings.

-Nahunta: Greatest damage was to forest where many trees were blown down or ruined; some roofs, mostly unsubstantial, were blown off and others damaged more or less; roads and bridges left in bad condition.

-St. Simons Island: Large number of trees blown down, blocking highways; boardwalks washed away and seawall damaged by very high tidal waves.

-Brunswick: Largest damage was to shipyard; damage estimated at \$75,000, including the following: several roofs blown away, four large cranes badly damaged, one scaffolding blown down. Tidewater swept over the entire eastern area of the city for distance inland of 1 mile, making it necessary to evacuate many from their homes. Many home and other building roofs damaged. Trees blown down, leaves and tree limbs scattered all over the city. Many telephone and electric lines down and out of order.

-Glennville: Highest wind occurred between 5 and 6 pm (22-23Z).

-Savannah Beach: Portions of roofing blown off, some entirely so; property losses not severe, estimated at only a few thousand dollars.

-Savannah: similar to others- moderate roof damage and trees and tree limbs down” (10/1944 GA Climatological Data).

“Landfall position south of Tampa, Estimated Minimum Central Pressure [not necessarily at US landfall] 948 mb” (Connor). “Tropical Cyclones in Florida – Oct. 18-19 – Peninsula – Major – 18 killed – damage \$60,000,000” (“Major” – winds 101 to 135 mph, central pressure 949 to 982 mb – Dunn and Miller). “Oct. 19 – 1012 mb environmental pressure, 102 kt 1 min maximum sustained wind estimate at US landfall” (Schwerdt et al.). “Oct. 19 – 962 mb central pressure from Sarasota observation, RMW- 34 nm, Speed- 15 kt, Landfall point- 27.0N, 82.4W” (Ho et al.). “In general, the storm surges associated with hurricanes and tropical storms rise and fall more rapidly than those associated with extratropical storms. This effect is illustrated by the records of storm surges produced by this [Oct. 18-20] storm, which changed from tropical to extratropical characteristics as it crossed Florida... It is interesting... to observe that the peak high water marks, as the storm passed from land to sea near Jacksonville, are of nearly the same magnitude as the peak values near the original landfall of the hurricane” (Harris). “1944 Oct – FL – 3SW, 2NE – 962 mb central pressure” (Jarrell et al.).

October 20:

HWM analyzes a tropical storm of at most 995 mb centered over northeastern South Carolina near 34.4N, 79.8W, with a warm front extending eastward, a dissipating warm front extending southwestward, and a trough extending southward from the cyclone’s center. HURDAT lists this as a 40 kt tropical storm at 33.5N, 80.1W. The MWR tracks of centers of cyclones shows a 00Z position near 30.6N, 80.5W and a 12Z position near 33.2N, 79.1W with a 992 mb central pressure. The MWR post-season track map shows a 00Z position near 31N, 81.7W and a 12Z position near 34N, 80.4W. Microfilm shows a low of at most 990 mb centered near 34.1N, 80.1W. Ship highlights: 35 kt ENE and 1011 mb at 37.5N, 76.5W at 13Z (COA); 40 kt E and 1004 mb at 37.5N, 76.5W (COA); 25 kt ESE and 1001 mb at 37.5N, 76.5W at 21Z (COA). One other gale and three other low pressures. Land highlights: 20 kt WSW and 989 mb at Jacksonville at 0030Z (OMR); 15 kt NW and 986 mb at Savannah at 0455Z (MWR); 990 mb at Charleston, SC at 0730Z (MWR); 22 kt SE and 994 mb at Florence, SC at 1128Z (MWR); 17 kt NNE and 991 mb at Columbia, SC at 12Z (MWR); 35 kt S (1-min) at Wilmington, NC at 1552Z (MWR); 17 kt N and 1000 mb at Greensboro, NC at 1830Z (MWR); 16 kt SW and 1002 mb at Raleigh, NC at 20Z (MWR). Six other low pressures. Regarding the track, “After traveling a short expanse of ocean the center moved inland just north of Savannah. Passing some distance inland through South Carolina, North Carolina, and Virginia, it again reached the Atlantic off the eastern shore of Maryland” (MWR). “The third tropical disturbance of the year moved inland southwest of Charleston, SC, and crossed over the southern border of North Carolina in Anson County. The storm passed through the central portion of the state mostly as an ordinary severe storm with winds 30 to 40 mph over a 500-mile radius. The estimated damage (to crops) was roughly \$200,000” (10/1944 NC Climatological Data).

October 21:

HWM analyzes a low of at most 1000 mb near 39.8N, 72.4W just south of Long Island, NY with a warm front attached to the low extending eastward and a cold front not quite attached to the center of the low. HURDAT lists this as a 45 kt extratropical storm at 39.4N, 73.3W. The MWR tracks of centers of cyclones shows a 00Z position near the

NC/VA border near 36.7N, 76.7W and a 12Z position near 38.8N, 73.3W. The MWR post-season track map shows a 00Z position near 36.8N, 77.7W and a 12Z position near 39.2N, 73.4W. Microfilm shows two split lows, both of at most 996 mb, and both within a single 998 mb contour. The low centered near 39.1N, 73.7W does not have any fronts analyzed to be associated with it. The low centered near 40.5N, 71.2W has a warm front extending to the ESE and a cold front extending to the south. Ship highlights: 20 kt NE and 997 mb at 41.5N, 71.5W at 17Z (COA); 40 kt W and 1006 mb at 36.5N, 72.5W at 17Z (COA); 35 kt WNW and 1007 mb at 37.5N, 77.5W (COA). Several other low pressures between 997-1005 mb. Land highlights: 9 kt W and 998 mb at Richmond, VA at 0015Z (MWR). Regarding the track, "Moving northeastward with increasing speed, it passed between Cape Cod and Nantucket, and reached Nova Scotia late on the 21<sup>st</sup>" (MWR).

October 22:

HWM analyzes an extratropical low of at most 990 mb near 48.3N, 59.7W over western Newfoundland with a warm front and cold front intersecting at the center of the low. HURDAT lists this as a 40 knot extratropical storm at 47.0N, 60.2W. The MWR tracks of centers of cyclones shows a 00Z position near 42.8N, 66.5W and a 12Z position near 47.4N, 59.3W with a 989 mb pressure. The MWR post-season track map last shows a position at 00Z near 42.8N, 68W. Ship highlights: 30 kt SSW and 1000 mb at 43.5N, 63.5W at 00Z (COA); 5 kt NW and 998 mb at 42.5N, 71.5W at 01Z (COA); 30 kt WSW and 1002 mb at 39.5N, 69.5W at 01Z (COA); 40 kt NW and 1012 mb at 42.5N, 69.5W at 13Z (COA). One other gale and one other low pressure. Regarding the intensity, "Gale winds of force 8 were observed over Newfoundland on (the 22<sup>nd</sup>)" (MWR).

October 23:

HWM analyzes an extratropical low of at most 955 mb centered near 59.7N, 50.8W southwest of Greenland, with a warm front extending eastward and a cold front extending southeastward from the cyclone's center. HURDAT lists this as a 35 kt extratropical storm at 60.0N, 48.8W. Ship highlights: 40 kt W and 955 mb at 58.8N, 51.1W at 12Z (HWM); 45 kt E and 967 mb at 61.5N, 45.5W at 15Z (COA). Two other low pressures of 973 and 981 mb. Additional highlights: 50 kt NNE and 983 mb at 60.0N, 43.0W at 12Z (HWM).

October 24:

HWM analyzes a large extratropical low of at most 975 mb centered near 66N, 33W along the southeast coast of Greenland, with an occluded front extending eastward from the cyclone's center. HURDAT no longer lists the cyclone on this date. No gales were observed on this date.

On 11 October, observations indicate that a disturbance was forming in the western Caribbean. At 12Z on the 12<sup>th</sup>, the disturbance had organized into a tropical depression based upon aircraft and surface observations, which is six hours earlier than analyzed in HURDAT originally. There were a few minor track changes made to this storm. On the 12<sup>th</sup>, the position is analyzed to be about a degree farther north than HURDAT's position, and on the 14<sup>th</sup>, the storm is analyzed to be south of the HURDAT position, indicating an

even slower forward motion during that time. The analyzed position remains near on slightly south of the HURDAT position through the 17<sup>th</sup>. All recommended track changes for this storm between Havana, Cuba and Savannah, Georgia are three-tenths of a degree or less. All track changes from the 20<sup>th</sup> through the 22<sup>nd</sup> are within one degree of the HURDAT position. On the 23<sup>rd</sup> at 12Z, the position is analyzed to be 1.5 degrees WSW of the HURDAT position. In the original HURDAT, the winds from this system went from 35 kt at 18Z on the 12<sup>th</sup> to 65 kt six hours later at 00Z on the 13<sup>th</sup>. Observations do indicate intensification to a hurricane, but at a more realistic rate – becoming hurricane force (70 kt at 18Z on the 13<sup>th</sup>). This indicated a major downward adjustment of intensity from 65 kt to 40 kt at 00Z on the 13<sup>th</sup>. A 979 mb pressure with 30 kt of wind at 00Z the 14<sup>th</sup> indicates a central pressure of about 976 mb. This pressure suggests winds of 83 kt from the south of 25N pressure-wind relationship – 80 kt is chosen for HURDAT as the cyclone was very slow moving at the time, up from 70 kt originally. Late on the 15<sup>th</sup>, the hurricane passed just south of Grand Cayman where peak sustained winds were 83 kt and lowest pressure was 984 mb. Winds are boosted at 00Z the 16<sup>th</sup> from 80 to 90 kt. Moving very slowly, the hurricane turned northward during the 16<sup>th</sup> and 17<sup>th</sup> along 83W. On the 17<sup>th</sup>, the hurricane began to gradually accelerate as it passed over the western edge of the Isle of Youth. When the hurricane was located just west of Havana at 12Z the 18<sup>th</sup>, HURDAT listed the winds at 100 kt. However, the Havana National Observatory recorded a fastest-mile wind of 122 kt (at 15Z) and a minimum pressure of 960 mb (at 12Z with 70 kt of wind) as the hurricane passed to the west of the city. This 122 kt fastest-mile wind is equivalent to about a 25-second averaged wind. Perez et al. (2000) indicates an estimated 937 mb central pressure at landfall in Cuba. This pressure yields a wind speed of 124 kt from the Brown et al. pressure-wind relationship for south of 25N, and 120 kt is chosen at landfall as the hurricane had developed a large circulation and was still moving slowly (~9 kt) at its landfall in Cuba. The 120 kt category 4 impact in Cuba is consistent with that from Perez et al. and is a major (20 kt increase) in intensity at 12Z on the 18<sup>th</sup>.

The hurricane, still traveling northward, started to make a gradual turn to the north-northeast. The eye of the hurricane went directly over the Dry Tortugas, FL between 16 and 18Z on the 18<sup>th</sup>. While the lighthouse-top anemometer was disabled after recording 104 kt at 15Z, a central pressure of 949 mb was observed at 18Z at the island. 949 mb suggests sustained winds of 112 kt from the Brown et al. south of 25N and 106 kt from the north of 25N pressure-wind relationships. Additionally, one could make use of the weakening systems pressure-wind relationships (as the central pressure filled 12 mb in about 9 hours), which would suggest 108 and 101 kt south and north of 25N respectively. Ho et al. estimated an RMW of 29 nm, which is substantially larger than climatological for that latitude and central pressure (~16 nm). Considering these and the earlier mentioned speed (~9 kt) and larger circulation, maximum sustained surface winds are estimated to be 105 kt. This makes the hurricane a category 3 impact for the Florida Keys (BFL3), and is no change from that shown originally in HURDAT for 18Z on the 18<sup>th</sup>.

The hurricane began accelerating to the NNE and made landfall just south of Sarasota, FL at 07Z on the 19<sup>th</sup>. A pressure of 962 mb was observed at Sarasota, and this pressure

is analyzed to be the central pressure. Brown et al.'s pressure wind relationship for north of 25N yields an intensity of 93 kt and 89 kt for north of 25N and weakening. Although the storm was large by this time (in both RMW and radius of outer closed isobar), its forward speed has increased to 15 kt. With all of these considerations, 90 kt is chosen for 06Z on the 19<sup>th</sup> and landfall, which is a major increase from the 65 kt indicated in HURDAT originally. A sustained wind of 87 kt was observed at Sanibel Island [elevated?] at 0530Z on the 19<sup>th</sup>, which was on the right side of the storm. The cyclone continued quickly toward the NNE and by 00Z on the 20<sup>th</sup> was located right on the southeast Georgia coast. The Kaplan and DeMaria inland decay model was run for 12Z and 18Z on the 19<sup>th</sup>. For 12Z, the model yielded an intensity of 60 kt; however, at 1405Z, there was an observed 71 kt 1-minute wind at Orlando. The analyzed 12Z intensity based on that observation is 75 kt (revised upward from 65 kt originally). At 18Z, the Kaplan and DeMaria model yields a 49 kt intensity. There was a SHIP observation of 60 kt at 17Z off the east coast of Florida. The analyzed 18Z intensity is 60 kt (no change from original HURDAT). A possible factor that could have caused the Kaplan and DeMaria model to be too low in this case is that the size of the storm was very large. From a total kinetic energy standpoint, large storms have a tendency to weaken more slowly than small storms (Chris Landsea, personal communication). Based upon these winds at landfall and at the synoptic times, it is analyzed the hurricane was a Category 3 impact in the Florida Keys (BFL3), a Category 2 impact in southwest Florida (but still part of the "BFL" region, so overall BFL is listed at category 3), a Category 1 impact in Northwest Florida (AFL1), and a Category 1 impact in Northeast Florida (DFL1). The Southwest Florida impact is unchanged, the Northeast Florida is a downgrade from a Category 2 originally, and the Northwest FL is a new inclusion into HURDAT. It was noted that in the original HURDAT that central pressure values were included after US landfall for each synoptic time from 12Z on the 19<sup>th</sup> to 06Z on the 21<sup>st</sup>. Only a couple of these eight values could be confirmed from observations, thus it appeared that these were analyzed values rather than strictly based upon observations. If the central pressure value could not be confirmed, but it looked reasonable based upon available peripheral readings and continuity, the value was left in (for 12Z on the 19<sup>th</sup> to 00Z on the 20<sup>th</sup>). Three of the points (06Z and 12Z on the 20<sup>th</sup> and 00Z on the 21<sup>st</sup>), we could locate central pressure values different and lower than what was in HURDAT originally and these are now included. Because of these changes, the central pressure of 996 mb at 18Z on the 20<sup>th</sup> did not look reasonable given the preceding and subsequent observations, and it was removed. Despite the statement in MWR about the cyclone moving briefly into the Atlantic, our small track revisions on the 19<sup>th</sup> and 20<sup>th</sup> kept the track right along the northeast FL and Georgia coastline. As the system continued moving north-northeastward on the 20<sup>th</sup>, it was gradually becoming more baroclinic and it is reanalyzed to have become extratropical at 12Z on the 20<sup>th</sup> consistent with the HWM analyses, but 12 hours earlier than HURDAT originally. The system did reintensify as an extratropical cyclone on the 23<sup>rd</sup> as it approached Greenland, based upon numerous ship and station reports. Additionally, the dissipation of the system was delayed 24 hours as it continued northeastward into the far North Atlantic Ocean.

1944 storm 14 (new to HURDAT)

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31895 11/01/1944 M= 3 14 SNBR= 707 NOT NAMED XING=0
31896 11/01*122 813 30 0*121 814 35 0*120 815 40 0*119 817 45 0*
31897 11/02*117 820 50 0*116 823 55 0*115 825 60 0*114 825 60 0*
31898 11/03*113 824 50 0*113 822 40 0*113 820 30 0*113 818 25 0*
31960 TS

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Monthly Weather Review indicates that a small, short-lived tropical storm (or perhaps even a hurricane) was located in the extreme southwestern Caribbean Sea on 2 November. Observations from the Historical Weather Map Series as well as the COADS ships database are also utilized in analyzing this storm.

November 1:

HWM does not analyze a closed low. HURDAT does not list this system. No gales.

November 2:

HWM does not analyze a closed low. Ship highlights: 60 kt W and 1002 mb at 1030Z at 11N, 82.6W (MWR). "On November 2 at about 5:30 am, a vessel, involved in a storm near latitude 11N, 82.6W, sent a report of a 60 knot wind from the west, pressure 29.60 inches (1002.4 mb), seas mountainous, and vessel laboring heavily. Similar conditions were reported for about 3 hours, during which time the vessel called for assistance. The storm dissipated or moved inland a short time later as aircraft reconnaissance early on the following day (3<sup>rd</sup>) failed to locate any disturbance. Since it is impossible to trace a movement, from available reports, or to determine whether the ship was involved in a small hurricane or a very severe squall, this storm is carried as a matter of record, and it is not listed as a tropical disturbance of the past season" (MWR).

November 3:

HWM does not analyze a closed low. No gales.

This system is added into the HURDAT database based primarily from the above MWR text under November 2. A 60 kt wind alone would not be sufficient evidence. But a 60 kt wind with a 1002 mb pressure, along with the conditions reported by that ship persisting for 3 hours warrants the strong possibility that a small tropical cyclone was present. The Historical Weather Maps and COADS are nearly completely lacking in ship observations during these three dates. However, station observations are consistent with a cyclone being present in the southwest Caribbean Sea. It is analyzed that the system formed early on the 1<sup>st</sup> as a tropical depression and became a tropical storm later that day. It is analyzed as reaching a peak intensity of 60 kt on the 2<sup>nd</sup>, but it is possible that this was instead a hurricane. A quick decay occurred on the 3<sup>rd</sup> with dissipation by 00Z on the 4<sup>th</sup>. Only a short counter-clockwise motion of the cyclone could be analyzed without the system making landfall. It is to be noted that there is a very nice analog in HURDAT for this system. Hurricane Martha in 1969 was located in nearly the same place and also occurred in November.

1944 additional notes

1)

A frontal low, which was nearly stationary over the north central Atlantic, was located on 1 May near 35.5N, 54W. Moving very little, the low began to slowly occlude on 2 May and 3 May. There was a gale observed on both the 2<sup>nd</sup> and the 3<sup>rd</sup>. On 4 May, the low was fully occluded and perhaps became subtropical. There were no observed gales with this system after the occlusion. By 5 May, there were no longer any fronts plotted with this low in HWM still located at nearly the same position as on the 1<sup>st</sup>. On 5 May, there was a 25 kt north wind with a 1006 mb pressure west of the center. This may have been a subtropical storm, but there is no evidence that there were any gale force winds.

DAY	LAT	LON	STATUS
May 1	35N	53W	Extratropical low
May 2	33N	53W	Extratropical storm
May 3	34N	53.5W	Extratropical storm
May 4	35N	53W	Subtropical low
May 5	34N	53W	Subtropical low
May 6	34N	52W	Subtropical low
May 7			Dissipated

2)

On 25 August, a strong tropical wave approached the Lesser Antilles. By 26 August, the wave was in the eastern Caribbean Sea. This system may have been a tropical depression. There were no observed gales and it is not clear if the center was closed. However, on the HWM analysis for the 26 August, combined with other available observations, there is an east wind, a north-northeast wind, a south wind, and a northwest wind in the locations that they should be for the low to be closed. Pressures are not very low though. The center was located somewhere near 13.5N, 61.5W around 12Z on 26 August. Thereafter, the wave became less defined as it moved toward the west or west-northwest, possibly because of sparse observations.

DAY	LAT	LON	STATUS
Aug 25			Open wave 11N 58W to 18N 54W
Aug 26	13.5N	61.5W	Tropical depression
Aug 27			Dissipated

3)

HWM analyzes that a low attached to the west end of a warm front on 23 August was located near 33N, 67W. Available observations indicate that the front had probably dissipated by 12Z on 23 August. There were 30 kt wind observations near the low, but there were no gales. Observations indicate that there is a good chance the low was closed

on this day. Also, temperatures around the low were warm. Therefore, this low may have been a tropical depression.

DAY	LAT	LON	STATUS
Aug 23	32.5N	67.5W	Tropical Depression
Aug 24	40.5N	59.5W	Tropical Depression
Aug 25			Absorbed by frontal system

4)

A low in the northeastern Caribbean Sea on 18 September near the Virgin Islands was producing ominous conditions in that area. The pilot of the aircraft investigating the system stated: "weather similar to that of last hurricane" (referring to the Great Atlantic Hurricane which struck the US east coast earlier that month. There were no observed gales with this system, but the low was definitely closed from 18 September to 20 September. By the 20<sup>th</sup>, it was located just north of Hispaniola, where pressures of 1009 mb were observed. The low dissipated on the 21<sup>st</sup>.

DAY	LAT	LON	STATUS
Sep 18	17N	64W	Tropical Depression
Sep 19	20N	67W	Tropical Depression
Sep 20	21.0N	70W	Tropical Depression
Sep 21			Dissipated

5)

HWM, NHC microfilm of synoptic weather maps and COADS indicate that a tropical depression formed as it approached the Lesser Antilles on October 13<sup>th</sup>. It continued into the extreme northeastern Caribbean Sea and apparently passed between Puerto Rico and Hispaniola on the 15<sup>th</sup>. The circulation seems to have dissipated late on the 16<sup>th</sup> near the southeast Bahamas. There were no gale observations, and the lowest observed pressures were 1008 mb. There is sufficient evidence of a closed circulation, so this system was likely a tropical depression.

DAY	LAT	LON	STATUS
Oct 13	14.5N	57.5W	Tropical Depression
Oct 14	16.5N	64.5W	Tropical Depression
Oct 15	19N	68W	Tropical Depression
Oct 16	22.5N	72.5W	Tropical Depression; Dissipating

6)

From 20 to 22 October, a low was located in the vicinity of 35N, 40W. It was definitely closed, but there were no observed gales. The highest observed wind was 30 kt and the lowest observed pressure was 1003 mb. HWM plots this as a frontal low during all three days. However, temperatures are warm, and on the 21<sup>st</sup>, the temperature gradient across the low was about 5 degrees.

DAY	LAT	LON	STATUS
Oct 20	37N	41.5W	Subtropical depression
Oct 21	38N	41.5W	Subtropical depression
Oct 22			Dissipated

7)

From 24 – 26 October, there was a low over the western Caribbean Sea. Available observations on the 25<sup>th</sup> suggest a closed circulation near 17N, 82.5W. Winds were 20 kt and pressures were 1008 mb. The low apparently moved westward and disappeared on the 26<sup>th</sup>.

DAY	LAT	LON	STATUS
Oct 24			Open wave
Oct 25	17N	82.5W	Tropical Depression
Oct 26			Dissipated

8)

An area of low pressure began to develop along a frontal boundary on 24 October, and by the 25<sup>th</sup>, this area of low pressure became better defined. Although temperatures are rather warm, this system is judged to be baroclinic throughout its life. There are several gales well removed from the center due to a strong pressure gradient to the northeast of the system on the 25<sup>th</sup>. On the 26<sup>th</sup>, the low occluded, but there were no gales near the center and still a significant temperature gradient across the low.

DAY	LAT	LON	STATUS
Oct 24			Open wave
Oct 25	33.5N	66W	Extratropical
Oct 26	37N	63W	Extratropical

9)

A low started to develop along the south end of a N-S frontal boundary on 2 November in the vicinity of 32N, 58W. There are not sufficient observations to call this low closed until the 4<sup>th</sup>. There were several gales on the 2<sup>nd</sup>, but they are due to the strong pressure gradient north of the low. The area of low pressure started to break off from the front on

the 3<sup>rd</sup> and gained its own identity forming a definite closed low on the 4<sup>th</sup>. On the 4<sup>th</sup>, the low contained a huge circulation with the structure of an extratropical cyclone. Also, there was a rather large temperature gradient across the low, so this low is judged to be baroclinic. Remaining nearly stationary, on the 5<sup>th</sup>, the low continued to display a very large circulation with pressure readings as low as 989 mb and highest winds of 35 kt, but still baroclinic due to the large circulation and the large temperature gradient across the low. By the 6<sup>th</sup>, the low moved north and clearly became frontal in nature.

DAY	LAT	LON	STATUS
Nov 2			Open
Nov 3			Open
Nov 4	35N	61W	Extratropical
Nov 5	38N	64W	Extratropical
Nov 6	45N	57.5W	Extratropical

10)

A low developed from the tail end of a frontal system in the central north Atlantic and moved slowly westward. The circulation of the low was large early on without a tight inner core. Although there are a few gales on the 11<sup>th</sup> and 12<sup>th</sup>, they are all north of the low where the pressure gradient increases dramatically. On the 13<sup>th</sup>, the low was not frontal at all and could be called subtropical, but there are no observed gales on this day. Another frontal system quickly came in from the west and absorbed the low by the 14<sup>th</sup>.

DAY	LAT	LON	STATUS
Nov 11	35.5N	38W	Extratropical
Nov 12	35.5N	42W	Extratropical
Nov 13	33N	46W	Subtropical depression
Nov 14			Absorbed by frontal system

11)

An extratropical low on 4 December was in the western Atlantic. On 5 December, it occluded and was located near 33.5N, 61.5W. Several gales accompanied the storm on this day. It started to acquire subtropical characteristics on 6 December, but it had a huge circulation on this day. Once the system started to become subtropical, there was only one observed gale after that, on 7 December, but the low was still large, and it didn't contract enough on the 7<sup>th</sup> to be a tropical cyclone. On 8 December, the low had contracted enough to be considered a tropical cyclone, but there were no gales. Furthermore, temperatures were not very warm and the temperature decreased steadily northwest of the low. The low persisted to 9 December and moved east-northeast located near 38N, 49W on the 9<sup>th</sup> before dissipating.

DAY	LAT	LON	STATUS
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Dec 4	33.5N	61W	Extratropical
Dec 5	33.5N	61.5W	Extratropical
Dec 6	33N	61.5W	Extratropical
Dec 7	34N	56.5W	Extratropical
Dec 8	35N	51.5W	Extratropical
Dec 9	38N	49W	Extratropical

## 1945

## 1945 Storm 1

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32725 06/20/1945 M=12 1 SNBR= 724 NOT NAMED XING=1 SSS=1
32725 06/20/1945 M=15 1 SNBR= 724 NOT NAMED XING=1 SSS=1
      **

32730 06/20* 0 0 0 0* 0 0 0 0*175 857 35 0*183 859 35 0*
32730 06/20* 0 0 0 0* 0 0 0 0*185 857 35 0*192 859 40 0*
      ***          ***          **

32735 06/21*192 861 35 0*203 862 35 0*214 863 40 0*222 863 40 0*
32735 06/21*199 861 40 0*206 862 40 0*214 863 40 0*222 863 40 0*
      ***          **          ***          **

32740 06/22*230 864 40 0*238 864 45 0*245 865 45 0*252 866 50 0*
32745 06/23*259 866 50 0*266 865 50 0*272 862 55 0*276 856 100 0*
32745 06/23*259 866 50 0*266 866 55 0*272 865 70 0*276 860 85 0*
      ***          **          ***          **          ***          **

32750 06/24*280 846 95 0*285 835 80 0*290 824 70 0*298 813 60 0*
32750 06/24*280 850 80 0*285 835 70 0*290 820 50 0*298 810 60 0*
      ***          **          **          ***          **          ***

32755 06/25*307 801 65 0*317 791 70 0*328 781 60 0*335 775 60 0*
32755 06/25*307 801 65 0*317 793 65 0*328 785 70 0*338 775 70 0*
      ***          **          ***          **          ***          **

32760 06/26*343 768 50 0*358 753 45 0*373 738 50 0*383 725 55 0*
32760 06/26*346 767 70 0*358 755 70 0*373 738 70 0*384 723 70 0*
      ***          ***          **          ***          **          **          ***          ***          **

32765 06/27*392 713 60 0*400 701 55 0*408 690 55 0*415 677 55 0*
32765 06/27*394 711 65 0E402 701 65 0E408 690 65 0E413 681 55 0*
      ***          ***          **          ****          **          *          **          ****          ***

32770 06/28*420 663 45 0E421 642 45 0E422 626 45 0E425 620 40 0*
32770 06/28E417 673 45 0E419 665 45 0E422 655 45 0E426 644 40 0*
      ****          ***          ***          ***          ***          ***          ***          ***

32775 06/29E429 613 40 0E434 607 40 0E441 600 40 0E467 570 40 0*
32775 06/29E431 632 40 0E438 617 40 0E448 600 40 0E459 583 40 0*
      ***          ***          ***          ***          ***          ***          ***          ***

32780 06/30E490 544 35 0E503 528 35 0E517 507 35 0E529 489 35 0*
32780 06/30E471 566 35 0E485 548 35 0E500 530 35 0E517 505 35 0*
      ***          ***          ***          ***          ***          ***          ***          ***

32785 07/01E543 468 35 0E560 445 35 0E578 412 35 0* 0 0 0 0*
32785 07/01E536 475 35 0E558 442 35 0E578 412 35 0E593 390 35 0*
      ***          ***          ***          ***          ***          ***          ****          ***          **

(The 2nd through the 4th are new to HURDAT.)
32786 07/02E603 373 40 0E607 358 40 0E610 345 40 0E612 333 40 0*
32787 07/03E614 323 35 0E617 313 35 0E620 300 30 0E624 286 30 0*
32788 07/04E629 271 30 0E636 256 30 0E645 240 25 0* 0 0 0 0*

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32790 HRAFL1

## U.S. Landfalls:

6/24/1945 08Z 28.6N 82.7W 70 kt 985 mb 1011 mb OCI 200 nmi ROCI

6/26/1945 01Z 34.7N, 76.6W 60 kt (intensity in revised HURDAT is 70 kt, as the peak winds remained offshore)

Minor track and major intensity changes are made to this early-season hurricane that made landfall in Florida. Three additional days were introduced for this system during its extratropical cyclone phase. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Dunn and Miller (1960), and Jarrell et al. (1992).

June 19:

HWM does not analyze a closed low on this day. HURDAT does not list a system on this day. No gales or low pressures.

June 20:

HWM analyzes a closed low of at most 1010 mb centered near 18N, 86W. HURDAT lists this as a 35 kt tropical storm at 17.5N, 85.7W. The MWR post-season track map shows a 00Z position near 15.5N, 84.0W and a 12Z position near 17.4N, 85.7W. Microfilm shows a low of at most 1008 mb centered near 18N, 85.5W. Ship highlights: 25 kt SE and 1004 mb (4 mb too low) at 19.5N, 83.5W (COA). One other low pressure from same ship. Land highlights: 10 kt E and 1005 mb at 18Z at Cozumel, Mexico (micro). Aircraft highlights: 35 kt SE at 14Z at 21.2N, 83.8W (micro). "A definite circulation was observed on the 20<sup>th</sup> when the disturbance was about 100 miles WNW of Swan Island" (MWR).

June 21:

HWM analyzes a closed low of at most 1005 mb centered near 21.5N, 86.2W. HURDAT lists this as a 40 kt tropical storm at 21.4N, 86.3W. The MWR tracks of centers of cyclones shows a position near 19.6N, 85W with a pressure of 1000 mb. The MWR post-season track map shows 00Z and 12Z positions near the HURDAT positions. Microfilm shows a low of at most 999 mb centered near the HURDAT position. Ship highlights: 20 kt SE and 1004 mb (4 mb too low) at 02Z at 18.5N, 83.5W (COA). Land highlights: 30 kt NW and 1005 mb at 12Z at Cozumel, Mexico (micro). Aircraft highlights: 35 kt S at 16Z at 21.0N, 86.3W (micro); 35 kt SW at 1645Z at 20.0N, 87.0W (micro). "The storm, attended by moderate gales and squalls, moved through the Yucatan Channel and into the Gulf of Mexico" (MWR).

June 22:

HWM analyzes a tropical storm of at most 1005 mb centered near 24.2N, 87.4W. HURDAT lists this as a 45 kt tropical storm at 24.5N, 86.5W. The MWR tracks of centers of cyclones shows a 00Z position near 21.7N, 85.5W and a 12Z position near 23N, 85W with a 999 mb pressure. The MWR post-season track map shows 00Z and 12Z positions near the HURDAT positions. Microfilm shows a low of at most 999 mb centered near 24.5N, 85.9W. Aircraft highlights: 40 kt ESE at 1345Z at 25.2N, 85.1W (micro). Two other gales.

June 23:

HWM analyzes a tropical storm of at most 1005 mb centered near 27.5N, 87W. HURDAT lists this as a 55 kt tropical storm at 27.2N, 86.2W. The MWR tracks of centers of cyclones shows a 00Z position near 25N, 85.3W and a 12Z position near 27N, 85.5W with a 999 mb pressure. The MWR post-season track map shows a 00Z position near 26.3N, 86.4W, and a 12Z position near 27.4N, 86.2W. Microfilm shows a low of at most 1002 mb centered near 27.4N, 86.9W. Aircraft highlights: 100 kt N and 997 mb at 2015Z at 28.3N, 85.5W (micro); 30 kt SSE and 1003 mb at 1245Z at 27.5N, 86.3W (micro); Eight other gales. One other low pressure. "It moved to the vicinity of 27.5N, 86.5W where it turned sharply northeastward and developed winds of full hurricane force as it approached the Florida coast. The crew of the reconnaissance plane which flew into the storm about 120 miles south of Apalachicola on the afternoon of the 23<sup>rd</sup>, estimated winds of 100 knots at two observation points near the center" (MWR).

June 24:

HWM analyzes a tropical storm of at most 1005 mb centered near 29.1N, 81.8W. HURDAT lists this as a 70 kt hurricane at 29.0N, 82.4W. The MWR tracks of centers of cyclones shows a 00Z position near 27.9N, 83.6W and a 12Z position near 28.5N, 82W with a 999 mb pressure. The MWR post-season track map shows 00Z and 12Z positions very close to HURDAT's position. Microfilm shows a low of at most 1002 mb centered in between the HWM and HURDAT positions. Ship highlights: 40 kt S and 1007 mb at 22Z at 29.5N, 79.5W (COA). Thirteen other gales between 35-40 kt. Land highlights: 45 kt SW and 1005 mb at 07Z at Tampa (micro); 52 kt at 08Z at Tampa, Florida (micro); 30 kt NNE and 1002 mb at 18Z at Jacksonville, FL (micro); 52 kt at 23Z at Tybee Island, Georgia (micro). Eight other gales and ten other low pressures. Aircraft highlights: 35 kt SE at 23Z at 30.5N, 78.0W (micro). One other gale. "The storm diminished in intensity as it reached the west coast of Florida and passed inland between Brooksville and Dunellon at about 4:00 am June 24. The circulation remained intact as the storm crossed the peninsula, attended by exceptionally heavy rains and winds of 45 to 55 miles per hour, moving into the Atlantic about noon of the 24<sup>th</sup> between Daytona Beach and St. Augustine" (MWR). "At the (Jacksonville) city office, the wind changed from northeast through north to northwest, with a maximum of 33 mph from the north at 3:01 pm EST of the 24<sup>th</sup> and an extreme of 35. The barometer did not register a decided rise until 6 pm. The wind damage at Jacksonville was slight, a few trees, wires and awnings blown down but total loss was probably less than \$500" (OMR). "A 24-hour rainfall total of 10.42 inches at Tampa broke all previous records at that station" (MWR). "Highest tide (at Tampa) was 5.2 feet about mean low water. The tropical storm was very beneficial to agriculture and caused only slight damage by wind and tides" (Tampa OMR). "Tropical Cyclones in Florida, 1945 June 24, N of Clearwater, Minimal ("Minimal" indicates winds of 74 to 100 mph, and 983 to 996 mb central pressure- Dunn and Miller). "1945 Jun FL, 1NW, 985 mb" – Jarrell et al.).

June 25:

HWM analyzes a tropical storm of at most 1000 mb centered near 32.5N, 79W. HURDAT lists this as a 60 kt tropical storm at 32.8N, 78.1W. The MWR tracks of centers of cyclones shows a 00Z position near 30.7N, 80.7W, and a 12Z position near 32N, 79W with a 998 mb pressure. The MWR post-season track map shows a 00Z

position near 31.1N, 80.2W and a 12Z position near HURDAT's position. Microfilm shows a low of at most 996 mb centered near 33N, 78.9W. Ship highlights: 40 kt SW and 1007 mb at 01Z at 29.5N, 79.5W (COA). Seven other gales. Land highlights: 57 kt ENE at 02Z at Tybee Island (32.0N, 80.9W) (micro); 35 kt NW and 1001 mb at 12Z at Charleston, SC (32.6N, 80.1W) (micro); 999 mb at 1230Z at Sullivans Island, SC (micro); 15 kt NE and 999 mb at 18Z at Myrtle Beach, SC (micro); 15 kt NNE and 998 at 18Z at Wilmington, NC (micro). Four other gales and six other low pressures between 998-1005 mb. Aircraft highlights: 40 kt NNW at 1645Z at 32.5N, 79.0W (micro). Two other gales. "Over the Atlantic it regained hurricane intensity, as indicated by reports of winds reaching 70 miles per hour in gusts at Tybee Island (Georgia) and Paris Island, while the center was moving northeastward some 60 miles offshore" (MWR). "Tropical Cyclones in the South Atlantic States – Carolinas and Georgia, 1945 June 25, N.C. Capes, Minor" ("Minor" indicates winds less than 74 mph and pressure above 996 mb – Dunn and Miller).

June 26:

HWM analyzes a hurricane of at most 995 mb centered near 38N, 73.3W with an approaching, but weakening cold front from the northwest. HURDAT lists this as a 50 kt tropical storm at 37.3N, 73.8W. The MWR tracks of centers of cyclones shows a 00Z position near 34N, 76.6W and a 12Z position near 36.5N, 74W with a 998 mb pressure. The MWR post-season track map shows a 00Z position near 35N, 76.1W and a 12Z position near 37N, 74W. Microfilm shows a low of at most 996 mb centered near 37.5N, 73.5W. Ship highlights: 40 kt N and 1003 mb at 13Z at 37.5N, 76.5W (COA); 40 kt S and 994 mb at 23Z at 38.5N, 68.5W (COA). Thirteen other gales and eleven other low pressures. Land highlights: 25 kt WNW and 989 mb at 6Z at Cape Hatteras, NC (micro); 48 kt NW around 08Z at Cape Hatteras, NC (OMR); 39 kt NE at 2330Z at Nantucket, MA (OMR). Six other gales and ten other low pressures. Aircraft highlights: 40 kt W at 1315Z at 36.0N, 72.5W (micro); 40 kt SW at 14Z at 37.7N, 71.0W (micro). Unknown highlights: 40 kt SSE and 997 mb at 38.2N, 69.6W (micro). Three other gales and two other low pressures. "It again lost force as it approached the North Carolina Capes, where the center passed over or very near Cape Hatteras about midnight of the 25<sup>th</sup> (5Z 26<sup>th</sup>), accompanied by winds of about 50 miles per hour. Indications are that for the third time, the storm regained hurricane intensity as it moved northeastward over the open waters of the north Atlantic" (MWR).

June 27:

HWM analyzes a hurricane of at most 995 mb centered near 41N, 69W with no frontal boundaries plotted anywhere near the hurricane. HURDAT lists this as a 55 kt tropical storm at 40.8N, 69.0W. The MWR tracks of centers of cyclones shows a 00Z position near 39N, 71.2W, and a 12Z position near 40.5N, 68.5W with a 997 mb pressure. The MWR post-season track map shows a 00Z position near 39N, 71.6W and a 12Z position near 40.8N, 69W. Microfilm shows a low of at most 990 mb centered near 40.5N, 67.5W. Ship highlights: 65 kt SSW and 997 mb at 1Z at 38.5N, 68.5W (COA); 60 kt SSW and 991 mb at 02Z at 38.5N, 68.5W (COA). Dozens of other gales and low pressures. Land highlights: 59 kt (1-min) NE at 0731Z at Nantucket, MA (OMR); 45 kt NE and 997 mb at 08Z at Nantucket, MA (OMR). Eleven other gales and three other low

pressures at Nantucket. “The center of the storm passed southeast of Nantucket during the night of the 26-27<sup>th</sup>, its forward movement considerably retarded. Gale winds prevailed at Nantucket from 7:00 pm EST of the 26<sup>th</sup> to 7:00 am EST of the 27<sup>th</sup>. Damage was mostly confined to the waterfront where high tides and northeast gales caused damage to a few small craft which were not adequately protected. Some trouble was also experienced from falling branches; power and communication lines in some sections suffered damage. The rainfall of 4.60 inches in 24 hours set a new record for June” (OMR). “The storm center reached a position south of Nova Scotia on the 27<sup>th</sup>, and thereafter weakened and dissipated” (MWR).

June 28:

HWM analyzes a tropical storm of at most 1000 mb centered near 41.9N, 66W with the western end of a W-E stationary front a few hundred miles east of the center. HURDAT lists this as extratropical with a 45 kt intensity at 42.2N, 62.6W. The MWR tracks of centers of cyclones shows a 00Z position near 40.6N, 66.5W and a 12Z position near 41N, 64.5W with a 999 mb pressure. The MWR post-season track map last shows this system at 00Z near 42.5N, 66.3W. Microfilm last shows this system at 06Z as a low of at most 999 mb with a position near 41N, 65.7W. Ship highlights: 35 kt WSW and 1003 mb at 06Z at 38.6N, 65.6W (micro). Six other gales and two other low pressures. Land highlights: 23 kt NNE and 1004 mb at 0030Z at Nantucket, MA.

June 29:

HWM analyzes a closed low of at most 1005 mb centered near 45N, 60W with a front extending from the low eastward. HURDAT lists this as extratropical with a 40 kt intensity at 44.1N, 60.0W. The MWR tracks of centers of cyclones shows a 00Z position near 41.4N, 62.9W and a 12Z position near 42.8N, 60.6W with a 1004 mb pressure. Ship highlights: 20 kt SSW and 1004 mb at 12Z at 44.0N, 60.0W (HWM); 35 kt SW and 1016 mb at 16Z at 41.5N, 55.5W (COA).

June 30:

HWM analyzes a closed low of at most 1005 mb near 48.5N, 50.8W at the west end of a dissipating front. HWM analyzes another low of at most 1005 mb embedded in a frontal zone near 53N, 50W. HURDAT lists this as extratropical with a 35 kt intensity at 51.7N, 50.7W. The MWR tracks for centers of cyclones shows a 00Z position near 45.2N, 57.3W and a 12Z position near 49N, 52W. Ship highlights: 20 kt SE and 1003 mb at 18Z at 55.5N, 44.0W (COA); 15 kt SSW and 1000 mb at 21Z at 55.5N, 44.0W (COA).

July 1:

HWM analyzes a large extratropical cyclone of at most 990 mb centered near 57.5N, 37.5W. HURDAT lists this as extratropical with a 35 kt intensity at 57.8N, 41.2W. Ship highlights: 20 kt W and 993 mb at 06Z at 55.5N, 44.0W (COA); 35 kt NNW and 1000 mb at 12Z at 55.5N, 44.0W (COA). Eleven other low pressures.

July 2:

HWM analyzes an occluded, extratropical cyclone of at most 985 mb centered near 61N, 33.5W. HURDAT does not list this system on this day. Ship highlights: 15 kt SSW and

983 mb at 12Z at 61.0N, 33.7W (HWM). Land highlights: 35 kt ENE and 1004 mb at 12Z at 65.5N, 37.8W (HWM).

July 3:

HWM analyzes an occluded, extratropical cyclone of at most 990 mb centered near 62.5N, 28.5W. Ship highlights: 25 kt W and 990 mb at 12Z at 60.8N, 32.4W (HWM).

July 4:

HWM analyzes an occluded low of at most 995 mb centered near 64N, 24W. Land highlights: 15 kt SSE and 993 mb at 12Z at 63.8N, 22.5W (HWM).

No changes were made to the timing of genesis of this system. Minor track changes were made on all days of its existence as a tropical cyclone, except for no alterations on the 22<sup>nd</sup>. The previous track had the storm center just barely clipping Cape Hatteras, but the new track is further west, taking the storm along the mainland coast of North Carolina, exiting at the north end of the Cape. Large alterations were made to the track on the 28<sup>th</sup> and 30<sup>th</sup> during the extratropical phase of the system. The largest track change was made to the position on the 30<sup>th</sup> when the position was moved about 2.5 degrees to the southwest, as warranted by available observations from COADS and HWM. Regarding the intensity changes, it is important to note that the original HURDAT had the intensity of this storm increasing from 55 kt at 12Z the 23<sup>rd</sup> to 100 kt at 18Z the 23<sup>rd</sup>, which is a change of 45 kt in 6 hours. There were two aircraft visual estimates of 100 kt surface winds around 18Z of the 23<sup>rd</sup> (micro), but the next highest wind observation on that day was 50 kt. There was a 997 mb pressure reported, but it is unclear whether that 997 mb pressure was reported at the same time as the 100 kt winds or was instead a central pressure. For either possibility, it is reasonable to assume that the 100 kt wind estimates are too high. Therefore, 85 kt is chosen at 18Z on the 23<sup>rd</sup> (previously 100 kt), which is analyzed to be the peak intensity of the hurricane. The 12Z intensity is boosted from 55 to 70 kt.

The hurricane made landfall around 08Z on the 24<sup>th</sup>, north of Tampa, FL around 28.6N, 82.7W. The system made landfall in a fairly data sparse portion of Florida, with lowest peripheral pressure observed of 1002 mb in Jacksonville, (after passed over the peninsula) and highest winds of 52 kt in Tampa. Based upon the modest impacts observed, 70 kt is analyzed as the landfall intensity – retaining the system as a category 1 hurricane. This is slightly weaker (80 kt) than originally indicated in HURDAT. Using the Brown et al. pressure-wind relationship for N of 25N to back out the pressure, this suggests a central pressure at landfall of 982 mb for all systems and 984 mb for those cyclones that are weakening. Given the 985 mb central pressure reported in Jarrell et al., this value is retained as the landfall pressure. (It is worth noting that Ho et al. did not include this hurricane on their U.S. landfalling hurricanes list, as their criteria was of less than 982 mb central pressure.) Employing the Kaplan and DeMaria inland decay model, the intensity at 12Z yields a value of 52 kt, while highest observed within 2 hours of synoptic time was 40 kt from a ship. 50 kt is chosen for 12Z, which is a major intensity change downward from the 70 kt originally in HURDAT. After oceanfall back to the Atlantic Ocean, the original HURDAT had the system reintensifying back into a minimal

hurricane. 57 kt ENE wind at Tybee Island early on the 25<sup>th</sup> north of the system would support stronger winds near the center, so this restrengthening was retained.

A second US landfall occurred around 01Z on the 26<sup>th</sup> near Cape Lookout, NC near 34.7N, 76.6W. Highest observed winds were 48 kt NW at 08Z at Cape Hatteras and lowest pressure of 989 mb with 25 kt WNW winds at 06Z. This pressure suggests winds of at least 61 kt from the north of 25N Brown et al. pressure-wind relationship and at least 64 kt from the Landsea et al. north of 35N pressure-wind relationship. 70 kt is analyzed as the intensity at the time of landfall and closest approach (06Z) to Cape Hatteras. This is a major increase from the original 50 and 45 kt, respectively, in HURDAT. However, because the cyclone's track had it skirting the coast, the strongest winds likely remained offshore. Highest estimated winds along the North Carolina coast are estimated to be 60 kt – or just below hurricane force. This is consistent with the assessment previously by MWR, Dunn and Miller, and Jarrell et al. that it was not a hurricane at the coast of North Carolina. After moving past North Carolina, the system again traversed the Atlantic Ocean. Two ship reports of 60 kt (with 991 mb pressure) and 65 kt (with 997 mb pressure) early on the 2<sup>nd</sup> indicate that the system still retained hurricane intensity on this date. Winds are boosted from 60 to 65 kt at 00Z. Early on the 27<sup>th</sup>, the system began transitioning to an extratropical cyclone and 06Z on the 27<sup>th</sup> is now indicated as the time of transition, which is 18 hours earlier than indicated previously in HURDAT based upon a fairly numerous amount of ship and coastal observations. It is of note that Nantucket, MA received 59 kt sustained winds at 0731Z on the 27<sup>th</sup>, after the system had become extratropical. Hurricane-force winds as an extratropical cyclone were kept until 12Z on the 27<sup>th</sup>. A significant addition is made to the end of the storm during the extratropical phase. Available observations indicate that the system could be tracked as a separate cyclone until 4 July, which adds an additional three days to the HURDAT track.

## 1945 Storm 2

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32795 07/19/1945 M= 4 2 SNBR= 725 NOT NAMED XING=0 SSS=0
32800 07/19* 0 0 0 0*255 924 35 0*260 925 40 0*265 926 40 0*
32800 07/19* 0 0 0 0*257 900 30 0*260 908 30 0*263 915 30 0*
          *** *** **          *** **          *** *** **

32805 07/20*270 928 45 0*275 931 45 0*279 934 45 0*282 939 45 0*
32805 07/20*266 922 35 0*268 928 35 0*270 934 35 0*273 939 35 0*
          *** *** **          *** *** **          *** **          *** **

32810 07/21*282 948 45 0*281 951 40 0*278 957 40 0*274 965 35 0*
32810 07/21*276 944 35 0*278 949 35 0*278 954 35 0*276 958 35 0*
          *** *** **          *** *** **          *** **          *** ***

32815 07/22*269 975 25 0*262 982 15 0* 0 0 0 0* 0 0 0 0*
32815 07/22*272 962 30 0*269 969 25 0*268 978 20 0* 0 0 0 0*
          *** *** **          *** **          *** *** **

32820 TS

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Major track changes but only minor intensity changes were implemented with this Gulf of Mexico tropical storm. Evidence for these alterations comes from the Historical

Weather Map series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

July 18:

HWM analyzes a spot low near 24.5N, 91. HURDAT does not list a system on this day. Microfilm shows a closed low of at most 1011 mb centered in the general vicinity of 26.7N, 90.4W. No gales or low pressures.

July 19:

HWM analyzes a closed low of at most 1010 mb centered near 25.7N, 93.1W. HURDAT lists this as a 40 kt tropical storm at 26.0N, 92.5W. The MWR tracks of centers of cyclones shows a position near 24N, 93W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1008 mb centered well north of the HURDAT position near 28N, 93.3W. No gales or low pressures. "This slight disturbance formed in the western Gulf of Mexico from a wave in the easterlies, and, through reconnaissance flights, a complete circulation was verified July 19" (MWR).

July 20:

HWM analyzes a low of at most 1010 mb centered near 27.6N, 92.1W. HURDAT lists this as a 45 kt tropical storm at 27.9N, 93.4W. The MWR tracks of centers of cyclones shows a 00Z position near 25.9N, 92.7W and a 12Z position near 27.6N, 92.5W. The MWR post-season track map shows 00Z and 12Z positions near the HURDAT position. Microfilm shows a broad low of at most 1011 mb centered in the general vicinity of 26.8N, 93.5W. No gales or low pressures. "Pilot balloon reports from stations along the coast later indicated that the circulation existed to at least 15,000 feet and probably extended to 20,000 feet. Despite this deep circulation, the disturbance remained weak throughout its 3-day history, and it is not likely that gales over 45 to 50 miles per hour were associated with it at the time of its greatest development" (MWR).

July 21

HWM analyzes a spot low in a trough near 27N, 94W. HURDAT lists this as a 40 kt tropical storm near 27.8N, 95.7W. The MWR tracks of centers of cyclones shows a 00Z position near 28.2N, 93.6W and a 12Z position near 28.5N, 95W. The MWR post-season track map shows a 00Z position near 28N, 94.3W and a 12Z position near the HURDAT position. Microfilm shows a low of at most 1008 mb centered near 27.3N, 95.1W. No gales or low pressures. "Occasional squalls and rough seas were encountered along the coast from Grand Isle, La., to Port Aransas, Tex." (MWR).

July 22:

HWM analyzes a low of at most 1010 mb inland near 23.5N, 100W. HURDAT last lists this system at 06Z as a 15 kt tropical depression at 26.2N, 98.2W. The MWR post-season track map last shows this system at 00Z near 26.8N, 97.2W. No gales or low pressures. "By the time the center moved inland, the storm had dissipated to such an extent that only fresh winds and a few scattered squalls were reported" (MWR).

Genesis of this system was unchanged. The original track of this tropical cyclone is an “n” shape between the 19<sup>th</sup> and 22<sup>nd</sup>. On the 19<sup>th</sup>, the track displays a more northward motion, with a sharp turn to the west the 20<sup>th</sup>, southwest on the 21<sup>st</sup>, and south-southwest on the 22<sup>nd</sup>. The revised track shows the storm starting farther east, with a slow west-northwestward motion followed by a 30 degree turn to left (a west-southwestward motion). The change at 06Z on the 19<sup>th</sup> at the initial point constitutes the only major change to the track of the cyclone. The remainder of the track changes are minor revisions. There are no available observations of gale force with this storm even though these observations were apparently close to the center. Development of the cyclone into a tropical storm is delayed 18 hours to 00Z on the 20<sup>th</sup>. Additionally, the 45 kt peak intensity is lowered to 35 kt on the 20<sup>th</sup> and 21<sup>st</sup>. In agreement with MWR, the revised HURDAT shows the cyclone weakening to a 25 kt tropical depression before landfall in Texas around 09Z on the 22<sup>nd</sup>. Once the storm weakened to a depression, a slower dissipation is analyzed. Six hours were added to the end of this storm as a closed circulation was still evident at 12Z on the 22<sup>nd</sup>, but the intensity at this time was 20 kt.

### 1945 Storm 3

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32825 08/01/1945 M= 4 3 SNBR= 726 NOT NAMED XING=0 SSS=0
32825 08/02/1945 M= 3 3 SNBR= 726 NOT NAMED XING=0 SSS=0
      ** *
(The 1st is removed from HURDAT.)
32830 08/01* 0 0 0 0*121 563 35 0*127 572 35 0*131 577 35 0*
32835 08/02*136 583 40 0*141 589 40 0*145 597 40 0*150 607 45 0*
32835 08/02*136 583 35 0*141 589 40 0*145 597 40 0*150 607 45 0*
      **
32840 08/03*156 620 45 0*161 633 50 0*166 647 50 0*169 662 50 0*
32845 08/04*172 675 50 0*176 687 45 0*180 698 35 0*184 709 25 0*
32845 08/04*172 675 50 0*176 687 50 0*181 700 50 0*187 713 30 0*
      ** *** ** *** **
32850 TS

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Minor track and intensity changes are implemented with this tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### July 31:

HWM analyzes a low, not closed, in a trough of low pressure near 10N, 54.5W. HURDAT does not list this system on this day. No gales or low pressures.

#### August 1:

HWM analyzes a closed low of at most 1010 mb centered near 12.2N, 57.3W. HURDAT lists this as a 35 kt tropical storm at 12.7N, 57.2W. Aircraft highlights: 40 kt E at 1545Z at 15.0N, 54.9W (micro). Two other aircraft gales. “The disturbance appeared east of the Lesser Antilles on August 1” (MWR).

#### August 2:

HWM analyzes a low of at most 1010 mb centered near 13.5N, 60.8W. HURDAT lists this as a 40 kt tropical storm at 14.5N, 59.7W. The MWR post-season track map shows a

position near 14.7N, 59.7W. Microfilm shows a low of at most 1008 mb centered near 14.8N, 59.3W. Aircraft highlights: 40 kt E at 18Z at 15.5N, 58.5W (micro). One other gale. "...moved west-northwestward between the islands of Guadeloupe and Dominica on the 2nd..." (MWR).

August 3:

HWM analyzes a low of at most 1010 mb centered near 16.7N, 64.8W. HURDAT lists this as a 50 kt tropical storm at 16.6N, 64.7W. The MWR post-season track map shows a 00Z position near 15.8N, 62.5W and a 12Z position near 16.5N, 65.2W. Microfilm shows a low of at most 1005 mb near 16.5N, 65W. No gales or low pressures. "...and during the 3<sup>rd</sup> passed south of Puerto Rico." (MWR).

August 4:

HWM analyzes a low of at most 1010 mb centered near 18N, 69.5W. HURDAT lists this as a 35 kt tropical storm at 18.0N, 69.8W. The MWR post-season track map shows a 00Z position near 17.5N, 67.8W and a 12Z position near 18.2N, 69.5W. Microfilm shows a low of at most 1005 mb centered near 18.6N, 69.7W. No gales or low pressures. "It crossed the southern coast line of the Dominican Republic west of Ciudad Trujillo on the 4<sup>th</sup> and dissipated as it moved inland. No winds over Beaufort force 9 (47 to 54 mph) accompanied the storm at any stage" (MWR).

HURDAT started this storm at 06Z on 1 August. However, there is sufficient aircraft data that indicate that the low was not closed until 00Z on the 2<sup>nd</sup>, at which time the storm was accompanied by 35 kt winds. The only track changes were made to the last two points, at 12 and 18Z on the 4<sup>th</sup>. The position is shifted slightly to the northwest, close to and inland over Hispaniola, respectively. Peak winds of 50 kt on the 3<sup>rd</sup> and 4<sup>th</sup> are unchanged. The largest intensity change was 10 kt stronger, at 12Z on the 4<sup>th</sup>. Santo Domingo received observed winds of at least 30 kt, and that city may have been close to the RMW around 14Z, but this is uncertain. The storm was still over water at this time, so a continuity of 50 kt up until landfall around 14Z on the 4<sup>th</sup> is employed instead of 35 kt, as indicated originally in HURDAT.

#### 1945 Storm 4

32855	08/17/1945	M= 5	4	SNBR= 727	NOT NAMED	XING=0	SSS=0						
32860	08/17*	0	0	0	0*	0	0	0	0*	0	0	0	0*174 553 35 0*
32860	08/17*	0	0	0	0*	0	0	0	0*	0	0	0	0*174 535 35 0*
													***
32865	08/18*177	564	45		0*179 575 50			0*182 585 55		0*185 596 60			0*
32865	08/18*177	549	45		0*179 564 55			0*182 580 65		0*185 597 65			0*
		***			*** **			*** **		*** **			**
32870	08/19*189	608	60		0*194 624 55			0*200 642 50		0*205 657 50			0*
32870	08/19*188	615	60		0*192 633 55			0*196 650 50		0*201 667 50			0*
		*** **			*** **			*** **		*** **			**
32875	08/20*210	672	45		0*215 688 40			0*219 705 40		0*225 723 35			0*
32875	08/20*206	683	45		0*211 699 40			0*214 716 40		0*216 732 35			0*
		*** **			*** **			*** **		*** **			**
32880	08/21*231	743	30		0*236 760 25			0* 0 0 0		0* 0 0 0			0*

32880 08/21\*218 748 30 0\*220 765 25 0\* 0 0 0 0\* 0 0 0 0\*

\*\*\* \*\*

32885 TS  
32885 HR  
\*\*

Minor track changes and minor intensity changes were implemented with this storm, although the peak intensity is changed from 60 to 65 kt, making this a hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### August 17:

HWM analyzes a low, not closed, in a trough of low pressure near 15N, 54.5W. HURDAT first lists this system at 18Z as a 35 kt tropical storm at 17.4N, 55.3W. No gales or low pressures. “When first detected by aircraft reconnaissance on August 17, this storm was centered near latitude 17-18 N, longitude 53-54 W, and showed a circulation with highest winds of Beaufort force 7 to 8 (32 to 54 mph)” (MWR).

#### August 18:

HWM analyzes a low, not closed, in a trough of low pressure near 18N, 57.5W. HURDAT lists this as a 55 kt tropical storm at 18.2N, 58.5W. The MWR post-season track map shows a position near 18N, 58W. Microfilm shows a low of at most 999 mb centered near 18.5N, 58.5W. Aircraft highlights: 65 kt E at 1330Z at 19.3N, 58.2W (micro). Five other aircraft gales. “It reached its greatest development on August 18, when reconnaissance reported winds of 65 knots in the vicinity of latitude 19N, longitude 61W. From this point, it began to lose intensity as it continued on a west-northwest course” (MWR).

#### August 19:

HWM analyzes a low, not closed, in a trough of low pressure near 21N, 64.5W. HURDAT lists this as a 50 kt tropical storm at 20N, 64.2W. The MWR post-season track map shows a 00Z position near 19N, 61.4W and a 12Z position near 19.8N, 64.5W. Microfilm shows a low of at most 1005 mb near 20N, 65W. Aircraft highlights: 40 kt E at 1345Z at 21.4N, 64.5W (micro). Two other gales.

#### August 20:

HWM analyzes a closed low of at most 1010 mb near 20.8N, 70.2W. HURDAT lists this as a 40 kt tropical storm at 21.9N, 70.5W. The MWR post-season track map shows a 00Z position near 21N, 67.7W and a 12Z position near 22N, 71.5W. Microfilm shows a low of at most 1011 mb centered near 21.4N, 71.1W. Aircraft highlights: 35 kt E at 2030Z at 23.1N, 72.8W (micro). One other gale. “By the morning of the 20<sup>th</sup>, when the center reached the vicinity of Turks Island, the highest winds were only 35 to 40 mph” (MWR).

#### August 21:

HWM does not analyze a closed low, in fact it only analyzes a weak trough. HURDAT last lists this system at 6Z as a 25 kt tropical depression at 23.6N, 76.0W. The MWR

post-season track map last shows this at 00Z near 22.7N, 74.7W. Microfilm also just analyzes a weak trough. No gales or low pressures. "Dissipation took place over the ocean between Cuba and the Bahama Islands during the night of August 20-21" (MWR).

No changes were made to the genesis of this cyclone. Throughout the lifetime of this system, the track had minor adjustments made to it. On the 19<sup>th</sup> through the 21<sup>st</sup>, the new track is slightly to the south and west of the HURDAT track. These changes were made mostly based on observations from microfilm and HWM. On the 18<sup>th</sup>, the intensity is increased slightly to a minimal hurricane compared with 60 kt originally due to an aircraft observation of estimated surface winds of 65 kt, which is now the peak intensity of the system. Weakening in accordance with HURDAT follows beginning on the 19<sup>th</sup> with no further changes because there are no additional wind speed observations higher than the HURDAT intensity. No changes were made to the dissipation of this cyclone.

1945 Storm 5 (note: this storm was reanalyzed prior to my work, so I did not write the metadata for this storm)

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32130 08/24/1945 M= 6 5 SNBR= 712 NOT NAMED XING=1 SSS=2
32135 08/24* 0 0 0 0*194 940 60 0*209 947 60 0*216 952 65 0*
32135 08/24*205 944 40 0*213 947 45 0*220 950 50 0*226 953 55 0*
      *** **
32140 08/25*224 957 70 0*234 961 75 0*243 964 80 0*249 966 85 0*
32140 08/25*233 956 60 0*240 958 70 0*247 960 80 0*253 962 85 0*
      *** **
32145 08/26*254 967 90 0*260 968 95 0*266 968 100 0*270 968 105 0*
32145 08/26*259 964 90 0*265 966 95 0*270 968 95 0*273 969 95 0*
      *** **
32150 08/27*273 968 110 0*278 965 115 0*282 962 115 963*286 961 120 966*
32150 08/27*275 969 95 0*278 968 95 0*281 967 95 963*285 964 90 966*
      *** **
32155 08/28*291 960 120 968*295 960 65 980*299 961 50 987*306 964 40 993*
32155 08/28*290 961 75 0*295 960 65 980*300 961 50 987*305 963 40 993*
      *** **
32160 08/29*310 966 35 998*315 971 30 1002*318 975 25 1006*321 979 20 1009*

32165 HRBTX2
32165 HRATX2BTX2CTX1
      ****

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U.S. Landfall: 8/27/1945 ~16 UTC - 28.3N, 96.6W - 18 nmi RMW - 963 mb - 95 kt

Minor changes to the track and major changes to the intensity shown in Neumann et al. (1999). Evidence for these alterations comes from the Historical Weather Map series, Monthly Weather Review, daily Surface Weather Observations from NCDC, U.S. Weather Bureau six hourly maps available via microfilm at NHC, the Daily Weather Map series, the COADS ship database, Connor (1956), Dunn and Miller (1960), Schwerdt et al. (1979), Ho et al. (1987), and Jarrell et al. (1992).

August 24:

HWM indicates a closed low of at most 1010mb near 25N, 95W. HURDAT lists this as a Tropical Storm at 20.9N, 94.7W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 21.8N, 94.9W (a.m.) and at 23.2, 95.5W (p.m.). Ship highlight: No gales or low pressures. Station highlight: No gales or low pressures. Aircraft highlight: 50kt at 21N, 93W at 1530 UTC (USWB). "The storm formed in an area of squalls which had persisted for several days over the Gulf of Campeche, near latitude 21.5N, longitude 95W. It rapidly developed into a hurricane during the morning of August 24 and began a northward movement at a rate of 8 to 10 mph. This rate of forward movement continued during the 24th and the 25th" (MWR).

#### August 25:

HWM indicates a storm with a center at approximately 26N, 96W. HURDAT lists this as a Category 1 hurricane at 24.3N, 96.4W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 24.8N, 96W (a.m.) and at 25.9N, 97W (p.m.). Ship highlight: 35 kt E with pressure of 1011mb at 24N, 92W at 0630 UTC (USWB). Station highlight: 39 kt NNE and 1006 mb at Port Isabel at 1830 UTC (USWB). Aircraft highlight: 75-80 kt NW at 25N, 96.3W at 1140 UTC (USWB).

#### August 26:

HWM indicates a storm with a center at approximately 26.5N, 97W. HURDAT lists this as a Category 3 hurricane at 26.6N, 96.8W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 27N, 96.5W (a.m.) and at 28.3N, 96W (p.m.) Ship highlight: No gales or low pressures. Station highlight: 72 kt NNE with pressure at 995mb at Corpus Christi at 2200 UTC (SWO). Aircraft highlight: 43 kt SE at 27N, 96.8W at 1745 UTC (USWB). "As the storm neared the coast on the 26th, the speed of translation dropped to about 5 mph, a rate which was maintained until the center moved inland near Port Aransas" (MWR). "Estm. position storm at 25.7 96.4 intensity 105 mph" at 0030 UTC (USWB).

#### August 27:

HWM indicates a closed low of at most 1005mb near 28N, 97W. HURDAT lists this as a Category 4 hurricane at 28.2N, 96.2W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 28.9N, 96.5W (a.m.) and at 29.9N, 96.3W (p.m.) Ship highlight: No gales or low pressures. Station highlight: 967 mb (possible central p pressure?) at Palacios at 2000 UTC (SWO); 91 kt E-W at 1930-2130 UTC and 968 mb pressure (peripheral - though no time given) at Port O'Connor (MWR). Aircraft highlight: 48 kt SSE at 27.3N, 95.9W at 1400 UTC (USWB). "Winds accompanying the storm were estimated as high as 135 miles per hour at Seadrift, Port O'Connor, and Port Lavaca... At [Port Aransas] a 20-minute lull in the wind between 1 a.m. and 2 a.m. on the 27th indicated passage of the calm eye of the storm. On the 27th the center also passed a short distance south of Seadrift, Tex., at about 10 a.m., and slightly north of Port O'Connor about 11 a.m. Neither place experienced a calm, although they are only 19 miles apart" (MWR). "Also, the lowest reliable barometer reading was recorded at Camp Hulen, Palacios, Tex., on August 27 about 3 p.m. It was 28.57 inches (967.5 mb), only 0.02 inch higher than the low reported for Galveston in the disastrous hurricane of September 8, 1900" (MWR). "Three deaths were attributed directly to the

hurricane: two men were drowned at Port Isabel when their small boat crashed into the jetties, and one person was killed about eight miles north-northeast of Houston in a small tornado that developed in the storm circulation on August 27" (MWR). "Tropical Cyclones in Texas - Aug. 26-27 - Middle Coast - Extreme [Category 4 or 5] - 3 killed - \$20,133,000 in damage" (Dunn and Miller). "Aug. 27 - 968 mb central pressure - 18 nmi RMW - 4 kt forward speed - landfall position 28.5N 96.2W" (Ho et al.). "1005 mb environmental pressure - 80 kt maximum sustained surface wind at landfall" (Schwerdt et al.). "TX - Category 2 - Central coast - 967 mb central pressure at landfall" (Jarrell et al.). "Center crossed coast near Palacios, 967 mb minimum central pressure" (Connor). "Reconnaissance flights by military planes into the vicinity of the hurricane while it was in the Gulf of Mexico greatly aided in determining the position and future movements of the storm. Without the information obtained from these flights, it would have been difficult if not impossible to issue advisories as accurately and so far in advance as was the case with this storm. Reconnaissance pilots located the storm in the Bay of Campeche and determined its dangerous character well before these facts would have been known otherwise" (Daily Weather Map series).

#### August 28:

HWM indicates a small low near 29N, 96W. HURDAT lists this as a Tropical Storm at 29.9N, 96.1W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 31N, 97W (a.m.) and at 31.3N, 97.5W (p.m.). Ship highlight: No gales or low pressures. Station highlight: 976mb at Bay City between 3 and 4 UTC (MWR). Aircraft highlight: No gales or low pressures. "Slow progression accounted for excessive precipitation along the coast and for a considerable distance inland. At Houston, for instance, 9.39 inches fell in a 6-hour period ending at 2:30 a.m., August 28. Rainfall along the coast, estimated as high as 30 inches, added to the flooding and damage caused by the wind-impounded waters of the Gulf" (MWR). "The storm decreased slightly in intensity as it moved inland, but winds of hurricane force were still reported over a small area near the center early on the 28th" (Daily Map Series).

#### August 29:

HWM indicates a closed low at approximately 31N, 98W. HURDAT lists this as a Tropical Depression at 31.8N, 97.5W at 12 UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center 32N, 98.5W (a.m.) and at 32.5N, 99W (p.m.). Ship highlight: No gales or low pressures. Station highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures. "Continuing a northeastward movement parallel to the coast, the storm began to recurve toward the northwest as it passed west of Matagorda and dissipated in the interior of Texas on the 29th" (MWR).

Genesis begun six hours earlier (at 00 UTC on the 24th) to account for a well developed vortex by the time aircraft reconnaissance reached the system around 14 UTC on the 24th. This change also corrects for an unrealistically abrupt movement in the system's first six hours and for a more gradual spin-up than starting the system at 60 kt. Small track changes are introduced for all but the 29th based upon aircraft reconnaissance and land station data. (Due to World War II, little ship observations were available operationally or from COADS.) Intensity originally was quickly brought up from a

tropical storm on the 24th, to a Category 1 on the 25th, to a Category 3 on the 26th, to a Category 4 on the 27th until landfall. Aircraft observations - which were relying upon estimates of wind from visual assessments of the wind effects on the ocean - did suggest that hurricane force was reached on the 25th. However, the aircraft reconnaissance did not provide any central pressure readings, or any confirmation of Category 3 or 4 winds. The most complete analysis of its intensity was at landfall, which was then used to adjust winds during the preceding two days.

The hurricane made landfall 28.3N 96.6W between Seadrift and Port O'Connor, Texas around 16 UTC on the 27th. Despite numerous reports of estimated (visually) wind gusts of up to about 120 kt, the highest observed winds were 91 kt at Port O'Connor. A possible central pressure of 967 mb was recorded at Palacios around 20 UTC, about four hours after landfall. Utilizing the Ho (1987) inland pressure decay model, this suggests a central pressure of 963 mb using the Florida peninsula version (to account for the hurricane primarily passing over Matagorda Bay after making initial landfall on the Texas barrier islands. 963 mb is slightly lower than the Ho et al. and Jarrell et al. estimate of 967 mb, which essentially assumed that the Palacios reading was a landfall value. 963 mb suggests winds of 97 kt from the Gulf of Mexico pressure-wind relationship. Given the slow speed of motion for this system at landfall (about 5 kt) and its near climatological RMW size (18 nmi versus 20 nmi climatologically from Vickery et al. 2000), 95 kt is chosen for the maximum sustained winds at landfall. This agrees with the Jarrell et al. and HURDAT assessment of Category 2, but requires a reduction in winds on the 26th and 27th. Due to observed hurricane conditions along a large stretch of the coast because of the near-parallel track, Category 1 impacts are also included for south Texas coast (south of Corpus Christi) and the north Texas coast (north of Matagorda Bay). Peak observed winds after landfall were 39 kt at 00 UTC on the 28th, 35 kt at 06 UTC, and below gale force at 12 UTC. Application of the Kaplan and DeMaria (1995) inland decay model suggests winds of 65 kt, 49 kt, and 39 kt, accordingly. Because of the transit of the system over a partial water terrain for the first few hours after landfall, winds are chosen above the model, though at 00 UTC the winds chosen are substantially lower than originally in HURDAT. Additionally, keeping the system hurricane force through 06 UTC on the 28th agrees with the assessment described in the Daily Map Series. No changes were made to the decay phase of the system. Unlike most hurricanes of its era, estimates had already been provided of the central pressure from just before landfall up until final dissipation. All of these value looked reasonable (including the pre-landfall one which agreed exactly with our landfall central pressure), except for 00 UTC on the 28th which appears to be a few millibars too low.

## 1945 Storm 6

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32930 08/29/1945 M= 4 6 SNBR= 729 NOT NAMED XING=0 SSS=0
32935 08/29* 0 0 0 0*130 826 35 0*142 818 35 0*148 815 40 0*
32935 08/29* 0 0 0 0*136 823 35 0*142 818 35 0*148 815 40 0*
          *** **
32940 08/30*155 813 40 0*164 815 45 0*172 822 50 0*176 832 50 0*
32945 08/31*177 844 50 0*178 859 45 0*177 873 40 0*174 886 35 993*
32945 08/31*177 844 55 0*178 856 55 0*177 869 60 0*174 882 60 990*
          **          *** **          *** **          *** **

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32950 09/01*172 894 25 0*167 906 20 0* 0 0 0 0* 0 0 0 0*
32950 09/01*172 894 40 0*171 904 30 0*170 913 25 0*170 920 25 0*
**          *** **          *** **          *** **          *** **

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32955 TS

Minor track changes and major intensity changes are introduced for this strong tropical storm that made a landfall at Belize City, Belize. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

August 29:

HWM analyzes a low of at most 1010 mb centered near 14N, 82W. HURDAT lists this as a 35 kt tropical storm at 14.2N, 81.8W. No gales or low pressures.

August 30:

HWM analyzes a low, not closed, in a trough near 16.8N, 82.3W. HURDAT lists this as a 50 kt tropical storm at 17.2N, 82.2W. The MWR post-season track map shows a position near 17.4N, 82.2W. Microfilm, although showing a closed low at 00Z, does not show a closed low, but a trough instead. No gales or low pressures. "This disturbance formed in the Caribbean Sea east of Belize on the 30<sup>th</sup> and moved westward into British Honduras" (MWR).

August 31:

HWM does not analyze a low, but does analyze a strong trough that is almost closed off. HURDAT lists this as a 40 kt tropical storm at 17.7N, 87.3W. The MWR post-season track map shows a 00Z position near 17.8N, 84.2W and a 12Z position near 18N, 87.3W. Microfilm shows a low of at most 996 mb centered near 17.7N, 86.8W. Ship highlights: 40 kt E at 7Z at 20.0N, 84.5W (micro). Land highlights: Calm and 990 mb at Belize City (17.4N, 88.2W) around 1730 UTC (MWR); 993 mb at 1930Z at Belize City (MWR). Aircraft highlights: 50 kt E at 1530Z at 17.7N, 87.4W (micro). Three other gales. "Belize, over which the center passed on the 31<sup>st</sup>, reported an almost complete calm at 12:30 pm and a low pressure of 29.33 inches (993 mb) at 2:30 pm. Winds of hurricane force did not accompany the storm at the surface, but it is believed that velocities of 60 mph marked its entire course. Actual wind damage was slight, but excessive rains and high tides resulted in flooding portions of Belize 2 to 3 feet" (MWR).

September 1:

HWM analyzes a low, not closed, located in a trough near 18N, 88.5W. HURDAT last lists this system at 6Z as a 20 kt tropical depression at 16.7N, 90.6W. The MWR post-season track map last shows this system at 00Z near 17.4N, 89.5W. Microfilm shows a low of at most 1005 mb centered in the general vicinity of 17.3N, 90.7W. No gales or low pressures. Regarding the storm tide... "Disturbance inland. Water over sea wall at Belize City. Three feet of water in the street" (Sep 01 0030Z Microfilm).

There were no changes made to the genesis of this system. The first position on the 29<sup>th</sup> was adjusted to provide a more realistic initial motion. The other track changes introduced for the 31<sup>st</sup> and 1<sup>st</sup> were near and after the time of landfall. On the 31<sup>st</sup>, the

12Z and 18Z positions are shifted about half a degree to the east based on available observations from HWM and microfilm. The system made landfall around 18Z on the 31<sup>st</sup> near Belize City. There were observations of 50 kt at the surface from aircraft just prior to landfall, but a 990 mb central pressure was recorded at Belize City as the center passed overhead. 990 mb gives 64 kt from the Brown south of 25N pressure-wind relationship. The size and speed of the storm are about average. 60 kt is chosen since damage reports indicate that wind damage was slight and the MWR text suggests that winds of hurricane force did not accompany this storm at the surface. However, this system may have been a minimal hurricane. Major intensity changes were thus made at these 12 and 18Z times on the 31<sup>st</sup>. The 12Z intensity is changes from 40 kt to 60 kt, and the 18Z intensity is changed from 35 kt to 60 kt. A run of the Kaplan-DeMaria inland decay model suggests winds of 42 kt for 00Z on the 1<sup>st</sup>. 40 kt (up from 25 kt originally) is indicated at this point. Dissipation of the system is delayed 12 hours to 00Z on the 2<sup>nd</sup>, as observations indicate that a closed circulation existed longer than originally listed.

### 1945 Storm 7

```
32960 09/03/1945 M= 4 7 SNBR= 730 NOT NAMED XING=1 SSS=0
32960 09/02/1945 M= 5 7 SNBR= 730 NOT NAMED XING=1 SSS=0
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(The 2<sup>nd</sup> is new to HURDAT.)

```
32962 09/02* 0 0 0 0* 0 0 0 0*170 858 25 0*177 857 25 0*
32965 09/03* 0 0 0 0* 0 0 0 0* 0 0 0 0*200 840 35 0*
32965 09/03*184 855 25 0*192 853 25 0*200 851 25 0*210 846 30 0*
*** ** ** *** ** ** *** ** ** *** ** **
32970 09/04*216 833 35 0*234 825 35 0*247 821 35 0*257 821 35 0*
32970 09/04*221 838 35 0*232 828 35 0*244 821 35 0*255 820 40 0*
*** ** ** *** ** ** *** ** ** *** ** **
32975 09/05*267 823 35 0*279 838 35 0*287 854 30 0*291 869 30 0*
32975 09/05*265 821 40 0*275 838 35 0*285 860 30 0*293 875 30 0*
*** ** ** *** ** ** *** ** ** *** ** **
32980 09/06*295 883 30 0*303 896 25 0*311 908 20 0*319 919 15 0*
32980 09/06*300 888 30 0*307 898 25 0*313 908 25 0*319 919 20 0*
*** ** ** *** ** ** *** ** ** *** ** **
32985 TS

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### U.S. Landfall:

9/5/1945 - 0000Z - 26.5N 82.1W – 40 kt

Minor track changes and minor intensity changes are implemented with this minimal tropical storm. A major alteration is made to the genesis, at it begun 30 hours earlier than originally indicated. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, the Original Monthly Records from NCDC, and NHC microfilm of synoptic weather maps.

### September 2:

HWM analyzes a tiny closed low of at most 1010 mb near 15N, 82.5W. HWM also analyzes a trough of low pressure extending from north of Honduras southward and

westward into the east Pacific. HURDAT does not list a system on this day. Microfilm does not plot a closed low. No gales or low pressures (the one ship that reports low pressures is biased 4 to 5 mb too low).

#### September 3:

HWM analyzes a low of at most 1010 mb centered near 19.5N, 84.1W. HURDAT first lists this system at 18Z as a 35 kt tropical storm at 20.0N, 84.0W. The MWR tracks for centers of cyclones has a 12Z position near 19N, 84W. Microfilm shows a very broad low with a 1011 mb contour closed off over the western Caribbean and Yucatan Peninsula. No gales or low pressures.

#### September 4:

HWM analyzes a large, elongated low of at most 1010 mb with the "L" plotted near 24.6N, 83.1W. HURDAT lists this as a 35 kt tropical storm at 24.7N, 82.1W. The MWR tracks for centers of cyclones has a 00Z position near 21.6N, 82.9W and a 12Z position near 24.2N, 82W. The MWR post-season track map shows a 00Z position near 21.7N, 83.9W and a 12Z position near the HWM position. Microfilm shows a position near the HURDAT position. Highlights: 35 kt S and 1009 mb at 18Z near Marathon, FL (micro); 40 kt S and 1010 mb at 18Z near Islamorada, FL (micro); 35 kt SE and 1010 mb at 18Z at 25.1N, 80.2W (micro). "A slight disturbance moved northward out of the Caribbean Sea, across western Cuba and into the Florida Peninsula near Fort Myers during September 3-4" (MWR).

#### September 5:

HWM analyzes a broad low of at most 1010 mb in the general vicinity of 29N, 86.5W, with the SW end of a SW-NE warm front almost touching the NE side of the 1010 mb isobar. HURDAT lists this as a 30 kt tropical depression at 28.7N, 85.4W. The MWR tracks for centers of cyclones shows a 00Z position near 26.7N, 82.3W and a 12Z position near 28N, 86W. The MWR post-season track map shows its last point at 00Z with a position near 26.4N, 82.8W. Microfilm shows a broad closed low of at most 1008 mb in the general vicinity of 28N, 88W. Land highlights: 35 kt SE and 1009 mb at 00Z at 28.9N, 80.8W (micro). "The lowest reported pressure (for this storm) was 29.77 inches, and the circulation about the center was not strong. However, squalls of tropical character, with winds reaching 40 miles per hour and gusts to 50 miles per hour, prevailed among the Keys and along the southeast Florida coast northward beyond Miami. The only damage reported was to small boats in Miami harbors" (MWR).

#### September 6:

HWM analyzes a low of at most 1010 mb centered near 31.2N, 90.2W. HURDAT lists this as a 20 kt tropical depression at 31.1N, 90.8W. The MWR tracks for centers of cyclones shows a 00Z position near 29N, 88.2W and a 12Z position near 31.5N, 90.3W with a 1010 mb pressure. Microfilm shows a low of at most 1010 mb centered near 31.5N, 90.2W. No gales or low pressures.

Available observations indicate that a tropical depression formed around 12Z on the 2<sup>nd</sup> near 17N, 86W. HURDAT had originally started this depression 30 hours later, at 18Z

on the 3<sup>rd</sup> to the north. Some minor track changes were made to this storm. The position at 18Z on the 3<sup>rd</sup> was adjusted about a degree to the northwest. The position adjustments are very minor around southern Florida as changes of a few tenths of a degree were made. Later in the Gulf of Mexico, the track is shifted to the left of the HURDAT track, but then near landfall at the northern Gulf Coast, the track is very similar to the HURDAT track again. There were no intensity changes larger than a 5 kt change. There was an observation on microfilm of a 40 kt wind near or at Islamorada, FL at 18Z on the 4<sup>th</sup>, so the peak intensity is raised from 35 to 40 kt for 18Z on the 4<sup>th</sup> and 00Z on the 5<sup>th</sup>. The cyclone made a brief landfall in southwestern Florida at 00Z of the 5<sup>th</sup> at 26.5N, 82.1W near Sanibel Island with winds of 40 kt. The system did make a second landfall early on the 6<sup>th</sup> near the border of Mississippi and Louisiana as a tropical depression, which is unchanged in intensity from originally indicated. No change is made to the dissipation stage of this cyclone.

### 1945 Storm 8

```
32990 09/10/1945 M= 3 8 SNBR= 731 NOT NAMED XING=0 SSS=0
32990 09/09/1945 M= 4 8 SNBR= 731 NOT NAMED XING=0 SSS=0
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(The 9<sup>th</sup> is new to HURDAT.)

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32992 09/09* 0 0 0 0* 0 0 0 0*164 583 45 0*174 592 45 1009*
32995 09/10*183 603 35 0*194 610 45 0*204 616 50 0*219 632 50 0*
32995 09/10*183 600 45 0*191 608 45 0*201 618 50 0*213 632 50 0*
      *** **          *** ***          *** ***          ***
33000 09/11*236 649 50 0*246 655 50 0*258 661 45 0*275 667 45 0*
33000 09/11*226 649 50 0*240 661 50 0*255 670 45 0*270 673 45 0*
      ***          *** ***          *** ***          ***
33005 09/12*294 671 40 0*313 671 40 0*332 671 35 0*351 667 30 0*
33005 09/12*286 674 40 0*303 673 40 0*322 671 35 0E345 667 30 0*
      *** ***          *** ***          ***          ****
```

33010 TS

Minor track changes and minor intensity changes are introduced for this tropical storm that stayed out over the open waters of the Atlantic. The decay of this cyclone is altered to include a brief extratropical stage. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

### September 9:

HWM analyzes a low in a trough located near 16.7N, 59.3W. HURDAT does not list a storm on this day. Microfilm locates a storm center by aircraft at 17.6N, 59.4W at 1915Z with sustained surface winds of 55 kt and minimum central pressure of 1009 mb. Aircraft highlights: 40 kt SE at 1630Z at 18.0N, 56.2W (micro). "A slight disturbance was located east of the Leeward Islands on the 9<sup>th</sup> of September" (MWR).

### September 10:

HWM analyzes a trough near the Virgin Islands. HURDAT lists this system as a 50 kt tropical storm at 20.4N, 61.6W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1005 mb centered near 20.1N, 61.8W. Aircraft highlights: 40 kt E at 22.5N, 63.4W at 2145Z (micro). Two other gales. "It moved northwestward during the 10<sup>th</sup>" (MWR).

September 11:

HWM does not analyze a closed low. HURDAT lists this as a 45 kt tropical storm at 25.8N, 66.1W. The MWR tracks of centers of cyclones shows a 00Z position near 20.6N, 61.5W and a 12Z position near 24.7N, 63.3W. The MWR post-season track map shows a 00Z position near 23N, 64.6W and a 12Z position near 26N, 66.2W. Microfilm shows a broad low of at most 1011 mb centered in the general vicinity of 25.2N, 66.5W. Aircraft highlights: 35 kt ESE around ~1230Z at 23.3N, 63.0W (micro). "...turned to northward along the 67<sup>th</sup> meridian on the 11<sup>th</sup>..." (MWR).

September 12:

HWM does not analyze a closed low, but analyzes a cold front approaching a few hundred miles west of the HURDAT position. HURDAT lists this as a 35 kt tropical storm at 33.2N, 67.1W. The MWR tracks for centers of cyclones shows a 00Z position near 28.2N, 64W, and a 12Z position near 32N, 65.3W. The MWR post-season track map shows a 00Z position near 29.2N, 67W and a 12Z position near 33N, 66.9W. Microfilm does not show a closed low. Aircraft highlights: 35 kt S at 0915Z at 30.7N, 66.0W (micro). One other gale. "...and began to dissipate as it passed about 100 miles west of Bermuda on the 12<sup>th</sup>. The storm did not develop a well-defined circulation, although at the time it was centered northeast of the Leeward Islands reports from reconnaissance planes indicated winds of 60 miles per hour" (MWR).

Two 6-hourly positions are added to the beginning of this storm. HURDAT started this storm at 00Z on the 10<sup>th</sup> as a 35 kt tropical storm. At 1915Z on the 9<sup>th</sup>, an aircraft performed a center fix on the storm, located at 17.6N, 59.4W. The aircraft visually estimated maximum surface winds of 55 kt 20 miles from the center. However, the aircraft measured a minimum central pressure in the center of 1009 mb. This pressure information hints that the maximum winds were overestimated by the aircraft. 1009 mb gives 29 kt according to the Brown pressure-wind relationship for south of 25N. An intensity of 45 kt is chosen for 18Z splitting the difference between the aircraft wind estimate the winds given from the pressure-wind relationship. On the 10<sup>th</sup> and 11<sup>th</sup>, the track of the storm is shifted slightly to the left (southwest). On the 12<sup>th</sup> at 12Z, the storm is analyzed to be due west of Bermuda, which is a degree south of HURDAT's position. The only intensity change made was the 00Z intensity of the 10<sup>th</sup> to reflect the earlier start time for this storm taking into account the given starting intensity. The 35 kt is raised to 45 kt at that time. The storm was becoming extratropical late on the 12<sup>th</sup>, as the baroclinic zone is approached, and the storm is analyzed as extratropical at its final point at 18Z on the 12<sup>th</sup>.

1945 Storm 9 (note: this storm was reanalyzed prior to my work, so I did not write the metadata for this storm)

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32255 09/12/1945 M= 9 9 SNBR= 716 NOT NAMED XING=1 SSS=3
32255 09/12/1945 M= 9 9 SNBR= 716 NOT NAMED XING=1 SSS=4
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32260 09/12*190 566 65 0*191 582 70 0*192 597 75 0*192 615 80 0*
32260 09/12*190 585 50 0*191 599 55 0*192 613 60 0*193 626 65 0*
*** ** *** ** *** ** *** ** *** ** ***

32265 09/13*194 633 85 0*195 649 95 0*199 665 95 0*204 683 100 0*
32265 09/13*195 638 70 0*198 649 80 0*202 662 90 0*206 680 95 972*
*** *** ** *** ** *** *** ** *** *** ** ***

32270 09/14*208 700 100 0*213 715 105 977*220 734 105 0*224 745 105 0*
32270 09/14*210 700 90 0*213 717 85 977*216 730 90 0*220 744 100 0*
*** ** *** *** *** *** ** *** ** ***

32275 09/15*230 760 105 0*236 773 110 0*242 785 115 0*249 796 120 0*
32275 09/15*226 758 105 0*234 772 110 0*242 786 115 0*251 800 115 949*
*** *** *** *** ** *** *** ** *** *** ** ***

32280 09/16*257 806 115 951*268 814 110 963*280 818 85 974*289 818 65 982*
32280 09/16*259 809 100 954*266 815 85 963*275 818 75 974*285 817 70 982*
*** *** *** *** *** ** *** ** *** ** ***

32285 09/17*298 816 55 987*310 812 50 990*322 808 45 991*334 804 40 996*
32285 09/17*296 815 65 987*310 812 70 990*323 807 75 991*334 803 50 996*
*** *** ** ** *** *** ** *** ** *** **

32290 09/18*346 799 40 1000*358 793 35 1006*370 785 35 1012E386 772 30 0*
32290 09/18*344 799 50 1000*356 793 45 1006E368 785 40 1012E383 770 35 0*
*** ** *** ** **** ** *** *** **

32295 09/19E406 753 25 0E427 727 25 0E441 694 25 0E451 655 25 0*
32295 09/19E403 750 30 0E423 724 25 0E441 690 25 0E451 650 25 0*
*** *** ** *** *** *** ** *** ***

32300 09/20E456 606 25 0E463 548 25 0E470 490 25 0E479 461 25 0*
32300 09/20E456 606 30 0E463 548 30 0E470 490 35 0E479 461 35 0*
** ** ** ** **

32305 HRCFL3
32305 HRCFL4BFL2AFL1 SC1
***** **

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#### U.S. Landfalls:

9/15 1930Z 25.3 80.3 115 kt 949 mb RMW 12 nmi OCI 1011 mb  
 9/15 2000Z 25.4 80.4 115 kt 949 mb RMW 12 nmi OCI 1011 mb  
 9/17 1100Z 32.1 80.8 75 kt 991 mb OCI 1013 mb

Minor track and major intensity changes are made to this cyclone that made landfall in the Bahamas and Southeast Florida as a major hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, the Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Connor (1956), Dunn and Miller (1960), Schwerdt et al. (1979), Ho et al. (1987), and Jarrell et al. (1992).

September 12:

HWM shows a weak low pressure centered near 15.5 N 61W. HURDAT list this as Category 1 hurricane at 19.2N 59.7W at 12UTC. The MWR tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 19N 59.5W (am) and 19.5N 63.5W (pm). Ship highlights: No gales or low pressures. Station highlights: No gales or low pressure. Aircraft highlights: 47kt NW at 20UTC at 18.9N 62.4W (NHC). “It was first noted east of the Leeward Islands on September 11” (MWR).

September 13:

HWM indicates a hurricane centered near 19.8 N 66.2W. HURDAT list this as a Category 2 hurricane at 19.9 N 66.5W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 20N 66W (am) 22N 69W (pm). Ship highlights: No gales or low pressures. Station highlights: No gales or low pressure. Aircraft highlights: 48kt NNE at 1200UTC at 21.0N 65.8W (NHC). 972 mb central pressure, center at 20.4N 67.0W at 1530Z (NHC), “105K at flight level, 120K at sfc etd” (NHC). “This system was noticed moving west-northwestward passing north over Puerto Rico during the morning of the 13<sup>th</sup>” (MWR).

September 14:

HWM shows a hurricane centered near 23.5N 73.5W. HURDAT lists this as a Category 3 hurricane at 22N 73.4W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbance showed a center at 22.5N 72W (am) 23.5N 75.5 (pm). Ship highlights: No gales or low pressure. Station highlights: 91 kt (no time - fastest mile) and 1001mb at Clarence Town, Bahamas at 1900 UTC (MWR) and 977mb at Turks Islands at 0530UTC (MWR). Aircraft highlights: 52kt S at 0200UTC at 21.8N 71.8W (NHC), Center fix of 21.7N 73.7W at 1415UTC (NHC). “The storm began a gradual curvature to the northwest while passing over the Great Bahama Bank...Turks Island reported gusts reaching 150 miles per hour (estimated).”(MWR)

September 15:

HWM shows a hurricane centered near 24.5N 79.5W. HURDAT lists this as a Category 3 at 24.5N 78.5W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 24N 79.5W (am) 25.5N 81W (pm). Ship highlights: No gales or low pressures. Station highlights: 951mb at 2055UTC at Homestead, FL (Army base) (MWR). 107kt SW at Carysfort Reef Light at 1935 UTC (MWR). 953mb at Carysfort Reef Light at 1900 UTC (MWR). Aircraft highlights: 65kt SE at 1900UTC at 24.9N 80.0W (NHC). “The hurricane struck inland on the south Florida coast over the northern end of Key Largo about 3:30pm on September 15<sup>th</sup>. Moving inland, the center passed almost directly over Homestead Army Air Base. After leaving the cities of the south coast, the hurricane traversed the swamplands of the Everglades for about 150 miles. La Belle, on Lake Okeechobee, was the only town to feel the full force of the winds in this area. Reports indicate that every house in town was damaged.” (MWR) “1009 mb environmental pressure, 101 kt max 1 min equivalent wind at landfall” (Schwerdt et al.). “Landfall at 25.3N 80.3W, Central pressure at landfall 951 mb observed in Homestead, FL, RMW 12 nmi, Speed of motion 10 kt” (Ho et al.). “FL, SE3, 951 mb central pressure” (Jarrell et al.).

## September 16:

HWM shows a hurricane center near 27.8N 82W. HURDAT lists this as a Category 2 hurricane at 28.0N 81.8W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 27N 83W (am) and 29.9N 82.9W (pm). Ship highlights: No gales or low pressure. Station highlights: 985 mb at Ft. Myers, FL at 0500UTC (MWR), 70kt SE at Miami (CO) at 0000UTC (OMR), and 70kt S at Ponce De Leon at 1900UTC (MWR). Aircraft highlights: 52kt SSE at 0330UTC at 23.5N 75.5W (NHC). “By the time the center reached the rich citrus belt of Florida the central pressure had filled approximately an inch, and winds had dropped to velocities only slightly in excess of 75 miles per hour, an intensity which was apparently maintained until the center reached the Atlantic, near St. Augustine, about 10:00pm”(MWR).

## September 17:

HWM shows a tropical depression centered near 33N 80W. HURDAT lists this as a Tropical Depression at 28.0N 81.8W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 33N 81.5W (am) and 34.8N 80.5W (pm). Ship highlights: No gales or low pressure. Station highlights: 74 kt E (no time) and 991mb at Paris Island, SC at 1145 UTC (MWR), 50kt E at 0845UTC and with pressure at 997mb at 1345UTC at Charleston, SC (WBO) (MWR). “Skirting over the Georgia coast, the center again moved inland on the South Carolina coast near Paris Island, where winds of 80 to 90 miles per hour were reported. As the storm began to lose force over the Carolinas, excessive rain caused considerable flooding, with resultant crop losses running into millions of dollars. Serious floods occurred along the Pee Dee reaching the highest of record. The storm was traced as far as Nova Scotia where it dissipated on the 19<sup>th</sup>” (MWR).

## September 18:

HWM shows a weak low centered near 44.5N 66W. HURDAT list this as a weak low at 37.0N 78.5W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 37N 79W (am) and 40.5N 75.5W (pm). Ship highlights: No gales or low pressure. Station highlights: No gales or low pressure. “Parts of Virginia as well as the Maryland/DC area are receiving great amounts of rain as the storm is steadily dissipating as the low continues north with a warm front leading the storm; it is constantly weakening with winds keeping steady between 20 and 40kt. The storm is now dissipating at a steady but fast pace as it approaches the Mason-Dixon Line bordering the New England states ” (MWR).

## September 19:

HWM shows a weak low centered near 44.5N 68W. HURDAT lists this as a weak low at 44.1N 69.4W at 12UTC. The MWR Tracks of N. Atlantic Hurricanes and Tropical Disturbances showed a center at 44.3N 68.5W (am). Ship highlights: No gales or low pressure. Station highlights: No gales or low pressure.

No change to the genesis time of this cyclone. The system was investigated as to whether it began farther east over the tropical North Atlantic. However, no ship reports could be obtained. HURDAT originally started the system as a 65 kt hurricane at 00Z on

the 12<sup>th</sup>. Minor track changes are introduced throughout the lifetime of the cyclone. Aircraft reconnaissance reached the cyclone on the 12<sup>th</sup> and visually estimated the surface winds to peak around 50 kt. Thus winds are revised to begin at 50 kt at 00Z on the 12<sup>th</sup>, though the system certainly was a tropical storm east of the initial position noted. The cyclone intensified on the 13<sup>th</sup>, with estimated maximum winds at flight level (1500') of 105 kt and estimated surface winds of 120 kt. Unfortunately, neither of these measurements of the era were well-calibrated or reliable. Fortunately, a central pressure reading of 972 mb at 1530Z on the 13<sup>th</sup> suggests winds of 88 kt from the south of 25N Brown et al. pressure-wind relationship. Given the fast speed of motion (16 kt), winds are assessed to be 90 kt at 12Z and 95 kt at 18Z on the 13<sup>th</sup> (5 kt weaker than originally indicated). No further aircraft central pressure measurements were obtained. On the 14<sup>th</sup> at 0530Z, the eye of the hurricane went over Turks Island, which observed 977 mb central pressure. This suggest winds of 81 kt, which again support max wind analysis of slightly higher (85 kt) given the continued fast forward speed. The hurricane also impacted the Bahama Islands with highest winds reported were 91 kt (fastest mile) from Clarence Town, some time during the 14<sup>th</sup>.

The hurricane made landfall in Southeast Florida around 1930UTC on the 15<sup>th</sup> at 25.3N 80.3W at Key Largo and at 2000UTC at 25.4N 80.4W on the mainland. A 951 mb central pressure was observed at the Homestead Army base about an hour (2055UTC) after landfall. Using the Ho et al. pressure-decay model with for the Florida peninsula stratification, this suggests that the central pressure at landfall was slightly deeper – 949 mb. This central pressure suggests winds of 112 and 106 kt for the Brown et al. south and north of 25N, respectively. Perhaps more appropriately, for the subset of intensifying tropical cyclones, 949 mb suggests winds of 114 and 108 kt, respectively. The hurricane had a small RMW (12 nmi) compared with climatology for that central pressure and landfall latitude (17 nmi - Vickery et al. 2001). The outer closed isobar of 1011 mb was near average, but the size was a tiny 100 nmi radius. The hurricane had slowed somewhat from its previously quick motion, but still made landfall with a forward speed of 11 kt, close to average speed. The small size of the hurricane indicates winds above that from the pressure-wind relationship, so 115 kt is chosen as the landfall intensity for southeast Florida. (It is of note that the Carysfort Reef Light had a peak 5 min wind of 107 kt at 1936 UTC and a fastest mile of 120 kt at 1937 UTC [making this a 30 sec wind]. The anemometer height of the Light was ??? m above sea level. Reducing the 120 kt wind to the standard 10 m gives ??? kt, which is consistent with a landfall intensity of 115 kt.) While the 115 kt value is slightly less (120 kt) than that previously indicated in HURDAT at 18 UTC on the 15<sup>th</sup>, it does boost the Saffir-Simpson Hurricane Scale from a Category 3 to a Category 4 (“CFL4”). After landfall, the highest observed winds within two hours of synoptic times were: 75 kt at 00 UTC on the 16<sup>th</sup>, 52 kt at 06 UTC, 39 kt at 12 UTC, 70 kt at 18 UTC, and 66 kt at 00 UTC on the 17<sup>th</sup>. Runs of the Kaplan-DeMaria inland wind decay model suggests winds of 80, 59, 42, 36, and 39 kt, respectively. Given the transit of the hurricane over the Everglades/Big Cypress as well as movement that kept the center of the hurricane not too far from the coast, substantially less decay to the winds may occur than suggested by the Kaplan-DeMaria model. Winds are selected to be 100 kt (a major change downward from 115 kt originally) at 00 UTC, 85 kt (down from 110 kt) at 06 UTC, 75 kt (down from 85 kt) at 12 UTC, 70 kt (up from

65 kt) at 18 UTC, and 65 kt (up from 55 kt) at 00 UTC on the 17<sup>th</sup> in the reanalysis. The winds selected better match the observed high winds late on the 16<sup>th</sup>/early on the 17<sup>th</sup> as well as the reported extreme destruction at inland locations. This also maintains the system as a hurricane all the way across the Florida peninsula until it briefly reached the Atlantic Ocean, previously the cyclone was downgraded to a tropical storm at 00 UTC on the 17<sup>th</sup> just south of 30N. Application of the Schwerdt et al. wind model suggests that Southwest Florida was impacted by Category 2 (almost Category 3) winds based upon the revised track and intensity. Thus Southwest Florida is now indicated as experiencing Category 2 winds (“BFL2”), while previously HURDAT did not list the area as a hurricane impact. Farther north in Florida, Northeast Florida is also now listed as a hurricane impact based upon the revised track and intensity, with Category 1 (“DFL1”) conditions as confirmed by the observations along the coast.

After reaching the Atlantic coast of Florida, the hurricane closely paralleled the Georgia coast until making a final landfall near the border of Georgia and South Carolina. Landfall is estimated to have occurred around 11 UTC on the 17<sup>th</sup> near 32.1N 80.8W. A 991 mb central pressure was recorded at Paris Island (now “Parris Island”), SC at 1145 UTC. This suggests winds of 58 kt from the Brown et al. pressure-wind relationship. The radius of the outer closed isobar had expanded to 250 nm and the forward speed had accelerated some to 14 kt, neither of which would one expect a large deviation from the pressure-wind relationship. However, there was an observed fastest-mile wind of 74 kt also at Paris Island. Thus 75 kt at landfall is the intensity estimated based primarily upon this observations, making the system a Category 1 hurricane for South Carolina, though previously this was considered a tropical storm event. This is a 30 kt increase from the 45 kt originally indicated in HURDAT. Runs of the Kaplan-DeMaria inland wind decay model suggest winds of 50 kt at 18 UTC on the 17<sup>th</sup>, 37 kt at 00 UTC on the 18<sup>th</sup>, and 30 kt at 06 UTC. Highest observed winds within 2 hours of the synoptic times were: 50, 48, and less than 34 kt, respectively. Winds are chosen for HURDAT to be 50 kt at 18 UTC (up from 40 kt originally), 50 kt at 00 UTC on the 18<sup>th</sup> (up from 40 kt), and 45 kt at 06 UTC (up from 35 kt). The cyclone became extratropical around 12 UTC on the 18<sup>th</sup>, near the North Carolina-Virginia border, which is six hours earlier than indicated in HURDAT. Winds were boosted on the 20<sup>th</sup> back to gale force while the system was still extratropical through available ship observations. No changes were made to the dissipation of this cyclone.

## 1945 Storm 10

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33070 10/02/1945 M= 4 10 SNBR= 733 NOT NAMED XING=0 SSS=0
33070 10/02/1945 M= 6 10 SNBR= 733 NOT NAMED XING=0 SSS=0
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33075 10/02* 0 0 0 0* 0 0 0 0* 0 0 0 0*153 803 60 0*
33075 10/02*160 805 35 0*160 810 40 0*160 815 50 0*161 820 60 0*
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33080 10/03*162 826 65 0*164 833 70 0*165 842 80 0*165 856 85 982*
33080 10/03*162 825 65 0*164 831 70 0*166 838 70 987*168 849 75 982*
*** ** ** *** ** ** *** ** ** *** **
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33085 10/04*165 870 80 0*164 883 70 0*162 894 60 0*160 903 50 0*
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33085	10/04*	166	861	75	0*164	874	75	0*162	887	75	0*160	900	55	0*
		***	***	**		***	**		***	**		***	**	
33090	10/05*	158	912	35	0*157	922	25	0*155	932	20	0*154	937	15	0*
33090	10/05*	158	913	35	0*157	926	30	0*155	940	30	0*155	957	35	0*
		***				***	**		***	**		***	***	**

(The 6<sup>th</sup> and 7<sup>th</sup> are new to HURDAT.)

33092	10/06*	158	977	40	0*163	997	40	0*1701015	40	0*1801027	40	0*
33094	10/07*	1931035	35	0*2101041	30	0*2301045	25	0*	0	0	0	0*

33095 HR

Major track changes and minor changes to the intensity are made to this hurricane that impacted Central America. An additional two days were added to this system, as it reintensified as a tropical storm in the Northeastern Pacific. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, the Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### October 2:

HWM analyzes a tropical storm inside a closed contour of at most 1010 mb centered near 16.3N, 82.6W. HURDAT firsts lists this at 18Z as a 60 kt tropical storm at 15.3N, 80.3W. The MWR post-season track map shows a 12Z position at 16N, 81.8W. Microfilm shows a low of at most 1008 mb centered near 16.2N, 82.4W. Ship highlights: 40 kt SE and 1002 mb at 16.2N, 81.6W at 18Z (micro). Aircraft highlights: 50 kt SE at 16.0N, 80.4W at 2115Z (micro). Five other gales. "This disturbance was first detected in the western Caribbean near latitude 16N, longitude 81-82W on October 2. From this position, the storm moved west-northwestward and passed about 50 miles south of Swan Island. Light sea swells, indicating a disturbance in the vicinity, were first noted during the afternoon of October 1. They increased in magnitude during the night and following morning, and by noon of the following day were very distinct, having a frequency of 7 per minute. Later the frequency dropped to 6 per minute at 4 pm (on the 2<sup>nd</sup>)" (MWR).

#### October 3:

HWM analyzes a tropical storm of at most 1000 mb centered near 16.2N, 84.2W. HURDAT lists this as a 80 kt hurricane at 16.5N, 84.2W. The MWR post-season track map shows a 00Z position near 16.3N, 82.8W and a 12Z position near 16.5N, 84W. Microfilm shows a position near the MWR position. Ship highlights: 40 kt SSE and 1002 mb at 15.7N, 81.7W at 4Z (micro); 55 kt SE and 1008 mb at 16.2N, 81.5W at 11Z (micro). One other gale. Land highlights: 1001 mb at Swan Island at 1010Z (min pressure) (MWR); 38 kt E (1-min) at Swan Island at 1345Z (MWR). Six other low pressures at Swan Island between 1001-1005 mb. Aircraft highlights: 85 kt NE at 16.8N, 84.1W at 14Z (micro); 982 mb pressure estimated from aircraft (MWR). Three other hurricane force wind obs. Ten tropical storm force wind obs (35-60 kt). "...and 5 per minute the following morning (referring to sea swell frequency on the morning of the 3<sup>rd</sup>), an indication that the storm was of considerable intensity. A plane on reconnaissance came on the storm while it was centered south of Swan Island, and the crew estimated winds at 85 knots with a central pressure near 29.00 inches. At Swan Island a maximum wind (5-min) of 39 mph from the east (extreme 1-min wind of 44 mph), was experienced at 8:45 am on the 3<sup>rd</sup>, with occasional gusts at 60 mph; the pressure was 29.57 inches at 5:10 am on that date. Hundreds of coconut palms were

uprooted on the island, and practically all banana trees were blown over. Other damage was slight” (MWR). Microfilms says that an aircraft reported the center at 1504Z to be at 16.5N, 84.2W with a pressure of 987 mb (29.15 in) (micro). Microfilm says that at 19Z, the center was at 16.9N, 85.1W.

October 4:

HWM shows a tropical storm of at most 1000 mb centered inland near 14.9N, 88.9W. HURDAT lists this as a 60 kt tropical storm at 16.2N, 89.4W. The MWR post-season track map shows a 00Z position near 16.6N, 85.7W and a 12Z position near the HURDAT position. Microfilm shows a low of at most 993 mb centered near 16.7N, 88.2W. Land highlights: 35 kt WSW and 1000 mb at 16.0N, 86.0W at 0Z (micro); 10 kt SW and 997 mb at Tela, Honduras (15.7N, 87.5W) at 9Z (micro). Three other low pressures. “Moving westward, the hurricane struck inland about 8 am, August 4, 60 to 80 miles south of Belize. Press reports indicate that three-fourths of the houses in Punta Gorda were flattened and that 40 houses were destroyed at Livingston on the Guatemala coast. Many were injured in towns along the coast, and one death was reported. After passing inland the storm continued on a westward course and lost force over Guatemala and Mexico” (MWR).

October 5:

HWM analyzes a low of at most 1005 mb centered near 15N, 93.5W. HURDAT lists this as a 20 kt tropical depression at 15.5N, 93.2W. No gales or low pressures. “Reports indicate that a center, accompanied by heavy rain, was recognizable as far west as Acapulco on October 5, making this hurricane as one of the rare tropical storms that have succeeded in maintaining a circulation as they passed from one ocean to another over Central America and Mexico” (MWR).

October 6:

HWM analyzes a tropical storm of at most 1005 mb centered near 17.3N, 101.4W. HURDAT does not list a system on this day. Ship highlights: 30 kt WNW and 1004 mb at 1Z at 14.5N, 98.5W (COA); 25 kt WSW and 1005 mb at 3Z at 14.5N, 98.5W (COA). Land highlights: 15 kt SSW and 1004 mb at Acapulco, Mexico (16.8N, 99.9W) at 12Z (HWM).

October 7:

HWM analyzes two closed lows in close proximity, both of at most 1005 mb. The larger one is centered near 19.2N, 105W and the smaller one is centered near 15.6N, 105.7W. HURDAT does not list a system on this day. Highlights: none.

HURDAT started this storm at 18Z on 2 October as a 60 kt tropical storm. However, it is chosen to start this storm 18 hours earlier at 00Z on 2 October based upon observations that the system underwent genesis at this time or earlier. At 08Z on the 2nd, there was a ship reporting 40 kt from the east along with 1004 mb pressure located north of where the center was thought to be located. This strong wind accompanied by a low pressure gives some confidence that there may have been a closed low located to the south, although it is not definitive proof. However, by 12Z, there were observed west winds south of the

center, and it was definitely closed at that time. 35 kt is chosen for 00Z on the 2nd, but the winds may have been higher. Minor track changes were introduced throughout the duration of the storm's existence, except for a major change westward on the original last position in HURDAT (at 18Z on the 5<sup>th</sup>). (More about the decay phase of this cyclone is given below.) An aircraft central pressure fix of 987 mb was measured at 15Z on the 3<sup>rd</sup>. This suggests winds of 68 kt from the south of 25N Brown et al. pressure-wind relationship. An 85 kt surface wind was visually estimated by aircraft at 14Z on the 3<sup>rd</sup>. A second central pressure of 982 mb was observed by aircraft at 18Z of the 3<sup>rd</sup>. The Brown et al. southern pressure-wind relationship for 982 mb is 75 kt. 70 kt is selected for 12Z and 75 kt is chosen for 18Z on the 3<sup>rd</sup>, as the visual estimated surface winds of the era were not well-calibrated. On the 4<sup>th</sup>, landfall of the hurricane at 16.1N, 88.8W near Punta Gorda, occurred around 13Z, which is a couple of hours later than in HURDAT. HURDAT had the intensity of the hurricane increasing to 85 kt at 18Z on the 3<sup>rd</sup> and then decreasing to 60 kt at 12Z of the 4<sup>th</sup>, the time of landfall. However, there is evidence to support that the hurricane did not weaken prior to landfall. Tela, Honduras recorded a minimum peripheral pressure of 995 mb while the storm passed more than half a degree latitude to the north on the 4<sup>th</sup>. Also, damage reports at landfall indicating that "three-fourths of the houses were flattened" suggest that the hurricane maintained its intensity of 75 kt until landfall (MWR). The reanalysis has the intensity reaching 75 kt, and staying at that value until landfall in Belize. Because of the mountainous terrain over Guatemala, a decay to a tropical depression is now indicated by 06Z on the 5<sup>th</sup>, 17 hours after landfall. HURDAT's last position on this storm is at 18Z on the 5<sup>th</sup> over the Pacific Ocean. However, there is evidence from HWM and COADS that the circulation remained intact as it crossed central America and extreme southern Mexico and then reintensified in the Northeastern Pacific. The depression then turned towards the WNW, paralleling the coast of Mexico, perhaps staying just offshore for much of the time. It strengthened back to a minimal tropical storm on 6 October. At 04Z on the 6<sup>th</sup>, a 30 kt west wind with a pressure of 1005 mb was observed south of the center of the storm. At 12Z, Acapulco reported a pressure of 1004 mb. 1004 mb corresponds to 39 kt using the Brown pressure-wind relationship, and 40 kt is chosen for 12Z on the 6<sup>th</sup>. The storm clearly moves inland later on the 6<sup>th</sup> over western Mexico and weakens to a depression thereafter. The last position is given at 12Z on the 7<sup>th</sup> as a dissipating tropical depression near 23N, 104.5W.

#### 1945 Storm 11:

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33100 10/10/1945 M= 7 11 SNBR= 734 NOT NAMED XING=0 SSS=0 L
33105 10/10* 0 0 0 0* 0 0 0 0*131 779 30 0*144 788 30 0*
33105 10/10* 0 0 0 0* 0 0 0 0*131 770 35 0*142 780 35 0*
*** ** *** *** **

33110 10/11*155 795 35 0*167 800 35 0*178 803 45 0*188 803 55 0*
33110 10/11*154 789 35 0*166 798 35 0*178 803 45 0*188 803 55 0*
*** *** *** ***

33115 10/12*196 802 65 0*205 798 70 0*216 793 85 1000*229 786 80 0*
33115 10/12*196 802 65 0*205 798 70 0*216 793 80 980*229 786 80 0*
** ****

33120 10/13*244 774 65 0*258 760 65 982*272 738 65 0*285 710 65 0*
33120 10/13*242 772 80 0*256 758 75 982*272 738 70 0*285 705 65 0*

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33125	10/14E299	680	65	0E312	642	55	0E324	605	40	0E335	567	30	0*
33125	10/14E299	680	65	0E312	642	55	0E324	605	40	0E332	575	35	0*
										***	***	**	
33130	10/15E345	529	30	0E353	490	30	0E360	449	30	0E367	422	30	0*
33130	10/15E340	545	35	0E349	505	35	0E358	455	35	0E367	422	35	0*
	***	***	**	***	***	**	***	***	**		**		
33135	10/16E372	400	30	0E378	377	30	0E383	350	30	0E390	322	30	0*
33140	HR												

Minor track changes and minor intensity changes are implemented with this small hurricane that made landfall in Cuba and the Bahamas. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Perez et al. (2000), and the Monthly Weather Review's 1966 article by Fernandez-Partagas.

#### October 10:

HWM does not analyze a low on this day. HURDAT lists this as a 30 kt tropical depression at 13.1N, 77.9W. A paper in the July 1966 MWR by Fernandez-Partagas (from now on referred to as "MWR 1966") had a center near the HURDAT position and tropical depression intensity. Land highlights: 35 kt SW and 1012 mb at Barranquilla, Columbia at 12Z. "Strong evidence of a tropical depression- or perhaps a tropical storm- has been found over the southwestern Caribbean, north of Colombia and Panama, as early as October 10, 1945" (MWR 1966).

#### October 11:

HWM analyzes a trough with a WSW-ENE frontal zone from 21N, 91W to 27N, 78W and HWM analyzes a low in the trough near 23.3N, 87W. HURDAT lists a 45 kt tropical storm at 17.8N, 80.3W. MWR 1966 shows a center near the HURDAT position and tropical storm intensity. No gales or low pressures. "It is believed that the storm reached hurricane intensity during October 11, while the storm was approaching the Cayman Islands and just in that vicinity. Little is known about the storm's passage over the Cayman Islands. The reference available came from some Cuban fishermen who were taken by surprise at Cayman Brac; they merely said that 'rain and winds' were felt there. The diameter of the storm was so small that the meteorological station at Grand Cayman, about 70 miles to the west, did not report any significant stormy weather" (MWR 1966).

#### October 12:

HWM analyzes a closed low of at most 1010 mb centered in the general vicinity of 22.3N, 86.1W along a complex SW-NE frontal structure extending from the Yucatan Peninsula to the low to Havana to the northwest Bahamas to beyond 28N, 71W. HURDAT lists an 85 kt hurricane at 21.6N, 79.3W. MWR 1966 shows a position near the HURDAT position with hurricane intensity. Land highlights: 60-65 kt around 12Z at Tunas de Zaza, Cuba (21.7N, 79.5W) (MWR 1966); 1000 mb around 12Z somewhere in the zone of Tunas de Zaza (MWR 1966); 45-50 kt around 13Z at Sancti-Spiritus, Cuba (21.9N, 79.4W) (MWR 1966). Regarding the storm in Cuba, "Based on observations received, the center of the storm moved ashore about 7 am EST (12Z) on the 12<sup>th</sup>, and emerged on the northern coast about 11:30 am (1630Z). While passing over Laberinto de las Doce Leguas (an archipelago off the southern coast of Cuba), the cyclone destroyed

almost all the mangrove trees at Cayo Breton. The center of the storm moved over Las Villas Province just east of Tunas de Zaza, near a place called Las Coloradas, where it also destroyed all the mangrove trees, and there the sea water advanced some distance ashore. It then moved to the vicinity of the Jatibonico sugar-mill where a lull was reported for about 5 minutes, and thereafter crossed over Mayajigua where a calm was reported for about the same period. The minimum value (storm's central pressure) was felt at Jatibonico, where the storm was violently felt. The storm emerged at the Bahamas Channel, west of Punta Alegre sugar-mill, and sea waters receded at that place." Regarding the storm speed, "The 'unrecorded' hurricane of October 1945 was moving fairly rapidly, at an average speed of 16-17 kt, while crossing over central Cuba, and slightly over 20 kt when emerging from the Bahamas into the Atlantic Ocean" (MWR 1966). Regarding the intensity, "Estimated winds over 100 mph as the storm moved across Cuba are in excellent agreement with those expected from the data available, if a  $vr^{1/2} = \text{constant}$  vortex with an inner radius of 4 miles or less is accepted. Also under this reasoning, it is very likely that the minimum sea level pressure was around 975-980 mb in accordance with Fletcher's empirical formula (used in Fletcher 1955). Therefore, hurricane force winds can be easily supported" (MWR 1966).

"Along the path south of Sierra de Jatibonico (rather low mountains in central Cuba), and about 20 km with, palm trees to the right of the center's path fell down toward the north, while those to the left did so toward the south. The eastern sector of the storm was more severe than the western one. Winds of 70 to 75 mph were reported at Tunas de Zaza. The influence of the storm was clearly noticed in Sancti-Spiritus where winds reached 55 mph and the barographic curve was typical of a tropical cyclone."

"Four persons died and 200 were injured in the furious storm which struck Jatibonico and Sancti-Spiritus. Damages are estimated at \$2 million. Strong winds affected Sancti-Spiritus and the outskirts of Tunas de Zaza, Guasimal, Zaza del Medio, and Taguasco from 9 to 11 am, the most affected being Guasimal."

The following is the only advisory released on this storm by a meteorological service: "National Observatory (Cuban Weather Service) October 12, 1945, 11 am. A small tropical storm, a disturbance somewhat greater in size than a tornado or waterspout, hit the zone of Tunas de Zaza with pressure reading of 1000 mb, strong northeasterly winds, and intermittent showers at 7:30 am this morning. The disturbance is moving northward; it is affecting places near its track and it is passing rapidly toward the northern coast."

The following three quotes are from El Pais (Havana, Cuba) evening issue, October 13, 1945:

"Mayajigua is without communications. A severe storm struck this town and its outskirts yesterday morning. Several buildings were seriously damaged."

"Zaza del Medio. Between 8:30 am and 11 am, a storm passed over this town, and caused heavy damage to houses and tobacco-houses (flimsy constructions where tobacco is processed)."

"Guayos. A tropical storm accompanied by torrential rain and strong northeasterly winds in gusts, affected this town in the morning hours yesterday; heavy damage was reported."

"The following quote is from Diario de la Marina, (Havana, Cuba), October 13, 1945:

'Many vessels have been torn away from their mooring at Tunas de Zaza because of the spout.'"

"1945, October 11-12, Category 1 hurricane for Cuba" (Perez et al.)

October 13:

HWM analyzes an extremely elongated closed low of at most 1010 mb centered in the general vicinity of 26.5N, 70.7W along a WSW-ENE frontal boundary extending from the Yucatan Peninsula, through the low to beyond 30N, 58W. HURDAT lists this as a 65 kt hurricane at 27.2N, 73.8W. MWR 1966 shows a position near the HURDAT position with hurricane intensity. Land highlights: 35-45 kt and 1005 mb (min p) at Nassau, Bahamas (MWR 1966); calm and 982 mb (uncorrected) at Eleuthera, Bahamas (25.0N, 76.3W) (MWR 1966); 60-80 kt at Eleuthera, Bahamas (MWR 1966); 40-45 kt and 1007 mb (uncorrected) at Andros Island, Bahamas (24.5N, 78.0W) (MWR 1966). Regarding the storm in the Bahamas, "Although wind estimates in the vicinity of the path over the Bahamas have been found to be somewhat contradictory, most of the data available are also in favor of the existence of winds in excess of 74 mph. Unfortunately, it has not been possible to pinpoint an accurate track of the center over the Islands because of the lack of proper information. However, unconfirmed calm reports have been stated by different persons who formerly lived in small villages on the southern tip of Andros and indications are that the center must have passed very close to Governor's Harbour (Eleuthera) where the minimum sea level pressure (982 mb, probably uncorrected) was recorded and where the heaviest damages were suffered. An upper-air study of this case was initially considered, but data were not sufficient to make a serious attempt. 500 mb maps of the HWM series have been examined for the period concerned, and a fairly good agreement of the track with the prevailing pattern of circulation was detected. Some slight warming was also noticed in the 500-mb radiosonde reports from southern Florida and Cuba on October 12, 1945.

Regarding the storm in the Bahamas, "According to press reports, the barometer read a minimum of 29.68 in. (about 1005 mb.) at Nassau, New Providence, where 40-50 mph winds were felt."

"Regarding Eleuthera, the *Nassau Guardian* published the following account on October 13: Storm damages small vessels. Takes one life at Eleuthera. Harbour Island experiences winds over 70 mph. Harbour Island (Eleuthera), where a number of small boats are destroyed, reports that there was a wind force last night of between 70 and 90 mph. No damage to houses was reported and crops also escaped. Winds of an estimated gale force were reported to have raged over the whole length of Eleuthera, sending two vessels ashore and tearing others from their moorings. It is understood that Governor's property as well as a number of privately-owned buildings have been very badly damaged, and that telephone lines are down and roads throughout the island are blocked...A severe north to northwest storm passed over the whole length of Eleuthera between 11:30 pm and 2 am (October 12-13). The wind was estimated at gale force and was accompanied by rain. Vessels were blown from their mooring."

"Some additional information on the storm's passage over Eleuthera is found in the 1945 Annual Report submitted to the Out Island Commissioner of the Bahamas by his colleague at the Governor's Harbour: 'Lowest reading: 29.00 inches. From 11 pm on the 12<sup>th</sup> to 3 am on the 13<sup>th</sup> of October a severe hurricane passed over the district.' Although it is not indicated in the report, it is obvious that the lowest barometer reading of 29.00 inches (982 mb) (probably uncorrected) must have been recorded at Governor's Harbour

during the hurricane's passage. There can be no possible confusion in this case, since no other hurricane directly affected the settlement in the whole year of 1945" (MWR 1966). "The Commissioner at Mangrove Cay, Andros, gave the following account in his Annual Report for 1945: 'On the 14-15<sup>th</sup> night of September a storm with full hurricane force at the center came near the District, passing slightly to the south. Again on October 12, a cyclonic storm with winds up to 50 mph struck the District! It was during these storms that the barometer fell to 1007 mb (uncorrected). The storm on October 12<sup>th</sup> struck the District with terrific force in sections. Apparently, it was more like a cyclonic storm. This brought greater destruction to farms and coconut trees. Thousands of coconut trees which had not recovered from the shocks of the storm of September were twisted, uprooted, snapped and dashed to the ground'" (MWR 1966).

October 14:

HWM analyzes a closed low of at most 1000 mb near 31.2N, 60.6W with a cold front extending from the low towards the WSW to 26N, 75W and a warm front extending ESE from the low to 29N, 52W. Another front is located just a few hundred miles north and west of the low and the cold front. HURDAT lists this as a 40 kt extratropical storm at 32.4N, 60.5W. MWR 1966 shows a position near the HURDAT position as an extratropical storm. No gales or low pressures.

October 15:

HWM analyzes a low of at most 1000 mb centered near 35.8N, 45W with a cold front extending southwestward from the low to 26N, 59W, and a warm front extending southeastward from the low to 28N, 38W. HURDAT lists this as a 30 kt extratropical low at 36.0N, 44.9W. MWR 1966 shows a position near the HURDAT position as extratropical. Ship highlights: 30 kt SSW and 1002 mb at 34N, 52W at 3Z (COA). One other low pressure.

October 16:

HWM analyzes an occluded low of at most 1000 mb centered near 38.5N, 35.5W with an occluded front extending down to a triple point with a warm and cold front near 34N, 34W. HURDAT lists this as a 30 kt extratropical low at 38.3N, 35.0W. MWR 1966 shows a position near the HURDAT position as extratropical. Ship highlights: 20 kt ESE and 1004 mb at 6Z at 42.0N, 37.0W (COA). Six other low pressures.

No changes were introduced for the genesis of this system. Track changes for this storm are minor and are introduced on all dates of the cyclone's lifetime except for the 12<sup>th</sup> and 16<sup>th</sup>. The system is now begun as a 35 kt tropical storm at genesis at 12Z on the 10<sup>th</sup> (rather than a 30 kt depression until 18Z originally) due to 35 kt observed at Barranquilla, Columbia at 12Z. The cyclone made landfall around 12Z on the 12<sup>th</sup> in southern Cuba. The estimated minimum pressure of the storm at landfall in Cuba was 975-980 mb based upon the Fletcher relationship applied to a 100 mb peripheral pressure reading. 980 is chosen as the central pressure (which replaces the 1000 mb erroneous central pressure value recorded in HURDAT originally). 980 mb yields a wind speed of 78 kt from the Brown et al. pressure-wind relationship. There was lower than usual environmental pressure (~1010 mb outer closed isobar), and the storm was moving slowly at 8 kt. These

arguments for going with a lower wind speed are counteracted by the extremely small RMW of this hurricane. So 80 kt (5 kt lower than originally) is chosen as the intensity at landfall in Cuba, making this a high end category 1 hurricane. This is supported by Perez et al. (2000) who indicated that the cyclone was a category 1 for Cuba. Since Eleuthera reported a 982 mb central pressure early on the 13<sup>th</sup>, the analyzed intensity is kept stronger than HURDAT through the hurricane's passage through the Bahamas. 982 mb equals 75 kt using the Brown pressure-wind relationship for south of 25N and 70 kt for N of 25 N. 80 kt is chosen for 00Z, 75 kt is chosen for 6Z, and 70 kt is chosen for 12Z, all higher than the constant 65 kt in HRUDAT. From late on the 14<sup>th</sup> through the 15<sup>th</sup>, during the extratropical stage, the intensity is analyzed to be slightly stronger than in HURDAT as well, due to available observations from HWM and COADS. There was no change to the extratropical transition phase or to the dissipation of this hurricane.

#### References:

Fernandez-Partagas, J. J., 1966: The "Unrecorded" Hurricane of October 1945. *Monthly Weather Review*, **94**, 475-480.

R.D. Fletcher, 1955: Computation of Maximum Winds in Hurricanes. *Bulletin of the American Meteorological Society*, **36**, 6, pp. 346-350.

#### 1945 additional notes:

1)

A large occluded low was located over the north central Atlantic on 23 May. There was one observed gale with this system (35 kt) at 00Z on 23 May, and the lowest observed pressure was 1008 mb also on 23 May. On this day, the system was baroclinic and had a very large circulation. On the 24<sup>th</sup> and 25<sup>th</sup>, the temperature gradient began to relax, but there was no observed gales or low pressures. By the 26<sup>th</sup>, the circulation opened up into a trough, and pressures were rising.

DAY	LAT	LON	STATUS
May 23	37N	53W	Extratropical
May 24	37N	50W	Extratropical
May 25	36.5N	46.5W	Subtropical
May 26			Open trough

2)

A general area of low pressure prevailed in the central Caribbean Sea between 24 May and 29 May. It is not certain that there was a closed circulation at any point during these days. The 26<sup>th</sup> and 27<sup>th</sup> are the days that the system is closest to attaining a closed circulation. But the wind barbs indicate a very elongated low, almost frontal in nature

(although there is no temperature gradient across the low). Also, there were no gales at all with this system, and the lowest pressure observed was 1007 mb. The highest wind was 30 kt on the 26<sup>th</sup>. This was likely a broad area of low pressure that stayed over the Caribbean for several days.

DAY	LAT	LON	STATUS
May 24			Open wave
May 25			Open wave
May 26	14.5N	77W	Broad low
May 27	16.5N	77.5W	Broad low
May 28	17N	77.5W	Broad low
May 29			Open wave

3)

A low associated with the tail end of a front moved into the extreme northeastern Gulf of Mexico on 18 August. Pressures as low as 1009 mb were recorded by ships as well as by land stations such as Apalachicola, FL. The low moved inland over the big bend area of FL on 19 August, and continued northeast. Microfilm and HWM both were consistent in showing this low. The low never seemed to fully detach from the front, however. Temperatures were very warm surrounding the low. The highest wind recorded (30 kt) was off the Atlantic coast east of Jacksonville during the afternoon of the 19<sup>th</sup>.

DAY	LAT	LON	STATUS
Aug 17			Open
Aug 18	29.5N	84.5W	Low
Aug 19			Open

4)

Microfilm indicates that a low formed in the central Gulf of Mexico on 29 August. At 00Z on 30 August, a NW wind of 30 kt along with an 1006 mb pressure was recorded by a ship at 24.8N, 93.2W (micro). The low continued westward, and six hours later there were wind observations from the south on the east side of the low. Therefore, there is a good chance that this system was a tropical depression at 00Z on 30 August. When this system was close to making landfall in northeast Mexico, at 12Z on 30 August, the center was located near 25N, 97W. Aircraft observations at this time show that the circulation center was closed and well-defined, confirming the existence of a tropical depression. Winds of 20 to 30 knots accompanied this depression from 18Z the 29<sup>th</sup> through landfall, which occurred between 12Z and 18Z on the 30<sup>th</sup>. But there were no observed gales. Dissipation occurred shortly thereafter as the depression moved inland over Mexico. The highest wind at Brownsville, TX was 30 kt from the east around 14Z (OMR). The winds shifted at Brownsville from NE to E to SE between 12Z and 16Z (OMR). One-minute winds of 25 kt or higher occurred at least once in each hour in Brownsville for 6

consecutive hours from 14Z to 20Z (OMR). 0.19" of precipitation fell at Brownsville with this depression. It is interesting to note that a rainbow was observed at Brownsville at 12Z on the 30<sup>th</sup> (OMR). The pressure at Brownsville at 12Z was 1011 mb, but the minimum pressure at Brownsville, which likely occurred a couple of hours later, is unknown.

DAY	LAT	LON	STATUS
Aug 29			Open
Aug 30	25.2N	97.2W	Tropical depression
Aug 31			Dissipated

5)

An extratropical low on 3 September was located over the northeastern Atlantic Ocean. This low moved south, then drifted around and moved eastward. Subtropical characteristics were gradually attained, but there were no observed gales at any point with this system.

DAY	LAT	LON	STATUS
Sep 3	46N	23W	Extratropical
Sep 4	41N	25W	Extratropical
Sep 5	39N	25W	Extratropical
Sep 6	40.5N	17.5W	Subtropical
Sep 7	43N	16.5W	Subtropical
Sep 8			Dissipated

6)

A small low formed from a dissipating stationary front on 8 September just off the North Carolina coast. This low remained stationary through 10 September. On the 11<sup>th</sup>, it moved northward to east of Nantucket. There were no observed gales associated with this system. The highest wind was 30 kt from the SSE, which occurred on 10 September at 15Z at 36N, 70W. There were not any pressures of 1005 or lower until the 11<sup>th</sup> north of 40N, and these low pressures were accompanied by 20-25 kt winds on that day. The lowest pressure was 1004 mb at 11Z of the 11<sup>th</sup>. At this time, the small low was in the warm sector of an approaching extratropical cyclone, so environmental pressures were low. The pressure-wind relationship of 1004 mb = 36 kt is assumed to be invalid for this case.

DAY	LAT	LON	STATUS
Sep 8	35.5N	73.5W	Tropical depression
Sep 9	35N	74W	Tropical depression
Sep 10	36N	73W	Tropical depression
Sep 11	41N	68.5W	Tropical depression

7)

A low may have broken off from the tail end of a dissipating stationary front in the eastern Bay of Campeche on 15 September. From the 15<sup>th</sup> to the 16<sup>th</sup>, the pressures along the Mexican coast of the western Bay of Campeche dropped as much as 7 mb. There is not enough evidence to know for sure if there was a closed low, but there is enough evidence to make a rough guess of the position if the low was indeed closed. The highest observed wind was 10 kt and the lowest pressure was 1010 mb.

DAY	LAT	LON	STATUS
Sep 15	15	93.5	Low
Sep 16	16.5N	97W	Low
Sep 17	inland in central Mexico and dissipated		

8)

An extratropical low formed along a front on 26 September near 40N, 37.5W. The low broke off from the front and attained either subtropical or tropical characteristics on the 27<sup>th</sup>. On the 27<sup>th</sup>, the highest observed wind was 25 kt and the lowest pressure was 1010 mb. A new approaching cold front from the west merged with the low and provided the low with renewed baroclinicity. A wind speed of 65 kt from the north was recorded at 21Z on the 28<sup>th</sup>, and several other gales were recorded. These winds are all associated with the frontal passage, and the temperatures drop significantly behind the front. On the 30<sup>th</sup>, the same low is still left behind, with no fronts plotted on HWM, but there is still a temperature gradient across the low, and there are no observed gales on the 30<sup>th</sup>.

DAY	LAT	LON	STATUS
Sep 26	40N	37.5W	Extratropical
Sep 27	38.5N	40.5W	Subtropical depression
Sep 28	36N	34.5W	Extratropical
Sep 29	37.5N	35W	Extratropical
Sep 30	41.5N	33.5W	Extratropical

9)

A small, closed area of low pressure developed on 26 September in the area of the Caribbean Sea just north of Honduras. Pressures fell in the area as the low deepened a few millibars from the 26<sup>th</sup> to the 28<sup>th</sup>. On the 28<sup>th</sup>, the low moved just inland on the coast of Honduras, but maintained itself as a closed low through the 30<sup>th</sup>. The lowest observed pressure was 1004 mb, but there were low environmental pressures. The highest observed wind was 25 kt. It is interesting to note that HWM plots a tropical

storm symbol on the 27<sup>th</sup>. This low was likely a tropical depression because the wind observations support a small, closed low, but there were no gales.

DAY	LAT	LON	STATUS
Sep 26	17.5N	85.5W	Tropical depression
Sep 27	17.5N	86W	Tropical depression
Sep 28	15.5N	86W	Tropical depression
Sep 29	15N	85W	Tropical depression
Sep 30	15.5N	86W	Tropical depression

10)

A low began to form in association with a front on 4 October in the northeastern Atlantic. The low was closed by 5 October, but it was attended by weak winds near the broad circulation center. The low was mostly occluded by 6 October, and there was not a large temperature gradient across the low on the 6<sup>th</sup> or 7<sup>th</sup>. The circulation was very broad, and there were no observed gales through October 8<sup>th</sup>. The lowest observed pressure was 1012 mb through the 8<sup>th</sup>. By the 8<sup>th</sup>, baroclinicity returned, and the extratropical low moved off slowly to the northeast.

DAY	LAT	LON	STATUS
Oct 5	36N	33W	Extratropical
Oct 6	36N	33W	Extratropical
Oct 7	36.5N	29.5W	Subtropical
Oct 8	42.5N	27.5W	Extratropical

11)

A closed low formed on 19 October near Miami and the Bahamas, possibly associated with a front. On the 19<sup>th</sup>, the temperature gradient across the low from the Bahamas to Tampa was 13 degrees. On the 20<sup>th</sup>, the baroclinicity may have lessened, and this system may have been a 30 kt tropical depression. On both the 19<sup>th</sup> and 20<sup>th</sup>, the circulation was very tight and compact like a tropical system, which is why this system is analyzed as a tropical depression on both the 19<sup>th</sup> and 20<sup>th</sup>. There were several 30 kt wind observations on the 20<sup>th</sup>, but there were no gales at any point. On 21 October, the circulation began to get larger and the low was becoming extratropical as it moved quickly off to the northeast. It should be noted that this low is tracked in the MWR Tracks for Centers of Cyclones October 1945 map from the 19<sup>th</sup> to the 22<sup>nd</sup>. The positions on the MWR map follow the positions in HWM fairly closely.

DAY	LAT	LON	STATUS
Oct 19	24.5N	78W	Tropical depression
Oct 20	29.5N	72.5W	Tropical depression
Oct 21	34.5N	62.5W	Becoming extratropical

Oct 22      39N   51W      Extratropical

## 1946

## 1946 Storm 1

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33145 06/13/1946 M= 4 1 SNBR= 735 NOT NAMED XING=1
33145 06/13/1946 M= 4 1 SNBR= 735 NOT NAMED XING=1

33150 06/13* 0 0 0 0* 0 0 0 0* 0 0 0 0*270 855 35 0*
33150 06/13* 0 0 0 0* 0 0 0 0*275 865 25 0*278 868 30 0*
          *** **
          *** **

33155 06/14*279 862 35 0*283 868 35 0*286 875 35 0*287 886 35 0*
33155 06/14*281 872 30 0*284 876 35 0*286 880 35 0*287 887 35 0*
          *** **          *** **          *** **          *** **

33160 06/15*287 897 35 0*288 905 35 0*288 912 35 0*288 922 35 0*
33160 06/15*287 895 35 0*288 903 35 0*288 910 35 0*289 917 35 0*
          ***          ***          ***          *** **

33165 06/16*291 930 35 0*296 935 35 0*302 940 35 0*308 945 25 0*
33165 06/16*291 924 30 0*294 931 30 0*297 938 25 0*301 948 20 0*
          *** **          *** **          *** **          *** **

33170 TS

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Minor changes to both track and intensity were made to this minimal tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, and Dunn and Miller (1960).

## June 13:

HWM does not analyze any features of interest on this day. HURDAT first lists this storm at 18Z at 27.0N, 85.5W with a 35 kt intensity. Microfilm plots a tropical storm symbol at 12Z near 27.8N, 87.1W. No gales or low pressures.

## June 14:

HWM does not analyze any features of interest on this day. HURDAT lists this as a 35 kt tropical storm at 28.6N, 87.5W. The MWR post-season track map shows a position near the HURDAT position. No gales or low pressures. "This disturbance, accompanied by a small area of squally weather with winds of 25-35 mph, was first detected near latitude 29.0N, longitude 86.5W, about 110 miles south of Valparaiso, FL" (MWR).

## June 15:

HWM does not analyze any features of interest on this day. HURDAT lists this as a 35 kt tropical storm at 28.8N, 91.2W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a tropical storm symbol plotted inside a closed low of at most 1014 mb near 28.5N, 91.0W. No gales or low pressures. "The highest wind velocity recorded was 36 mph at Grand Isle, LA, on June 15, at 1:30 am (630Z). No damage or loss of life was reported, although the sea was very rough in Mississippi Sound as the disturbance, traveling westward, moved across the Gulf to the south" (MWR).

## June 16:

HWM does not analyze any features of interest on this day. HURDAT lists this as a 35 kt tropical storm at 30.2N, 94.0W. The MWR post-season track map shows a position near 30.1N, 93.7W. Microfilm shows a closed low of at most 1016 mb near 29.5N, 93.7W. No gales or low pressures. “The center moved west-northwestward during its 3-day life span, and passed inland on the Texas coast near Port Arthur on the 16<sup>th</sup>, attended by winds of gentle to moderate force” (MWR). “Tropical Cyclones in Texas – 1946 – June 16 – Port Arthur – Minor (“Minor” – Maximum winds less than 74 mph, Minimum central pressure above 996 mb.)” (Dunn and Miller 1960).

A tropical depression formed in the northeastern Gulf of Mexico at 12Z on 13 June with 25 kt maximum sustained winds (HURDAT originally started this at 18Z as a 35 kt tropical storm). Because the circulation was very well defined by 18Z, and there were 10 kt west winds south of the center at 12Z, the low is analyzed to be closed at 12Z. At 18Z, there are many observations close to the center, and the highest observed wind was 25 kt. HURDAT’s 35 kt intensity is thus revised downward to 30 kt. The largest track change to this storm was made at 18Z on the 13<sup>th</sup>. The depression is analyzed to be over 1.5 degrees to the WNW of the HURDAT position based on aircraft observations from the 1830Z microfilm map. The depression moved very slowly to the northwest on the 13<sup>th</sup> and early on the 14<sup>th</sup>, and made a westward turn during the morning of the 14<sup>th</sup>, paralleling the Louisiana coast with the center not far offshore. The forward motion only increased slightly on the 14<sup>th</sup>. The highest sustained wind observation available is 31 kt at Grand Isle, LA at 0630Z on the 15<sup>th</sup>, suggesting that perhaps this was indeed a tropical storm. The depression is analyzed to have become a 35 kt tropical storm at 06Z on the 14<sup>th</sup> (18Z on the 13<sup>th</sup> originally) before it began to parallel the Louisiana coastline. The intensity remained at 35 kt until 00Z on the 16<sup>th</sup> (12Z the 16<sup>th</sup> originally), when it weakened back to a tropical depression and was located off the coast of Lake Charles, LA. The depression then made a northwestward turn and made landfall as a 25 kt depression at 12Z on the 16<sup>th</sup> at the Texas/Louisiana border. It had originally made landfall as a 35 kt tropical storm a little farther east and a couple of hours earlier. Although the only direct landfall of this system was as a tropical depression, it is possible that the coast of Louisiana felt tropical storm force winds when the storm traveled just offshore. No changes were made to the timing of inland dissipation of this system.

## 1946 Storm 2

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33175 07/05/1946 M= 6 2 SNBR= 736 NOT NAMED XING=1
33180 07/05* 0 0 0 0*290 790 35 0*318 796 40 1006*327 793 40 0*
33180 07/05* 0 0 0 0*314 793 30 0*320 792 30 0*326 789 35 0*
          *** **
          *** **

33185 07/06*334 789 40 0*340 784 40 0*346 777 40 0*354 767 45 0*
33185 07/06*332 786 40 0*337 783 40 0*344 780 40 1005*351 770 45 0*
          *** **
          *** **

33190 07/07*361 754 55 0*363 738 60 0*365 723 65 0*367 708 70 0*
33190 07/07*358 756 45 0*368 736 55 0*378 721 65 0*382 706 70 0*
          *** **
          *** **

33195 07/08*370 693 70 0*375 677 70 0*380 660 70 0*385 645 70 0*
33195 07/08*382 691 70 0*381 676 70 0*380 660 70 0*380 642 70 0*
          *** **
          *** **

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33200	07/09E390	630	65	0E396	616	60	0E404	601	55	0E414	582	50	0*
33200	07/09E384	622	65	0E391	602	60	0E400	585	55	0E410	572	50	0*
	***	***		***	***		***	***		***	***		
33205	07/10E427	560	45	0E442	538	40	0E448	515	40	0E460	497	35	0*
33205	07/10E421	560	45	0E433	550	40	0E448	540	40	0E465	530	35	0*
	***			***	***		***			***	***		

33210 HR

U.S. Landfall:

Jul. 6<sup>th</sup> – 08Z – 33.9N 78.2W – 40 kt

Major track changes and minor changes to intensity were implemented with this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, and NHC microfilm of synoptic weather maps.

July 5:

HWM plots a low (not closed) near 31.8N, 77W located just east of the intersection of a warm front, which extends to the northeast, and a cold front, which extends southward and then westward. HURDAT lists this as a 40 kt tropical storm at 31.8N, 79.6W. The MWR tracks of centers of cyclones shows a position near 32.3N, 79.3W with a pressure of 1016 mb. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a closed low of at most 1017 mb near 32.8N, 79.7W located on a SW-NE frontal boundary. No gales or low pressures. “A small tropical disturbance moved north-northeastward along the coast of South Carolina during July 5” (MWR).

July 6:

HWM analyzes a closed low of at most 1010 mb near 34.3N, 77.5W, with a dissipating warm front plotted extending from the low northeastward and a dissipating cold front plotted extending from the low southwestward. HURDAT lists this as a 40 kt tropical storm at 34.6N, 77.7W. The MWR tracks of centers of cyclones shows a 00Z position near 33.4N, 78.4W, and a 12Z position near 34.3N, 77.4W with a 1006 mb pressure. The MWR post-season track map shows a 00Z position near 33.3N, 78.9W and a 12Z position near 34.9N, 77.6W. Microfilm shows a low of at most 1008 mb near 34.3N, 78.1W at 12Z. Land highlights: 39 kt (1-min; max wind) S at Cape Hatteras, NC at 2130Z (OMR); 37 kt SSW and 1005 mb (min pressure) at Cape Hatteras, NC at 22Z (OMR); 40 kt sustained gusting to 45-50 kt at Wrightsville Beach, NC (MWR). “At 6 am (11Z) on the 6<sup>th</sup>...moved inland over North Carolina in the vicinity of Wilmington. At 5:50 am on the 6<sup>th</sup> (1050Z), during the passage of the center over Wilmington, the barometer there reached a low of 29.71 inches (1006.1 mb). A maximum wind velocity of 30 mph (with gusts estimated at 45 mph) was recorded at Wilmington at 1 am, some 5 hours before the passage of the center. Reports for Carolina and Wrightsville beaches indicate that winds reached 45 mph (50-60 mph in gusts) in that area. Little damage was reported to beachfront property. In and near Wilmington wind damage was limited to plate-glass breakage and a short interruption of power and communication services. However, considerable crop damage (15 to 20 percent in some areas) resulted from the heavy rainfall. At Manteo, NC (35.9N, 75.7W) rainfall measuring 7.84 inches fell in less

than 24 hours. This was the greatest 24 hour rainfall ever to have been recorded since the beginning of records at Manteo in 1905. As the storm moved seaward on July 6, between Cape Hatteras and Elizabeth City, NC, it showed marked signs of greater intensity. During the next 4 days the center moved northeastward some distance off the coast” (MWR).

July 7:

HWM analyzes a closed low of at most 1010 mb near 37.3N, 71.3W. HURDAT lists this as a 65 kt hurricane at 36.5N, 72.3W. The MWR tracks of centers of cyclones shows a 00Z position near 36.4N, 75.5W and a 12Z position near 37.2N, 72.3W with a 1005 mb pressure. The MWR post-season track map shows a position similar to the HURDAT position. Microfilm shows the storm centered near 37.7N, 72.5W at 12Z. Land highlights: 35 kt (1-min) W around 0230Z at Cape Hatteras, NC (OMR).

July 8:

HWM analyzes a low of at most 1010 mb near 37.3N, 67.6W with a W-E cold front just one or two hundred nm north of the low. HURDAT lists this as a 70 kt hurricane at 38.0N, 66.0W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a broad closed low of at most 1011 mb. No gales or low pressures.

July 9:

HWM analyzes a low of at most 1015 mb located near 39N, 62.5W located near the intersection of a warm front and cold front. HURDAT lists this as a 55 kt extratropical storm at 40.4N, 60.1W. The MWR post-season track map shows a position similar to the HURDAT position. No gales or low pressures.

July 10:

HWM analyzes a closed, elongated low of at most 1015 mb near 44N, 53.5W. HURDAT lists this as a 40 kt extratropical storm at 44.8N, 51.5W. The MWR post-season track map shows a position near 45.1N, 51.5W. Microfilm shows a tropical storm symbol near 44.8N, 53.8W, located within a closed low of at most 1017 mb. No gales or low pressures. “By the morning of the 10<sup>th</sup>, it reached a point southeast of Newfoundland” (MWR).

A tropical depression with 30 kt winds formed at 6Z on 5 July (analyzed downward from 35 kt) about 100 nm east of Daytona Beach, FL (no change to timing of genesis). A large track change was introduced at the initial position, but minor adjustments were made throughout the remainder of the lifetime of the system as a tropical cyclone. The depression intensified to a tropical storm by 18Z on the 5<sup>th</sup> (12 hours later than originally) as it moved northward, and then north-northeastward towards the Carolina coast. It made landfall as a 40 kt tropical storm at 8Z on the 6<sup>th</sup>, just west of Oak Island, NC. The track changes made at the time of landfall are very minor (four-tenths of a degree or less). Wilmington, NC recorded a pressure of 1006 mb with 10 kt of wind at 12Z, which means that the central pressure was about 1005 mb. This value is added into HURDAT. The Brown et al. pressure-wind relationship for 1005 mb gives 34 kt N of 25N and the

Landsea et al. pressure-wind relationship suggests 40 kt N of 35 N. 45 kt is analyzed to be the intensity for 00Z on the 7<sup>th</sup> (down from 55 kt originally). As the cyclone moved over the Atlantic, some larger track changes were made on the 7<sup>th</sup>, 9<sup>th</sup>, and 10<sup>th</sup>. The cyclone made an eastward turn on the 7<sup>th</sup>, but this eastward turn is analyzed to have occurred farther north than in HURDAT. It then turned back towards the northeast around 00Z on the 9<sup>th</sup>, but the turn is analyzed to have occurred farther east than in HURDAT. On the 10<sup>th</sup>, the position is analyzed well west of the HURDAT position, a major change in location. HURDAT strengthened this tropical storm to a hurricane at 12Z on the 7<sup>th</sup> when the cyclone was located between 150-200 nm east of the Virginia coastline and maintained hurricane strength until it became extratropical at 00Z on the 9<sup>th</sup>. The last observed gale was at 0230Z on the 7<sup>th</sup> at Cape Hatteras. After that, the observations became very sparse, and therefore, no changes are made to HURDAT's intensity from 12Z on the 8<sup>th</sup> through the remaining duration of its lifetime. On the 9<sup>th</sup> and 10<sup>th</sup> there were some ship observations with pressures below 1000 mb, but these obs are all from the same ship, and are analyzed to be too low. There are no changes to the timing of extratropical transition, which occurred at 00Z on the 9<sup>th</sup>. The storm dissipated around 18Z on the 10<sup>th</sup> (no change to timing of dissipation) as a 35 kt extratropical storm a short distance from the eastern tip of Newfoundland. July 11<sup>th</sup> was checked using HWM and COADS to see if the storm still existed on that day, but it was found that the low was no longer closed on the 11<sup>th</sup>.

### 1946 Storm 3

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33215 08/25/1946 M= 2 3 SNBR= 737 NOT NAMED XING=0
33220 08/25*205 932 35 0*211 950 35 0*214 960 35 0*219 978 35 0*
33220 08/25*210 940 35 0*212 948 40 0*215 960 45 0*220 976 50 0*
      *** **
      *** **
      *** **
      *** **
      *** **

33225 08/26*225 999 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
33225 08/26*225 995 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
      ***

33230 TS

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Minor track and intensity changes are analyzed for this short-lived tropical storm that struck near Tampico, Mexico. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, and the New Orleans Weather Bureau operational advisories.

#### August 25:

HWM does not analyze a closed low on this day. HURDAT lists this as a 35 kt tropical storm at 21.4N, 96.0W. The MWR post-season track map shows a position near the HURDAT position. No gales or low pressures. "Although the lack of a trade inversion over Swan Island, West Indies, during the several days previous indicated that conditions were favorable for the formation of a tropical disturbance in that vicinity, no development was detected until the morning of August 25, when reconnaissance flights located a well-defined circulation east of Tampico" (MWR).

#### August 26:

HWM does not analyze a closed low on this day. HURDAT last lists this system at 00Z as a 30 kt tropical depression at 22.5N, 99.9W. No gales or low pressures. “The disturbance moved west-northwestward and passed inland a short distance south of Tampico, Mexico, dissipating rapidly during the night as it reached the mountains west of Tampico” (MWR). From the New Orleans Weather Bureau advisory... “New Orleans Advisory Number two, 9:45 pm est (25<sup>th</sup>) (0245Z- 26<sup>th</sup>). The tropical storm has moved inland near Tampico Mexico and is central near latitude 22.2N, longitude 98W or a short distance west of Tampico. The highest wind reported at Tampico was 60 mph” (Weather Bureau).

A tropical storm formed in the Bay of Campeche around 00Z on 25 August. HURDAT starts this as a 35 kt tropical storm at 00Z on 25 Aug at 20.5N, 93.2W. There are not very many available observations around 00Z, but the 00Z position is adjusted to 21.0N, 94.0W to show a more consistent storm speed between 00Z and 12Z on the 25<sup>th</sup>. The storm moved towards the west-northwest for its entire lifetime of 1 day, and only minor changes were made to the track of the cyclone. The storm made landfall just south of Tampico around 19Z on the 25<sup>th</sup> near 22.1N, 97.8W. The New Orleans Weather Bureau advisory stated that Tampico reported a wind of 60 mph. An intensity of 50 kt is therefore analyzed for 18Z and landfall. The tropical storm likely weakened to a 30 kt tropical depression at 00Z on the 26<sup>th</sup> as it moved rapidly inland over the mountainous terrain. No changes are made to the timing of dissipation.

#### 1946 Storm 4

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33235 09/12/1946 M= 6 4 SNBR= 738 NOT NAMED XING=0
33240 09/12* 0 0 0 0*238 796 50 0*249 792 55 0*256 788 60 0*
33240 09/12*235 790 35 0*240 792 40 0*245 787 50 0*252 780 55 0*
      *** **
33245 09/13*264 779 65 0*272 768 75 994*284 750 85 0*301 735 85 975*
33245 09/13*260 772 65 0*269 763 75 0*278 752 85 0*292 738 85 975*
      *** **
33250 09/14*318 720 80 0*334 709 80 0*350 700 75 0*368 688 75 0*
33250 09/14*308 725 80 0*327 713 80 0*348 702 75 0*369 690 70 0*
      *** **
33255 09/15*387 675 70 0*407 660 65 0E427 642 60 0E448 620 55 0*
33255 09/15E390 675 60 0E410 660 55 0E430 642 50 0E448 615 50 0*
      **** **
33260 09/16E470 589 50 0E487 542 50 0E497 494 45 0E498 464 45 0*
33260 09/16E465 585 50 0E487 542 50 0E497 504 45 0E501 468 45 0*
      *** **
33265 09/17E499 432 45 0E500 391 45 0E510 350 40 0* 0 0 0 0*
33265 09/17E504 432 45 0E508 391 45 0E515 350 40 0E525 305 35 0*
      *** **

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33270 HR

Minor changes to both track and intensity were implemented with this hurricane. Evidence for these alterations comes from the Historical Weather Maps series, the

COADS ship database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

September 12:

HWM analyzes a low of at most 1010 mb near 25.5N, 79W. HURDAT lists this as a 55 kt tropical storm at 24.9N, 79.2W. The MWR tracks of centers of cyclones shows a 00Z position near 19N, 79.6W, and a 12Z position near 22.2N, 79.2W. The MWR post-season track map shows a 12Z position near 25.2N, 78.8W. Microfilm shows a low of at most 1011 mb near 24.9N, 78.8W at 12Z. Ship highlights: 35 kt SW at 18Z at 25.9N, 77.1W (micro). Aircraft highlights: 40 kt S at 15Z at 25.6N, 78.5W (micro); center fix near 25.5N, 78.2W with max winds of 55 kt (micro). “On the 11<sup>th</sup> of September an area of falling pressure was noted over the Bahama Islands, with a minimum pressure over Andros Island. By 7:30 am of the 12<sup>th</sup> there were evidences of a weak cyclonic circulation, and reconnaissance flights were arranged for the forenoon and afternoon. The afternoon flight located a definite center with an “eye” about 8 miles in diameter, surrounded by a 5-mile wide ring of winds with speeds up to 55 knots. At 4 pm of the 12<sup>th</sup> the area of high winds was about 20 miles in diameter, with the center located about 125 miles east of Miami, FL, and 90 miles northwest of Nassau” (MWR). At 20Z, the aircraft estimated 55 kt winds within 5 miles of the eye and 15-20 kt winds extended outward to 19 miles from the eyewall edge (micro).

September 13:

HWM analyzes a tropical storm near 28.4N, 73.8W located within a closed low of at most 1005 mb. HURDAT lists this as an 85 kt hurricane at 28.4N, 75.0W. The MWR tracks of centers of cyclones shows a 00Z position near 25.2N, 77.8W, and a 12Z position near 28N, 76W. The MWR post-season track map shows a 00Z position near 26.9N, 77.8W, and a 12Z position near 29.0N, 75.2W. Microfilm shows a low of at most 996 mb centered near 28.2N, 74.9W at 12Z. Ship highlights: 85 kt near 16Z at 28.7N, 74.8W (micro, MWR); 50+ kt NW and (988 mb?) 1730Z at 29.2N, 73.8W (micro?). Land highlights: 55 kt W gust to 75 kt and 995 mb at 0520Z at Hopetown, Bahamas (26.6N, 77.0W) (micro, MWR). Aircraft highlights: center fix at 27.9N, 75.2W at 1315Z with 80 kt max winds (micro); 85-90 kt around 18Z in the vicinity of 29.2N, 73.8W (MWR); 975 mb central pressure at 1830Z at 29.2N, 73.8W (MWR). “The center passed over Great Abaco Island, Bahamas, about midnight (5Z on the 13<sup>th</sup>). Hopetown reported a west wind of 65 miles per hour; gusts of higher velocity; and a low pressure at the center of 29.38 inches (994.9 mb). Continuing a northeastward movement over the Atlantic, the disturbance soon developed full hurricane force. A reconnaissance plane flew into the center at about 1:30 pm of the 13<sup>th</sup>, near latitude 29.2N, longitude 73.8W, and encountered winds of 85 to 90 knots. On this flight the central pressure was reported as 28.80 inches (975.3 mb). Several hours earlier the *S. S. St. Cloud* was involved in the hurricane near latitude 28.7N, longitude 74.8W, and reported winds of 100 mph” (MWR). On the same flight around the same time that the 975 mb central pressure was reported (the plane is believed to be flying at about 2,000 feet), “the wind structure of the hurricane as reported by pilot passing thru storm + eye on NE course (the following ranges are distance from the center in miles from SW to NE across the center, and then estimated surface wind speed in knots): 60-45 miles SW of center- 30-40 kt winds; 45-33

miles SW of center- 40-50 kt winds; 33-24 miles SW of center – 50-60 kt winds; 24-8 miles SW of center- 60-70 kt winds; 8 miles SW to 8 miles NE of center- 70-90 kt winds were the highest (implying the RMW was less than 8 miles); 8 to 23 miles NE of center- 60-70 kt winds; 23-40 miles NE of center- 50-60 kt winds; 40-55 miles NE of center- 40-50 kt winds; 55-70 miles NE of center- 30-40 kt winds” (micro).

#### September 14:

HWM analyzes a tropical storm near 34.7N, 70.9W located within a 1005 mb closed contour. HURDAT lists this as a 75 kt hurricane at 35.0N, 70.0W. The MWR tracks of centers of cyclones shows a 00Z position near 30.2N, 74W, and a 12Z position near 33N, 71W. The MWR post-season track map shows a 00Z position near 32.1N, 72.9W, and a 12Z position near 35.0N, 70.4W. Microfilm shows a closed low centered near 34.7N, 70.2W at 12Z. Ship highlights: 45 kt N and 1005 mb around 8Z at 32.7N, 72.2W (micro). Aircraft highlights: 40 kt SSW at 1445Z at 35.1N, 69.3W (micro); > 40 kt NW (85 kt at flight level of 1300 feet) at 1530Z at 36.3N, 69.6W (micro). Six other gales. “During the 14<sup>th</sup> and 15<sup>th</sup> the forward movement of the storm increased at a rapid rate as it moved northeastward some distance off the Atlantic coast” (MWR).

#### September 15:

HWM analyzes a low of at most 1005 mb near 43.4N, 62.9W near the intersection of a W-E warm front and a NNE-SSW cold front. HURDAT lists this as a 60 kt extratropical storm at 42.7N, 64.2W. The MWR tracks for centers of cyclones shows a 00Z position near 38.1N, 66.7N, and a 12Z position near 42.6N, 62.8W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a closed low centered near 43.4N, 63.9W at 12Z. Ship highlights: 35 kt W and 1012 mb at 12Z at 41.0N, 65.0W (HWM); 35 kt S and 1006 mb at 18Z at 43.9N, 60.0W (micro). One other gale. Land highlights: 25 kt NE and 1005 mb at 18Z at Sydney, Prince Edward Island (near 46.1N, 60.2W) (micro). “It skirted Nova Scotia on the 15<sup>th</sup> and, diminishing in intensity, passed into Newfoundland accompanied by winds reduced to gale force” (MWR).

#### September 16:

HWM analyzes a low of at most 995 mb near 49N, 47.5W, located at the intersection of a warm front, which extends east-southeastward from the low, and a cold front, which extends southwestward from the low. HURDAT lists this as a 45 kt extratropical storm at 49.7N, 49.4W. The MWR tracks for centers of cyclones shows a 00Z position near 46.5N, 56.7W, and a 12Z position near 49.4N, 51.5W with a 998 mb pressure. The MWR post-season track map last shows a position at 00Z near 47N, 58.4W. Ship highlights: 25 kt SW and 1005 mb at 18Z at 47.0N, 44.2W (COA). Land highlights: 30 kt NW and 1003 mb at 00Z at Sydney, Nova Scotia (46.1N, 60.2W) (micro); >25 kt WNW and 1004 mb at 12Z at 47.3N, 54.7W (HWM). One other low pressure.

#### September 17:

HWM analyzes an occluded low of at most 995 mb near 51.2N, 34.2W with an occluded front extending east-southeastward from the low to a triple point with a cold front and warm front. HURDAT lists this as a 40 kt extratropical storm at 51.0N, 35.0W. The

MWR tracks for centers of cyclones last shows a position at 00Z near 51.2N, 47W. Ship highlights: 45 kt NE and 993 mb at 6Z at 52.0N, 39.4W (COA). Three other gales of 35 kt, and several other low pressures between 997-1005 mb.

A tropical storm formed at 00Z on 12 September (6 hours earlier than originally) apparently from the northern portion of a tropical wave which was moving westward. The disturbed weather associated with the tropical wave was tracked back to 10 September using microfilm and HWM when it was located farther east. At 00Z on the 12<sup>th</sup>, available observations indicate a closed low. The highest observed wind at 00Z is 30 kt (from Nassau, Bahamas), and it is reasonable to assume that this was a 35 kt tropical storm by that time (originally begun as a 50 kt tropical storm at 06Z). As soon the tropical storm formed, it began moving northward and immediately turned towards the northeast. At 20Z on the 12<sup>th</sup>, aircraft estimated 55 kt surface winds and provided a location of the center. The 18Z (12<sup>th</sup>) intensity is revised downward from 60 to 55 kt. The intensities at 06Z and 12Z on the 12<sup>th</sup> are also lowered to allow for a steady strengthening between 00Z and 18Z on the 12<sup>th</sup>. On the 12<sup>th</sup> and early on the 13<sup>th</sup>, the analyzed track is slightly to the right of the previous HURDAT track. The tropical storm center passed over parts of the northwest Bahamas as a category 1 hurricane (the storm is analyzed to have become a hurricane at 00Z on the 13<sup>th</sup>- no change from previous HURDAT). There were no observations available from Great Abaco Island, where the center of the hurricane passed around 5Z of the 13<sup>th</sup>. The only land observation available from the Bahamas is at Hopetown where a 55 kt wind with a 995 mb pressure was recorded at 0520Z on the 13<sup>th</sup>. During the afternoon of the 13<sup>th</sup>, aircraft estimated surface winds of 85-90 kt and measured a central pressure of 975 mb. A central pressure of 975 mb gives 79 kt using the N of 25N pressure-wind relationship. But as this was a small hurricane, 85 kt is retained in HURDAT for 18Z on the 13<sup>th</sup>. No changes were made to intensity from 00Z the 13<sup>th</sup> to 12Z the 14<sup>th</sup>. The hurricane reached its peak intensity of 85 kt from 12-18Z on the 13<sup>th</sup>, and it started to slowly weaken on the 14<sup>th</sup> as it continued to move northeastward about halfway between the NC coast and Bermuda. The hurricane is analyzed to have weakened below hurricane strength and to have become extratropical at 00Z on the 15<sup>th</sup> (12 hours earlier than in the original HURDAT for both). Microfilm shows a large temperature gradient across the storm on its 12Z map (15<sup>th</sup>). Although observations are sparser on the 00Z and 06Z maps, the observations that are available combined with such a large temperature gradient across the low at 12Z indicate the storm was extratropical at 00Z. At the time, observations no longer supported hurricane force winds, so the intensity was lowered to 60 kt (down from 70 kt originally). On the 15<sup>th</sup>, the storm passed over Nova Scotia and Newfoundland. Track changes of one degree or less were made on the 15<sup>th</sup> and 16<sup>th</sup>. On the 15<sup>th</sup>, the intensity was lowered slightly as the available observations indicated a weaker storm. HURDAT previously ended this storm at 12Z on the 17<sup>th</sup> at 51.5N, 35.0W as a 40 kt extratropical storm. A 00Z/18<sup>th</sup> map was plotted with available observations to check if the extratropical storm had been absorbed at that point by another system. By 00Z, it had already been absorbed, but the data suggests that it was probably not absorbed yet at 18Z on the 17<sup>th</sup>, so one extra 6-hour point is added to HURDAT for the end of this storm.

## 1946 Storm 5 (new to HURDAT)

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33271 10/01/1946 M= 6 5 SNBR= 738 NOT NAMED XING=0
33271 10/01* 0 0 0 0* 0 0 0 0*305 375 25 0*320 362 30 0*
33271 10/02*333 349 40 0*343 337 45 0*350 325 50 0*355 313 50 0*
33271 10/03*358 302 50 0*359 293 50 0*360 285 50 0*362 289 55 0*
33271 10/04*368 288 60 0*374 287 65 0*380 286 70 0*385 285 70 0*
33271 10/05*388 285 70 0*391 285 70 0*395 285 70 0*403 283 65 0*
33271 10/06*415 279 60 0E430 275 55 0* 0 0 0 0* 0 0 0 0*
33271 HR

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HWM, COADS, and a newspaper article from the Azores Islands indicate that a hurricane, previously undocumented in HURDAT, occurred between October 1<sup>st</sup> and 6<sup>th</sup>, striking the Azores on the 4<sup>th</sup>.

## October 1:

HWM analyzes an elongated closed low of at most 1015 mb near 31.5N, 35W with a warm front extending east-northeastward from the low and a cold front extending southwestward from the low. HURDAT did not previously list this system. No gales or low pressures.

## October 2:

HWM analyzes a large, closed low of at most 1010 mb near 34N, 26W, with a warm front extending ENE and a cold front extending SW of the low. HWM analyzed another closed low of at most 1005 mb near 43N, 22W. Ship highlights: 35 kt SE and 1004 mb at 00Z at 33.5N, 35.0W (COA); 45 kt N and 1007 mb at 06Z at 32.7N, 36.5N from the same ship (COA).

## October 3:

HWM analyzes a very large closed low of at most 1010 mb near 36.5N, 26W with a warm front extending to the ENE and a cold front extending to the south of the low. No gales or low pressures.

## October 4:

HWM analyzes an occluded low of at most 995 mb near 38N, 28.5W with an occluded front extending from the low NE to a triple point at 40N, 25W, with a warm front extending to the ENE and a weak cold front extending to the SE of the triple point. Ship highlights: 25 kt NW and 1005 mb at 12Z at 35.2N, 33.2W (COA); 35 kt NE and 1005 mb at 18Z at 40.4N, 33.5W (COA). Land highlights: 30 kt SE and 1006 mb at 12Z at an island in the Azores near 37.8N, 25.7W (HWM).

## October 5:

HWM analyzes a low of at most 990 mb near 39.5N, 28.5W with a dissipating occluded front wrapped around part of the low. Ship highlights: 25 kt NE and 1005 mb at 00Z at 40.2N, 33.5W (COA); 15 kt NE and 1003 mb at 06Z at 40.5N, 33.2W (COA); 20 kt N and 1002 mb at 12Z at 40.7N, 33.0W (COA); 15 kt NE and 1001 mb at 40.9N, 32.7W (COA). Land highlights: 30 kt N and 994 mb at 12Z at 39.3N, 30.6W (HWM); unknown wind speed SW and 991 mb at 12Z at 38.5N, 28.2W (HWM). Regarding the storm in the Azores... "One hundred and 20 fishermen were reported missing today at the island of

Santa Maria in the wake of a 98 mile-an-hour typhoon which destroyed 12 fishing vessels, two port tugs and several launches. Four fishing boats were missing. Reports from San Miguel and Santa Maria Island said the winds did ‘catastrophic’ damage yesterday, destroying crops, ruining homes, smashing pineapple hot-houses and wrecking communications. Latest reports said the American-built airfield in the Azores was practically destroyed” (newspaper article).

October 6:

HWM analyzed a large low of at most 990 near 50N, 28.5W, with a cold front extending to the south of the low and another extratropical low approaching closely from the west. Ship highlights: 50 kt NNW and 1003 mb at 00Z at 40.9N, 33.9W (COA); 30 kt NW and 1002 mb at 00Z at 41.0N, 32.5W (COA); 45 kt NNW and 1015 mb at 06Z at 40.4N, 35.2W (COA); 30 kt NNW and 1002 mb at 12Z at 41.2N, 31.7W (COA); 20 kt WSW and 1004 mb at 42.1N, 22.0W (HWM); 30 kt S and 1005 mb at 45.0N, 17.2W (COA).

A tropical depression formed at 12Z on 1 October at 30.5N, 37.5W. Moving towards the northeast, the depression became a tropical storm by 00Z on the 2<sup>nd</sup>. Early on October 2<sup>nd</sup>, a fairly tight circulation was found with gales and relatively low pressures in the vicinity of 33.5N, 35W. The first observed gale occurred at 00Z the 2<sup>nd</sup>- a 35 kt wind from the SE at 33.5N, 35W. This observation occurred with an 1004 mb pressure. Six hours later, there was a ship observation of 45 kt from the N with a 1007 mb pressure, and this observation was about 100 nm WSW of the previous observation. Assuming the storm was moving to the NNE or NE, these two observations indicate that at 00Z, a storm was just SW of the 00Z ob, and by 6Z, the storm was further east, or ENE of the 6Z observation. For 00Z, 06Z, and 12Z on the 2<sup>nd</sup>, 40, 45, and 50 kt are analyzed for intensity. There were no available observations of gales on the 3<sup>rd</sup>, but on the 4<sup>th</sup> and 5<sup>th</sup>, the storm hit the Azores with strong winds and did damage, according to the newspaper article from the Azores newspaper. Although the newspaper reports that 98 mph winds struck the Azores, it is unknown whether this was a gust or sustained wind, and it is unknown how this wind was measured or if it was estimated (though a specific value of “98 mph” would suggest a measured, rather than an estimated wind speed). The article says that the airfield was “practically destroyed.” Damaging winds are typically defined as 50 kt or greater. The total destruction of an airfield would have to have been caused by significantly higher winds than the minimum criteria for causing damage. The lowest pressure recorded on the 5<sup>th</sup> was 991 mb, a peripheral value. Using the Landsea et al. north of 35N pressure wind relationship, this suggests winds of at least 61 kt. 70 kt is chosen for the maximum intensity attained by this hurricane, between 12Z of 4 October and 12Z of 5 October. The storm moved northward away from the Azores late on the 5<sup>th</sup>, and at 00Z on the 6<sup>th</sup>, a 50 kt wind from the NNW with a 1003 mb pressure was recorded by a ship some distance west of the center. An intensity of 60 kt is analyzed for 00Z on the 6<sup>th</sup>, decreasing to 55 kt at 06Z. At 12Z on the 6<sup>th</sup>, the tropical storm had merged with a strong, extratropical low to its north, so 06Z is analyzed as the last position in HURDAT at 43N, 27.5W.

1946 Storm 6 (originally Storm 5)

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33275 10/05/1946 M=10 5 SNBR= 739 NOT NAMED XING=1 SSS=1
33275 10/05/1946 M=10 6 SNBR= 739 NOT NAMED XING=1 SSS=1
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33280 10/05* 0 0 0 0*180 872 35 0*184 867 40 0*186 865 45 1005*
33280 10/05* 0 0 0 0* 0 0 0 0* 0 0 0 0*182 870 35 *
*** ** ** ** ** ** ** ** ** ** ** ** **
33285 10/06*188 862 55 0*191 860 60 0*196 856 65 993*203 851 75 0*
33285 10/06*188 863 45 0*194 858 55 0*200 853 65 993*207 848 75 0*
*** ** ** ** ** ** ** ** **
33290 10/07*213 846 85 0*223 841 100 0*237 836 110 0*254 832 115 979*
33290 10/07*215 844 80 0*225 840 80 0*237 836 85 0*254 833 80 979*
*** ** ** ** *
33295 10/08*270 828 65 0*286 826 40 0*303 824 35 0*319 821 35 0*
33295 10/08*270 829 75 980*286 825 70 0*308 821 55 0*325 817 50 0*
*** ** ** ** *
33300 10/09*335 816 30 0*346 807 30 0E353 794 25 0E358 778 25 0*
33300 10/09*335 816 40 0*340 813 35 0E343 806 30 0E347 788 30 0*
*** ** ** ** *
33305 10/10E361 762 25 0E363 746 25 0E362 729 25 0E359 702 25 0*
33305 10/10E353 768 30 0E359 750 35 0E362 733 40 0E359 710 40 0*
*** ** ** ** *
33310 10/11E353 672 25 0E345 650 25 0E338 635 25 0E332 627 25 0*
33310 10/11E353 677 35 0E345 650 35 0E338 635 30 0E332 627 25 0*
*** ** ** ** *
33315 10/12E326 621 25 0E321 617 25 0E315 614 25 0E304 612 25 0*
33320 10/13E292 613 25 0E281 620 25 0E272 629 25 0E266 640 25 0*
33325 10/14E264 650 25 0E263 658 25 0E262 667 25 0E262 677 25 0*
33325 10/14E262 652 25 0E258 665 25 0E255 680 25 0E253 695 25 0*
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33330 HRBFL1

#### US Landfall:

10/8/1946 at 02Z at 27.5N, 82.6W; 75 kt; 980 mb; 35 nmi RMW; 1009 mb outer closed isobar; 325 nmi radius of outer closed isobar

Minor track changes and major changes to intensity are analyzed with this hurricane that made landfall in Cuba and Florida. Evidence for these alterations comes from the Historical Weather Maps series, the COADS ship database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Conner (1956), Dunn and Miller (1960), Jarrell et al. (1992), and Perez et al. (2000).

#### October 5:

HWM analyzes a low of at most 1005 mb near 18.4N, 86.7W. HURDAT lists this as a 40 kt tropical storm at 18.4N, 86.7W. Microfilm does not show a closed low, and the lowest pressure observation on microfilm is 1005 mb. Ship highlights: 25 kt SE and 1004 mb at 18Z at 19.0N, 86.9W (COA, micro). Land highlights: 10 kt SW and 1004 mb at 18Z at Belize City (17.4N, 88.2W) (micro). Two other low pressures. "Late on October 5 a poorly defined cyclonic circulation passed northeastward from Guatemala

into the Caribbean Sea. The forward movement of this low pressure area slowed to about 12 mph as it moved out over the waters of the Caribbean” (MWR).

October 6:

HWM analyzes a low of at most 1005 mb near 19.2N, 84.7W. HURDAT lists this as a 65 kt hurricane at 19.6N, 85.6W. The MWR tracks of centers of cyclones shows a position at 12Z near 20.2N, 83.3W with a pressure of 1000 mb. Microfilm shows a low of at most 996 mb centered near 20.2N, 85.5W at 12Z. Ship highlights: 30 kt S and 989 mb at 1830Z (micro); > 50 kt S-SSE and 995 mb around 15Z at 20.5N, 84.8W (micro); 75 kt E at 21Z at 21.4N, 84.5W (micro). Five other ship obs of 45 kt or greater and numerous other gales. Four other ship obs of 995 mb or less, and numerous other low pressures below 1005 mb. Land highlights: 10 kt SE and 1005 mb at 00Z at Belize City (17.4N, 88.2W) (micro); 25 kt N and 1001 mb at 9Z at Cozumel (20.5N, 86.9W) (micro); 15 kt S and 1005 mb at Swan Island (17.3N, 83.9W) (micro). Aircraft highlights: Army Pirep Center fix at 1515Z at 20.5N, 85.0W (micro); 85 kt maximum sustained winds east of center around 18Z reported by the Navy (micro); center fix at 20.6N, 84.4W with maximum sustained winds of storm 85 kt (micro). At least five other aircraft gales. “Between 1:30 pm of the 5<sup>th</sup> and 7:30 am of the 6<sup>th</sup>, the central pressure fell from 1005 mb to 993 mb, with winds increasing to over 50 mph. During the late afternoon of the 6<sup>th</sup> winds of 85 mph were measured from aircraft and surface vessels” (MWR). From the weather office in Key West... “Tropical disturbance formed south of Yucatan Channel during early morning. It was reported to be increasing in intensity and would move over Western Cuba and Fla. Straits giving winds of hurricane force. Hurricane warnings deployed 5:00 pm” (OMR). “A Navy destroyer about 40 to 50 miles south of the extreme western tip of Cuba reported a maximum wind of 85 knots at 5:30 pm (2230Z) of the 6<sup>th</sup>. During the night the center crossed extreme western Cuba and the station at San Julian reported winds in gusts of 112 mph” (10/1946 FL Climatological Data).

October 7:

HWM analyzes a tropical storm near 24.9N, 83.2W located inside a closed 995 mb contour. HURDAT lists this as a 110 kt hurricane at 23.7N, 83.6W. The MWR tracks of centers of cyclones shows a 00Z position near 22N, 83.6W, and a 12Z position near 24N, 83.3W with a 990 mb pressure. The MWR post-season track map shows a 00Z position near 21.7N, 84.9W, and a 12Z position near 23.7N, 84.4W. Microfilm shows a closed low of at most 996 mb centered in the general vicinity of 24N, 84W at 12Z. Ship highlights: 75 kt NW and 990 mb at 1530Z at 24.0N, 84.9W (micro); 50 kt WSW and 985 mb at 20Z at 25.2N, 83.6W (micro). Three other ships obs of at least 50 kt and numerous other gales. Several other ships obs between 988-1000 mb. Land highlights: 45 kt SE and 991 mb at 4Z at 22.3N, 83.8W (Cuba) (micro); 73 kt (1-min; max w) S and 995 mb at 1730Z at Dry Tortugas (24.6N, 82.9W) (micro, MWR). Several other gales and low pressures reported across western Cuba, south Florida, and the Keys. Aircraft highlights: 68 kt S at 1230Z at 24.4N, 83.0W (micro); center fix at 1310Z at 24.0N, 83.4W (micro); 115 kt at 24.1N, 83.6W (MWR); 110 kt W at 1630Z at 23.9N, 84.5W (micro); 50 kt N and 994 mb at 1915Z at 26.5N, 83.9W (micro); 979 mb at 26.1N, 83.7W (MWR); center fix (~19-21Z) at 26.3N, 83.2W with 979 mb central pressure and estimated maximum sustained surface winds of 85 kt (micro). Numerous other gales and

two other low pressures. “The center crossed extreme western Cuba, with the station at San Julian, Cuba, reporting gusts reaching 112 mph. Moving into the Gulf, the center passed a short distance west of Dry Tortugas, which, at 12:30 pm on the 7<sup>th</sup>, recorded an extreme wind velocity (~1-min sustained wind) of 84 mph from the south. Several ships west of the island reported winds of 80-100 kt, and a reconnaissance plane flying into the center estimated a wind of 115 kt (132 mph). After passing the latitude of Dry Tortugas, the storm began to lose intensity, as indicated by reports from a plane that flew into the storm at 4:18 pm, while it was centered about 100 miles WSW of Fort Myers; no winds greater than 85 kt (98 mph) were reported” (MWR). From the weather office in Key West... “Tropical hurricane continued to move northward and passed about 130 miles west of Key West during the day. By night fall all danger was passed. Hurricane warnings lowered at 4:00 pm. No damage reported” (OMR). From the FL Climatological Data “A reconnaissance plane estimated highest wind at 115 knots, but there is some question about the accuracy of this estimate” (10/1946 FL Climatological Data). Regarding the forward motion, “the forward movement accelerated rapidly from 14 mph to when leaving Cuba to 33 mph while passing over Florida and southeastern Georgia. The rapid acceleration doubtless contributed to loss of force, however, winds were nearly as strong over northeastern Florida as on the west coast where it first struck” (10/1946 FL Climatological Data). “No name – 1946 – October 7 – Category 1 (no track changes recommended)” (Perez et al. 2000).

October 8:

HWM analyzes a low of at most 995 mb near 31N, 82.2W with a warm front extending from just northeast of the low northeastward for several hundred miles. HURDAT lists this as a 35 kt tropical storm at 30.3N, 82.4W. The MWR tracks of centers of cyclones shows a 00Z position near 26.5N, 83.4W, and a 12Z position near 31.5N, 82.4W with a 996 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 990 near 31.2N, 81.9W at 12Z. Ship highlights: 35 kt ENE and 1004 mb at 6Z at 24.9N, 83.5W (COA). Two other low pressures of 1004 mb. Land highlights: 50 kt (1-min, max w) ESE at 0127Z at Fort Myers (26.6N, 81.9W) (MWR); 56 kt (1-min, max w) SSE at 145Z at Okeechobee, FL (27.2N, 80.8W) (MWR); 980 mb (min p) at 330Z at Cortez, FL (27.5N, 82.7W) (MWR); 65 kt (1-min, max w) SSE at 4Z at Punta Gorda (27.0N, 82.1W) (MWR); 985 mb (min p) around 515Z at Lakeland, FL (28.0N, 82.0W) (micro); 57 kt SSE (max w) and 993 mb (min p) at 8Z at Daytona Beach (29.2N, 81.1W) (MWR, micro); 35 kt SE and 989 mb (min p) at 1615Z at Savannah, GA (32.1N, 81.2W) (OMR, MWR). Several other gales and low pressures. “As the storm approached the Florida coast, the ring of hurricane-force winds, which probably never exceeded 50 miles in width, was destroyed at the surface, leaving a poorly defined and relatively flat central area surrounded by a broad circulation of gale-force winds. Some Florida stations directly in the path of the storm reported winds which gradually decreased from 40-50 mph down to 15-20 mph, and gradually increased again, without any relative calm period intervening. Others reported a complete calm for periods as long as 1 hour. However, a short distance above the surface, there seemed to be little disruption of the hurricane-force winds. Several stations reported very rapidly moving low clouds at the height of the storm, with only fresh surface winds; and one observer stated that while small trees were being gently swayed

by the wind at the peak of the storm, the tops of the taller pines in the same field were being violently twisted and sheared. Along the west Florida coast the maximum winds reported were 75 mph. These high velocities were reported from stations to the right of the center of the storm, in the Fort Myers-Punta Gorda section. Tampa, over which the calm center passed about midnight (5Z the 8<sup>th</sup>), reported a highest wind of only 47 mph” (MWR). From the Tampa weather office... “A tropical disturbance passed about directly over the station on the night of October 7-8, 1946. Lowest pressure was 29.14 sea level. No damage in the vicinity of the station” (OMR). Regarding the storm in Jacksonville... “The highlight of the month was the threat of a hurricane, the center of which passed west of Jacksonville during the morning of the 8<sup>th</sup>. The maximum (5-min) wind was 33 (mph) South at 7:00 am EST, with extreme (1-min) the same. The airport reported 39 (mph) ESE at 4:33 am, with gusts up to 60 mph. The lowest barometer, 29.21 inches (sea-level) occurred at both the airport and the city office at 5:50 am (1050Z). There was only minor damage reported in the city, mostly from water. Twenty-nine (29) families were made homeless by the loss of their houseboats and waterfront homes along the river at the foot of Dora and Jackson streets, just east of Riverside Avenue. A similar settlement across the river, on the south side was demolished. The Red Cross estimated the total losses in the neighborhood of \$8,111.00” (OMR). Regarding the damage on the Georgia coast (from Savannah weather office)... “There was no damage from the tropical storm in this area. Unusually high tides were not high enough to do any damage at Savannah Beach. High tides in the Brunswick area did considerable damage to piers and beach installations and the water came up to around several houses. It did not get high enough to come above the doors” (OMR). The tropical storm passed to the west of Savannah on the 8<sup>th</sup> (Savannah OMR). From the Columbia, SC weather office... “The tropical storm which passed inland near Tampa, FL entered South Carolina in the vicinity of Augusta, GA. The center passed a short distance west of Columbia during the mid-afternoon of the 8<sup>th</sup>. Moderately heavy rains and comparatively high winds were experienced but damage was negligible. The lowest sea-level pressure, 29.29 inches, was the lowest October pressure since the establishment of the station, equaling the low of October 1944” (OMR). From the Charleston, SC weather office... “The maximum wind velocity (5-min) was 36 mph on the 8<sup>th</sup>, at which time the hurricane was passing to the west of the station, with greatly diminished intensity” (OMR). From the Greenville, SC weather office... “Remnants of the tropical storm that moved up from Florida hit us on the 8<sup>th</sup> and high winds with one gust up to 79 mph was recorded. No property damage was reported” (OMR). Regarding the forward motion of the storm... “The forward movement of the hurricane accelerated rapidly during the 7-8<sup>th</sup>, from about 14 mph upon leaving Cuba to 33 mph when passing over Florida and southeastern Georgia. Coming to an abrupt stop between Columbia, SC and Augusta, GA on the 8<sup>th</sup>, it continued to lose force” (MWR). Regarding the damage... “The greatest damage in Florida was to the citrus crop, and was estimated at 2 percent, or 2,000,000 boxes of fruit, at \$2.50 per box, amounting to \$5,000,000. In some west coast counties, such as Sarasota, Charlotte, and Lee, the loss ran to 10% for oranges and 15-20 percent for grapefruit, but the production in these counties is small compared to the total crop. Other property damage was confined to about \$200,000, most of which resulted from unusually high tides along the west Florida coast. No loss of life or serious injury was reported for the Gulf or Atlantic coasts of the United States. However, press reports stated that 5 lives were lost as a result

of this hurricane in western Cuba” (MWR). Regarding the high tides in Florida, “tides on the Florida coast were unusually high and caused much of the damage reported. The town of Everglades (City) was inundated to depths ranging 1.5 to 3 feet. Parts of Punta Gorda and Ft. Myers were also flooded as well as low beaches and islands from Tampa Bay to the Keys. Some few beach cottages were undermined and damaged or destroyed, while piers, bulkheads, sea-walls, and house-boats suffered considerable damage. Slight damage was also reported along the Atlantic Coast from around Titusville, FL to Charleston, SC, mostly from high tides” (10/1946 FL Climatological Data). “1946 – Oct – FL, 1SW – 980 mb” (Jarrell et al. 1992). “Tropical Cyclone in Florida – 1946 – Oct. 7-8 – West Coast – Minimal – Tides high, damage \$5,200,000” (Dunn and Miller 1960).

#### October 9:

HWM analyzes a low of at most 1000 mb near 34.5N, 80W with a dissipating warm front somewhat wrapping around the low. HURDAT lists this as a 25 kt extratropical low at 35.3N, 79.4W. The MWR tracks of centers of cyclones shows a 00Z position near 33.6N, 81.9W, and a 12Z position near 35.1N, 81.3W with a 999 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 999 mb centered near 33.8N, 85.7W. Land highlights: 31 kt NE and 995 mb at 0010Z at Greenville, SC (34.8N, 82.4W). Ten other low pressures between 999-1004 mb across parts of Georgia, South Carolina, and North Carolina. “Heavy rains spread over the Carolinas and Virginia, with diminishing winds. After remaining stationary for about 18 hours, the weak low-pressure system moved over the North Carolina Capes and into the Atlantic” (MWR).

#### October 10:

HWM analyzes a low of at most 1000 mb near 36N, 72.8W with no fronts in the vicinity. HURDAT lists this as a 25 kt extratropical low at 36.2N, 72.9W. The MWR tracks of centers of cyclones shows a 00Z position near 35.9N, 76.9W, and a 12Z position near 36.5N, 73.6W with a 1002 mb pressure. Microfilm shows a broad low of at most 1005 mb in the general vicinity of 36.8N, 73.6W, with frontal structures extending from the low. Ship highlights: 10 kt E and 1003 mb at 6Z at 37.7N, 73.7W (COA). Four other low pressures. Land highlights: 10 kt N and 1002 mb (min p) at 445Z at Hatteras, NC (35.2N, 75.6W) (OMR); 35 kt NE and 1010 mb at Atlantic City, NJ (39.4N, 74.4W) (micro). One other low pressure.

#### October 11:

HWM analyzes a low of at most 1005 mb near 35N, 63W. HURDAT lists this as a 25 kt extratropical low at 33.8N, 63.5W. The MWR tracks of centers of cyclones shows a 00Z position near 36.6N, 70.2W, and a 12Z position near 32.4N, 64.7W with a 1008 mb pressure. No gales or low pressures.

#### October 12:

HWM analyzes a low of at most 1005 mb near 31.8N, 61.8W. HURDAT lists this as a 25 kt extratropical low at 31.5N, 61.4W. The MWR tracks of centers of cyclones last shows a position at 00Z near 31.3N, 62.4W. No gales or low pressures.

October 13:

HWM analyzes a larger low of at most 1005 mb in the general vicinity of 27.3N, 63W. HURDAT lists this as a 25 kt extratropical low at 27.2N, 62.9W. No gales or low pressures.

October 14:

HWM analyzes a large low of at most 1008 mb in the general vicinity of 26.2N, 67W with a stationary front located a couple hundred miles to the west of the low. HURDAT lists this as a 25 extratropical low 26.2N, 66.7W. No gales or low pressures.

A tropical storm formed at 18Z on 5 October (12 hours later than originally) in the extreme western Caribbean Sea just off the coast of the Belize/Mexico border. The tropical storm apparently originated from a trough of low pressure over northern Central America. The tropical storm moved slowly at first to the northeast on the 5<sup>th</sup> and 6<sup>th</sup>, intensifying to a hurricane at 12Z on the 6<sup>th</sup> (no change to the time hurricane strength was attained). Then the hurricane accelerated and moved more in a NNE direction, crossing extreme western Cuba as an 80-kt category 1 hurricane on the 7<sup>th</sup>. Minor adjustments were made to the track for all days of this tropical cyclone, except for no changes on the 12<sup>th</sup> and 13<sup>th</sup> when it was an extratropical cyclone. For intensity, Belize City recorded a peripheral pressure of 1004 mb at 18Z on the 5<sup>th</sup>. According to the Brown et al. south of 25 N pressure-wind relationship, the tropical storm should have maximum sustained winds of at least 39 kt. However, the storm was moving slow and the environmental pressure was low, so 35 kt is chosen for the start of this tropical cyclone at 18Z on the 5<sup>th</sup> (revised downward from 45 kt at 18Z). MWR indicates that the central pressure on the 6<sup>th</sup> at 12Z was 993 mb. This value yields 59 kt using the South of 25N pressure-wind relationship. However, by 18Z, aircraft had estimated maximum surface winds of 85 kt, and there was a 989 mb pressure along with 30 kt of wind from a SHIP. 989 mb (not a central pressure) yields greater than 65 kt maximum winds. Considering the above information including the aircraft estimate of 85 kt winds, the intensity at 12Z on the 6<sup>th</sup> is kept at 65 kt and at 18Z the intensity is kept at 75 kt. Winds are accordingly ramped early on the 6<sup>th</sup> starting from the 35 kt at 18Z on the 5<sup>th</sup>.

The hurricane made landfall in western Cuba around 02Z on the 7<sup>th</sup> of October. The assessment by Perez et al. indicated that the hurricane was a category 1 hurricane at Cuban landfall, and winds were slightly reduced at 00Z from 85 kt to 80 kt. The hurricane moved into the Florida Straits just after 06Z on the 7<sup>th</sup>. During midday on the 7<sup>th</sup>, when the hurricane was passing west of the Dry Tortugas, aircraft estimated maximum sustained winds of 115 kt. This was likely an overestimate, because approximately 4 hours later around 20Z, aircraft measured a central pressure of 979 mb. 979 mb yields 79 and 76 kt for south of 25N and north of 25N respectively. The highest direct wind observation available from a ship is 75 kt, although MWR text states that several ships west of Dry Tortugas reported winds of 80-100 kt. Observations from the Dry Tortugas station recorded a maximum wind of 73 kt at 1730Z, as the hurricane passed just to the west of the islands. Taking all of the information into account, 85 kt is chosen as the intensity of this storm at 12Z (which is now analyzed to be the peak lifetime intensity of the system) and 80 kt at both 06Z and 18Z (originally the values

were 100, 110, and 115 kt respectively for 06, 12, and 18Z). The changes introduced for the winds at these three times are major revisions. The hurricane is analyzed to have made landfall near Cortez, FL around 02Z on 8 October. The revised positions around the time of landfall are within half of a degree of the previous HURDAT positions. Cortez reported a central pressure of 980 mb. This suggests maximum winds of 73 kt from the north of 25N pressure-wind relationship. The highest wind observation on the Florida Peninsula was 65 kt at Punta Gorda, FL at 4Z on the 8<sup>th</sup>, indicating a large RMW. Additional factors are the somewhat fast forward speed (16 kt), but large size (35 nm RMW and 325 nm radius of outer closed isobar). Taken together, this suggests a maximum wind of 75 kt at landfall in southwest Florida (Category 1). This storm continued quickly after landfall northward through northern Florida, eastern Georgia, and into South Carolina by 00Z on the 9<sup>th</sup>. A run of the Kaplan and DeMaria inland decay model for 6Z, 12Z and 18Z on the 8<sup>th</sup> yields intensities of 60, 46, and 35 kt respectively. Peak observed winds (within 2 hr of synoptic time) were 65, 35, and 63 kt respectively. One surprising observation from Greenville, SC was a 1-minute wind of 63 kt around 18Z on the 8<sup>th</sup>. However it is likely that this wind was enhanced due to local topography effects. Surrounding observations make it hard to believe that the observation at Greenville is representative of the winds not influenced by terrain. 70, 55, and 50 kt are chosen for 06, 12, and 18Z on the 8<sup>th</sup> (up from 40, 35, and 35 kt originally). The first two are major changes upward in intensity. Additionally, as the cyclone is still a hurricane at 06Z, it is also considered a Category 1 impact for northwest Florida. The system weakened below tropical storm intensity at 12Z on the 9<sup>th</sup> (12 hours later than originally) and became extratropical around the same time (no change to timing of extratropical transition).

On the 9<sup>th</sup>, the depression turned eastward in North Carolina and emerged off of the Atlantic coast between 00 and 06Z on the 10<sup>th</sup> moving due east. The extratropical low made a large loop during the next 4 days (in HURDAT and confirmed in the reanalysis). Moving eastward near 36N, 74 on the 10<sup>th</sup>, it turned towards the ESE and SE on the 11<sup>th</sup>, southward on the 12<sup>th</sup> (near 32N, 61W), southwestward on the 13<sup>th</sup> (near 27N, 63W), and westward on the 14<sup>th</sup> (near 26N, 67W) before dissipating. Observations indicate that it briefly regained gale force on the 10<sup>th</sup> and 11<sup>th</sup> as an extratropical cyclone.

#### 1946 Storm 7 (originally Storm 6)

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33335 10/31/1946 M= 4 6 SNBR= 740 NOT NAMED XING=1 L
33335 10/31/1946 M= 4 6 SNBR= 740 NOT NAMED XING=1
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33340 10/31* 0 0 0 0*200 710 35 0*206 720 35 0*219 735 35 0*
33340 10/31* 0 0 0 0* 0 0 0 0* 0 0 0 0*219 735 30 0*
*** ** ** *** ** **

33345 11/01*230 750 40 0*239 765 40 0*248 780 40 0*258 793 40 0*
33345 11/01*230 753 40 0*239 765 40 0*246 778 40 0*258 793 40 1002*
*** ** ** *** ** *****

33350 11/02*268 803 35 0*277 812 30 0*285 818 25 0*302 820 25 0*
33350 11/02*268 803 35 0*277 812 30 0*285 818 25 0*291 820 25 0*
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33355	11/03*317	810	20	0*323	799	20	0*330	788	15	0*	0	0	0	0*
33355	11/03*297	818	20	0*309	807	20	0*	0	0	0	0*	0	0	0*
	***	***		***	***		***	***	**					

33360 TS

## U.S. Landfall:

Nov. 1<sup>st</sup> – 21Z – 26.6N, 80.1W – 40 kt – 1002 mb

Major track changes and minor intensity changes were analyzed for this minimal tropical storm that made landfall at Palm Beach, FL. Evidence for these alterations comes from the Historical Weather Maps series, the COADS ship database, Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Dunn and Miller (1960), and Simpson (1948).

## October 31:

HWM analyzes a trough axis from 24N, 69W to a low located near 14N, 77W. HURDAT lists a 35 kt tropical storm at 20.6N, 72.0W. The MWR post-season track map shows a position close to the HURDAT position. Microfilm shows a low of at most 1011 mb near 20.7N, 71.5W. No gales or low pressures. “This disturbance developed from a wave formation in the pressure field which was noted moving westward north of Puerto Rico and Hispaniola on October 31” (MWR). “Early on the 31<sup>st</sup>, it became apparent that the (tropical wave) axis had rotated into a forward or westward inclination. At the same time deepening began to occur and there was some evidence of a closed circulation as low as 7,000 feet. On the afternoon and evening of October 31<sup>st</sup>, rapid deepening occurred with 24-hour katallobaric centers over the wave crest increasing on three successive six-hourly maps from 1.5 to 5.0 millibars” (Simpson 1948).

## November 1:

HWM analyzes a low of at most 1010 mb near 25N, 76.5W with a trough extending south-southwestward from that low to another broad low in the Caribbean. HURDAT lists this as a 40 kt tropical storm at 24.8N, 78.0W. The MWR tracks of centers of cyclones shows a 00Z position near 21N, 76.4W, and a 12Z position near 23.8N, 76.2W with a 1008 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1008 mb near 24.2N, 77.4W. Ship highlights: 35 kt NE and 1007 mb at 1830Z at 27.5N, 79.5W (micro). One low pressure of 1005 mb at an unknown location at 2045Z. Land highlights: 35 kt E and 1006 mb at 1830Z at 26.7N, 79.0W (micro); 10 kt SE and 1004 mb at 23Z at West Palm Beach (26.7N, 80.1W) (micro). Two other low pressures of 1005 mb at West Palm Beach. “Early on November 1, a rather concentrated fall in pressure was noted as the wave moved through the Bahama Islands. During the morning, aircraft reconnaissance located signs of a forming cyclonic circulation, which was, however, still weak and poorly defined. The highest wind reported from the Bahamas area was Beaufort force 8 (39-46 mph), at West End, Grand Bahama Island, and aboard two ships north of that island. From the Bahamas the center moved northwestward and passed over the Florida coast near Palm Beach at about 4:30 pm (2130Z) on the 1<sup>st</sup> of November. Wind velocities over Florida at no time exceeded 40 mph, although squalls and winds between 30-40 mph were reported from near Miami to Daytona Beach” (MWR). “Circulation

rapidly developed at the surface and extended vertically to 30,000 feet by the morning of November 1<sup>st</sup>. The tropical cyclone which formed did not attain hurricane force before moving inland over South Florida” (unknown source). “Tropical Cyclones in Florida – 1946 – Nov. 1-2 – Palm Beach – Minor – Damage several millions (“Minor” – Maximum winds less than 74 mph, Minimum central pressure above 996 mb)” (Dunn and Miller 1960).

November 2:

HWM analyzes a low of at most 1008 mb near 28.8N, 80.4W. HURDAT lists this as a 25 kt tropical depression at 28.5N, 81.8W. The MWR tracks of centers of cyclones shows a 00Z position near 26.9N, 80.1W, and a 12Z position near 27.9N, 81.6W with a 1005 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1006.5 mb in the general vicinity of 28.5N, 81.4W. Ship highlights: 15 kt SE and 1003 mb at 00Z at 26.4N, 80.0W (micro). Land highlights: 15 kt SSE and 1005 mb at 830Z at Melbourne, FL (28.1N, 80.6W) (micro); 5 kt E and 1004 mb at 1830Z at Ocala, FL (29.2N, 82.1W) (micro). At least six other low pressures of 1005 mb on the Florida peninsula. “Moving more slowly and continuing a northwestward movement, the center reached a location between Lakeland and Orlando, FL by 7:30 am on November 2. Thereafter the disturbance deteriorated rapidly with the remnants finally drifting into the Atlantic near Jacksonville. In Florida, no wind damage occurred, but heavy rains that accompanied the disturbance flooded crops from Lake Okeechobee to the coast, with damage amounting to 50-75 percent (several million dollars) of early fall plantings” (MWR).

November 3:

HWM analyzes a low of at most 1010 mb near 31.8N, 77.8W. HURDAT lists this as a 15 kt tropical depression near 33.0N, 78.8W. The MWR tracks of centers of cyclones last shows a position at 00Z near 30.5N, 82W. The MWR post-season track map last shows a position at 00Z near 29.8N, 81.9W. Microfilm does not show a low. No gales or low pressures.

A tropical depression with 30 kt winds formed on 31 October at 18Z near 21.9N, 73.8W from a westward moving tropical wave. HURDAT originally started this cyclone at 06Z on the 31<sup>st</sup> as a 35 kt tropical storm. Observations do not indicate a closed low at 06Z or at 12Z. Furthermore, text from Simpson indicates that the low was closed down to 7,000 feet, but not down to the surface the morning of the 31<sup>st</sup>. The starting intensity is revised downward because there are no observed gales on the 31<sup>st</sup>. The depression moved between WNW and NW and became a tropical storm at 00Z on 1 November (18 hours later than originally). The first observed gale occurred at 1830Z on the 1<sup>st</sup> at Grand Bahama Island. This 35 kt wind was observed along with a pressure of 1006 mb. The tropical storm made landfall with a 40 kt intensity at Palm Beach, FL (26.6N, 80.1W) at 21Z on the 1<sup>st</sup> of November. Although the lowest pressure at West Palm Beach was 1004 mb with 10 kt of wind, there was a ship just off the coast that recorded a pressure of 1003 mb with 15 kt of wind. Using these to obtain a 1002 mb central pressure at landfall suggests a maximum wind of 40 kt using the Brown et al. north of 25N pressure-wind relationship. The highest observed wind was 35 kt. An intensity of 40 kt is chosen for

HURDAT at 18Z (unchanged) and landfall, and 35 kt is retained at 00Z on the 2<sup>nd</sup>. A central pressure of 1002 mb was added in to HURDAT at 18Z on the 1<sup>st</sup>. On the 2<sup>nd</sup>, the cyclone turned north through the Florida Peninsula. It weakened to a depression at 06Z on the 2<sup>nd</sup> (unchanged). Track changes from genesis through 12Z on the 2<sup>nd</sup> were very minor. Larger track changes were made after the depression passed Orlando, FL. From 18Z on the 2<sup>nd</sup> through 06Z on the 3<sup>rd</sup>, a much slower forward motion and a track to the right of the previous track are analyzed. Originally, HURDAT dissipated this depression after 12Z on the 3<sup>rd</sup> at 33.0N, 78.8W, but the reanalysis does not find a closed low at 12Z, and dissipates the depression after 06Z at 30.9N, 80.7W.

#### 1946 Storm 8 (new to HURDAT)

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33271 11/03/1946 M= 2 8 SNBR= 738 NOT NAMED XING=0 L
33271 11/03*343 760 35 0*352 761 35 0*361 760 30 0*369 759 25 0*
33271 11/04E377 758 25 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
33271 TS

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#### U.S. Landfall:

Nov. 3<sup>rd</sup> – 05Z - 35.0N 76.1W – 35 kt

HWM, COADS, microfilm, and OMR indicate that a small tropical storm, previously undocumented in HURDAT, occurred near the North Carolina coast from November 3-4, 1946.

#### November 2:

HWM does not analyze a closed low on this day. HURDAT did not previously list this system. Microfilm does not show a closed low. Ship highlights: 35 kt ESE-E and 1013-1015 mb at 35.5N, 75.5W at 20Z, 21Z, 22Z, and 23Z (COA).

#### November 3:

HWM analyzes a closed low of at most 1007.5 mb near 37N, 73.5W. Microfilm at 00Z shows a tiny closed low near 34.3N, 75.6W with 35 kt east winds just north of their analyzed center. Microfilm at 12Z plots a low, not closed, near 37N, 75.5W, with developing trough or frontal features extending from the low. Ship highlights: 35 kt E gust 50 kt and 1013 mb at 00Z at 34.6N, 75.4W. Land highlights: 33 kt SE (1-min) and about 1012.5 mb around 00Z at Hatteras, NC (35.2N, 75.6W) (OMR). The wind direction at Hatteras, NC, changed 180 degrees from east to west, through south between ~2330Z on the 2<sup>nd</sup> to ~0930Z on the 3<sup>rd</sup>, a period of 10 hours. Hourly averaged winds higher than 20 kt were observed between 22Z on the 2<sup>nd</sup> and 01Z on the 3<sup>rd</sup> at Cape Hatteras (OMR).

#### November 4:

HWM plots a closed low at 12Z of at most 1005 mb near 42.5N, 65W embedded within frontal features; however, according to the analysis, this low may be a combination of the remnants of the tropical storm and another developing baroclinic low that approached from the continent. The last available microfilm image is at 00Z, and it shows an elongated closed low of at most 1014 mb in the general vicinity of 37.5N, 73.5W with a

frontal feature extending to the east from the low and another frontal feature extending to the SSW from the low. No gales or low pressures.

A trough accompanied by gale force winds was evident late on 2 November according to available microfilm maps and COADS just off the coast on North Carolina in the area between Wilmington and Hatteras. There were five observations of E to ESE 35 kt winds from 20Z on the 2<sup>nd</sup> to 00Z on the 3<sup>rd</sup>. After 00Z on the 3<sup>rd</sup>, there were no more observed gales. It is difficult to close off the low at 00Z due to insufficient observations south of where the center is believed to be. A definite closed low is found at 06Z on the 3<sup>rd</sup>. Due to the gales observed at 00Z, and the closed circulation at 06Z, it is reasonable to believe that the low was closed by 00Z on the 3<sup>rd</sup>. This system is started at 00Z on the 3<sup>rd</sup> as a 35 kt tropical storm at 34.3N, 76.0W. It moved northward, and made landfall in North Carolina southwest of Cape Hatteras around 05Z on the 3<sup>rd</sup> as a 35 kt tropical storm. Continuing towards the north, the tropical storm weakened to a tropical depression by 12Z on the 3<sup>rd</sup> at 36.1N, 76.0W. The depression weakened and began being absorbed by a frontal boundary by 00Z on the 4<sup>th</sup>, with a final position of 37.2N, 75.8W with 25 kt winds. Uncertainty about including this system into HURDAT is mainly with respect to its baroclinicity on the 3<sup>rd</sup>. While no frontal boundaries were indicated on microfilm on 00 at 06Z on the 3<sup>rd</sup>, they were shown at 12 at 18Z on the same date. Given the modest (~5 deg F) surface temperature gradient indicated early on the 3<sup>rd</sup> while the system was the strongest, suggests that the cyclone did acquire enough tropical characteristics to warrant its inclusion as a tropical storm, albeit quite short-lived.

#### 1946 additional notes

1)

Between 15-20 May, there were several observations of low pressures and gales along the coasts of Louisiana and Texas, and low pressure also prevailed along the upper Mexican coast. Several references were utilized to determine whether these high winds and low pressures were due to a frontal passage, but there were no indications of a definite frontal passage. The HWM maps indicate that the entire area was in a general area of low pressure starting on the 15<sup>th</sup>, but late on the 18<sup>th</sup> and into the 19<sup>th</sup>, a possible trough-like feature that may have come from the Rocky Mountains region could have enhanced the area of the low pressure and produced some high winds and low pressures on the 19<sup>th</sup>. It is still possible that a tropical or subtropical storm struck near Port Arthur late on the 19<sup>th</sup>, and this possibility should not be ruled out. The COADS data was obtained for this period, but there were few ships in the entire area of the western Gulf during this time in the COADS database. If more data in the western Gulf of Mexico becomes available in the future, this suspect should be evaluated again. The following are highlight observations from OMR from coastal stations during this period:

Shreveport, LA: lowest pressure 1003 mb at 22Z on the 17<sup>th</sup>; highest wind 41 kt at 0430Z on the 19<sup>th</sup>.

Port Arthur, TX: very strong winds on the 15<sup>th</sup> and again on the 19<sup>th</sup>; highest wind 47 kt E on the 19<sup>th</sup>; lowest pressure 1001 mb at 2230Z on the 19<sup>th</sup>.

Galveston, TX: Highest wind 33 kt N at 2030Z on the 19<sup>th</sup>; lowest pressure 1005 mb at 0030Z on the 20<sup>th</sup>.

Corpus Christi, TX: lowest pressure 1002 mb at 22Z on the 19<sup>th</sup>; S wind 25 kt on the 19<sup>th</sup>, NE wind 25 kt on the 20<sup>th</sup>.

DAY	LAT	LON	STATUS
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No positions provided

2)

An area of low pressure, which originated from a trough over the eastern United States, was nearly stationary over the NC coast during 9 and 10 July. On the 11<sup>th</sup> and 12<sup>th</sup>, the area of low pressure moved into the Atlantic Ocean. On the 13<sup>th</sup>, HWM analyzes the low near 40N, 60W. The first observed gales and low pressures associated with this low also occurred on the 13<sup>th</sup>. HWM plots a cold front coming from the west that is getting very close to the low by 12Z on the 13<sup>th</sup>. To the east of the low, there was a south wind of 40 kt along with a pressure of 1008 mb. Right at the position of the analyzed low in HWM, a ship in COADS reported 20 kt winds from the SSE with a 999 mb pressure. The pressure readings from this ship are not reliable as the ship recorded a pressure of 1020 mb just six hours later with no indication of an increase in its winds. One observation west of the supposed "center" is a WSW wind, and this wind is responding to the front. So it is undeterminable whether the low is closed at the time of our first gale (12Z). Furthermore, by this same time (12Z on the 13<sup>th</sup>), a significant temperature gradient existed across the low, even entirely ahead of the front so this system may not have been tropical at this time.

DAY	LAT	LON	STATUS
July 11	34N	73W	broad low/trough
July 12	36N	71W	broad low/trough
July 13	40N	61W	extratropical storm (maybe closed)
July 14			Absorbed by larger extratropical low

3)

HWM shows that a low with a warm front extending from the low east-northeastward and a cold front extending from the low west-southwestward moved off the east coast of the US and into the western Atlantic on 16 July. Observations from HWM along with COADS confirm the existence of a broad, closed low on the 16<sup>th</sup>, but not quite a tropical depression. The system continued northeastward on the 17<sup>th</sup> and 18<sup>th</sup>. On the 17<sup>th</sup>, there are no observed west winds south of the low, so a closed circulation could not be confirmed. The temperature gradient across the low was small on the 16<sup>th</sup> and 17<sup>th</sup>, but there are no observed gales or low pressures for the duration of this system. On the 19<sup>th</sup>, the low merged with another extratropical low.

DAY	LAT	LON	STATUS
July 16	34N	73W	broad low
July 17	35N	68W	broad low/trough
July 18	39N	62W	Extratropical
July 19			Absorbed

4)

A weak low appeared to have formed on 9 September in the area of the Caribbean north of Honduras and east of Belize. HWM indicates a small, weak trough at 84W on the 8<sup>th</sup>, so it is possible that the low may have formed from a tropical wave. Microfilm observations indicate a closed low at 12 and 18Z on the 9<sup>th</sup>. By the 10<sup>th</sup>, this low is gone, and it is unclear whether the low dissipated or moved inland into Central America. There were no observed gales or low pressures with this system.

DAY	LAT	LON	STATUS
September 8			Trough along 84W
September 9	17N	86W	Tropical depression
September 10			Dissipated

5)

HWM shows a closed low of at most 1005 mb on 22 September near 23N, 90W. There were no observed west winds south of the center on this day. On 23 September, HWM shows the closed low has moved westward to near 24N, 96W. Brownsville, TX recorded a minimum pressure of 1002 mb at 1730Z of the 22<sup>nd</sup>, but the highest wind on this day was 19 kt from the SE, and there was not much of a wind shift. The highest wind on the 23<sup>rd</sup> was 21 kt, but Brownsville may have been influenced by the tail end of a cold front during the evening of the 23<sup>rd</sup>. There were no observed gales with this system, and the time of the minimum pressure at Brownsville is not consistent with HWM's position of the low.

DAY	LAT	LON	STATUS
September 22	23N	90W	Broad low/trough
September 23	24N	96W	Broad low/trough
September 24			Dissipated

6)

A broad low was noted in HWM in the central Caribbean Sea on 16 October. It moved westward for the next day and then became stationary near 80W as the low appeared to become part of a trough (tail-like feature) extending all the way down from the mid-latitudes from a low in the central Atlantic. The area of low pressure persisted in the

western Caribbean for the next few days. There were no observed gales or low pressures with this area of low pressure. There is no evidence that the low is closed at any time. On the 19<sup>th</sup>, there are south winds, east winds, and north winds, but there are no west winds south of the center. Instead, there is a light east wind south of the center.

DAY	LAT	LON	STATUS
October 16	15N	72W	Broad low/trough
October 17	17N	80W	Broad low/trough
October 18	18N	80W	Broad low/trough
October 19	16N	80W	Broad low/trough
October 20	15N	79W	Broad low/trough

7)

A low, which likely originated from a mid-latitude system over New England, became evident in the Atlantic Ocean on 10 November in the general area near 31N, 58W. On the 11<sup>th</sup>, the low strengthened and occluded. There were a few observed gales on the 11<sup>th</sup> including a 40 kt NNW wind along with a 1006 mb pressure west of the center. This storm had a large circulation. On the 12<sup>th</sup>, the circulation became much larger and moved southward. There were not any gales near the center on the 12<sup>th</sup>. On the 13<sup>th</sup>, the low continued to be very large and broad, covering an area from 15-35N, and at least 48-68W. It had a central pressure of about 997 mb, but the strongest observed winds were 30 kt. On the 14<sup>th</sup>, the low consolidated somewhat, but the radius of strongest winds were still well removed from the center. Also on the 14<sup>th</sup>, a frontal system was approaching from the west and it was very close to the low by 12Z on the 14<sup>th</sup>. By the 15<sup>th</sup>, the low was likely absorbed by the frontal system and pushed up north along the front towards the extratropical cyclone associated with the front. The highest observed wind with this system was 40 kt on the 11<sup>th</sup> and the lowest observed pressure was 990 mb on the 14<sup>th</sup>.

DAY	LAT	LON	STATUS
November 10	31N	58W	Broad low/Trough
November 11	33N	54W	Extratropical storm
November 12	25N	56W	Extratropical
November 13	27N	56W	Extratropical
November 14	35N	57W	Extratropical
November 15			Absorbed

8)

A low formed north of Puerto Rico and Hispaniola on 5 December. The low was closed, but elongated SW-NE. This low is analyzed as extratropical on the 5<sup>th</sup> due a moderate temperature gradient across the low. HWM analyzes a warm front extending to the ENE from the low, and this analysis appears to be accurate. There is a strong pressure gradient

to the NW of the low producing two 30 kt wind observations. The lowest observed pressure on the 5<sup>th</sup> is 1010 mb. On the 6<sup>th</sup>, the system has a similar structure as on the 5<sup>th</sup>, except on this day there were several observed gales where the strong pressure gradient was in place. On the 6<sup>th</sup>, the low appears even more elongated than on the 5<sup>th</sup>. The highest wind on the 6<sup>th</sup> is 40 kt and the lowest observed pressure is 1008 mb. On the 7<sup>th</sup>, the system began to pull northward and it appears as if there are two different circulations associated with the frontal system, but the circulations are ill-defined and it may not be closed on the 7<sup>th</sup>.

DAY	LAT	LON	STATUS
December 5	23N	68W	Extratropical low
December 6	28N	64W	Extratropical storm
December 7	30N	58W	Broad low/Trough

9)

HWM tracks a low from the southwestern Caribbean Sea to the coast of Alabama between 11-20 December with steady progression. On certain days, it is somewhat unclear whether the low is the same system as the previous day. Also, on certain days, the low is closed and on other days, the low appears to not be closed. By the time the supposed low reaches the coast of Alabama, it is located in a strongly baroclinic environment with cold, winter temperatures. There are no observed gales or low pressures with this system until it reaches the Alabama coast, and it is unclear whether the strong winds observed along the Alabama coast were from this system or from a separate baroclinic system. From the Mobile, Alabama OMR, "Dec. 20 Sand Island light house reported winds to 50 mph. A local disturbance covering small area around Hollingers Island (30.5N, 88.1W)...occurred about 0300 (8Z 20<sup>th</sup>) with minor damage to homes...strong winds grounded tugs and cast barges adrift" (OMR).

DAY	LAT	LON	STATUS
December 11	14N	80W	open trough
December 12	15N	81W	open trough
December 13	19N	83W	low (maybe closed)
December 14	22N	81W	low (closed, but not a TD)
December 15	22N	80W	low (closed, but not a TD)
December 16	22N?	80W?	open trough
December 17	?	?	open trough
December 18	24N	81W	open trough
December 19	26N?	84W?	low?
December 20	30N	88W	extratropical low

## 1947

## 1947 Storm 1

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33365 07/31/1947 M= 3 1 SNBR= 741 NOT NAMED XING=1
33365 07/31/1947 M= 3 1 SNBR= 741 NOT NAMED XING=0
*
33370 07/31* 0 0 0 0*195 920 35 0*202 938 35 0*206 947 35 0*
33370 07/31* 0 0 0 0*195 936 30 0*202 938 35 0*210 940 35 0*
*** ** *** ***
33375 08/01*211 953 35 0*226 958 35 0*241 962 35 0*250 967 35 0*
33375 08/01*220 943 35 0*230 947 35 0*241 954 35 0*249 963 40 0*
*** *** *** *** *** *** **
33380 08/02*256 973 40 0*260 982 40 0*263 990 35 0* 0 0 0 0*
33380 08/02*256 973 45 0*260 981 40 0*261 985 30 0* 0 0 0 0*
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33385 TS

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## U.S. impact:

8/2/1947 – 00Z – 35 kt winds felt along Texas coastline from Port Isabel southward

Minor changes to both track and intensity are implemented with this tropical storm that struck Mexico not far from its border with Texas. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Mexican observations, Connor (1956), and Dunn and Miller (1960).

## July 31:

HWM analyzes a low of at most 1005 mb centered near 20.7N, 94.1W. HURDAT lists this as a 35 kt tropical storm at 20.2N, 93.8W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a broad, closed low of at most 1008 mb in the general vicinity of 20.5N, 93W. No gales or low pressures. “A weak tropical disturbance formed in the southwest Gulf of Mexico on July 31, moved westward and then north-northwestward across the western Gulf of Mexico, and passed inland on the Gulf Coast a short distance south of Brownsville, Tex” (MWR).

## August 1:

HWM analyzes a low of at most 1005 mb near 23.5N, 94.1W. HURDAT lists this as a 35 kt tropical storm at 24.1N, 96.2W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a closed low of at most 1002 mb centered in the general vicinity of 23.7N, 94.8W. Land highlights: 10 kt S and 1005 mb at 18.3N, 94.5W (micro); 1002 mb (min p) at 2320Z at Brownsville, TX (OMR). “The strongest wind reported was 44 mph at Port Isabel, Tex. Heavy rains caused some damage to the cotton crop. Among the recorded heavy amounts of precipitation which fell in Texas during the passage of the storm are: Raymondville, 9.78 inches; Falfurrias, 8.11 inches; and Brownsville, 4.41 inches” (MWR). “Preliminary estimate of damage to cotton crop, about \$2,000,000, caused by heavy rain...” (MWR). “A weak tropical storm moved

inland just south of Brownsville during the early night. The lowest pressure recorded was 29.56 inches at 6:30 pm. No damage was done” (Brownsville OMR). “Tropical Cyclones in Texas – Aug. 1 – Lower coast – Minor – Rain damage \$2,000,000” (“Minor” indicates winds less than 74 mph and central pressure above 996 mb- Dunn and Miller).

#### August 2:

HWM analyzes a low of at most 1005 mb centered near 26N, 98.7W. HURDAT lists this as a 35 kt tropical storm at 26.3N, 99.0W. The MWR post-season track map last shows a position at 00Z near the 00Z HURDAT position. Microfilm shows a closed low of at most 1005 mb centered near 26.2N, 98.6W. Ship highlight: 40 kt ESE and 1003 mb at 06Z at 26.5N, 97.0W (micro). Land highlights: 25 kt ESE and 1001 mb at 00Z at Port Isabel, TX (26.1N, 97.2W) (micro); 38 kt at 06Z at Port Isabel, TX (micro).

A tropical depression formed in the Bay of Campeche at 06Z on 31 July with a 30 kt intensity. No changes were made to the timing of genesis, except that HURDAT started this as a 35 kt tropical storm. However, the initial position at 06Z is adjusted westward for a more realistic initial motion (much too fast originally). HWM indicates a trough east of Yucatan on the 29<sup>th</sup> and west of Yucatan on the 30<sup>th</sup>, but there is no evidence of a closed low on these days. From genesis until landfall, there are only a few ship or aircraft observations near the center. The cyclone is brought up to tropical storm intensity (six hours after that indicated originally in HURDAT) by 12Z of the 31<sup>st</sup>. After that, the storm is analyzed to have moved towards the NNW, instead of NW and then NNW as in HURDAT, so a track to the right of the previous HURDAT position is analyzed up until just before landfall. Landfall occurred on the Mexican coastline around 00Z on 2 August, 30 miles SSE of Brownsville at 25.6N, 97.3W. Port Isabel, TX recorded a pressure of 1001 mb simultaneously with 30 kt of wind at 00Z on the 2<sup>nd</sup>. Using the Brown et al. pressure-wind relationship for N of 25N, an 1001 mb peripheral pressure yields an intensity of greater than 42 kt, and for south of 25N, greater than 45 kt. No changes were made to the timing or position of landfall, but the intensity at landfall is raised from 40 to 45 kt. Also, the highest ship observation was 40 kt, and this came six hours after landfall. For 06Z, the HURDAT intensity of 40 kt is maintained due to the 06Z ship observation of 40 kt. At 12Z on the 2<sup>nd</sup>, HURDAT’s 35 kt intensity is lowered to 30 kt and the cyclone is analyzed to be a half degree east of the previous position. There were no changes made to the timing of dissipation, and 12Z on the 2<sup>nd</sup> is maintained as the last point in HURDAT.

#### 1947 Storm 2

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33390 08/09/1947 M= 8 2 SNBR= 742 NOT NAMED XING=0
33395 08/09* 0 0 0 0*137 746 35 0*138 755 35 0*139 764 35 0*
33395 08/09* 0 0 0 0*127 755 25 0*130 762 25 0*133 769 25 0*
          *** **
          *** **

33400 08/10*141 773 35 0*145 782 35 0*150 790 35 0*155 796 35 0*
33400 08/10*137 776 25 0*141 783 25 0*145 790 25 0*150 797 25 0*
          *** **
          *** **

33405 08/11*160 801 35 0*166 805 35 0*172 810 40 0*179 820 40 0*
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33405	08/11*155	804	30	0*160	812	30	0*165	820	30	0*172	830	30	0*
	***	***	**	***	***	**	***	***	**	***	***	**	
33410	08/12*187	834	45	0*193	850	50	0*197	866	50	0*200	881	55	0*
33410	08/12*181	842	35	0*191	854	40	0*197	866	45	0*200	879	40	0*
	***	***	**	***	***	**			**	***	**		
33415	08/13*203	896	60	0*206	911	60	0*210	925	70	0*214	936	70	0*
33415	08/13*203	893	40	0*206	907	45	0*208	919	50	0*208	929	60	0*
	***	**		***	**		***	***	**	***	***	**	
33420	08/14*216	943	80	0*217	948	85	0*218	953	90	0*219	958	90	0*
33420	08/14*208	938	70	0*211	944	80	0*216	950	90	0*219	958	90	977*
	***	***	**	***	***	**	***	***					***
33425	08/15*220	964	95	0*220	972	95	0*220	980	60	0*220	986	55	0*
33425	08/15*220	966	95	0*220	972	100	0*218	978	90	0*215	983	70	0*
	***			***			***	***	**	***	***	**	
33430	08/16*220	990	50	0*220	995	45	0*	0	0	0*	0	0	0*
33430	08/16*210	986	45	0*203	988	30	0*	0	0	0*	0	0	0*
	***	***	**	***	***	**							

33435 HR

Minor changes to track and major intensity changes are documented for this storm which struck the Yucatan Peninsula as a tropical storm and then made a second Mexican landfall as a major hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, Mexican observations, and Connor (1956).

August 9:

HWM analyzes a low of at most 1010 mb near 14.4N, 71.2W. HURDAT lists this as a 35 kt tropical storm at 13.8N, 75.5W. Microfilm shows a very broad closed low of at most 1011 mb between 8-16N, 74-81W. No gales or low pressures.

August 10:

HWM analyzes a low of at most 1010 mb near 15N, 77.7W. HURDAT lists this as a 35 kt tropical storm at 15.0N, 79.0W. Microfilm does not show a closed low at 12Z. No gales or low pressures.

August 11:

HWM analyzes a low of at most 1010 mb near 18.5N, 81W. HURDAT lists this as a 40 kt tropical storm at 17.2N, 81.0W. Microfilm shows a closed low of at most 1012 mb near 16.3N, 82.2W. No gales or low pressures.

August 12:

HWM analyzes a low of at most 1010 mb near 19.5N, 85.9W. HURDAT lists this as a 50 kt tropical storm at 19.7N, 86.6W. Microfilm shows a low of at most 1005 mb near 19.9N, 86.3W. Ship highlights: 35 kt ENE and 1010 mb at 06Z at 20.2N, 85.7W (micro); 40 kt SSE and 1011 mb at 0830Z at 20.3N, 85.4W (micro). Aircraft highlights: three obs of 35 kt SE-SSE all near 20Z between 20-21N, 86.5-87.5W (micro). "On August 12 a tropical storm formed over the northwestern Caribbean Sea and then moved on a westerly course over the Yucatan Peninsula" (MWR).

## August 13:

HWM analyzes a low of at most 1010 mb near 20N, 90.5W. HURDAT lists this as a 70 kt hurricane at 21.0N, 92.5W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1005 mb near 20.5N, 92.4W. Ship highlights: 40 kt NE and 999 mb at 20Z at 21.7N, 93.4W (micro); 40 kt E and 997 mb at 22Z at 21.9N, 93.0W from the same ship (micro). One other gale. Aircraft highlights: 40 kt ESE at ~21Z at 22.7N, 94.4W (micro). One other gale.

## August 14:

HWM analyzes a tropical storm of at most 1005 mb near 22N, 94.7W. HURDAT lists this as a 90 kt hurricane at 21.8N, 95.3W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 999 mb centered near 21.7N, 94.8W. Ship highlights: 65 to 70 kt NNE and 972 mb around 12Z at 21.7N, 95.0W (micro). Two other gales and one other low pressure. Aircraft highlights: 65 kt E around 00Z at 20.8N, 95.0W (micro); center fix at 1717Z at 22.1N, 95.8W with a 977 mb central pressure and maximum surface winds of 100 kt (micro). Seven other gales. Land highlights: 35 kt NNW and 1007 mb at both 22Z and 2330Z at Tampico (22.2N, 97.8W) (micro). "From Army Recon- Tropical cyclone definitely hurricane; winds northern quadrant 100 knots; precipitation heavy; turbulence moderate to severe at 400 feet. Surface pressure at center 977 mb; diameter is eye 20 NM; 1717Z position of center 22.1N, 95.8W; movement of center WNW 7 knots. Radius of squally weather in west and northwest quadrants 80 to 100 NM" (micro). "Navy plane estimates storm center at 21.9N, 95.9W at 1930Z" (micro).

## August 15:

HWM analyzes a tropical storm of at most 1005 mb near 21.9N, 98W. HURDAT lists this as a 60 kt tropical storm at 22.0N, 98.0W. The MWR post-season track map shows a position near the HURDAT position. Microfilm analyzes a low of at most 996 mb centered near 21.8N, 97.7W. Land highlights: 96 kt (max wind) at Tampico (22.2N, 97.8W) (MWR); gust to 35 kt WSW and 1000 mb at 0935Z at Tuxpan (21.0N, 97.4W) (micro); 70 kt ENE gust 80 kt and 1005 mb at 12Z at Tampico (micro). Two other observations of hurricane force winds at Tampico at 1435Z and 1635Z (micro). Six other gales observations at Tampico and Tuxpan. "After developing hurricane force winds while passing over the southern Gulf of Mexico, it moved inland on the Mexican east coast a short distance south of Tampico. On the morning of August 15, winds as high as 110 mph were reported at that city. There were 19 deaths from this hurricane, one in Tampico and 18 in the oil fields to the south" (MWR).

## August 16:

HWM analyzes an open trough between 20-23N, 97-100W. HURDAT last lists this system at 06Z as a 45 kt tropical storm at 22.0N, 99.5W. The MWR post-season track map last shows a position at 00Z near 22.0N, 98.7W. Microfilm last shows a closed low at 06Z of at most 1005 mb centered near 20.7N, 98.5W. Land highlight: 40 kt E at 0030Z at Tampico.

HURDAT originally started this as a 35 kt tropical storm at 06Z on 9 August in the central Caribbean Sea. There are no changes to the timing of genesis; however, a 25 kt tropical depression is analyzed instead of a 35 kt tropical storm at 06Z on the 9<sup>th</sup>. The analysis keeps this a depression for nearly three days and does not bring it to tropical storm strength until 00Z on the 12<sup>th</sup>. In addition to having no gales or low pressure observations from the 9<sup>th</sup> to the 11<sup>th</sup>, the above quote by MWR on 12 August which states that a tropical storm formed on August 12 adds further evidence for delaying the attainment of tropical storm intensity. At this time, the intensity in the original HURDAT had increased to 45 kt. Track changes during the first 3 days keep the cyclone to the southwest (or left) of the original HURDAT track by about one degree. By 00Z on the 12<sup>th</sup>, the storm had already passed to the north of Swan Island and was beginning to approach the Yucatan Peninsula. The storm is analyzed to have made landfall as a 45 kt tropical storm (50 kt originally) at 15Z on the 12<sup>th</sup> in the Yucatan Peninsula south of Cozumel, or about halfway between Cancun and the border with Belize. HURDAT originally had this tropical storm strengthening from 50 to 60 kt while over the Yucatan Peninsula. There are no observations that support this unusual behavior, and the storm is analyzed to have weakened from 45 kt to 40 kt while crossing the Yucatan Peninsula. It emerged back over water in the Bay of Campeche between 00Z and 06Z on 13 August moving westward. HURDAT originally had this becoming a hurricane at 12Z on the 13<sup>th</sup> located at 21.0N, 92.5W. It is analyzed that at this time, the storm's intensity had increased to only 50 kt and was located at 20.8N, 91.9W. Observations from the ship *Sheldon* late on the 13<sup>th</sup> were helpful in the analysis. The peak observation from this ship was 40 kt E and 997 mb at 22Z at 21.9N, 93.0W. From the Brown et al. pressure-wind relationship for south of 25N, a 997 mb peripheral pressure yields an intensity greater than 53 kt. Also, an aircraft estimated surface winds of 65 kt around 00Z on the 14<sup>th</sup>. 70 kt is chosen as the intensity at 00Z on the 14<sup>th</sup> (down from 80 kt originally). On the 14<sup>th</sup> around 12Z, a ship near the center reported a pressure of 972 mb with 65 to 70 kt of wind. This would suggest that the central pressure was at most around 965 mb. A 972 mb peripheral pressure yields at least 88 kt from the Brown et al. south of 25N pressure-wind relationship. However, five hours later, at 1717Z, an aircraft reported a central pressure of 977 mb. A 977 mb central pressure yields a wind speed of 81 kt from the Brown et al. south of 25N pressure-wind relationship. This aircraft also reported information that suggests that the RMW of the hurricane was about 12 to 15 nm at the time. The climatological RMW for this location/central pressure (Vickery et al. 2000) is 18 nm, so the hurricane was a smaller than average. An average of the 977 mb central pressure with a central pressure of at most 965 mb from the ship yields 971 mb around the 12-18Z time frame on the 14<sup>th</sup>. This value yields exactly 90 kt from the Brown et al. south of 25N pressure-wind relationship for intensifying systems. 90 kt is chosen for both 12Z and 18Z on the 14<sup>th</sup> (both unchanged from HURDAT). A 977 mb central pressure (from the aircraft observation) is added in to HURDAT at 18Z on the 14<sup>th</sup>.

Landfall is analyzed to have occurred on the Mexican coast near 21.8N 97.6W about 30 miles SSE of Tampico at 11Z on the 15<sup>th</sup>. The closest approach of the center to Tampico may have been less than 30 miles since the storm was moving slightly south of west at the time. The previous HURDAT had landfall closer to Tampico, at 22.0N latitude (Tampico is at 22.2N). The peak observed wind at Tampico was 96 kt (MWR).

Therefore, 100 kt is chosen as the intensity at 06Z (revised up from 95 kt) and at landfall. This storm is analyzed to have intensified by 60 kt in the 54 hour period from 00Z on the 13<sup>th</sup> to 06Z on the 15<sup>th</sup>, while the previous HURDAT showed an intensification of 35 kt during this period. Runs of the Kaplan and DeMaria (1995) Inland Decay Model yields 85 kt for 12Z on the 15<sup>th</sup>, 61 kt for 18Z, 44 kt for 00Z on the 16<sup>th</sup>, and 35 kt for 06Z. Highest observed winds within 2 hr of the synoptic times were: 96 kt around 12Z (but likely at time of landfall), 74 kt around 18Z, 40kt around 00Z on the 16<sup>th</sup>, and less than gale force around 06Z. Revised winds in HURDAT are 90 kt at 12Z on the 15<sup>th</sup> (up from 60 kt originally), 70 kt at 18Z (up from 55 kt), 45 kt at 00Z on the 16<sup>th</sup> (down from 50 kt), and 30 kt at 06Z (down from 45 kt). The values chosen are above the Kaplan-DeMaria model at 12 and 18Z due to the observed high winds. After landfall, the storm is analyzed to have been making a turn towards the SW and then move towards the SSW until dissipation, while the original HURDAT kept the cyclone on a westward course through Mexico. However, both HURDAT and this analysis agree that the cyclone moved inland slowly after landfall, and did not reach the higher terrain of Mexico until around 00Z on the 16<sup>th</sup>. The winds chosen at 00Z and 06Z on the 16<sup>th</sup> are below Kaplan-DeMaria because of the impact of the higher terrain in quickening the tropical cyclone's weakening. No changes were made to the timing of dissipation, and 06Z is maintained as the last point in HURDAT.

### 1947 Storm 3

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33440 08/18/1947 M=10 3 SNBR= 743 NOT NAMED XING=1 SSS=1
33445 08/18* 0 0 0 0* 0 0 0 0* 0 0 0 0*240 800 35 0*
33445 08/18* 0 0 0 0* 0 0 0 0* 0 0 0 0*240 812 35 0*
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33450 08/19*241 815 35 0*241 823 40 0*242 831 40 0*243 840 45 0*
33450 08/19*241 820 35 0*241 828 40 0*242 836 45 0*241 844 45 0*
*** ** ***

33455 08/20*243 849 45 0*244 856 45 0*245 862 40 0*246 867 35 0*
33455 08/20*241 854 45 0*242 863 45 0*244 870 45 0*246 873 45 0*
*** *** *** ** ***

33460 08/21*248 872 35 0*251 879 40 0*254 887 45 0*257 893 50 0*
33460 08/21*253 873 40 0*262 874 40 0*276 876 40 0*280 884 40 0*
*** *** ** *** *** ** *** *** **

33465 08/22*260 898 55 0*263 902 60 0*265 906 65 0*269 912 70 0*
33465 08/22*283 892 40 0*286 898 40 0*289 902 40 0*293 907 35 0*
*** *** ** *** *** ** *** *** **

33470 08/23*272 917 70 0*275 921 70 0*278 925 70 0*281 931 70 0*
33470 08/23*289 912 35 0*284 917 40 0*279 923 45 0*280 929 55 0*
*** *** ** *** *** ** *** *** **

33475 08/24*284 936 70 0*287 939 70 0*290 943 70 0*292 948 70 0*
33475 08/24*283 935 60 0*286 939 65 0*289 941 70 0*291 945 70 984*
*** *** ** *** ** *** *** *** ***

33480 08/25*295 953 60 0*298 958 60 0*302 962 60 0*305 966 55 0*
33480 08/25*293 950 65 0*296 955 50 0*300 960 35 0*304 965 30 0*
*** *** ** *** *** ** *** *** **

33485 08/26*308 970 35 0*310 973 25 0*314 975 20 0*318 977 20 0*
33485 08/26*308 970 30 0*312 973 25 0*316 976 20 0*320 979 20 0*
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33490 08/27*323 978 15 0*333 979 15 0*340 979 15 0*350 979 15 0*
33490 08/27*324 981 20 0*330 980 20 0*338 979 15 0*350 979 15 0*
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33495 HRCTX1

#### U.S. Landfalls:

8/22/1947 14Z, 29.1N 90.3W, 40 kt

8/24/1947 22Z, 29.2N 94.9W, 70 kt, 984 mb, 1010 mb oci, 75 nmi radius oci

Major track and intensity changes are both analyzed for this storm. In addition to the category 1 hurricane landfall near Galveston on the 24th, an additional landfall is analyzed in Louisiana as a 40 kt tropical storm two days earlier. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Connor (1956), Dunn and Miller (1960), and Jarrell et al. (1992).

#### August 18:

HWM analyzes a trough axis extending from 26N, 76W to 16N, 86W. HURDAT first lists a system at 18Z as a 35 kt tropical storm at 24.0N, 80.0W. Microfilm first shows a closed low at 12Z of at most 1014 mb centered near 24N, 81W. Highlight: 35 kt SE and 1017 mb at 12Z at 24.8N, 79.1W (micro). This disturbance formed in an easterly wave that moved westward through the Florida Straits on August 18” (MWR).

#### August 19:

HWM analyzes a low of at most 1010 mb near 23.6N, 84.5W. HURDAT lists this as a 40 kt tropical storm at 24.2N, 83.1W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1005 mb centered near 24N, 83.7W. Land highlights: 40 kt SE and 1012 mb at 12Z at Dry Tortugas (micro). “Navy recon 23.5N, 83.8W at 1330Z: Passed through front...wind shift...no definite center; area of bad weather 24N – 84W” (micro). “By the morning of the 19<sup>th</sup> a circulation had formed some 150 miles west-southwest of Key West, Fla. During this stage of development the highest wind reported was about 45 mph in squalls at some points along the Florida Keys” (MWR). “Navy recon 23.5N, 83.3W at 1330Z: Passed through front with wind shift. No definite center; area of bad weather 24N-84W” (micro).

#### August 20:

HWM analyzes a low of at most 1010 mb near 24N, 86.4W. HURDAT lists this as a 40 kt tropical storm at 24.5N, 86.2W. The MWR tracks of centers of cyclones shows a 00Z position near 23.7N, 83.6W, and a 12Z position near 23.8N, 86.1W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1008 mb centered in the general vicinity of 24N, 87.4W. Ship highlights: 35 kt ESE and 1008 mb at 14Z at 25.5N, 84.2W (micro); 35 kt SE and 1012 mb at 16Z at 26.5N, 84.9W (micro).

#### August 21:

HWM analyzes a low of at most 1010 mb near 25.6N, 89.7W. HURDAT lists this as a 45 kt tropical storm at 25.4N, 88.7W. The MWR tracks of centers of cyclones shows a 00Z position near 24.4N, 87.8W, and a 12Z position near 24.9N, 89.6W. The MWR post-season track map shows a 00Z position near the HURDAT position and a 12Z position near 25.2N, 88.4W. The MWR post-season track map also shows the position of a second tropical storm at 12Z near 27.3N, 87.7W. Microfilm shows a low of at most 1008 mb centered near 25.7N, 88.7W. Ship highlights: 40 kt E and 1013 mb at 08Z at 26.9N, 88.6W (micro). Two other gales. "The disturbance moved slowly westward to the middle Gulf, where on the 21<sup>st</sup> it was so weak that its path could not be followed with certainty" (MWR).

#### August 22:

HWM analyzes a low of at most 1015 mb near 28.6N, 90W. HURDAT lists this as a 65 kt hurricane at 26.5N, 90.6W. The MWR tracks of centers of cyclones shows a 00Z position near 26.7N, 89.7W, and a 12Z position near 27.9N, 90.7W. The MWR post-season track map shows a position near the HURDAT position. The MWR post-season track map also shows a position of the second tropical storm located at 00Z near 28.2N, 88.8W and at 12Z near 29.2N, 90.1W. Microfilm shows a low of at most 1011 mb centered near 28.8N, 90.6W. Land highlights: 37 kt SE and 1014 mb at 14Z at Grand Isle (29.2N, 90.0W) (micro).

#### August 23:

HWM analyzes a low of at most 1010 mb near 28.6N, 91.9W. HURDAT lists this as a 70 kt hurricane at 27.8N, 92.5W. The MWR tracks of centers of cyclones shows a 00Z position near 28.7N, 92.6W, and a 12Z position near 27.7N, 94.2W. The MWR post-season track map shows a 00Z position near 26.7N, 91.5W, and a 12Z position near 27.3N, 92.4W. Microfilm shows a low of at most 1002 mb near 27.8N, 92.3W. Ship highlights: 35 kt SE and 1004 mb at 15Z at 28.2N, 92.0W (micro); 35 kt S and 1008 mb at ~17Z at 28.2N, 92.6W (micro). Aircraft highlights: 40 kt SSW at 2215Z (micro).

#### August 24:

HWM analyzes a low of at most 1010 mb near 28.7N, 93.2W. HURDAT lists this as a 70 kt hurricane at 29.0N, 94.3W. The MWR tracks of centers of cyclones shows a 00Z position near 26.7N, 95.3W, and a 12Z position near 27.1N, 96.6W. The MWR post-season track map shows a 00Z position near 27.8N, 93.2W, and 12Z position near 28.7N, 94.2W. Microfilm shows a low of at most 1005 mb centered near 28.9N, 94.3W. Ship highlights: 15 kt NNE and 994 mb at 0030Z at 27.8N, 94.0W (micro); 35 kt SE and 1012 mb at 08Z at 28.4N, 93.0W (micro). Land highlights: 52 kt NW and 1001 mb at 2136Z at Galveston (29.3N, 94.8W) (micro); 992 mb (min pressure) at Galveston at 2145Z (also approximate time of landfall) (MWR, OMR, climo data); 63 kt (1-minute wind, max wind) E at ~2230Z at Galveston (OMR, MWR). Five other observations of winds at Galveston between 35-57 kt. "It redeveloped and moved into Texas in the vicinity of Galveston on the 24<sup>th</sup>, as a storm of small diameter accompanied by winds of near-hurricane force. The lowest observed pressure, 992.2 mb. (29.30 inches), reported by the Galveston office, occurred at 4:45 pm (2145Z). There was little evidence of a storm tide until shortly before the approach of the center: the rise of 0.6 foot, from 3.4 to 4.0 feet,

took place on August 24 between 3 and 4 pm. Total damage from the storm was estimated at \$200,000. In the city of Galveston, it was confined mainly to roofs, signs, plate glass, and the interiors of dwellings, for the most part caused by the wind-driven rain. In Galveston County, outside the city, property damage was estimated at \$150,000 and crop damage at \$32,500” (MWR). “A tropical storm, the first to visit this section of the Gulf Coast since July 1943, passed inland on the 24<sup>th</sup> with a maximum wind velocity of 66 mph from the east at 5:04 pm” (Galveston OMR). “On August 23<sup>rd</sup>, a small tropical storm developed from an area of squall about 150 miles southeast of Galveston and moved inland over Galveston about 4:45 pm, August 24. The total damage was estimated at \$757,000; of this amount \$500,000 was to buildings and improvements and the remainder to crops” (Texas climo data). “Tropical Cyclones in Texas, 1947 Aug. 24 – Galveston – Minimal – 1 killed, damage \$757,000” (“Minimal” indicates winds of 74 to 100 mph, and 983 to 996 mb central pressure- Dunn and Miller). “1947 Aug TX, 1N – Cat 1 – 992 mb” – Jarrell et al.).

#### August 25:

HWM shows a low of at most 1010 mb near 30N, 96W. HURDAT lists this as a 60 kt tropical storm at 30.2N, 96.2W. The MWR tracks of centers of cyclones shows a 00Z position near 28.8N, 96.5W, and a 12Z position near 29.6N, 97.9W with a 1011 mb pressure. The MWR post-season track map shows a 00Z position near 29.2N, 95.3W and a 12Z position near 29.7N, 96.3W. Microfilm shows a low of at most 1011 mb centered near 29.8N, 96W. Land highlights: 59 kt SE and 1000 mb at 0030Z at Galveston (OMR); 39 kt (1-minute wind, max wind) E at ~0430Z at Houston (29.7N, 95.2W) (OMR). One other gale at Houston.

#### August 26:

HWM does not analyze a closed low on this day, but instead analyzes a cold front located within a trough over east-central Texas. HURDAT lists this as a 20 kt tropical depression at 31.4N, 97.5W. The MWR tracks for centers of cyclones shows a 00Z position near 30.4N, 98.9W, and a 12Z position near 31.5N, 98.6W with a 1008 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 1011 mb centered near 31.8N, 97.8W apparently with an approaching frontal system very near the low. No gales or low pressures.

#### August 27:

HWM does not analyze a closed low associated with the tropical depression, but does analyze a closed low of at most 1015 mb well to the north, over Nebraska with a cold front extending northeastward from the low. HURDAT lists this as a 15 kt tropical depression at 34.0N, 97.9W. The MWR tracks of centers of cyclones shows a 00Z position near 32.9N, 98.9W, and a 12Z position near the HURDAT position with a 1014 mb pressure. The MWR post-season track map shows a 00Z position near 32.5N, 98.1W, and a 12Z position near 33.8N, 98.3W. Microfilm shows a low of at most 1014 mb near the HURDAT position. No gales or low pressures.

A tropical storm formed from a westward moving tropical wave in the Florida Straits at 18Z on 18 August (no changes to timing of genesis). Available observations show

evidence of a closed low despite an aircraft that could not locate a definite center at 12Z on the 19<sup>th</sup>. During the next 48 hours following 18Z on the 18<sup>th</sup>, as the tropical storm moved westward, the revised track as each point is generally about half of a degree to a degree west of the original HURDAT position. The largest intensity change made through the 20<sup>th</sup> was an alteration of 35 kt to 45 kt at 18Z on the 20<sup>th</sup>. Between 18Z on the 20<sup>th</sup> and 12Z on the 21<sup>st</sup>, it is analyzed that the center quickly moved or underwent a reformation to the north of its previous position. At 18Z the 20<sup>th</sup>, the analyzed position is 24.6N, 87.3W (24.6N, 86.7W originally), and at 12Z on the 21<sup>st</sup>, the analyzed position is 27.6N, 87.6W (25.4N, 88.7W originally). A weakening of 45 kt to 40 kt is analyzed to have occurred from 18Z on the 20<sup>th</sup> to 00Z on the 21<sup>st</sup> when the storm began the reformation process. After the storm reformed, it moved towards the WNW until making landfall in southeastern Louisiana at 14Z on the 22<sup>nd</sup> at 29.1N, 90.3W. An intensity of 40 kt is maintained from 00Z on the 21<sup>st</sup> until landfall. Ship and Grand Isle station observations confirm this 40 kt intensity. The Monthly Weather Review had interpreted what had occurred to instead to have been a second tropical cyclone to making Louisiana landfall, with the original system continuing very slowly over the central Gulf of Mexico. HURDAT, however, had no indication of a second system. (See more discussion below in the final paragraph.) At 12Z on the 22<sup>nd</sup>, when the re-analyzed tropical storm was nearing the Louisiana coastline at 28.9N 90.2W with 40 kt winds, HURDAT originally had the cyclone at 26.5N, 90.6W well south of Louisiana as a 65 kt hurricane. If there was a hurricane at HURDAT's position, the system would likely have been located some distance to the east or east-southeast on the 21<sup>st</sup>. However, upon looking at the 8/21 1230Z (previous day's) microfilm map, sufficient observations between 24-27N, 83-90W indicate no presence of any significant circulation. On the 22<sup>nd</sup>, there are only a few available observations near the location of HURDAT's position, and none of these observations indicate the possibility of the existence of a tropical cyclone at HURDAT's position. All of the evidence is indicative of only one cyclone in existence though with a substantially different track and intensity on the 21<sup>st</sup> and 22<sup>nd</sup> of August.

After landfall in Louisiana, the tropical storm moved about 30 miles inland by 18Z on the 22<sup>nd</sup>, but at this time, the storm is analyzed to have made a turn back to the southwest, and the tropical storm re-emerged back into the Gulf of Mexico around 22Z on the 22<sup>nd</sup>, 8 hours after it made landfall in Louisiana. The storm is analyzed to have maintained tropical storm intensity while over Louisiana (35 kt is analyzed at 18Z on the 22<sup>nd</sup> while over Louisiana, and 40 kt is reached again by 06Z on the 23<sup>rd</sup> after the storm emerged back over the Gulf of Mexico). During the time that this weak tropical storm is analyzed over southern Louisiana, HURDAT has this storm about 2.5 degrees to the SSW as a hurricane. After re-entering the Gulf of Mexico, the storm is analyzed to have kept moving to the southwest or south-southwest until around 12Z on the 23<sup>rd</sup>, when it again turned back to the original west-northwesterly direction. Although there is not an abundance of available observations on the 23<sup>rd</sup> at 00Z and 06Z, enough evidence exists at both of those times to show the analyzed southward motion from 18Z on the 22<sup>nd</sup> to 12Z on the 23<sup>rd</sup>. At 12Z on the 23<sup>rd</sup>, a ship observation with a 1004 mb pressure along with a 35 kt SE wind was very helpful for determining a position at this time. By 12Z on the 23<sup>rd</sup>, the analyzed position is close to the HURDAT position for the first time since

18Z on the 20<sup>th</sup>. The intensity is analyzed to have increased slightly to 45 kt by 12Z on the 23<sup>rd</sup> (but still substantially lower than the 70 kt originally in HURDAT).

After 12Z on the 23<sup>rd</sup>, the cyclone continued on a reasonably straight path until landfall near Galveston, which occurred at 22Z on 24 August. Analyzed intensities during this time are 55 kt at 18Z of the 23<sup>rd</sup>, 60 kt at 00Z of the 24<sup>th</sup>, 65 kt at 06Z, and 70 kt at 12Z and 18Z. HURDAT previously had 70 kt for all of these times. The positions from 8/23 12Z to 8/25 12Z are all very near the HURDAT positions, but are all shifted a few tenths of a degree to the southeast. Key observations from Galveston help locate the time and location of landfall which is analyzed to have occurred just a few miles SW of Galveston (one-tenth of a degree). Galveston recorded a 52 kt wind at 2136Z, just 9 minutes before its minimum pressure of 992 mb (2145Z). This indicates that the center of the storm likely did not pass directly over Galveston. On the other hand, during those 9 minutes, the pressure at Galveston dropped from 1001 mb to 992 mb. It is possible that this hurricane had a small RMW, and that maybe the winds were calm when the pressure was 992 mb, but there is no available wind speed data at the exact time that the lowest pressure was recorded. The maximum wind of 63 kt (1-minute) at Galveston was recorded 45 minutes after the time of the lowest pressure. From the Brown et al. pressure-wind relationship for north of 25N, a 992 mb peripheral pressure would produce winds greater than 56 kt, and for the relationship for intensifying systems, it produces winds greater than 59 kt. This storm was significantly smaller than average; however, it was slow-moving. 70 kt is chosen for landfall, which agrees with HURDAT and the Jarrell et al. characterization of a Category 1 hurricane. A category 1 hurricane is also consistent with the damage that occurred. The 992 mb central pressure reported in Jarrell et al., however, is judged likely to be instead a peripheral pressure with an estimate instead of 984 mb central pressure at landfall in Texas. The analyzed landfall time is about 3 hours later than originally in HURDAT. After landfall, the cyclone continued moving very slowly towards the NW and gradually weakened over land. The Kaplan and DeMaria (1995) Inland Decay Model was run for 00Z, 06Z, 12Z, and 18Z on the 25<sup>th</sup>. For 00Z, the inland decay model yields 59 kt, and the highest observed wind around this time is also 59 kt at Galveston, and 65 kt is chosen (up from 60 kt originally) as the intensity two hours after landfall because the area of strongest winds on the right side of the cyclone might have still been occurring over Galveston Bay. For 06Z, the inland decay model yields 45 kt, and the highest observed wind is 36 kt at Houston, and 50 kt is chosen for 06Z (down from 60 kt originally). For 12Z, the inland decay model yields 36 kt and there were no observed gales, so 35 kt is chosen (down from 60 kt originally) for this time. For 18Z, the inland decay model yields 29 kt and there were no observed gales, so 30 kt is chosen (down from 55 kt originally) for this time. After weakening to a depression at 18Z of the 25<sup>th</sup>, it is analyzed that this depression maintained itself as a closed low through 18Z the 27<sup>th</sup> as shown in HURDAT. Positions during this time are all analyzed to be within three-tenths of a degree of the HURDAT position, and there are no changes to the timing of dissipation.

In summary, it is noteworthy that on the 21<sup>st</sup> and 22<sup>nd</sup>, the MWR post-season track map showed two separate tropical cyclones separated by just 2 degrees latitude. The southern cyclone, storm 3, formed (according to MWR) in the Florida Straits on the 19<sup>th</sup> and

continued on a straight line and at a very slow speed all the way to landfall in Galveston as a category 1 hurricane. The northern cyclone formed (according to MWR) around 12Z on the 21<sup>st</sup> about 2 degrees north of storm 3, made landfall in Louisiana on the 22<sup>nd</sup>, and then dissipated. If the MWR post-season track map was correct, there would have been a Fujiwara Effect between the two tropical cyclones, but that is not what is analyzed to have occurred. By the time the more northern circulation was evident from observations, the more southern circulation was already ill-defined and weak, and probably no longer a closed low. This strongly suggests that the storm reformed to the north. It is clearly evident from observations that a tropical storm made landfall in Louisiana. It is also clear from observations that at 12Z on the 23<sup>rd</sup>, the storm was located again well to south of the southwestern Louisiana coastline, and then continued towards Galveston. 500 mb maps show high pressure located to the north over the United States, which explains the westward motion of the storm, but does not explain the erratic motion that occurred. In addition to the MWR post-season track map being incorrect, the previous HURDAT is likely incorrect as well. The previous HURDAT shows one tropical cyclone on a path through the central Gulf that stays well south of Louisiana and makes landfall in Galveston. One reason why this scenario is unlikely (in addition to observations at several times that indicate there is likely no closed low on the more southern route) is because this storm was very slow-moving throughout much of its lifetime. Slow-moving tropical cyclones tend not to move in straight lines for prolonged periods of time and often have erratic paths.

When performing the reanalysis for this storm, there were three scenarios considered. In scenario number one (the most unlikely scenario), the storm that developed in the Florida Straits went on a straight path through the Gulf to hit Galveston, and a second storm developed on the 21<sup>st</sup> two degrees north of the first storm and this second storm hit Louisiana. In the 2<sup>nd</sup> scenario (slightly more likely than the 1<sup>st</sup> scenario, but still unlikely), the storm that developed in the Florida Straits reformed to the north on the 21<sup>st</sup> and made landfall in Louisiana and dissipated inland in Louisiana, while a second storm developed on the 23<sup>rd</sup> in the west-central Gulf and hit Galveston as a category 1 hurricane. In the third scenario (the most likely scenario, which was used for this reanalysis), only one tropical cyclone occurred. It formed in the Florida Straits, reformed to the north on the 21<sup>st</sup>, made landfall in Louisiana, dipped back southward over the Gulf of Mexico, and then turned towards the WNW and strengthened into a category 1 hurricane making landfall in Galveston.

1947 Storm 4 (note: this storm was reanalyzed prior to my work, so I did not write the metadata for this storm)

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32740 09/04/1947 M=18 4 SNBR= 728 NOT NAMED XING=1 SSS=4
32745 09/04* 0 0 0 0*145 201 45 0*143 215 50 0*142 228 60 0*
32745 09/04* 0 0 0 0*145 201 30 0*143 215 30 0*142 228 30 0*
** ** **
32750 09/05*141 240 65 0*140 250 65 0*140 261 70 0*140 271 70 0*
32750 09/05*141 240 35 0*140 250 35 0*140 261 40 0*140 271 40 0*
** ** **
32755 09/06*141 282 70 0*142 293 70 0*143 304 75 0*143 315 75 0*

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32755	09/06*141	282	45	0*142	293	45	0*143	304	50	0*143	315	50	0*
			**			**			**		**	**	
32760	09/07*143	326	75	0*142	337	75	0*140	348	75	0*137	360	80	0*
32760	09/07*142	326	50	0*141	337	50	0*140	348	50	0*139	360	50	0*
	***		**	***		**			**	***		**	
32765	09/08*133	372	80	0*128	385	80	0*124	398	80	0*121	410	80	0*
32765	09/08*138	372	50	0*137	385	50	0*136	398	50	0*135	410	50	0*
	***		**	***		**	***		**	***		**	
32770	09/09*119	420	80	0*117	429	80	0*116	438	85	0*116	448	85	0*
32770	09/09*134	420	50	0*133	429	50	0*132	438	50	0*132	448	50	0*
	***		**	***		**	***		**	***		**	
32775	09/10*117	457	85	0*120	467	85	0*123	476	90	0*127	486	90	0*
32775	09/10*133	457	50	0*135	467	50	0*138	476	50	0*141	484	50	0*
	***		**	***		**	***		**	***	***	**	
32780	09/11*132	497	90	0*137	505	95	0*142	514	95	0*151	529	95	0*
32780	09/11*144	490	50	0*148	498	50	0*152	510	50	999*157	525	55	0*
	***	***	**	***	***	**	***	***	**	***	***	***	**
32785	09/12*161	547	100	0*172	567	100	0*182	586	105	0*189	600	105	0*
32785	09/12*163	545	65	0*169	565	75	0*176	584	85	977*186	603	95	0*
	***	***	***	***	***	***	***	***	***	***	***	***	***
32790	09/13*195	614	110	0*203	629	110	0*210	643	115	0*215	653	115	0*
32790	09/13*196	622	100	0*206	640	105	0*214	654	110	0*220	664	115	952*
	***	***	***	***	***	***	***	***	***	***	***	***	***
32795	09/14*220	662	120	0*225	672	120	0*230	682	125	0*236	695	125	0*
32795	09/14*226	674	120	0*232	684	120	0*237	694	125	0*242	704	125	938*
	***	***		***	***		***	***		***	***		***
32800	09/15*243	711	125	0*251	722	130	0*258	733	130	0*262	742	135	0*
32800	09/15*248	716	125	0*254	728	125	0*260	737	120	0*265	745	115	0*
	***	***		***	***	***	***	***	***	***	***	***	
32805	09/16*264	749	135	0*265	754	140	0*266	760	140	0*267	768	140	0*
32805	09/16*267	752	110	951*267	757	105	0*267	762	105	956*267	769	105	954*
	***	***	***	***	***	***	***	***	***	***	***	***	***
32810	09/17*267	776	140	0*266	785	140	0*265	795	135	947*263	804	130	0*
32810	09/17*267	778	105	0*265	788	110	0*263	798	115	940*262	806	105	0*
	***	***		***	***	***	***	***	***	***	***	***	***
32815	09/18*261	812	120	0*261	818	85	0*263	825	85	0*269	838	80	0*
32815	09/18*262	813	95	0*263	820	85	0*266	830	85	0*270	843	90	0*
	***	***	***	***	***		***	***		***	***	**	
32820	09/19*277	856	80	0*289	877	80	0*300	897	80	966*304	910	75	970*
32820	09/19*276	857	95	0*284	873	95	0*294	890	95	966*303	907	70	970*
	***	***	**	***	***	**	***	***	**	***	***	**	
32825	09/20*308	922	60	984*316	937	35	987E327	952	30	994E341	959	25	996*
32825	09/20*311	922	55	984*319	937	45	987*327	952	35	994*337	959	30	996*
	***	**		***		**	*		**	*		**	
32830	09/21E354	946	25	997E364	933	20	999E374	920	20	1000*	0	0	0*
32830	09/21*350	950	25	997*364	933	20	999E380	915	20	1000*	0	0	0*
	****	***		*			***	***					
32835	HRCFL4	LA3	MS3BFL2										
32835	HRCFL4	LA2	MS2BFL2										
	***	***											

## U.S. Landfalls:

9/17 16Z 26.2N, 80.1W, 940 mb, 115kt, RMW 27 nmi

9/19 14Z 29.6N, 89.5W, 966 mb, 95kt, RMW 23 nmi

Minor changes to the track and major changes to the intensity shown in Neumann et al. (1999). Evidence for these alterations comes from the Historical Weather Map series, Monthly Weather Review, daily Surface Weather Observations from NCDC, U.S. Weather Bureau six hourly maps available via microfilm at NHC, the COADS ship database, Tannehill (1952), Connor (1956), Dunn and Miller (1960), Schwerdt et al. (1979), Ho et al. (1987), Jarrell et al. (1992), and Barnes (1998).

September 3:

HWM indicates a closed low of at most 1010 mb near 15N, 17W. HURDAT does not mention a storm on September 3. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

September 4:

HWM indicates a closed low of at most 1010 mb near 14N, 21W. HURDAT lists this as a Tropical Storm at 14.3N, 21.5W 12 UTC. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures. "The Pan American Airways station at Dakar, F. W. A., had reported that a low pressure area had developed over French West Africa on September 2 and had moved westward across the coast line. Over the water the depression deepened, and on September 4 gave Dakar 3.36 inches of rain" (MWR).

September 5:

HWM indicates a closed low of at most 1010mb near 14N, 26W. HURDAT lists this as a Category 1 hurricane at 14.0N, 26.1W at 12 UTC. Station highlight: No gales or low pressures. Ship highlight: 30kt NNW with pressure of 1003mb at 20.2N, 24.2W at 1800 UTC (COA). Aircraft highlight: No gales or low pressures.

September 6:

HWM indicates a closed low of at most 1010mb near 14N, 30.5W. HURDAT lists this as a Category 1 hurricane at 14.3N, 30.4W at 12 UTC. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

September 7:

HWM indicates a closed low of at most 1010mb near 14N, 35W. HURDAT lists this as a Category 1 hurricane at 14.0N, 34.8W at 12 UTC. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

September 8:

HWM indicates a closed low of at most 1010mb near 12N, 39.5W. HURDAT lists this as a Category 1 hurricane at 12.4N, 39.8W at 12 UTC. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

**September 9:**

HWM indicates a closed low of at most 1010mb near 11N, 44W. HURDAT lists this as a Category 2 hurricane at 11.6N, 43.8W at 12 UTC. Ship highlight: No gales or low pressures. Station highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

**September 10:**

HWM indicates a closed low of at most 1005mb near 11N, 48.5W. HURDAT lists this as a Category 2 hurricane at 12.3N, 47.6W at 12 UTC. Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

**September 11:**

HWM indicates a storm of at most 1000mb near 14N, 51.8W. HURDAT lists this as a Category 2 hurricane at 14.2N, 51.4W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 15.5N, 51.5W (a.m.) and at 17.5N, 54.9W (p.m.). Station highlight: No gales or low pressures. Ship highlights: 35kt NE with pressure of 1011mb at 15.1N, 49.1W at 1600 UTC (USWB). Aircraft highlight: 45kt maximum surface wind estimate, central pressure of 999mb at 15.5N, 51.4W at 1500 UTC (USWB). "The first indication that a well developed tropical storm had formed over the Atlantic came in a report from the S.S. Arakaka, radioed during the night of September 10 from a position near latitude 15N, longitude 49W" (MWR).

**September 12:**

HWM indicates a storm of at most 1000mb near 18N, 58.5W. HURDAT lists this as a Category 3 hurricane at 18.2N, 58.6W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 18N, 59W (a.m.) and at 19.5N, 61.5W (p.m.). Station highlight: No gales or low pressures. Ship highlight: 65kt NW at 18.0N, 59.0W at 1200 UTC (HWM); 61kt SE with 1000mb at 18.0N, 58.0W at 1200 UTC (HWM). Aircraft highlight: 125kt surface wind estimate, central pressure of 977mb at 17.8N, 59.3W at 1345 UTC (USWB).

**September 13:**

HWM indicates a storm of at most 1000mb near 21N, 66W. HURDAT lists this as a Category 4 hurricane at 21N, 64.3W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 21N, 64W (a.m.) and at 22N, 67W (p.m.). Station highlight: No gales or low pressures. Ship highlight: No gales or low pressures. Aircraft highlights: 100kt surface wind estimate, central pressure of 952mb at 22.3N, 66.6W at 1930 UTC (USWB).

**September 14:**

HWM indicates a storm of at most 1000mb near 23.5N, 68.5W. HURDAT lists this as a Category 4 hurricane at 23N, 68.2W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 23.5N, 69W (a.m.) and at 24.5N, 71W (p.m.). Station highlight: No gales or low pressures. Ship highlight: 74kt NW with

pressure of 1000mb at 23.5N, 68.5W at 1200 UTC (HWM). Aircraft highlight: 110kt at 24.1N, 69.3W at 1530 UTC (USWB); 95kt SW with pressure of 997mb at 25.0N, 68.2W at 1600 UTC (USWB); 938 mb central pressure at 24.2N, 70.6W at 2027 UTC (USWB).

#### September 15:

HWM indicates a storm of at most 1000mb near 26.5N, 73.5W. HURDAT lists this as a Category 4 hurricane at 25.8N, 73.3W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 26N, 73W (a.m.) and at 26.5N, 75W (p.m.). Station highlight: 35kt N with pressure of 1009mb at Abaco at 2030 UTC (USWB). Ship highlight: 43kt NNW at 26.1N, 76.2W at 2030 UTC (USWB). Aircraft highlight: 80kt NNW at 25.5N, 74.0W at 1240 UTC (USWB); 100kt with pressure of 951mb at 26.6N, 74.8W at 2108 UTC (USWB). "From the time of the storms detection on September 10, reconnaissance planes of the Army and the Navy followed it on a west-northwesterly course until it reached a position east of Abaco Island in the Bahamas on the 15th. Here it came to a virtual standstill for about 24 hours and then moved west-southwestward over that island and on to the Florida east coast at Fort Lauderdale on the 17th." (MWR)

#### September 16:

HWM indicates a storm of at most 1000mb near 27.5N, 77W. HURDAT lists this as a Category 5 hurricane at 26.6N, 76W at 12 UTC. The MWR Tracks of North Atlantic Hurricanes and Tropical Depressions showed a center at 27N, 76.5W (a.m.) and at 27N, 80.5W (p.m.). Station highlight: 83kt NW with pressure of 983mb at Hopetown at 1430 UTC (USWB); 954mb at Hopetown at 1830 UTC (USWB). Ship highlights: 39kt W with pressure of 1002mb at 26.0N, 76.2W at 1230 UTC (HWM); 3kt WSW with pressure of 997mb at 25.4N, 77.8W at 1730 UTC (USWB). Aircraft highlight: 100kt with pressure of 956mb at 26.5N, 77.0W at 2045 UTC (USWB). "Hopetown, on Abaco Island, recorded a highest wind speed of 160mph when the center passed near the observatory" (MWR).

#### September 17:

HWM indicates a strong storm of at most 985mb near 26.7N, 78.8W. HURDAT lists the storm as a category 4 hurricane with winds of 155mph and a central pressure of 947mb. MWR tracks of lows show the hurricane being at 26.5N, 79.5W (am) and at 26.5N, 80.5W (pm). Station highlight: 105kt with pressure of 947mb at Hillsboro Lighthouse, 26.3N, 80.1W, at 1625 UTC for lowest pressure and 1457 for highest wind measurement (MWR). Ship highlights: 43kt SE with pressure of 1006mb at 25.1N, 75.1W at 0030 UTC (USWB); 29kt NW with pressure of 999mb at 25.3N, 80.3W at 0630 UTC (USWB). Aircraft highlight: No gales or low pressures. "The highest wind recorded by a reliable instrument in Florida was 155mph, at Hillsboro Light near Pompano at 12:56pm on the 17th, at which time the lowest reliable pressure reading of 947.2mb (27.97 inches) was also recorded. Wind of 100mph or over were experienced generally along the Florida east coast from the northern portion of Miami to well north of Palm Beach, a distance of about 70miles, while winds of hurricane force prevailed from approximately Cape Canaveral to Carysfort Reef Light, a distance of about 240 miles. The great expanse of coast subjected to hurricane force winds, from this storm that moved inland at right angles to the coast line, classes it as one of the great storms on record. It was fortunate

that in Florida the most destructive portion of the storm passed inland between the large communities of Miami and Palm Beach. As it was, the less heavily populated area between Fort Lauderdale and Lake Worth bore the brunt of its violence. Pompano, Deerfield, Boca Raton, and Delray Beach were in the path of the strongest winds. Moving on a westward course across the State at about 10mph, the storm emerged into the Gulf of Mexico, with the center passing a short distance north of Naples at about 10pm on the 17th. It had passed over swamplands of the Everglades and the Big Cypress, with little damage resulting. The section around Lake Okeechobee was swept by the highest winds, but the dikes held and there was no flooding of rich farm lands and pastures. The loss to crops, especially sugarcane, was estimated at several million dollars, and a considerable number of livestock were lost. Reach Florida's west coast communities, the storm retained much of its intensity. The strongest wind reported was observed at Sanibel Light, where gusts of 120mph were recorded. At Fort Myers the highest wind was estimated at 90mph, with gusts to 110mph. Heave damage occurred along the west coast from Everglades City to Sarasota, with greatest damage in the Ft. Myers-Punta Gorda area. Everglades City was inundated to a depth of 2 feet by tidewater which rose 5.5 feet above normal. At Naples the lull was felt for an hour between 9 and 10pm on the 17th, with the wind dropping to 12mph at 9:45pm. North of Naples strong offshore winds resulted in below-normal tides" (MWR).

#### September 18:

HWM shows the hurricane as being below 990mb centered around 26.5N, 83.5W. HURDAT lists the system as a category 2 hurricane with winds of 100mph at 12UTC. MWR tracks of lows shows the system at 26.5N, 83W (am) and at 27.5N, 85.5W (pm). Station highlight: 92kt at Naples at 0000Z and 975mb at Naples at 0445Z (MWR). Ship highlight: 35kt SSE with pressure of 1007mb at 24.9N, 80.2W at 0630 UTC (COA). Aircraft highlight: No gales or low pressures.

#### September 19:

HWM indicates the system making landfall with pressures of at most 990mb near 34.2N and 89.2W. HURDAT lists the storm as a category 1 hurricane with 90mph winds and 966mb central pressure at 12UTC. MWR tracks of lows shows the storm at 34.5N and 89.5W (am). Station highlight: Pressure of 969mb at New Orleans at 1600 UTC (MWR) and 57kt NW at Burrwood at 1028UTC (MWR). Ship highlight: 35kt WNW with pressure of 1005mb at 25.7N, 87.5W at 0000 UTC (COA). Aircraft highlight: No gales or low pressures. "...[the storm] swept on to the Mississippi and Louisiana coasts during the morning of September 19. By 5 a.m. winds of hurricane force were being felt over the Chandeleur Islands as far northward as Chandeleur Light. The highest tide, 14 feet above normal high tide, was recorded at Chandeleur Light. Along the Mississippi coast, from Pearlinton to Pascagoula, winds reached hurricane force at about 6:30 a.m. of the 19th. Similar winds reached New Orleans at 7:30 a.m. and an hour later extended to the Moisant Airport, just west of the city. These coastal communities experienced the strongest winds of the storm and the greatest duration of hurricane force winds. From Pearlinton, which endured 5.5 hours of these winds, an observer reported that at 3 p.m. he noticed that a south wind was carrying water back into the Pearl River. At 4p.m. the bayous near Pearlinton and the Pearl River at Logtown were overflowing and inundating

the land up to the floor level of the Logtown Post Office, with the river flowing upstream at a rate of about 15m.p.h. Tides along the Mississippi coast rose to 12 feet at Biloxi, Bay St. Louis, and Gulfport, and to about 9 feet at Pascagoula and in the Lake Catherine-Chef Menteur area. The calm center, which passed directly over the business district of New Orleans and the city of Baton Rouge, was estimated to be about 25 miles in diameter as it passed over New Orleans. Moisant Airport was flooded to a depth of 2 feet, and during the height of the storm part of the road of the Administration Building gave way, forcing employees to run to another building in the area. Baton Rouge was not seriously menaced by high winds until about noon, by which time the hurricane was dissipating rapidly. Hurricane force winds did not reach any section west of Melville, LA., where the highest wind was estimated as 75 m.p.h., occurring between 3:30 and 4:00p.m. In Mississippi and Louisiana it was estimated the 90 percent of the damage was caused by water. In Mississippi most of the severe water damage was limited to a section within 2 blocks of the water front. Homes there are built practically to the edge of the water, and there is no sea wall for protection. Minor flooding, occurred in one section of New Orleans due to a break in the Industrial Canal levee, and more severe flooding occurred in Jefferson Parish because of breaks in the embankment or overflowing in sections not protected by embankments"(MWR).

September 20:

HWM indicates the system with a closed low of at most 1000mb near 32.9N, 94W. HURDAT lists the storm as an extratropical storm with 994mb and 35mph winds at 12UTC. MWR tracks of lows did not track to storm inland. Station highlights: 43kt NE with a pressure of 1007mb at Pine Bluff, 34.2N, 92.0W at 0630 UTC (USWB); 21kt SW with pressure of 990mb at Lafayette at 0030 UTC (USWB). Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

September 21:

HWM indicates the storm was completely absorbed by the front. HURDAT lists the storm as an extratropical storm of 1000mb and 25mph winds at 37.4N, 92.0W at 12UTC. MWR tracks of lows did not track the storm inland. Station highlight: 13kt E with pressure of 999mb at Fort Smith at 0030 UTC (USWB). Ship highlight: No gales or low pressures. Aircraft highlight: No gales or low pressures.

No changes are made to the genesis of this hurricane. Small to moderate track alterations were introduced for all days except for the 4th through the 6th, based upon available ship and land-based observations. In the original HURDAT, the system was quickly brought up to hurricane status on the 5th just south of the Cape Verde Islands. However, the COADS, HWM, and other sources (including Monthly Weather Review in 1947) provided no evidence that hurricane intensity was attained that far east. (Observations, as is usual for the eastern tropical North Atlantic in this era, were quite sparse from the 4th until the 10th.) Indeed, both the 1947 MWR and Tannehill showed this system starting on the 11th near 50W, so it is unclear on what evidence was used to call this a hurricane originally in HURDAT on the 5<sup>th</sup> near the Cape Verde Islands. Fortunately, aircraft reconnaissance found a central pressure of 999 mb and maximum estimated surface winds of 45 kt around 15Z on the 11th. 999 mb central pressure suggests winds of 49 kt

from the southern pressure-wind relationship - 50 kt chosen for HURDAT at 12Z. This is down from 95 kt originally, quite a drastic reduction. Given this rather strong evidence that it was not a hurricane near 50W, the intensity is adjusted downward accordingly on the 4th to the 11th and it is carried across the Atlantic as a 50 kt tropical storm. The system was investigated again by aircraft at 1345Z on the 12th, which found 977 mb central pressure and estimated maximum sustained surface winds of 125 kt. (It is to be noted that aircraft of this era did not have flight-level winds and relied upon visual inspection of the sea state for their surface wind estimates. These, will likely helpful up to Category 1 hurricane conditions, would not be well-calibrated for winds above about 70-80 kt. Thus not much weight is placed upon this 125 kt surface wind value.) 977 mb central pressure suggests winds of 81 kt from the southern pressure-wind relationship. 85 kt is chosen for HURDAT as the system was quickly (20 kt) moving toward the west-northwest, which is down from 105 kt originally. Aircraft monitored the hurricane again on 1930Z on the 13th with a central pressure of 952 mb and estimated maximum surface winds of 100 kt. This pressure suggests winds of 108 kt from the southern pressure-wind relationship. Winds are chosen for HURDAT to be 115 kt due to the tiny (6 nmi diameter) eye reported by reconnaissance, which are the same winds as originally in HURDAT. On the 14th, aircraft reported a central pressure of 938 mb and estimated maximum surface winds of 110 kt. This pressure suggests winds of 120 kt from the southern pressure-wind relationship. 125 kt is chosen for HURDAT at 18Z on the 14th (no change from previously) as it is assumed that the size of the eye remains small. Aircraft reconnaissance measured 951 mb central pressure at 2108Z on the 15<sup>th</sup> and estimated surface winds of 100 kt. 951 mb pressure suggests winds of 109 kt and 102 kt from the southern and subtropical pressure-wind relationships, accordingly. 110 kt chosen for HURDAT (down from 135 kt originally) as the eye diameter had expanded to 30 nmi. Around 12 UTC on the 16th, aircraft measured a 956 mb central pressure and estimated surface winds of 100 kt. 956 mb central pressure suggests winds of 104 kt and 98 kt from the southern and subtropical pressure-wind relationships - 105 kt chosen for HURDAT down from 140 kt originally. Hopetown, Bahamas reported a minimum of 954 mb pressure at 1830Z on the 16th, which may have been a central pressure. 954 mb pressure suggests winds of 106 kt and 99 kt from the southern and subtropical pressure-wind relationship. 105 kt chosen for HURDAT at 18Z, down from 140 kt originally.

After passing through the northern Bahamas, the hurricane made landfall in southeast Florida just north of Ft. Lauderdale at 26.2N, 80.1W around 16 UTC on the 17th. Lowest pressures recorded were 956 mb in Ft. Lauderdale (which experienced a "1-hr lull") and 947 mb in Hillsboro Light (which experienced "no lull"). These somewhat contradictory data points make ascertaining the central pressure problematic. But if one accepts the 947 mb at Hillsboro Light as being outside of the eye, then a 940 mb central pressure at landfall as is currently in Jarrell et al. can be chosen. It is noted that both Ho et al. and the 12Z listing in HURDAT use the 947 mb value as a central pressure, though this does not appear to be the case. A 940 mb central pressure reading suggests winds of 119 kt from the southern pressure-wind relationship and 115 kt from the subtropical pressure-wind relationship. Given that the hurricane's inner core had enlarged to an RMW of 27 nmi (Ho et al.) which is significantly larger than 16 nmi from climatology for this pressure and latitude (Vickery et al.), 115 kt is chosen as the maximum sustained surface

winds at landfall. Note that Hillsboro Light observed peak winds of 105 kt 5 min maximum and 135 kt 1 min maximum. The latter value is likely in error because of the noisiness of the instrument utilized in that era for shorter timescale measurements. A conversion of the 5 min wind to 1 min (Powell et al. 1996) gives 111 kt. A run of the Kaplan/DeMaria inland decay model suggests winds of 95 kt at 18Z on the 17th and 67 kt at 00Z on the 18th. Naples observed a peak 5 min wind of 87 kt (converts to 92 kt 1 min) 0005Z. Given the much higher observed winds compared to Kaplan/DeMaria, 105 kt is chosen for 18Z (down from 130 kt) and 95 kt is chosen for 00Z (down from 120 kt). The hurricane made oceanfall back into the Gulf of Mexico around 05Z on the 18th, near Naples. No reconnaissance aircraft was available in the Gulf of Mexico.

The hurricane accelerated toward the northwest and made a second U.S. landfall around 14Z on the 19th at 29.6N 89.5W southeast of New Orleans. New Orleans observed 969 mb central pressure at 1547Z, which suggests about a 966 mb central pressure at landfall. This is in agreement with the assessment by Ho et al. and what was listed in HURDAT at 12Z. A 966 mb pressure suggests winds of 89 kt from the new Brown et al. (2006) pressure-wind relationship for tropical cyclones north of 25°N. Given the faster than normal forward speed (about 18 kt), maximum sustained winds at landfall are estimated to be 95 kt. Thus winds in HURDAT are boosted accordingly on the 18th and 19th. This makes the impact a Category 2 for Louisiana, which is lower than previously indicated in HURDAT. Based upon an application of the simplified wind model in Schwerdt et al., it is estimated that Mississippi also received Category 2 hurricane conditions, which is a reduction from Category 3 shown originally. After landfall, the maximum observed winds were 48 kt within 2 hr of 18Z, 39 kt near 00Z on the 20th, and 43 kt near 06Z. Application of the Kaplan/DeMaria inland decay model suggests winds of 66 kt, 49 kt, and 40 kt, respectively. Thus winds are reduced to 70 kt at 18Z (down from 75 kt), Reduced to 55 kt at 00Z (down from 60 kt), and bumped up (from 35 kt) to 45 kt at 06Z. While the system was originally analyzed in HURDAT to have become extratropical by 12Z on the 20th over northeastern Texas, observations indicate that a frontal boundary was well to the northwest of the system at that time. Extratropical transition is now indicated to have occurred around 12Z on the 21st.

## 1947 Storm 5

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33600 09/07/1947 M= 2 5 SNBR= 745 NOT NAMED XING=1
33600 09/07/1947 M= 3 5 SNBR= 745 NOT NAMED XING=1
      *

33605 09/07* 0 0 0 0* 0 0 0 0* 0 0 0 0*279 850 40 0*
33605 09/07*277 856 25 0*279 861 25 0*282 867 30 0*285 873 35 0*
      *** ** ** *** ** ** *** ** ** *** ** **

33610 09/08*290 866 40 0*295 873 40 0*300 880 35 0*307 890 30 0*
33610 09/08*290 876 40 0*295 877 50 0*300 880 45 0*307 887 35 0*
      *** *** ** ** ** **

(The 9th is new to HURDAT.)
33612 09/09*315 895 25 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*

33615 TS

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U.S. Landfall:

Sep. 8<sup>th</sup> – 14Z – 30.3N 88.2W – 45 kt

Major track changes and minor intensity changes are analyzed for this tropical storm which made landfall in Mississippi just west of its border with Alabama. Evidence for these alterations comes from the Historical Weather Map series, Monthly Weather Review, the Original Monthly Records from NCDC, NHC microfilm of synoptic weather maps, Connor (1956), and Dunn and Miller (1960).

September 7:

HWM analyzes a low of at most 1015 mb near 28.2N, 85.6W. HURDAT firsts lists this system at 18Z as a 40 kt tropical storm at 27.9N, 85.0W. No gales or low pressures. Land highlights: 32 kt (1-minute wind, max wind) E at ~2030Z at Mobile (30.7N, 88.0W) (OMR). “During the afternoon of September 7 a small tropical storm formed over the northeast Gulf of Mexico” (MWR).

September 8:

HWM analyzes a low of at most 1015 mb near 29.5N, 87.8W. HURDAT lists this as a 35 kt tropical storm at 30.0N, 88.0W. The MWR tracks of centers of cyclones shows a position near 29N, 87.4W with a 1014 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Ship highlights: 45 kt NW at 0630Z at 30.2N, 88.1W (micro); 35 kt SE at 10Z at 30.2N, 87.2W (micro). Land highlights: 1006 mb (min pressure) at Mobile (MWR); gust to 44 kt sometime between 07Z-10Z at Pensacola (MWR). “Moving northwestward, it passed over the Gulf coast between Mobile, Ala., and Biloxi, Miss., on the afternoon of the 8<sup>th</sup>. Gusts of 45 mph were reported at Mobile and 51 mph at Pensacola, Fla. Two ships went aground in Mobile Bay during the morning of September 8, but were refloated early in the afternoon. No other damage was reported” (MWR). “Tropical Cyclones in Louisiana, Mississippi, and Alabama – Sept. 8 – Biloxi-Mobile – Minor” (“Minor” indicates winds less than 74 mph and pressure above 996 mb – Dunn and Miller).

September 9:

HURDAT does not list a system on this day. The MWR tracks of centers of cyclones shows a 00Z position near 30.7N, 89.1W and a 12Z position near 32.6N, 89.9W with a pressure of 1014 mb. No gales or low pressures.

HURDAT originally started this system as a 40 kt tropical storm at 18Z on 7 September at 27.9N, 85.0W. A 00Z ship observation from microfilm (northwest wind) on the 7<sup>th</sup> along with observations later that day suggest that there was a closed low at 00Z on the 7<sup>th</sup>, so this cyclone is started as a 25 kt tropical depression at 00Z on the 7<sup>th</sup> at 27.7N, 85.6W – 18 hours than originally indicated in HURDAT. The depression is analyzed to have attained tropical storm intensity of 35 kt by 18Z (40 kt originally) and the new 18Z position is 28.5N, 87.3W, which constitutes a major track change. As this tropical storm moved towards the north-northwest and approached the north Gulf Coast, observations indicate that it intensified. A 45 kt observed wind at 06Z on the 8<sup>th</sup> from a ship along with two other gale observations around the storm suggests that the maximum winds at

that time may have been 50 kt, so 50 kt is analyzed for 06Z on the 8<sup>th</sup> (up from 40 kt originally). Although the storm is not analyzed to have made landfall until 14Z, the intensity is brought down to 45 kt at 12Z (consistent with HURDAT bringing down the intensity from 40 to 35 kt during this time), two hours prior to landfall because sufficient spatial coverage of observations at this time indicates the storm was likely slightly weaker than at 06Z. No change is made to the HURDAT positions at 12Z on the 8<sup>th</sup> and there are no changes to the timing or location of landfall, which occurred on the Mississippi coast just west of its border with Alabama at 14Z on the 8<sup>th</sup> as a 45 kt tropical storm. At 18Z, the intensity is analyzed to be 35 kt (up from 30 kt originally). One six-hour point is added to end of this cyclone's life time at 00Z on the 9<sup>th</sup> with a position of 31.5N, 89.5W with a 25 kt intensity.

### 1947 Storm 6

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33620 09/20/1947 M= 6 6 SNBR= 746 NOT NAMED XING=1
33620 09/19/1947 M= 8 6 SNBR= 746 NOT NAMED XING=1
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(The 19th is new to HURDAT.)

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33622 09/19* 0 0 0 0* 0 0 0 0*174 743 25 0*181 754 25 0*
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33625 09/20* 0 0 0 0*186 781 35 0*189 787 35 0*192 794 35 0*
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33625 09/20*187 765 30 0*192 777 35 0*195 787 35 0*197 794 35 0*
      *** ** **      *** **      ***      ***
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33630 09/21*196 800 35 0*200 806 40 0*205 812 40 0*213 820 40 0*
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33630 09/21*199 800 35 0*202 806 40 0*205 812 40 0*211 820 45 0*
      ***      ***      ***      **
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33635 09/22*222 828 40 0*230 834 40 0*238 834 45 0*247 837 45 0*
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33635 09/22*220 828 45 0*230 833 45 0*238 834 45 0*247 834 50 993*
      *** **      *** **      *** **      ***
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33640 09/23*257 836 45 0*267 834 50 0*277 832 50 0*285 830 50 0*
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33640 09/23*257 834 50 994*267 834 50 0*276 832 55 0*285 829 55 0*
      *** ** ***      *** **      *** **      *** **
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33645 09/24*294 827 50 989*312 821 45 0E330 812 35 0E341 802 30 0*
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33645 09/24E294 826 50 987E307 821 45 0E324 812 40 0E336 802 40 0*
      *      ***      ***      ***      ***      **      ***      **
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33650 09/25E351 788 25 0E360 769 20 0E370 750 15 0E377 735 15 0*
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33650 09/25E346 788 35 0E356 769 35 0E366 748 40 0E373 723 35 0*
      *** **      *** **      *** *** **      *** *** **
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(The 26th is new to HURDAT.)

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33655 09/26E380 683 35 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
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33655 TS

### U.S. Landfall:

Sep 23 – 22Z – 28.9N 82.7W – 55 kt

Minor track changes are made to this tropical storm that made a landfall on the Gulf Coast of Florida. Major intensity changes are made, but only during the extratropical portion of this cyclone's lifetime. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from

NCDC, NHC microfilm of synoptic weather maps, Connor (1956), Dunn and Miller (1960), and Perez et al. (2000).

September 12:

HWM analyzes a wave axis from 16N, 38W to 8N, 41W. HURDAT does not list a system on this day. No gales or low pressures.

September 13:

HWM analyzes a closed low of at most 1010 mb near 9N, 45W. HURDAT does not list a system on this day. No gales or low pressures.

September 14:

HWM analyzes a low of at most 1010 mb near 8.8N, 48.7W. HURDAT does not list a system on this day. No gales or low pressures.

September 15:

HWM analyzes a low of at most 1010 mb near 10N, 54.4W. HURDAT does not list a system on this day. Aircraft highlights: 30 kt W at 1745Z at 8.5N, 53.4W (micro).

September 16:

HWM analyzes a low of at most 1010 mb near 11.8N, 60.4W. HURDAT does not list a system on this day. No gales or low pressures.

September 17:

HWM analyzes a low of at most 1010 mb near 13N, 63.1W. HURDAT does not list a system on this day. No gales or low pressures.

September 18:

HWM analyzes a low of at most 1010 mb at 14.8N, 67W. HURDAT does not list a system on this day. No gales or low pressures.

September 19:

HWM analyzes a low of at most 1005 mb near 16.2N, 74W. HURDAT does not list a system on this day. No gales or low pressures.

September 20:

HWM analyzes a low of at most 1005 mb near 19.3N, 78.4W. HURDAT lists this as a 35 kt tropical storm at 18.9N, 78.7W. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a closed low of at most 1008 mb centered near 19N, 79W. No gales or low pressures. "This disturbance developed in the eastern Caribbean south of Cuba on September 20 from an easterly wave" (MWR). "The tropical disturbance of September 20-25, formed in the Caribbean south of Cuba on the 20<sup>th</sup> from an easterly wave" (Florida climo data).

September 21:

HWM analyzes a low of at most 1000 mb centered near 20.8N, 81.8W. HURDAT lists this as a 40 kt tropical storm at 20.5N, 81.2W. The MWR tracks of centers of cyclones shows a 12Z position near 18.3N, 80.9W with an 1005 mb pressure. The MWR post-season track map shows a 00Z position near 19.6N, 79.8W, and a 12Z position near 20.6N, 81.2W. Microfilm shows a low of at most 1002 mb centered in the general vicinity of 20.8N, 81.1W at 12Z. Ship highlights: 35 kt E and 1006 mb at 1725Z at 22.7N, 79.4W (micro). One other gale of 35 kt and one low pressure of 1005 mb. Land highlights: 43 kt (max wind) SW at ~17Z at Grand Cayman (19.3N, 81.4W) (micro); 15 kt and 1002 mb at 2130Z at the Isle of Youth (21.8N, 82.8W) (micro).

#### September 22:

HWM analyzes a low of at most 1000 mb centered near 24.8N, 83.4W. HURDAT lists this as a 45 kt tropical storm at 23.8N, 83.4W. The MWR tracks of centers of cyclones shows a 00Z position near 21.3N, 82.4W, and a 12Z position near 23.3N, 83.0W with a 1003 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 999 mb centered near 24.5N, 83.4W at 12Z. Ship highlights: NE wind and 994 mb at ~1830Z at 24.6N, 83.5W (micro); 20 kt S and 1001 mb at ~1830Z at 24.3N, 82.7W (micro). One other low pressure. Land highlights: 35 kt SE and 997 mb at 1830Z at Dry Tortugas (24.6N, 82.9W) (micro); 20 kt S and 996 mb at 2230Z at Dry Tortugas (micro). Several other gales of 35 kt and low pressures between 996-1005 mb in the Keys and extreme south Florida. Aircraft highlights: Center fix with a 996 mb pressure at 2249Z at 26.0N, 83.1W (micro). A few gales or 35 kt. "Moving northwestward, it crossed western Cuba during the night of the 21<sup>st</sup> without becoming a well-define circulation, although it was preceded by an area of squalls with winds up to 40-50 mph for a distance of 200 miles or more to the northward" (MWR). "September 22 – TS in Cuba" (Perez et al.). "Duck Special locates center at 2249Z at 2601N, 8305W. Central pressure 995.5 mb (29.40 inches)" (micro). "2330Z- unconfirmed tornadoes 12 miles E (of the coastline near 27.9N, 82.7W)" (micro).

#### September 23:

HWM analyzes a tropical storm of at most 995 mb centered near 27.9N, 83.0W with a WSW-ENE stationary front located just a couple hundred nm to the northwest of the cyclone. HURDAT lists this as a 50 kt tropical storm at 27.7N, 83.2W. The MWR tracks of centers of cyclone shows a position near the HURDAT position with a 994 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 996 mb centered near 27.3N, 83.1W at 12Z. Ship highlights: 40 kt ESE and 1006 mb at 0630Z at 27.2N, 79.8W (micro); 25 kt NE and 994 mb at 1330Z at 28.3N, 82.9W. One other low pressure. Land highlights: 50 kt SSE (27 meter elevation?) and 991 mb at 1330Z at Egmont Key (27.6N, 82.8W) (micro); 40 kt SE gust 52 kt and 994 mb at 1751Z at Tampa (28.0N, 82.4W); 49 kt S (1-minute wind, max wind) at ~18Z at Tampa (OMR); 30 kt NNW gust 35 kt and 990 mb (min pressure) at 2230Z at Cedar Keys (29.1N, 83.0W) (micro, MWR); 990 mb at St. Leo (28.3N, 82.3W) (MWR). Numerous other gales and low pressures. Aircraft highlights: 40 kt W at 1845Z at 28.0N, 83.6W (micro). Two other gales. The highest winds experienced in Florida were estimated to be around 60 mph (~52 kt) (MWR). "After it entered the Gulf

of Mexico, west of Havana, it slowly increased in intensity and thereafter had a fairly well-defined center as it moved up the Florida west coast and passed inland between Tampa and Cedar Keys, between 5 and 6 pm (22 and 23Z) on the 23<sup>rd</sup>. Winds of about 60 mph were reported along the west Florida coast from Sarasota northward to near Cedar Keys, and squalls of 40-60 mph were quite general over the entire peninsula. The lowest pressures reported were 989.8 mb. (29.23 inches) at Cedar Keys and 989.5 mb (29.22 inches) at Saint Leo, and the center passed inland between these two communities. Rainfall was heavy throughout the state. There was some damage along the beaches from Bradenton to Tarpon Springs and slight damage to power and communication lines. Total damage was estimated at \$100,000” (MWR). From the Tampa OMR... “The center passed west of St. Petersburg at 10:00 am September 23. Highest wind at Tampa was 43 mph at 12:45 pm September 23<sup>rd</sup>. Lowest pressure 29.37 MSL at 11:40 am 23<sup>rd</sup>. Small tornadoes were reported in this section of the state during the evening of the 22<sup>nd</sup>. Tides were abnormally high during afternoon of September 23, but no loss of life or important property damage” (Tampa OMR). “Tropical Cyclones in Florida – Sept. 23 – N of Clearwater – Minor – St. Leo bar. 29.22 in.” (“Minor” indicates winds less than 74 mph and pressure above 996 mb – Dunn and Miller).

#### September 24:

HWM analyzes a low of at most 1005 mb centered near 32.6N, 82.2W with a cold front extending to the SW from the low and another front extending to the ENE from the low. HURDAT lists this as a 35 kt extratropical storm at 33.0N, 81.2W. The MWR tracks of centers of cyclones shows a 00Z position near 29.5N, 82.8W, and a 12Z position near 32.1N, 81.7W with a 1002 mb pressure. The MWR post-season track map shows a 00Z position near 29.4N, 82.6W, and a 12Z position near 32.6N, 81.4W. Microfilm shows a low of at most 1001 mb centered near 32.3N, 81.4W with a front extending to the south and southwest from the low and another front extending from the low towards the northeast. Ship highlights: 40 kt SW and 1004 mb at 1230Z at 30.7N, 80.1W (micro); 35 kt SSW and 1006 mb at 1830Z at 31.7N, 79.5W (micro). One other gale. Land highlights: 25 kt ESE and 991 mb at 0030Z at Gainesville (29.6N, 82.4W) (micro); 37 kt (1-minute wind, max wind) NE at ~0530Z at Charleston (32.8N, 79.9W) (OMR); 35 kt (1-minute wind, maximum wind) SW at ~1730Z at Wilmington (34.2N, 77.9W) (OMR). Numerous other low pressures between 994-1005 mb. “The storm lost force rapidly as it moved northeastward. It passed west of Jacksonville during the night of the 23<sup>rd</sup> and on the following morning was located west of Savannah and Charleston” (MWR). From Jacksonville OMR... “The tropical storm crossed northern Florida from the Gulf into Georgia, its center passing only a short distance west of Jacksonville, near midnight 23-24. The lowest barometer reading was 29.45 at 11 pm of the 23<sup>rd</sup>, and the maximum wind was 30 mph from the south at 12:27 am of the 24<sup>th</sup>. The rainfall was very heavy, and 9.44 inches fell in 48 hours. The storm was accompanied by several local squalls or tornadoes on the forenoon of the 23<sup>rd</sup>. Several houses lost chimneys and some roofing, and sustained other damage, one house in Arlington was moved off its foundations, and in all sections affected by these local storms power and telephone lines went down” (Jacksonville OMR). From Charleston, SC OMR... “Winds reached near gale force during the passage of a storm on the 24<sup>th</sup>” (Charleston OMR).

## September 25:

HWM analyzes an elongated, but still closed low of at most 1010 mb centered near 36.5N, 75W with a cold front extending southward from the low and a warm front extending eastward from the low. HURDAT lists this as a 15 kt extratropical low at 37.0N, 75.0W. The MWR tracks of centers of cyclone shows a 00Z position near 34.5N, 78.9W and a 12Z position near 36.1N, 74.9W with a 1009 mb pressure. The MWR post-season track map shows a 00Z position near 35.0N, 78.5, and a 12Z position near 36.8N, 74.7W. Microfilm shows an elongated, closed low of at most 1008 mb centered near 36N, 75W with a front extending southward and southwestward from the low and another front extending northeastward from the low. Ship highlights: 40 kt NE and 1012 mb at 14Z at 39.5N, 73.5W (COA). Five other ships gales between 35-40 kt. Land highlights: 37 kt (max wind) N at ~15Z at Cape Henry (36.9N, 76.0W) (OMR). Two other gales of 35 kt N at Cape Henry between 1430Z and 1530Z. "Its remnants moved off into the Atlantic between the North Carolina and the Virginia Capes on the morning of the 25<sup>th</sup>" (MWR).

## September 26:

HURDAT does not list a system on this day. The MWR tracks of centers of cyclones shows a 00Z position near 37.8N, 68.3W, and a 12Z position near 39.5N, 62.5W with a 1013 mb pressure. The last microfilm image of this system is the 00Z image, and it shows an elongated closed low of at most 1011 mb centered in the general vicinity of 37.5N, 70.0W with a front extending from the low southward, and another front extending from the low to the NE. No gales or low pressures.

A tropical depression formed from an easterly wave at 12Z on 19 September at 17.4N, 74.3W with a 25 kt intensity (genesis occurred 18 hours later at 06Z on 20 September as a 35 kt tropical storm in HURDAT originally). The easterly wave that spawned this cyclone can be traced back to 40W longitude on 12 September via HWM. Aircraft observations on the 15<sup>th</sup> indicate the possibly that the low may have been closed on the 15<sup>th</sup> in the vicinity of 10N, 54W, but observations on subsequent days fail to show a closed low. The depression passed north of Jamaica around 00Z to 06Z on the 20<sup>th</sup>, and it strengthened to a tropical storm by 12Z. Although all track changes for the whole lifetime of the cyclone are minor, for nearly the entire storm the new analyzed track is about half of a degree to the right of the previous HURDAT track. Moving towards the west-northwest, the storm passed to the northeast and north of the Cayman Islands, where a maximum wind of 43 kt from the SW was recorded around 17Z on the 21<sup>st</sup>. The storm then started to make a turn towards the north. By the time the storm reached the Isle of Youth, it was moving northwestward; by the time it reached the north coast of Cuba, it was traveling north-northwestward, and when it passed by the Dry Tortugas, it turned towards the north-northeast. No intensity changes are made from 06Z on the 20<sup>th</sup> through 12Z on the 21<sup>st</sup> as the cyclone traveled slowly past the Cayman Islands. However, at 18Z on the 21<sup>st</sup>, a 45 kt intensity is analyzed (40 kt originally) due to the 43 kt wind at Grand Cayman at 17Z. The tropical storm crossed over the Isle of youth between 21Z on the 21<sup>st</sup> and 00Z on the 22<sup>nd</sup> as a 45 kt tropical storm. It then crossed over western Cuba between about 02Z and 06Z on the 22<sup>nd</sup>, maintaining its 45 kt intensity. The cyclone passed just a little to the west of the Dry Tortugas around 18Z on the 22<sup>nd</sup>. A central

pressure of 993 mb is added into HURDAT at 18Z on the 22<sup>nd</sup> due to a ship observation inside the RMW at 18Z of 15 kt NE and 994 mb. A 993 mb central pressure yields 59 kt from the S of 25N Brown et al. pressure-wind relationship and 55 kt from the N of 25N relationship. By this time, the pressure field of this cyclone was broad as both the RMW and radius of outermost closed isobar are larger than average, gales extended outward far from the center, and the cyclone was moving slowly. An intensity of 50 kt is chosen for 18Z on the 22<sup>nd</sup> (45 kt originally). The tropical storm continued slowly northward, and by 12Z on the 23<sup>rd</sup> was located just west of Tampa Bay. At 1330Z, a 50 kt wind was recorded at a 27m elevation along with a pressure of 991 mb at Egmont Key. A 991 mb peripheral pressure yields an intensity of greater than 58 kt from the Brown et al. N of 25N pressure-wind relationship. An intensity of 55 kt is chosen for 12Z the 23<sup>rd</sup> again lower than the wind from the pressure-wind relationship because of the large size and slow motion of the cyclone (up from 50 kt originally).

The cyclone made landfall along the west coast of the Florida peninsula late on the 23<sup>rd</sup>. The 55 kt intensity is maintained until landfall, which occurred at 22Z at 28.9N, 82.7W. The lowest observed pressure was 990 mb at both Cedar Keys and St. Leo, although the center did not pass over either of these locations. The Cedar Keys pressure of 990 mb came along with a 30 kt wind, and a 987 mb central pressure is added into HURDAT for 00Z on the 24<sup>th</sup>. A central pressure of 987 mb yields 64 kt from the Brown et al. N of 25N pressure-wind relationship, but 55 kt is chosen for landfall due to the large size of the storm, its slow (~9 kt) motion, and that the highest observed winds were 50 kt (both at the elevated location in Egmont Key, and at Tampa, which was a non-elevated location). The storm had already begun extratropical transition prior to landfall, and it is analyzed that extratropical transition was complete by 00Z on the 24<sup>th</sup>, just two hours after landfall (12 hours earlier than originally). Continuing towards the north-northeast and then northeast, the storm stayed inland west of Jacksonville, Savannah, and Charleston, but finally passed seaward north of Cape Hatteras between 06Z and 12Z on the 25<sup>th</sup>. The original HURDAT weakened the storm considerably while over land, and kept it weak after emerging over water, but observations indicate that it did not weaken as much as shown in HURDAT. From 12Z on the 24<sup>th</sup> to 18Z on the 25<sup>th</sup>, the intensity changes are as follows: 40 kt (35 originally), 40 kt (30 kt originally), 35 kt (25 kt originally), 35 kt (20 kt originally), 40 kt (15 kt originally), and 35 kt (15 kt originally). At 18Z on the 25<sup>th</sup> the track is shifted over a degree to the east-southeast. 18Z on the 25<sup>th</sup> was HURDAT's last position. At 00Z on the 26<sup>th</sup>, although the low was elongated and frontal in nature, it is analyzed to be closed, so an addition point is added to HURDAT with a 35 kt intensity.

## 1947 Storm 7

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33660 10/06/1947 M= 3 7 SNBR= 747 NOT NAMED XING=1
33660 10/05/1947 M= 5 7 SNBR= 747 NOT NAMED XING=1
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(The 5th is new to HURDAT.)

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33662 10/05* 0 0 0 0* 0 0 0 0* 0 0 0 0E250 785 25 0*
33665 10/06* 0 0 0 0*220 770 45 0*260 778 45 0*288 789 45 0*
33665 10/06E259 781 30 0E268 780 35 0E278 781 35 0E288 786 45 0*
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**** ** **      **** ** **      **** ** **      **** ** **
33670 10/07*304 803 40  0*309 827 35  0*308 833 30  0*301 848 30  0*
33670 10/07*302 800 50  0*309 821 45  0*306 849 30  0*303 860 30  0*
      *** ** **      *** **      *** **      *** **
33675 10/08*293 838 25  0*306 828 25  0*321 826 20  0*336 823 20  0*
33675 10/08*296 845 25  0*300 838 25  0*312 834 20  0*325 832 20  0*
      *** **      *** **      *** **      *** **

(The 9th is new to HURDAT.)
33677 10/09*335 830 20  0*340 826 15  0* 0 0 0  0* 0 0 0  0*

33680 TS

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#### U.S. Landfall:

Oct. 7<sup>th</sup> – 04Z – 30.8N 81.5W – 50 kt

Major track changes and minor intensity changes are analyzed with this tropical storm that made landfall in Georgia. A large change to the genesis of this system is also introduced with the cyclone beginning as an extratropical storm, which transitioned into a tropical cyclone. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, and NHC microfilm of synoptic weather maps.

#### October 5:

HURDAT does not list a system on this day. Microfilm first analyzes a closed low at 2130Z of at most 1008 mb near 25.5N, 78.5W. No gales or low pressures.

#### October 6:

HWM analyzes a closed low of at most 1010 mb centered near 24.6N, 78.2W with a warm front extending eastward from the low. HURDAT lists this as a 45 kt tropical storm at 26.0N, 77.8W. The MWR tracks of centers of cyclones shows a 00Z position near 21.3N, 77.2W and a 12Z position near 25.8N, 77.1W with a 1007 mb pressure. The MWR post-season track map shows a 12Z position near 28.0N, 78.0W. Microfilm shows an elongated, closed low of at most 1005 mb centered near 28.3N, 77.8W with a front extending southward from the low and another front extending eastward from the low. Ship highlights: 35 kt E and 1011 mb at 0630Z at 28.0N, 78.5W (micro); 35 kt NE and (1005 mb?) at 1825Z at 30.6N, 79.8W (micro); 40 kt at ~21Z (MWR). Land highlights: 33 kt (max wind) NE at ~2130Z at Jacksonville (30.3N, 81.8W) (OMR). Aircraft highlights: 40 kt NE at 1945Z at 30.8N, 80.2W (micro). “A moderate and partly developed easterly wave disturbance had its inception over the Bahama Islands and Florida Straits on October 6. It advanced northward and then northwestward and moved inland near Brunswick, GA., during the night of October 6-7. Highest winds reported were Beaufort force 9 (47-54 mph) from ships off the Georgia coast during the afternoon of the 6<sup>th</sup>. The strongest wind along the coast was about 50 mph. No damage was reported” (MWR). From the Jacksonville OMR... “Particularly heavy 24-hour rainfall occurred on the 5-6, when 3.89 inches fell. The city streets were flooded, and there was much water in low-lying residential sections. Heavy rains and unusually high tides, brought the river up over its banks in some places. High tides at the beaches did

considerable additional damage to that done in September. The highest maximum velocity was 36 mph from the NE on the 6<sup>th</sup>, with an extreme of 38 mph” (Jacksonville OMR). “At Fernandina high winds lasted from 5:30 pm to 10:45 pm of the 6<sup>th</sup>, with highest estimated at 60 mph. At Fernandina a tug was sunk, and other boats were torn loose from their moorings” (Florida climo data). “Winds of 50 to 60 mph occurred along the coast” (Florida climo data).

October 7:

HWM analyzes a closed low of at most 1010 mb centered near 30.2N, 82.6W with a warm front extending eastward from the low. HURDAT lists this as a 30 kt tropical depression at 30.8N, 83.3W. The MWR tracks of centers of cyclones shows a 00Z position near 29.8N, 79.5W, and a 12Z position near 30.8N, 84.3W with a 1010 mb pressure. The MWR post-season track map shows a 00Z position near 30.4N, 80.2W, and a 12Z position near 30.5N, 84.5W. Microfilm shows a low of at most 1011 mb centered near 30.4N, 84.4W. Ship highlights: 45 kt ENE and 1000 mb at 0030Z at 31.4N, 79.8W (micro). Three other gales and two other low pressures. Land highlights: ~43 kt (MWR); 35 kt NNE and 1004 mb at 0330Z at Brunswick (31.2N, 81.5W) (micro). One other low pressure. From the Jacksonville OMR... “A tornado struck about 3.5 miles north of the business center of Jacksonville about 8 pm on the 7<sup>th</sup>. It moved from south to north, with a path from 50 to 150 yards in width and nearly  $\frac{3}{4}$  of a mile long, affecting several city blocks. Trees and utility poles were blown down, windows shattered, several roofs were taken off and house-hold furnishings damaged by heavy rain. Property damage (associated with the tornado) has been estimated at nearly \$100,000” (Jacksonville OMR).

October 8:

HWM analyzes a closed low of at most 1010 mb centered near 31.8N, 83.1W with a warm front extending from 100 nm NE of the low eastward from there. HURDAT lists this as a 20 kt tropical depression at 32.1N, 82.6W. The MWR tracks for centers of cyclones shows a position near the HURDAT position with an 1010 mb pressure. Microfilm shows a low of at most 1011 mb centered near 31N, 83.7W with a front extending from about 100 nm NE of the low east-northeastward from there. No gales or low pressures.

October 9:

HURDAT does not list a system on this day. The MWR tracks for centers of cyclones shows a 00Z position near 33.6N, 82.6W and a 12Z position near 34.6N, 82.2W with a 1014 mb pressure. Microfilm last shows a closed low at 00Z of at most 1011 mb centered near 33.5N, 82.8W with a front extending from the low east-northeastward. No gales or low pressures.

HURDAT previously started this at 06Z on 6 October as a 45 kt tropical storm at 22.0N, 77.0W. The new analysis starts this at 18Z on 5 October as a 25 kt extratropical low in the vicinity of 25.0N, 78.5W. The extratropical nature of this low can be seen from the wind field structure on some of the microfilm maps on the 5<sup>th</sup> and 6<sup>th</sup>. In the new analysis, by 06Z on 6 October, the low is still extratropical, although the intensity had

increased to 35 kt and the analyzed position is near 26.8N, 78.0W (nearly 5 degrees north of the previous HURDAT position at this time, making this a major change in track). HURDAT has the cyclone moving northward at a speed of 40 kt between 06Z and 12Z, which is an unrealistic speed. By 12Z, the HURDAT position is 2 degrees south of the analyzed position. The extratropical storm then turned towards the northwest (towards the SE US coastline). The remainder of the track changes introduced are minor. It is analyzed that this low finally became a tropical cyclone by 00Z on the 7<sup>th</sup> with a 50 kt intensity (40 kt at this time originally). The increase in winds is due to a 45 kt ship report and a 43 kt station report from Brunswick early on the 7<sup>th</sup>.

Landfall occurred just four hours after transitioning to a tropical storm, at 4Z on the 7<sup>th</sup> along the Georgia coast at 30.8N, 81.5W as a 50 kt tropical storm. The tropical storm accelerated westward and started a loop towards the southwest with a new 12Z position of 30.6N, 84.9W (30.8N, 83.3W originally). It also weakened to a 30 kt tropical depression by 12Z on the 7<sup>th</sup> (unchanged). The depression moved as far west as 86.0W at 18Z, at which time it moved south over the Gulf of Mexico before looping towards the southeast, and then northeast by 06Z on the 8<sup>th</sup>. The depression moved back inland into Florida around 06Z on the 8<sup>th</sup> near 30.0N, 83.8W as a 25 kt tropical depression. At 12Z on the 8<sup>th</sup>, the depression is analyzed to have weakened to 20 kt (unchanged) with a position more than one degree southwest of the previous HURDAT position. HURDAT last listed this depression at 18Z on the 8<sup>th</sup>, but the microfilm analysis from 00Z on the 9<sup>th</sup> still shows a closed low, and a 20 kt tropical depression is maintained with a position at 00Z of 33.5N, 83.0W. There is still a closed low at 06Z on the 9<sup>th</sup>- a 15 kt tropical depression at 34.0N, 82.6W, which is now the last position before dissipation.

#### 1947 Storm 8 (new to HURDAT)

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33685 10/08/1947 M= 4 8 SNBR= 748 NOT NAMED XING=0
33690 10/08*347 428 40 0*351 425 45 0*355 422 50 0*359 419 50 0*
33691 10/09*363 417 50 0*367 415 50 0*370 410 50 0*374 402 50 0*
33692 10/10*377 392 50 0*380 380 50 0*383 368 50 0*386 355 50 0*
33693 10/11E391 340 45 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
33734 TS

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HWM, COADS, and microfilm indicate that a tropical storm, previously undocumented in HURDAT, existed in the north Atlantic from 00Z 8 October to 00Z 11 October, 1947.

#### October 7:

HWM analyzes a NE-SW stationary front from 35N, 33W to west of 25N, 60W, with a cold front extending northeastward from the NE end of the stationary front. HURDAT did not previously list this system. No gales or low pressures.

#### October 8:

HWM analyzes a closed low of at most 1010 mb centered near 35N, 42.5W, with a warm front extending eastward from the low to 35N, 27W, and a cold front extending southward from the low curving to westward to beyond 25N, 51W. Ship highlights: 35 kt NE and 1013 mb at 06Z at 36.5N, 44.0W (COA); 15 kt SE and 1005 mb at 06Z at

34.0N, 42.9W (COA); 35 kt NNE and 1012 mb at 12Z at 36.4N, 43.6W (HWM); 45 kt N and 1013 mb at 12Z at 36.9N, 43.2W (COA). One other gale.

October 9:

HWM analyzes a closed low of at most 1010 mb centered near 36N, 42W, with an occluded front extending from the low northeastward to a triple point at 39N, 37W. A warm front extends from the triple point eastward and then southeastward to 35N, 25W, and a cold front extends from the triple point wrapping around the east side of the low and then fading off to the southwest to beyond 29N, 38W. No gales or low pressures.

October 10:

HWM analyzes a closed low of at most 1005 mb centered near 38.5N, 37.5W with no fronts attached to this low, but with a strong frontal system approaching from the northwest. Ship highlights: 35 kt S and 1001 mb at 18Z at 38.7N, 34.4W (COA).

October 11:

HWM shows that the low has been absorbed by a larger, extratropical low. HWM shows that this extratropical low of at most 1000 mb is centered near 51.5N, 26.0W.

A 40 kt tropical storm developed at 00Z on 8 October. It originated from a frontal system. By 12Z on the 8<sup>th</sup>, it was located near 35.5N, 42.2W, with an intensity of 50 kt. It moved slowly towards the northeast on the 8<sup>th</sup> and 9<sup>th</sup>, and east-northeast on the 10<sup>th</sup>, retaining its 50 kt intensity. Since there were no observed gales or low pressures on the 9<sup>th</sup>, we were tempted to lower the intensity from the previous day. However, on the 10<sup>th</sup> at 18Z, an observed 1001 mb peripheral pressure suggests winds of greater than 47 kt using the Brown et al. pressure-wind relationship for north of 35N, so a steady 50 kt is analyzed from 12Z on the 8<sup>th</sup> to 18Z on the 10<sup>th</sup>. At 18Z on the 10<sup>th</sup>, the storm was located near 38.6N, 35.5W. On the 11<sup>th</sup>, the tropical storm was absorbed by an extratropical low. The last point is given at 00Z on the 11<sup>th</sup> as an extratropical storm with a 45 kt intensity.

### 1947 Storm 9 (originally Storm 8)

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33685 10/09/1947 M= 8 8 SNBR= 748 NOT NAMED XING=1 SSS=2
33685 10/08/1947 M= 9 9 SNBR= 748 NOT NAMED XING=1 SSS=2
      **          *  *
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(The 8<sup>th</sup> is new to HURDAT.)

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33688 10/08* 0 0 0 0* 0 0 0 0* 0 0 0 0*135 823 25 0*
33690 10/09* 0 0 0 0*154 820 35 0*160 822 35 0*165 825 35 0*
33690 10/09*142 825 25 0*149 827 30 0*156 830 30 0*164 833 35 0*
      *** *** **      *** *** **      *** *** **      *** ***
33695 10/10*170 827 40 0*175 829 40 0*180 830 45 0*197 835 50 0*
33695 10/10*172 835 40 0*181 837 40 0*191 840 45 0*201 841 50 1000*
      *** ***      *** ***      *** ***      *** ***      ****
33700 10/11*207 837 55 0*223 837 55 0*230 832 60 0*241 823 65 0*
33700 10/11*211 839 55 0*221 837 55 0*231 833 60 0*242 829 75 983*
      *** ***      ***      *** ***      *** ***      *** *** ** ***
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33705	10/12*251	814	70	0*258	806	75	0*266	798	75	991*273	787	75	0*
33705	10/12*252	817	80	978*260	805	70	0*267	795	70	0*273	785	65	0*
	***	***	**	***	***	***	**	***	***	**	***	***	**
33710	10/13*281	775	70	0*293	758	70	0*305	746	70	0*314	746	70	0*
33710	10/13*281	772	60	0*293	758	60	0*306	750	65	0*316	749	70	982*
	***	**				**	***	***	**	***	***		***
33715	10/14*319	757	65	0*318	764	65	0*318	771	65	0*318	776	65	0*
33715	10/14*321	756	70	0*323	764	75	0*321	771	75	0*319	776	80	975*
	***	***	**	***		**	***	**		***	**	**	***
33720	10/15*319	782	70	0*320	795	75	0*319	810	75	973*318	823	65	0*
33720	10/15*317	784	85	966*316	795	90	0*318	811	90	966*316	831	55	0*
	***	***	**	***	***	**	***	***	**	***	***	***	**
33725	10/16*317	834	50	0*318	842	40	0*322	850	35	0*325	858	25	0*
33725	10/16*313	839	40	0*311	845	30	0*318	852	25	0*325	863	25	0*
	***	***	**	***	***	**	***	***	**	***	***	**	
33730	HR	GA2	SC2CFL1										
33730	HR	GA2	SC2BFL1CFL1										
			****										

### U.S. Impacts:

Close Approach: 10/11/1947 – 19Z – 24.5N 82.8W – 75 kt – 983 mb – 1010 mb OCI – 275 nm ROCI

Landfall: 10/12/1947 - 02Z - 25.4N, 81.2W - 80 kt - 978 cp - 1009 mb oci - 250 nmi radius oci

Landfall: 10/15/1947 - 11Z - 31.8N, 80.9W - 90 kt - 966 cp - 1009 mb oci - 300 nmi radius oci

Minor changes to both track and intensity are made to this hurricane that made two landfalls- one in Florida and one in Georgia. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, The Miami Herald, Dunn and Miller (1960), Schwerdt et al., Ho et al. (1987), Jarrell et al. (1992), Barnes (1998), and Perez et al. (2000).

### October 6:

HWM analyzes a closed low of at most 1010 mb centered near 13.7N, 74.7W with trough/wave axis drawn through the low from 11N, 75W, northward to 22N, 72W. HURDAT does not list a system on this day. No gales or low pressures.

### October 7:

HWM analyzes a closed low of at most 1010 mb centered near 13.5N, 79.5W. HURDAT does not list a system on this day. No gales or low pressures.

### October 8:

HWM analyzes a closed low of at most 1010 mb centered near 14.0N, 81.6W with the ITCZ axis extending from 9N, 76W to 12N, 79W to 11N, 83W to 10N, 87W. HURDAT does not list a system on this day. Microfilm shows a low of at most 1005 mb centered

near 13.5N, 81.5W. No gales or low pressures. "It was first spotted as a tropical low deep in the Caribbean off the coast of Nicaragua on October 8" (Barnes).

#### October 9:

HWM analyzes a low of at most 1010 mb centered near 16.0N, 83.7W. HURDAT lists this as a 35 kt tropical storm at 16.0N, 82.2W. The MWR post season track map shows a position near 15.4N, 82.6W at 12Z. Microfilm shows a low of at most 1008 mb centered near 15.4N, 83.2W at 12Z. No gales or low pressures. "This storm was first noted as it developed on the intertropical convergence zone which had moved north of the Isthmus of Panama. On the 9<sup>th</sup> the storm was centered off the coast of Cape Gracias, Nicaragua" (MWR).

#### October 10:

HWM analyzes a low of at most 1005 mb centered near 20.2N, 83.7W. HURDAT lists this as a 45 kt tropical storm at 18.0N, 83.0W. The MWR tracks of centers of cyclones shows a position near 17.6N, 82.9W with a pressure of 1003 mb. The MWR post-season track map shows a 00Z position near 17.0N, 83.5W and a 12Z position near 18.7N, 84.1W. Microfilm shows a low of at most 1005 mb centered near 19.0N, 84.0W. Ship highlights: 35 kt E and 1003 mb at 15Z at 19.9N, 84.1W (micro). Land highlights: 20 kt NW and 1003 mb at 03Z at Swan Island (17.3N, 83.9W) (micro). One other low pressure at Swan Island. Aircraft highlights: center fix at 1530Z at 19.6N, 84.4W with 1000 mb central pressure and 45-55 kt maximum sustained winds (micro); center fix at 1808Z at 20.2N, 84.2W with 1000 mb central pressure and 50 kt maximum sustained winds (micro). At least three other aircraft gales between 35-40 kt between 18-19Z. "Army Recon Plane at 10/1530Z reports tropical storm located 19.6N, 84.4W; highest wind 45-55 kts; lowest pressure 1000 mbs" (micro). "Synopsis of Navy flight: Tropical storm centered at 2013N, 8415W at 1808Z. 50 knot winds radius 30 miles north of center. 40 knot winds 60 miles north of center. 35 kt winds south of center. Eye approximately 15 miles in diameter and circular: central pressure 1000 mbs. Heavy squalls extend from storm center to Miami" (micro).

#### October 11:

HWM analyzes a low of at most 1005 mb centered near 23.4N, 82.9W. HURDAT lists this as a 60 kt tropical storm at 23.0N, 83.2W. The MWR tracks of centers of cyclones shows a position near the HURDAT position with a 990 mb pressure. The MWR post-season track map shows a position near the HURDAT position as well. Microfilm analyzes a low of at most 999 mb centered near 23.4N, 83.2W. Ship highlights: 40 kt SE and 986 mb at 1715Z at 24.3N, 82.8W (micro); at least 50 kt NNE at 20Z at 24.8N, 82.8W (micro). Two other ships obs of 40 kt NNE-NE and 996 mb near 24.5N, 83.0W between 18-19Z (micro). Land highlights: 35 kt SSE and 1005 mb at 00Z at the Isle of Youth (21.5N, 82.7W) (micro); 73 kt with an estimated gust to 130 kt at 1737Z at the Dry Tortugas (24.6N, 82.9W) (MWR); 993 mb (min p) at 19Z at the Dry Tortugas (climo data); ~70 kt N and 996 mb at (20Z?) at the Dry Tortugas (micro); 57 kt (1-minute wind, max wind) SSE at 2001Z at Key West (24.6N, 81.7W) (climo data); 35 kt (1-minute wind) SW and 999 mb (min pressure) at 2230Z at Key West (OMR). Numerous other gales and low pressures. Aircraft highlights: center fix at 1716Z at 24.2N, 82.9W with

central pressure of 983 mb (micro); apparently, a 993 mb peripheral pressure along with 80-85 kt surface winds at 1910Z at 24.2N, 83.0W (micro). At least five other gales. “During the night of the 10<sup>th</sup> it crossed Cuba a short distance west of Havana as a moderate storm, with the strongest winds reported as gusts of 57 mph at Batista Field. After entering the Gulf of Mexico, and within a short period of 3 to 4 hours, the storm’s winds rapidly increased to hurricane force. At Dry Tortugas the anemometer became inoperative at 12:30 pm on the 11<sup>th</sup>, while the instrument was registering 84 mph, and the observer reported that higher winds were experienced during the hour following this reading” (MWR). “It slowly drifted northward with little increase in strength until the morning of the 11<sup>th</sup>, when it passed over western Cuba. At that point, it turned toward the northeast and intensified rapidly, growing from tropical storm to hurricane strength in the few hours prior to its landfall in Florida. Weather Bureau reports indicated that the anemometer at the Dry Tortugas ‘froze at 84 mph due to friction from lack of oil.’ Observers at that station watched the wind increase until it reached an estimated 150 mph” (Barnes). From the Key West OMR... “A hurricane of moderate intensity crossed western Cuba on the night of Oct 10-11. The storm decreased in strength while crossing land but on the morning of the 11<sup>th</sup> a rapid restrengthening took place and by early afternoon the hurricane center, 55 miles west of Key West, was attended by winds in excess of 100 mph. While due west of Key West its course altered somewhat from NNW to N to NNE to NE. When about 40 miles NW of Key West the highest velocity occurred. This was 37 mph from the SW and 5:23 pm. No damage reported in this area” (Key West OMR). “Navy radar bearing from Key West- center 280° and 65 mi at 20Z; bank of clouds 5-10 mi north of center moving 15-18 mph. (At 2130Z?) Navy radar bearing 305° and 50 mi from Key West; center 20 mi diameter; speed 18 mph heading NNE. Navy radar rpt 2200Z- bearing 310° from Key West; center now well defined by cloud formations. Storm continuing in a more easterly direction than former position at 18 mph. Navy radar fix 2300Z- center 39 mi from Boca Chica still holding course 070°; speed 18 mph; well defined center. Navy radar fix 2330Z; Bearing 350° and 40 mi from Boca Chica; still steady at 070° moving 18 mph” (micro). “October 11 – TS in Cuba” (Perez et al.).

October 12:

HWM analyzes a low of at most 1005 mb near 26.2N, 78.6W. HURDAT lists this as a 75 kt hurricane at 26.6N, 79.8W. The MWR tracks of centers of cyclones shows a 00Z position near 25.0N, 82.0W, and a 12Z position near 26.9N, 79.1W with a 996 mb pressure. The MWR post-season track map shows a 00Z position near 24.8N, 81.2W and a 12Z position near 26.2N, 79.5W. Microfilm shows a low of at most 999 mb centered near 26.8N, 79.2W. Ship highlights: 30 kt E and 1005 mb at 0330Z at 25.7N, 79.3W (micro). One other low pressure. Land highlights: 62 kt (1-minute wind, max wind) S at 0548Z at downtown Miami (25.8N, 80.2W) (Miami Herald); 994 mb (min pressure) at 0540Z at Miami (KMIA- 25.8N, 80.3W) (Miami Herald); 43 kt S and 996 mb at Miami (OMR); 982 mb with pressure still falling at 07Z at Fort Lauderdale (26.1N, 80.2) (Miami Herald); 80 kt (1-minute wind, maximum wind) at 0730Z at Hillsboro Lighthouse (elevated observation) (26.3N 80.1W) (climo data); 991 mb (min pressure) at 0745Z at Hillsboro Lighthouse (MWR, climo data); 30 kt SSW and 996 mb at 1530Z at west end, Grand Bahama Island (26.7N, 79.0W) (micro). Aircraft highlights: center fix

over Cape Sable at 0130Z (micro); 35 kt ENE at 17Z at 26.3N, 78.5W (micro). “During the night of October 11-12 the hurricane passed over the extreme southern portion of the Florida Peninsula. Although at this stage, the storm was accompanied by a small center of hurricane winds, there was little wind damage as it passed over swamplands from the time it entered the west coast north of Cape Sable until it reached the east coast communities between Miami and Palm Beach. The Weather Bureau Office in downtown Miami recorded 62 mph for the fastest wind speed at 12:23 am, and a low pressure of 998.0 mb (29.47 inches) as the center passed a short distance to the northwest. At the Airport Station, about 7 miles closer to the storm center, the lowest pressure recorded was 995.3 mb (29.39 inches). In moving off the east coast into the Atlantic the center passed directly over Hillsboro Lighthouse, near Pompano, where the calm center was experienced between 3:30 am and 4:30 am on the 12<sup>th</sup>. The strongest winds recorded were 86 mph averaged for 5 minutes, and 92 mph for the fastest mile of wind, both registered at 2:30 am. The lowest pressure, 991.2 mb (29.27 inches), occurred at 2:45 am” (MWR). Regarding the damage... “Since this was the same area that had been raked by the great hurricane of the previous month, there was little left that could be damaged by the weaker winds of the second storm. However, the heavy rainfall associated with it, added to the dangerous flood conditions already existing over south Florida, resulted in the worst flood ever experienced in this section. Rainfall of 5 to 13 inches with this hurricane was confined to south Florida from around the Lake Okeechobee area southward. At the Hialeah Water Plant rain was so intense that a recording gage registered 6 inches in 1 hour and 15 minutes, before the gage overflowed. At the Miami City Office, which was on the edge of the heavy rain area, 3.60 inches of rain fell in 1 hour, and 1.32 inches in 10 minutes. Such rains did not in themselves cause the flood but climaxed a very wet season for which total flood damage in the state was estimated at \$20,000,000. The flooded area covered a good portion of 12 counties and lesser portions of others, extending from Osceola County southward to the lower end of the peninsula. Wind damage in Florida amounted to about \$75,000” (MWR). From Florida’s Hurricane History... “The storm center apparently turned just after passing the Dry Tortugas and struck the Florida coast near Cape Sable. The Weather Bureau reported that ‘as the storm passed over Florida it was preceded by spectacular thunderstorm activity and heavy rainfall. Barograms show a double minimum, a weak one at the time of the thunderstorm with a short recovering before the minimum of the storm center itself.’ Witnesses reported seeing an almost continuous display of lightning around the eye, which some local meteorologists noted was among the most vivid they had ever seen. Winds of 95 mph buffeted the area around Cape Sable, where the hurricane came ashore. At the Miami airport, winds were sustained at 80 mph, and the Hillsboro Lighthouse recorded maximum winds of 92 mph. The storm’s most damaging effects...resulted from very heavy rains. The rapid accumulation of water was more than the streets of South Florida could handle, and severe flooding resulted. Water was waist deep in Hialeah, Miami Springs, and Opa-Locka. In some portions of Hialeah, standing water was more than six feet deep. Mayor Henry Milander declared a state of emergency and restricted access to the city. Flooded neighborhoods throughout the area left more than 2,000 Dade County families homeless. US1 was under water from Miami to Fort Lauderdale, as was much of the Tamiami Trail all the way to Everglades City. Miami was also submerged; most streets became flowing streams, and cars stalled when water rose over their engines. The

Miami River overflowed near the Northwest Twelfth Avenue bridge, and Little River and the Seybold Canal also spilled over their banks. Miami Beach was also affected; North Bay Road was inundated, as were many sidewalks along Collins Avenue from South Beach through Surfside. Store owners were helpless to prevent the destructive flood from saturating their goods and furnishings. At least two tornadoes were documented during the hurricane's approach- one that ripped through portions of Coral Gables and Miami and another that struck Miami Beach. The Miami Beach twister was short-lived, but it touched down on Lenox Avenue just long enough to destroy three large construction warehouses. In the aftermath of the storm, residents of the Miami area could travel only by small boat. The floodwaters did not quickly recede, partly because the region had recently experienced a very wet period and water levels were high before the storm. Even the great hurricane of 1926 had not left this much water behind. According to the *Miami Herald*, Red Cross rescue chief E. W. Deering said: "We have never had a water situation like this before" (Barnes). From the Miami OMR... "During the passage of the freak tropical disturbance on the 11<sup>th</sup>-12<sup>th</sup>, a severe thunderstorm was experienced in the eastern quadrant. This gave torrential rain over the entire area, and several small tornadoes formed in the southwest section of Miami, South Miami, and the Royal Palm State Park south of Homestead. In only one instance damage of consequence occurred, this in Miami when a dwelling of concrete block construction was partially demolished. The heavy rains came at a time when extensive flooding was occurring in the Everglades, and additional high water covered the villages of Hialeah and Miami Springs and adjacent areas to the Everglades to a depth of 2 to 5 feet. Water damage resulted in an amount estimated at nearly \$3,000,000. Many homes and business establishments were flooded, and it was necessary to evacuate hundreds of families to other locations until waters subsided. Dikes were built around many of these areas and water was pumped out" (Miami OMR). "Navy radar report (0130Z?) - center 35° and 54 miles from Boca Chica; center over Cape Sable. At 0220Z, Rarep center bearing 37° dist 70 miles from Key West; course 65°, speed 24 mph. Rarep 0320Z: center bearing 035° dist 85 miles from Key West; course 30° moving 12-15 mph. WBAS 2935 0540Z; MM 2947 0605Z" (micro). "Tropical Cyclones in Florida - Oct. 12 - S Fla. - Minimal 5 to 13 in. rain" ("Minimal" indicates winds of 74 to 100 mph and central pressure 983 to 996 mb - Dunn and Miller). "1947 Oct FL, 1SE" (Jarrell et al.).

October 13:

HWM analyzes a tropical storm of a most 1005 mb centered near 30.5N, 74.2W. HURDAT lists this as a 70 kt hurricane at 30.5N, 74.6W. The MWR tracks of centers of cyclones shows a 00Z position near 28.5N, 76.5W and a 12Z position near 29.8N, 74.8W. The MWR post-season track map shows a 00Z position near 28.7N, 76.8W and a 12Z position near 30.7N, 75.3W. Microfilm shows a low of at most 1005 mb centered near 31.2N, 73.3W. Ship highlights: 35 kt SSW and 1007 mb at 11Z at 27.9N, 74.5W (micro); 35 kt W and 1008 mb at 12Z at 30.0N, 73.3W (HWM). Land highlights: 38 kt (1-minute wind, maximum wind) N at 1145Z at Ponce De Leon light (elevated observation?) (29.1N, 80.9W) (climo data). Aircraft highlights: center fix at ~18Z at 31.5N, 74.9W with 60 kt winds in the SW quadrant (micro); center fix at 20Z at 32.1N, 75.1W with a 982 mb central pressure and 70 kt winds in the NE quadrant. At least six other gales. "The most unusual feature however, was the apparent dissipation of the

original center about 100 miles southeast of Cape Hatteras, and the formation and rapid development of a secondary center 180-200 miles southwest of the original. This secondary developed hurricane force and moved westward with the center reaching the coast a short distance south of Savannah about 7 am of the 15<sup>th</sup>..." (Florida climo data). "0700Z- navy radar reports posit 2907N, 7502W, no eye apparent in storm area. 0740Z- hrcn posit 2949N, 7548W, course 042°, spd 15, no eye apparent in storm so far" (micro). Army plane located center (1705Z or 1905Z?) at 31.5N, 74.9W; highest winds in SW quadrant are 60 knots and extend outward 30 miles from the center. Navy plane located center 20Z at 32.1N, 75.1W; diameter of eye 12 miles; winds 70 knots within 40 miles of center in NE quadrant; lowest pressure in center 982 mb" (micro).

October 14:

HWM analyzes a tropical storm of at most 995 mb centered near 31.6N, 76W. HURDAT lists this as a 65 kt hurricane at 31.8N, 77.1W. The MWR tracks of centers of cyclones shows a 00Z position near 31.4N, 74.3W, and a 12Z position near 32.5N, 76W. The MWR post-season track map shows a 12Z position near 32.3N, 77.0W. Microfilm shows a low of at most 993 mb centered near 32.2N, 76.6W with trough or frontal-like features beginning to develop with a trough extending southward from the low and another trough extending east-northeastward from the low, and another trough extending southwestward from the low just for 100-200 nm. Ship highlights: 45? kt E and 1007 mb at 00Z at 34.0N, 73.0W (micro); 35 kt NNW and 994 mb at 12Z at 31.8N, 78.3W (micro); 40 kt NNW and 995 mb at 18Z at 31.4N, 78.5W (micro); 35 kt NNE and 991 mb at 18Z at 32.3N, 77.5W (micro); 40 kt N and 986 mb at 21Z at 31.8N, 78.2W (micro). Numerous other gales and low pressures. Land highlights: 1004 mb (min pressure) at Wilmington (34.2N, 77.9W) (climo data). Aircraft highlights: center fix at 6Z at 32.3N, 76.7W with 70-80 kt winds at flight level of 5000 feet (micro); center fix at 2137Z at 31.7N, 77.7W with central pressure of 975 mb and maximum winds of 80 kt (micro, MWR). "After leaving Florida the hurricane was followed by aircraft as it moved on a northeastward course over the Atlantic, although insufficient observations during the night of October 13-14 made its movement uncertain during that time. A reconnaissance plane entered the storm area during the early hours of the 14<sup>th</sup>, and highest winds were estimated at 50 to 55 knots. During the afternoon the storm gained force, and when another plane flew into the center at about sunset, winds were estimated at 80 knots" (MWR). "Recon weather reports: 14/0330Z- storm not definitely located. Frontal lines starting 65 miles south of Cape Lookout extending 200 miles eastward and curving south. Radar plane #6L36 at 0510Z reports accumulation of thunderstorms at 3340N, 7520W- seems to indicate general position of storm; unable to get definite center. Plane #9L36 at 0705Z- posit (of plane?) 3355N, 7555W; course 045, speed 130, hurricane not definitely located yet. 0950Z- 3525N, 7503W- mdt turbulence and heavy rain within 100 miles of storm. Info received by phone from (Navy Weather?) at 1130Z- Navy radar officer on recon flight out of Miami ran into separate center at 32°20'N, 76°40'W at 06Z with 70-80 knots at 5000'; the other center at about 34°35'N, 74°03'W. 1830Z- in eye of storm; diameter of eye 12 miles, highest winds 50 to 55 kt north of center. Eye of storm located by Navy Hurricane plane at 2137Z at 31.7N, 77.7W, 80 knot winds 10 miles radius of eye in NE and NW quadrants; winds 40 knots within 60 to 75 miles of eye in NE and NW

quadrants; diameter of eye 12 miles; lowest pressure recorded 975 mbs; (gale?) winds extend 180 miles in SW quadrant” (micro).

October 15:

HWM analyzes a tropical storm of at most 1005 mb centered close to Savannah, GA, near 32.1N, 81.0W. HURDAT lists this as a 75 kt hurricane at 31.9N, 81.0W. The MWR tracks of centers of cyclones shows a 00Z position near 32.2N, 77.8W and a 12Z position near 32.2N, 80.5W with a pressure of 971 mb. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 981 mb centered near 31.8N, 81.3W. Ship highlights: at least 50 kt WSW and 982 mb at 00Z at 32.0N, 78.0W (micro); 966 mb reported in eye by ship at 0230Z at 31.6N, 78.6W with 50 kt SE winds before the eye and 50 kt SW winds after the eye (micro); 70 to 80 kt NE and 971 mb at 0645Z at 31.9N, 79.4W (micro); 35 kt ESE and 978 mb at 0705Z at 31.9N, 79.4W (micro). Several other gales and low pressures. Land highlights: 996 mb (min pressure) at 0830Z and 47 kt NE (1 minute wind, maximum wind) at 0855Z at Charleston (32.8N, 79.9W) (climo data); 984 mb (min pressure) at 0945Z at Parris Island (32.4N, 80.7W) (OMR); 74 kt (1-minute wind, maximum wind) NE with estimated gusts to 83 kt and 974 mb (minimum pressure) at 12Z at Savannah (32.1N, 81.3W) (MWR, OMR); 30 kt SW and 994 mb at (~14Z?) at Brunswick (31.2N, 81.5W) (micro); 43 kt NW (1-minute wind, max wind) at 1510Z and 984 mb (min pressure) at 1630Z at Alma (31.5N, 82.5W) (climo data); 33 kt (max wind) at 2129Z at Jacksonville (climo data). Several other gales and low pressures. Aircraft highlights: center fix at 0520Z at 31.4N, 79.3W (micro). “Moving on a westward course, the center moved over Georgia at about 7 am (12Z) of the 15<sup>th</sup>, a short distance south of Savannah. The lowest pressure at Savannah was 973.9 mb (28.76 inches) at 7 am, and the strongest wind was estimated at 85 mph at 6:59 am, with gusts estimated as high as 95 mph. The area of hurricane winds was small, probably about 40 miles in width. The city of Savannah and its vicinity experienced the worst part of the hurricane when the center passed inland about 15 miles to the south. Damage in the Savannah area was estimated at approximately \$2,000,000, while in all other areas of Georgia damage did not exceed \$500,000. Some structural damage occurred in Savannah, with many roofs damaged either by direct action of the wind or by falling trees. Window glass was extensively broken while signs, ventilators, chimney tops, awnings, and like objects were blown down. High tides along the Georgia and South Carolina coasts ranged from 12.0 feet above mean low tide at Savannah Beach, Ga., and Parris Island, SC., to 9.0 feet at Charleston, SC, and 9.6 feet at St. Simons Island, near Brunswick, Ga. The lower portions of Charleston were flooded to a depth of about 1 foot, while low-lying beaches and islands in the area also suffered considerable damage. Salt-water flooding damaged the rice crop. Some small communities as far north as Cape Hatteras were partly or wholly inundated by tides” (MWR). From Florida’s Hurricane History... “The October hurricane of 1947 is remembered for another distinction: it was the first hurricane ever to be seeded. Scientists had speculated in the laboratory that adding dry ice to clouds near the eye might reduce a hurricane’s strength by forcing its clouds to ‘rain themselves out.’ Early in 1947, scientists from General Electric and teams from the U.S. Army, the Office of Naval Research, and the U.S. Weather Bureau formed Project Cirrus, which set out to test the dry ice theory on a real storm. After soaking much of South Florida on the night of October 11, the

hurricane skipped out to sea near Pompano Beach just after dawn the following day. Once it was safely offshore, the Project Cirrus team selected this hurricane for its experiment. By this time, it was some 350 miles off the coast of Jacksonville and headed on a northeasterly track that should have carried it far out into the open Atlantic. On the morning of October 13, a plane carrying eighty pounds of dry ice flew into the storm and dispensed the substance over a course of 100 miles. The scientists hoped that the seeding would have some measurable effect so further adjustment could be made in future hurricane experiments. But...shortly after seeding, the hurricane abruptly stalled and then turned back toward the U.S. coast – a most unwelcome development. It moved due west with little drop in intensity and struck the Georgia coastline below Savannah. High tides flooded the barrier islands as far north as Charleston, and heavy damages were reported to finishing fleets, wharves, and warehouses. Winds at Savannah were clocked at 85 mph, with gusts to 95 mph. One Savannah resident was killed, and many people were injured. Including the property losses in Florida, the total damage estimate for the storm topped \$20 million” (Barnes). From Savannah OMR... “The hurricane of the 15<sup>th</sup> did very little crop damage except where rains were heavy. It blew off about 90% of the pecan crop and damaged many trees. It also blew down sugarcane. Total damage in this hurricane has been estimated at \$2,725,000 in Chatham County. The bulk of this was in roofs and frame houses, though there was considerable commodity damage in warehouses where blowing rains and high tides did the most of it. Many trees were blown down. Much shrubbery was destroyed or damaged. The wind was estimated at 95 mph in gusts, 85 mph extreme mile, and 77 mph 5-minute velocity from the northeast at about 0655-0700. This exceeded the old October record of 57 and the 71 miles record for all months. The sea-level barometer established a new low of 28.77 inches at 0700 in the 15<sup>th</sup>” (Savannah OMR). “The storm...struck Savannah Beach on the Georgia coast at about 6:00 am (11Z) on the 15<sup>th</sup>...high winds at Savannah Beach were estimated at 100 mph. Exceptionally heavy damage was sustained at Savannah and Savannah Beach; some structures were practically demolished, and extensive destruction included roofs blown off or badly lashed...” (Georgia climo data). Total damage along the South Carolina coast totaled to around \$185,000 (South Carolina climo data). “Center located at 31:25N, 77:52.5W, pressure 975 mb (~00Z?). Tanker (SHIP) reports the center of hurricane at 0230Z at latitude 31°35’N and long 78°35’W, pressure in center 28.54 (966 mb), winds SE force 10 to SW. Special Navy Recon plane reports radar fix on hurricane at 0240Z- 31.5N, 78.6W; well defined eye 20 miles diameter; heavy weather surrounding eye to a distance of 55 miles. Recon plane located center at 0520Z at 31°27’N, 79°20’W. S.S. Rhode Island reports center passed south of position (31.9N, 79.4W) at 0645Z, wind NE 80-90 mph, barometer 28.66 (970 mb); at 0705Z, wind ESE force 8 (35 kt) with barometer 28.88 (978 mb). SH special 1030Z- gusts NNW 62 (mph), Barometer 29.20 (989 mb); 1100Z- wind steady 60 mph, barometer 29.10 (985 mb), gust recorders out. NOTAM SH 15/1035Z- Savannah Airport control tower abandoned; all facilities inoperative 1035Z. TSV about 1130Z- Ventilators and other solid objects being blown from Fed. Building, estimated gusts to 100 mph, severe lightning north of station” (micro). “Tropical Cyclones in the South Atlantic States – Carolinas and Georgia – Oct. 15 – Savannah – Minimal – Damage \$3,000,000” (“Minimal” indicates winds of 74 to 100 mph and central pressure 983 to 996 mb – Dunn and Miller). “Oct 15, 1947 – 1013 mb environmental pressure – 89 kt 1 min wind equivalent” (Schwerdt et al.). “Oct. 15,

1947 – 968 mb (from 974 mb observed at Savannah) – 13 nm RMW – 17 kt speed – 31.9N, 81.1W landfall” (Ho et al.). “1947 Oct GA, SC, 2 – Cat 2 – 974 mb” (Jarrell et al.).

October 16:

HWM analyzes a low of at most 1005 mb centered near 32.7N, 83.9W. HURDAT lists this as a 35 kt tropical storm at 32.2N, 85.0W. The MWR tracks of centers of cyclones shows a position near the HURDAT position with a pressure of 1005 mb. Microfilm shows a low of at most 1005 mb centered near the HURDAT position. Ship highlights: 15 kt NW and 1004 mb at 00Z at 30.5N, 87.5W (COA). Several other pressures of 1005 mb. Land highlights: 20 kt NNE and 1000 mb at 00Z at Albany (31.5N, 84.2W) (micro). Three other low pressures.

October 17:

HURDAT does not list a system on this day. The MWR tracks of centers of cyclones shows a 00Z position near 33.0N, 87.9W and a 12Z position near 36.6N, 88.4W with a pressure of 1010 mb. Microfilm no longer plots a closed low at 00Z. No gales or low pressures.

HURDAT originally started this on 9 October at 06Z as a 35 kt tropical storm. There is evidence that there was a closed low in the western Caribbean Sea as early as 18Z on the 8<sup>th</sup>, and this is analyzed as the time of genesis with a 25 kt intensity. By 06Z on the 9<sup>th</sup>, the depression had strengthened to 30 kt (down from 35 kt originally). There is not an abundance of data available on the 9<sup>th</sup>, but the depression is analyzed to have become a tropical storm at 18Z on the 9<sup>th</sup> (12 hours later than originally) when it was near 16.4N, 83.3W. Also, a peripheral pressure of 1003 mb from Swan Island at 03Z on the 10<sup>th</sup> suggests that the storm intensity was greater than 41 kt using the Brown et al. southern pressure wind relationship. 40 kt is chosen for 00Z on the 10<sup>th</sup> (no change), as the environmental pressures were low. The track changes introduced throughout the lifetime of the system are all minor. From genesis up until landfall in Cuba, which occurred around 7Z on the 11<sup>th</sup>, the new track is generally to the left (west) of the previous HURDAT track by less than one degree. At both 1530Z and 1808Z on the 10<sup>th</sup>, aircraft reconnaissance made center fixes providing the location, central pressure, and estimated maximum surface winds. Based on this information, a central pressure of 1000 mb is added into HURDAT at 18Z on the 10<sup>th</sup>. 1000 mb equals 47 kt according to the Brown et al. southern pressure-wind relationship. 45 kt is chosen for 12Z and 50 kt is chosen for 18Z (no change to either). The tropical storm then made landfall in Cuba around 7Z on the 11<sup>th</sup> near 22.2N, 83.5W as a 55 kt tropical storm. This is in agreement with Perez et al.’s assessment of a tropical storm in Cuba. It is analyzed to have exited the north coast of Cuba around 11Z near 22.9N, 83.4W. In this analysis, the intensities are kept unchanged at 06Z (55 kt) and 12Z (60 kt). When the storm reached the Florida Straits it began a turn more towards a northeasterly direction and it intensified into a hurricane before passing perhaps 10 nm to the southeast of Dry Tortugas at 19Z on the 11<sup>th</sup>. The Dry Tortugas recorded sustained winds of at least 73 kt at 1737Z and aircraft reconnaissance measured a central pressure of 983 mb at 1716Z. A central pressure of 983 mb is added into HURDAT for 18Z on the 11<sup>th</sup>. 983 mb equals 74 kt using the

Brown et al. southern pressure-wind relationship and 69 kt for N of 25N. For intensifying systems, this value equals 74 and 72 kt respectively. Dry Tortugas likely experienced the maximum winds in the NW quadrant, but the winds in the NE quadrant could have been higher. 75 kt is chosen for the 18Z intensity on the 11<sup>th</sup> (up from 65 kt originally). A land-based radar on Boca Chica easily tracked the center of the hurricane from 20Z to 2330Z on the 11<sup>th</sup>, so the position was known with good accuracy.

The hurricane made landfall on the extreme southern part of the west coast of Florida, northwest of Cape Sable, near 25.4N, 81.2W at 02Z on the 12<sup>th</sup>. Since there are no land observations available on the southwest coast of mainland Florida where the hurricane made landfall, the landfall intensity was estimated based on observations from the previous day as well as observations from the southeast Florida metro areas when the storm passed that area a few hours later. At 18Z the previous day, 8 hours before landfall, the assigned intensity was 75 kt. Just an hour later, at 1910Z, an aircraft estimated 80-85 kt maximum surface winds, keeping in mind that aircraft estimates during this era could be off by 15 kt with a high bias more often than not. When the storm reached the east coast of Florida, the strongest sustained wind recorded was 80 kt at Hillsboro Lighthouse (elevated site). MWR notes that the lowest pressure there was 991 mb at 2:45 am, but the calm center passed there from 3:30 am to 4:30 am. The 991 mb observation is therefore not treated as a central pressure in the analysis because it occurred 15 minutes after the maximum wind and 45 minutes before the beginning of the calm period. A barometer in Fort Lauderdale confirmed this suspicion by registering a reading of 982 mb at 07Z. The barometer was reported to be still falling at the time of this measurement, thus this is not a central pressure reading either. A combination of the 983 mb central pressure measured by reconnaissance at 1716Z on the 11<sup>th</sup> and the 982 mb peripheral pressure reading in Fort Lauderdale at 07Z on the 12<sup>th</sup> suggests a central pressure of 978 mb at landfall in southwest Florida at 02Z on the 12<sup>th</sup>. 978 mb suggests winds of 81 kt from the intensifying subset of Brown et al. south of 25N hurricanes and 78 kt for north of 25N. An intensity of 80 kt is chosen for 00Z on the 12<sup>th</sup> and landfall (up from 70 kt originally). This makes the hurricane a Category 1 at landfall in Southwest Florida (BFL1), which is now added into HURDAT (the system was inexplicably not counted as a Southwest Florida hurricane originally). A run of the Kaplan and DeMaria inland decay model yields a value of 61 kt for 06Z, and highest observed winds within two hours of 06Z were 54 kt (aside from the Hillsboro Lighthouse measurement). Taking into consideration the observed pressure at Fort Lauderdale and the fact that the hurricane was traveling over the swampy Everglades, an intensity of 70 kt is analyzed for 06Z (down from 75 kt originally). This confirms considering the system to be a hurricane for Southeast Florida (CFL1). The hurricane emerged over the Atlantic Ocean around 09Z on the 12<sup>th</sup>. (The 991 mb central pressure listed in HURDAT originally comes from the Hillsboro Lighthouse measurement, which has been determined to have been a peripheral pressure and is removed.)

A 12th/19Z aircraft fix along with the 09Z center fix over Hillsboro Light allowed for the 12Z and 18Z positions to be interpolated. The new positions are only a few tenths of a degree east of the previous HURDAT positions. There is some evidence that weakening occurred on the 12<sup>th</sup> and 13<sup>th</sup> as the cyclone moved towards the northeast over the

Atlantic. Around 07Z on the 13<sup>th</sup>, with the storm in the vicinity of 29.3N, 75.8W, aircraft radar did not show an eye. It is clearly evident that a degradation of the storm structure took place from the time it exited Florida (09Z on the 12<sup>th</sup>) to 07Z on the 13<sup>th</sup>. In addition, the highest available observed wind during this 22-hour period was only 35 kt. It is analyzed that the hurricane weakened to a 60 kt tropical storm by 00Z on the 13<sup>th</sup>. The reanalyzed intensities from 12Z on the 12<sup>th</sup> to 06Z on the 13<sup>th</sup> are as follows (with original HURDAT values in parentheses): 70 (75); 65 (75); 60 (70); 60 (70). On the 13<sup>th</sup>, the cyclone began an unusual, rather sharp turn in its forward motion from northeast to north to northwest to west, and by the 14<sup>th</sup>, it was evident that this cyclone was going to make landfall on the SE coast of the US. The revised track has this loop occurring slightly further west than in HURDAT previously. At 20Z on the 13<sup>th</sup>, aircraft measured a central pressure of 982 mb with estimated maximum winds of 70 kt. A central pressure of 982 mb is added into HURDAT at 18Z on the 13<sup>th</sup>. 982 mb equals 70 kt using the Brown et al. pressure-wind relationship for north of 25N and 73 kt for intensifying systems. 70 kt is chosen for 18Z (unchanged) and 65 kt is chosen for 12Z (6 hours previous) (down from 70 kt originally). So, after weakening to a tropical storm at 00Z the 13<sup>th</sup>, it strengthened back to a hurricane at 12Z on the 13<sup>th</sup>. From the 13<sup>th</sup> until landfall in Georgia, which occurred at 11Z on the 15<sup>th</sup>, several center fixes were made. The largest track change made during the time period is about a half degree. Several gales and low pressures as low as 985 mb were observed between late on the 13<sup>th</sup> and late on the 14<sup>th</sup>. At 2137Z on the 14<sup>th</sup>, a central pressure was reported by aircraft of 975 mb along with 80 kt estimated surface winds. Five hours later, at 0230Z on the 15<sup>th</sup>, a ship reported venturing through the eye of the hurricane with calm winds and a central pressure of 966 mb. Ten minutes later, at 0240Z, an aircraft reported a center fix just one-tenth of a degree from the ship location of the eye. The 966 mb value was likely accurate because another ship recorded a 971 mb pressure along with winds of 70 to 80 knots at 06Z on the 15<sup>th</sup>. A central pressure of 975 mb is added into HURDAT at 18Z on the 14<sup>th</sup>, and a central pressure of 966 mb is added into HURDAT at 00Z on the 15<sup>th</sup>, with the hurricane moving westward, located at 31.7N, 78.4W. 975 mb equals 79 kt according to the Brown et al. N of 25N pressure-wind relationship and 82 kt for intensifying systems, and 80 kt is chosen for 18Z on the 14<sup>th</sup>. 966 mb equals 89 kt and 93 kt, respectively. 90 kt is chosen for HURDAT at 06Z on the 15<sup>th</sup>. From 18Z on the 14<sup>th</sup> until landfall at 12Z on the 15<sup>th</sup>, the previous HURDAT intensity is increased by 15 kt at each point.

The hurricane continued westward and made landfall a few miles south of Savannah Beach, GA at 11Z on the 15<sup>th</sup> as a 90 kt hurricane. The station at Savannah, which is located inland from the coast, recorded its maximum wind and minimum pressure at the same time around 12Z. These values are 74 kt and 974 mb, respectively. There were three sources that contained that information, and one of the sources said that the 74 kt one-minute sustained wind at Savannah was estimated, but the other two sources did not indicate that the observation was estimated. Regardless, the central pressure was likely around 966 mb – based upon both the ship's eye observation several hours before landfall along with the 974 mb accompanied by hurricane force winds measured in Savannah - which supports a 90 kt intensity at landfall. A landfall central pressure of 966 mb is analyzed and added into HURDAT at 12Z on the 15<sup>th</sup>. 90 kt at landfall is a Category 2

hurricane for Georgia and South Carolina, confirming the original HURDAT estimate. From the analyzed positions, it appears that the hurricane moved relatively quickly between 06Z and 18Z on the 15<sup>th</sup> compared to before and after that time. After landfall, the cyclone moved quickly inland towards the west-southwest, but after 18Z, its forward motion slowed once again. Around 06Z on the 16<sup>th</sup>, with the cyclone located over southwestern Georgia, it made a turn towards the northwest, and dissipated after 18Z the 16<sup>th</sup>, 31 hours after landfall. The Kaplan and DeMaria inland decay model was run for 18Z on the 15<sup>th</sup> through 06Z on the 16<sup>th</sup>, yielding values of 54 kt, 38 kt, and 29 kt respectively. The highest wind observations within two hours of the synoptic times are 43 kt, 33 kt, and 20 kt respectively. 55 kt, 40 kt, and 30 kt are chosen for HURDAT (down from 65 kt, 50 kt, and 40 kt originally). 25 kt and 20 kt are chosen for 12Z and 18Z on the 16<sup>th</sup> respectively (down from 35 kt and 25 kt originally). There was no longer a closed low evident at 00Z on the 17<sup>th</sup>, so no changes were made to the timing of dissipation.

### 1947 Storm 10 (originally Storm 9)

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33735 10/16/1947 M= 7 9 SNBR= 749 NOT NAMED XING=0 L
33735 10/17/1947 M= 6 10 SNBR= 749 NOT NAMED XING=0 L
      **          * **
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(The 16<sup>th</sup> is removed from HURDAT.)

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33740 10/16* 0 0 0 0* 0 0 0 0* 0 0 0 0*174 624 35 0*
33745 10/17*184 639 50 0*190 653 60 0*197 666 65 0*204 678 70 0*
33745 10/17*190 632 35 0*195 647 40 0*200 662 45 1000*207 675 50 0*
      *** ** **      *** ** **      *** ** **      *** ** **
33750 10/18*210 687 75 0*218 696 75 0*228 702 80 0*237 705 85 0*
33750 10/18*214 687 60 0*221 696 65 0*228 702 70 990*237 704 80 981*
      *** **      *** **      *** **      *** **      *** **
33755 10/19*247 705 85 0*261 702 90 0*277 697 95 0*289 690 95 0*
33755 10/19*247 705 85 0*259 702 90 0*273 699 100 0*286 692 105 0*
      ***      *** **      *** **      *** **      *** **
33760 10/20*301 681 100 0*314 669 105 0*327 657 105 0*337 645 105 0*
33760 10/20*299 684 105 0*313 671 105 0*327 661 105 0*337 652 105 961*
      *** ** **      *** **      *** **      *** **      *** **
33765 10/21*348 632 95 0*361 614 85 0*375 590 65 0E388 566 60 0*
33765 10/21*348 635 95 0*361 614 90 0*375 590 85 0*386 566 85 0*
      ***      *** **      *** **      *** **      *** **
33770 10/22E400 541 55 0E415 500 50 0* 0 0 0 0* 0 0 0 0*
33770 10/22*397 528 80 0E415 485 65 0* 0 0 0 0* 0 0 0 0*
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33775 HR

Minor track changes and major intensity changes are analyzed with this major hurricane that recurved in the Atlantic near 70W and then affected Bermuda. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, and Tucker (1995).

October 14:

HWM analyzes a closed low of at most 1012.5 mb centered near 15.8N, 59.0W with a wave axis running through the low from 18N, 55W to 12N, 61W. HURDAT does not list a system on this day. Ship highlight: 15 kt E and 1005 mb at 12Z at 17.7N, 51.2W (HWM).

October 15:

HWM analyzes an open trough with a wave axis inside the trough running from 19N, 58W to 11N, 63W. HURDAT does not list a system on this day. Microfilm shows a low near 17.5N, 55.8W, but aircraft claims to have found a cyclonic circulation further south. No gales or low pressures. "Cyclonic circulation of light intensity, lowest pressure 1008 mbs, area covered by CB with moderate rain; easterly wave evident north of center; swells easterly entire flight (15°20'N, 58°10'W) (micro).

October 16:

HWM analyzes a closed low of at most 1010 mb centered near 15.4N, 63.7W at 12Z. HURDAT firsts lists this at 18Z as a 35 kt tropical storm at 17.4N, 62.4W. Microfilm shows a closed low of at most 1011 mb near 16N, 59.5W at 12Z. Ship highlight: 35 kt ENE and 1010 mb at 20Z at 20.7N, 61.5W (micro). "The last storm of the season was first noted east of the Leeward Islands as an easterly wave. This wave developed into a closed circulation on the 16<sup>th</sup> north of the Virgin Islands and moved on a broad curving path over the Atlantic" (MWR).

October 17:

HWM analyzes a low of at most 1010 mb centered near 20N, 66.5W. HURDAT lists this as a 65 kt hurricane at 19.7N, 66.6W. The MWR tracks of centers of cyclones shows a position near 19.9N, 65W. The MWR post-season track map shows a 00Z position near 18.5N, 63.2W and a 12Z position near 19.4N, 66.8W. Microfilm shows a low of at most 1002 mb centered near 20.0N, 66.2W. Ship highlights: 35 kt NE and 1010 mb at 12Z at 21.8N, 66.6W (micro); 35 kt NE and (1005 mb?) at 1830Z at 21.6N, 68.4W (micro). Aircraft highlights: center fix at 1150Z at 20.0N, 66.2W with 1002 mb lowest measured pressure and maximum winds of 30 kt (micro); center fix at 1739Z at 20.9N, 67.3W with central pressure 1004 mb and 35 kt maximum winds (micro). "It reached hurricane intensity during the night of the 17<sup>th</sup> when it was some distance northeast of Turks Island" (MWR). "It had first been detected by the Bermuda Meteorological Office on Friday 17<sup>th</sup> through wireless messages of various ships just north and east of the Leeward Islands" (Tucker). "Navy plane reports at 1150Z- complete circulation 20.0N, 66.2W, highest wind 30k, lowest pressure 1002 mbs. 19.8N, 66.4W, 12Z, center diffuse, 10 miles in diameter, wind calm in eye. Army B17 5654 report storm 20.9N, 67.3W, winds 35 knots, pressure 1004, sudden wind shift from 170 to 350 degree (17/1739Z). Duck special 2: storm center at 20.4N, 66.9W at (1947Z)? Definite eye 30 miles across, three small twisters on NW side" (micro).

October 18:

HWM analyzes a tropical storm of at most 1005 mb centered near 22.4N, 68.8W. HURDAT lists this as an 80 kt hurricane at 22.8N, 70.2W. The MWR tracks of centers of cyclones shows a 00Z position near 21.2N, 68.1W, and a 12Z position near 22.7N,

69.7W with a 981 mb pressure. The MWR post-season track map shows a 00Z position near 20.9N, 68.4W, and a 12Z position near 22.1N, 70.3W. Microfilm shows a low of at most 996 mb near 22.6N, 70.1W. Ship highlights: 50 kt ESE at 00Z at 21.4N, 68.4W (micro); 40 kt SE and 1000 mb at 03Z at 21.1N, 68.2W (micro); 50 kt SE and 998 mb at 23Z at 24.3N, 69.2W (micro). A few other gales and low pressures. Aircraft highlights: center fix at 1310Z at 22.6N, 70.2W with central pressure 990 mb and maximum winds 85 kt (micro); center fix at 1925Z at 23.8N, 70.4W with central pressure 981 mb and maximum winds 100 kt (micro). A few other gales. "By Saturday afternoon (the 18<sup>th</sup>) it had approached the Turks Islands where it recurved in a more northerly direction, and it was definitely established that the centre was of full hurricane intensity, with gales extending from it in all directions for about 150 miles" (Tucker). "Hurep from recon plane: Hurricane centered 18/1310Z at 22.38N, 70.15W. Maximum winds approx 5 miles from center east 65 knots. North 85 knots. Northwest 85 knots. West 80 knots. SW 70 knots. South 55 knots. SE 60 knots. Very tight center with lowest pressure 990 mbs. Southeast side very weak. Vicious turbulence encountered on west side of storm. Center weather broken STCU based 1200 tops 3500. AVC altostratus based 1500 feet" (micro). "Recon from AWXAN: Eye of hurricane located at 23.8N, 70.4W at 1925Z, highest wind 100 knots, lowest pressure 981 mbs" (micro).

October 19:

HWM analyzes a hurricane of at most 1000 mb centered near 27.2N, 67.9W. HURDAT lists this as a 95 kt hurricane at 27.7N, 69.7W. The MWR tracks of centers of cyclones shows a position near the HURDAT position. The MWR post-season track map shows a 00Z position near 24.5N, 70.5W and a 12Z position near 27.2N, 69.5W. Microfilm shows a low of at most 987 mb with a radar center fix at 27.8N, 69.3W at 1430Z and a 1440Z position of 27.8N, 69.8W which is "more accurate than the previous position." Ship highlights: At least 50 kt SE and 996 mb at 14Z at 28.3N, 68.7W (micro); at least 50 kt ESE and (970 mb?) at (17Z?) at 28.2N, 69.0W (micro); at least 50 kt NW and 994 mb at 20Z at 27.8N, 69.3W (micro). A few other gales and low pressures. Aircraft highlights: center fix at 1515Z at 27.7N, 69.2W with maximum winds of 125 kt (micro); center fix at 1633Z at 28.5N, 69.3W with 90 kt maximum winds (micro); center fix at 2215Z at 29.8N, 69.0W with maximum winds of at least 87 kt (micro). Several other gales. "The latest report received Sunday night (night of Oct 19) by the 'Royal Gazette', from the Meteorological Station, based on a radar 'fix' taken by a Hurricane Hunter aircraft from Kindley AFB, stated that the hurricane's position was about 280 miles S.W. of Bermuda, moving north-northeast at about 15 miles per hour. A B-17 weather reconnaissance aircraft made two flights into the hurricane from Bermuda on Sunday, October 19, penetrating the eye of the storm on each occasion and gathering weather data. Winds of over one hundred miles per hour were reported" (Tucker). "Radar plane report: Storm center 25.41N, 69.54W at 0520Z. Fix by radar accurate within five miles. 0745Z- center 26.28N, 70.17W- fix by radar. This is my third hurricane position report: center position 26.36N, 70.08W, course 045, speed 11 knots; the 0745Z and 0830Z positions determined by definite radar fixes..." (micro). "Duck hurep high three- high by radar 27.8N, 68.8W at 1440Z; this position more accurate than previous position. Position of center at 1515Z 27.40N, 69.10W; winds estimated 125 kts near center, 100 kts within 40 miles of center, 75 kts within 80 miles of center, 45 kts within 140 miles of

center; lightning in NW quad; moderate to heavy rain in northern semicircle; moderate to heavy turbulence. DH4 says 'sight of hurricane 28.5N, 69.3W at 1633Z...90 knots surface winds.' DH5 says 'radar...at 28.4N, 69.3W at 1722Z.' Hurricane special- eye of storm found at 2215Z at 29.8N, 69.0W (by Army plane). Winds estimated in excess of 100 mph. Eye by radar at 2355Z (29.9N, 68.6W)" (micro).

October 20:

HWM analyzes a hurricane of at most 995 mb centered near 32.7N, 65.4W with a SW-NE frontal system approaching about 500 nm to the NW of the hurricane. HURDAT lists this as a 105 kt hurricane at 32.7N, 65.7W. The MWR tracks of centers of cyclones shows a 00Z position near 30.0N, 68.1W and a 12Z position near 31.8N, 66.1W with a 970 mb pressure. The MWR post-season track map shows a position near the HURDAT position. Microfilm shows a low of at most 978 mb centered near 32.4N, 65.9W. Ship highlights: (87 kt?) NNE and 991 mb at (16Z?) at 34.4N 66.4W (micro). Seven other gales and two other low pressures. Land highlights: At least 87 kt at Bermuda (32.3N, 64.7W) (MWR); 40 kt SSE and 989 mb at 1330Z at Bermuda (micro); (104 kt?) WSW and 991 mb at (16Z?) at Bermuda. Several other gales and low pressures at Bermuda. Aircraft highlights: center fix at 1615Z (location unknown) with maximum winds of 112 kt and gusts to 125 kt (micro); center fix at 2038Z at 34.3N, 65.1W with central pressure 961 mb and maximum winds at least 100 kt (micro). A few other gales. "Its curving path brought the center to a point slightly west of Bermuda, where during the forenoon of the 20<sup>th</sup> winds in excess of 100 mph were reported" (MWR). "Throughout the night (early on the 20<sup>th</sup>) about 12 ships in the path of the storm provided valuable meteorological data by radio, so that by 4 A.M. (local time) (8Z?) it was exactly located as 150 miles SW of the islands and moving NE. Between 8 and 10 A.M. of Monday the 20<sup>th</sup> it curved past Bermuda, just 40 miles to the west, now moving at the rate of 25 miles per hour and causing winds to lash the islands at a velocity of over 100 miles an hour. By 8 A.M. winds blew across the islands of hurricane force and so continued until 10 o'clock, by which time the centre had passed within 40 miles to the north and was still moving ENE. The Meteorological Office reported it as 'only an average disturbance for this type of storm.' And by 6 P.M. the local winds had decreased to 45 miles per hour." (Tucker). "Hurricane eye positions by radar: 0640Z- 31°15'N, 66°48'W; 0715Z- 31°35'N, 66°30'W. Hurep 1615Z- west quad 82 kt, gusts to 110 kt; east quad 112 kt, gusts to 125 kt. Blue sky to SE. Position of eye at 2038Z at 3420N, 6506W...(120 knot?) winds 30 miles radius, 100 knot winds 60 miles radius, 65 knot winds extend 130 miles from eye in NW and SW quadrants, 40 knot winds extend 250 miles in NW and SW quadrants; lowest pressure 961 mb; eye diameter estimated 15 miles" (micro).

October 21:

HWM analyzes a low of at most 985 mb centered near 38.8N, 57.6W with a complex SW-NE frontal structure beginning to interact with the low. Also, a trough is plotted extending southward and then southwestward with the north end of the trough about 200 nm south of the low center. HURDAT lists this as a 65 kt hurricane at 37.5N, 59.0W. The MWR tracks of centers of cyclones shows a 00Z position near 34.6N, 62.4W and a 12Z position near 36.9N, 58.4W. The MWR post-season track map shows a position near the HURDAT position. Microfilm analyzes a low of at most 990 mb centered near

38.0N, 58.9W with an approaching mid-latitude low of at most 993 mb near 47.5N, 61W, with a front extending southwestward from the mid-latitude low. Ship highlights: 50 kt ESE and 998 mb at 00Z at 36.0N, 63.0W (micro); 40 kt N and (992 mb?) at 06Z at 36.8N, 62.5W (micro); 45 kt SW and 999 mb at 12Z at 33.7N, 57.9W (COA); 45 kt W at 21Z at 36.2N, 54.3W (micro); 85 kt S and 992 mb at 2140Z at 38.3N, 51.0W (micro); 75-85 kt SW and 989 mb at 2250Z at 37.8N, 51.5W (micro). Several other gales and low pressures. Land highlights: 15 kt W and 1004 mb at 00Z at Bermuda (micro).

October 22:

HWM shows one large, intense, occluded low (the TC and the mid-latitude low had already combined before 12Z) of at most 970 mb centered near 50N, 44.5W with an occluded front wrapping around from just north of the low to a triple point (located at 52N, 37W, a warm front extending from the triple point southeastward to 45N, 30W, and a cold front extending from the triple point southwestward for a great distance. HURDAT last listed this system at 06Z as a 50 kt extratropical storm at 41.5N, 50.0W. The MWR tracks of centers of cyclones shows a 00Z position near 39.7N, 51.2W and a 12Z position near 43.8N, 40W. Microfilm last shows this system at 00Z as a low of at most 975 mb centered near 39.3N, 51.8W. Ship highlights: 45 kt N and 987 mb at 00Z at 38.8N, 53.8W (micro); 40 kt SE and 962 mb at 12Z at 49.3N, 41.1W (COA); 45 kt WSW and 975 mb at 18Z at 49.7N, 38.7W (COA); 60 kt (MWR); 958 mb (MWR). Numerous other gales and low pressures. “A report from the Danish S. S. *Astra* indicated that winds of Beaufort force 11 (64-75 mph) and a low barometric pressure of 958.4 mb (28.30 inches) were experienced near the center of this storm as far north as latitude 42.5N” (MWR). “The last Bermudians heard of the storm itself was on Wednesday, October 22<sup>nd</sup>, when it was charted as 1800 miles NE of Bermuda (46.5N, 37W), heading towards Iceland and the north of Scotland, but gradually dispersing and losing its velocity. In the meantime, Bermuda was appraising its casualties – widespread secondary damages but no disaster of a major character, except one death – that of an Electric Light Company’s linesman who fell from a pole while attempting to fix broken wires. Kindley AFB looked deserted, barren, stripped of its accustomed aircraft. Gibbs Hill Lighthouse had swayed visibly – and sufficiently to spill the mercury from the trough in which the revolving light is set. Some of the hotel in more elevated positions had the appearance of bombed-out areas. The total damage to property was estimated at thousands of pounds; that it was mostly of secondary nature was entirely due to the very adequate warnings received” (Tucker). From the Washington, D.C. Weather Bureau- advisory issued 11/22 at 16Z: “The Atlantic hurricane still maintains its intensity and was centered near lat 46.5N, long 37.0W or about 750 miles east of Cape Race, Newfoundland at 1600Z moving east-northeast with a tendency towards northeast at about 50 mph. Hurricane winds are still being experienced near and about 100 miles south of the center...” (Washington DC Weather Bureau advisory).

This tropical cyclone likely formed from an easterly wave. On 14 October, there was a ship ob of 15 kt E and 1005 mb around 52W longitude, likely north of where the disturbance was at that time, but that is the only available observation in the vicinity on that day. On the 15<sup>th</sup>, the low looks closed according to available aircraft observations around 56W, but on the 16<sup>th</sup>, sufficient observations show that there is not a closed low.

HURDAT starts this at 18Z on the 16<sup>th</sup> at 17.4N, 62.4W with an intensity of 35 kt. At 00Z on the 17<sup>th</sup>, there is a reliable west wind (although only 10 kt), so the new analysis starts this system at 00Z on the 17<sup>th</sup> (6 hours later than HURDAT) at 19.0N, 63.2W (less than 1 degree northeast of the HURDAT position at that time) with an intensity of 35 kt (down from 50 kt originally). At 12Z on the 17<sup>th</sup>, a center fix and a complete circulation were reported by an aircraft at 20.0N, 66.2W, about half of a degree northeast of the HURDAT position. The maximum estimated surface winds and minimum surface pressure encountered by the aircraft were 30 kt and 1002 mb respectively; however, the 1002 mb observation was a peripheral observation with 15 kt winds, believed to be in the RMW. Using the 10 kt equivalent to 1 mb inside the RMW rule, 1000 mb central pressure is added into HURDAT at 12Z. A central pressure of 1000 mb equals 47 kt according to the Brown et al. southern pressure-wind relationship, and 45 kt is chosen for 12Z on the 17<sup>th</sup> (down from 65 kt originally). The intensity changes introduced on the 17<sup>th</sup> were major downward adjustments. A 60 kt intensity is chosen for 00Z on the 18<sup>th</sup> due to a ship observation of 50 kt with a few other 45 kt observations and peripheral pressures below 1000 mb. On the 18<sup>th</sup>, the cyclone turned towards the north after 12Z. From 12Z on the 18<sup>th</sup> to 12Z on the 21<sup>st</sup>, most of the new positions are very close to the HURDAT position and all changes are less than one degree adjustments. At 1310Z of the 18<sup>th</sup>, there was an aircraft center fix at 22.6N, 70.2W, with estimated maximum surface winds of 85 kt and a central pressure of 990 mb. According to the Brown et al. southern pressure-wind relationship, 990 mb equals 64 kt, and 70 kt is chosen for HURDAT at 12Z (down from 80 kt originally). A central pressure of 990 mb is added into HURDAT for 12Z. This cyclone is analyzed to have reached hurricane intensity by 06Z of the 18<sup>th</sup> (18 hours later than originally). Another center fix at 1925Z of the 18<sup>th</sup> was reported by aircraft at 23.8N, 70.4 with a central pressure of 981 mb and estimated surface winds of 100 kt. According to the Brown et al. southern pressure-wind relationship, a central pressure of 981 mb equals 76 kt, and 80 kt is chosen for HURDAT (down from 85 kt originally), keeping in mind that aircraft surface wind visual estimates were usually accurate to within 15 to 20 kt. A central pressure of 981 mb is added into HURDAT for 18Z on the 18<sup>th</sup>. The next center fix (by aircraft radar) came at 0520Z of the 19<sup>th</sup> at 25.7N, 69.9W, but no aircraft intensity estimates were available at night. More center fixes at 0745Z and 0830Z confirm that the 06Z HURDAT position need only minor adjustments. There were four center fixes between 12Z and 18Z on the 19<sup>th</sup>, with max wind estimates ranging from 90 kt to 125 kt, but no central pressures. At 17Z, a ship reported winds of at least 50 kt along with a pressure of 970 mb. The hurricane is analyzed to have reached its peak intensity of 105 kt at 18Z on the 19<sup>th</sup> and is analyzed to have maintained this intensity through 18Z on the 20<sup>th</sup>. HURDAT previously had 105 kt from 06Z to 18Z on the 20<sup>th</sup>. The hurricane passed west of Bermuda, making its closest approach around 14Z on the 20<sup>th</sup>. Tucker (1995) claims that the center passed 40 miles from Bermuda at closest approach, but minor track adjustments indicate that the center passed about 60 nautical miles from Bermuda at closest approach. The highest available observed wind speed at Bermuda was 120 mph (104 kt) at 16Z, and the lowest available observed pressure at Bermuda was 989 mb at 1330Z. An aircraft reported a central pressure of 961 mb at 2038Z of the 20<sup>th</sup>. According to the Brown et al. pressure-wind relationship for 25-35N, 961 mb equals 94 kt, and it equals 89 kt for north of 35N from the Landsea et al. pressure-wind relationship. The center fix occurred at 34.3N, 65.1W,

and 120 kt max winds were estimated. Since the 104 kt at Bermuda occurred at 16Z, and this aircraft center fix occurred at 2038Z, 105 kt is chosen for 18Z and 95 kt is chosen for 00Z on the 21<sup>st</sup> (both unchanged). The 961 mb central pressure is added into HURDAT for 18Z on the 20<sup>th</sup>. The hurricane gradually turned towards the east-northeast after 12Z on the 21<sup>st</sup>. The position at 12Z on the 21<sup>st</sup> is unchanged. For intensity, later on the 21<sup>st</sup>, around 22Z, two separate ships reported 85 kt winds roughly 125-175 nm east of the center, so 85 kt is chosen for the intensity at 12Z and 18Z (up from 65 and 60 kt respectively), and 80 kt is chosen for 00Z on the 22<sup>nd</sup> (up from 55 kt originally). The intensity changes between 12Z on the 21<sup>st</sup> until 00Z on the 22<sup>nd</sup> are major upward adjustments. At 00Z on the 22<sup>nd</sup> the position is altered about a degree and a half to the east-southeast of the previous HURDAT position. HURDAT originally had this hurricane becoming extratropical at 18Z of the 21<sup>st</sup>, but available observations indicate that it did not become extratropical until 06Z on the 22<sup>nd</sup>. A 65 kt intensity is analyzed for 06Z on the 22<sup>nd</sup> (up from 50 kt originally). Shortly after that time it was absorbed by a large, powerful extratropical low. This low produced pressures as low as 944 mb later that day but much farther to the north and east. It should be noted that in an advisory by the Washington, D.C. Weather Bureau office, issued on the 22<sup>nd</sup> at 16Z, not only did it say that hurricane force winds were still being experienced, but their wording also implies that the system was still a hurricane at that time (see above quote in October 22 paragraph). This was considered, but not included into HURDAT, as it appears that the original cyclone was indeed absorbed by this separate, large extratropical cyclone.

#### 1947 additional notes

1)

A weak low formed between the southeastern US and Bermuda from the remains of a front on 7 June. It moved northeastward until it was absorbed by the next frontal system between 00Z and 12Z on the 10<sup>th</sup>. There were no observed gales or low pressures with this system until the time it was merging on the 10<sup>th</sup>. From the 7<sup>th</sup> to the 9<sup>th</sup>, there were uniform temperatures around the low. It is possible that the low was a tropical depression, but it was likely a broad area of weak low pressure instead. It should be noted that this suspect is in Jack Beven's list highlighted in yellow- the 2<sup>nd</sup> mostly likely color to be added into HURDAT. However, the additional data obtained does not warrant inclusion into HURDAT.

DAY	LAT	LON	STATUS
Jun 7	29.5N	72.5W	Broad low
Jun 8	33.0N	69.0W	Low
Jun 9	35.0N	65.0W	Low
Jun 10			Absorbed

2)

A low moved westward into Belize from the Caribbean Sea around 12-13 June. There were no observed gales with this system, but of note are 2 obs of 1003 mb and 1005 mb respectively at 12Z the 13<sup>th</sup> near the southern Bay of Campeche coast of Mexico. By the 14<sup>th</sup>, the low seems to disappear or perhaps gets dragged quickly northward with a front.

DAY	LAT	LON	STATUS
Jun 12			Open wave 16N 89W to 22N 82W
Jun 13	18.5N	91.0W	Tropical depression
Jun 14			Dissipated

3)

An area of low pressure formed at the tail end of a front just off the SE coast of the US late on 31 August or early on 1 September. On 1 September, this may have been a tropical depression, and temperatures were warm all the way around the low. There were no observed gales or low pressures with this system. By 12Z on 2 September, this low had moved north and merged with a larger frontal system.

DAY	LAT	LON	STATUS
Sep 1	32.0N	75.5W	Tropical depression
Sep 2			Absorbed

4)

HWM and microfilm indicate that a low broke off of an exiting front sometime around 9 September and stayed near the SC-NC coast until 14 September. On the 10<sup>th</sup> and 11<sup>th</sup>, the low may have been closed, but this was not likely a tropical depression. The low opened up back into a trough on the 12<sup>th</sup>, lingering around the same location. There were no observed gales or low pressures with this system.

DAY	LAT	LON	STATUS
Sep 8			Open trough 37N, 70W to 35N, 75W to 33N, 77W
Sep 9			Open trough 36N, 73W to 33N, 76.5W to 31.5N, 79W
Sep 10	33.0N	78.5W	Low
Sep 11	33.0N,	80.5W	Low
Sep 12			Open trough 35N, 75W to 31N, 81W
Sep 13			Open trough 34N, 77W to 30N, 80W
Sep 14			Open trough 35N, 74W to 31N, 78W

5)

HWM indicates that a disturbance emerged off of Africa on the 15<sup>th</sup> and then was lost for several days as it likely traveled west-northwestward through the Atlantic until the 22<sup>nd</sup>,

reaching a point near 24.0N, 53.5W. At this point, the movement became slow and erratic as it meandered staying over the central Atlantic through the end of the month. There were no observed gales or low pressures associated with this system, but it may have been a tropical depression. It should be noted that there is a possibility that the low seen on the 23<sup>rd</sup>, which is more clearly evident on the 25<sup>th</sup> and 27<sup>th</sup>, may not have originated from Africa on the 15<sup>th</sup>. It may have originated from the remnants of a frontal boundary on the 22<sup>nd</sup> and 23<sup>rd</sup>.

DAY	LAT	LON	STATUS
Sep 15	13.0N	22.0W	Tropical depression
Sep 16	14.0N	27.0W	Tropical depression
Sep 17	15.0N	32.0W	Tropical depression
Sep 18	16.0N	37.0W	Tropical depression
Sep 19	18.0N	41.0W	Tropical depression
Sep 20	20.0N	45.0W	Tropical depression
Sep 21	22.0N	49.0W	Tropical depression
Sep 22	24.0N	53.5W	Tropical depression
Sep 23	24.5N	52.0W	Tropical depression
Sep 24	26.0N	50.0W	Tropical depression
Sep 25	27.5N	47.5W	Tropical depression
Sep 26	27.0N	49.5W	Tropical depression
Sep 27	26.5N	52.0W	Tropical depression
Sep 28	29.5N,	52.5W	Tropical depression
Sep 29	31.0N	48.0W	Tropical depression
Sep 30	32.5N	43.0W	Extratropical low
Oct 01			Merged with front

6)

On 21 September, a low developed along a front in the central north Atlantic. It moved off to the northeast by the 22<sup>nd</sup> with increasing baroclinicity. Early on the 21<sup>st</sup>, in the first few hours after the low became closed, the temperature gradient across the low may not have been very large. But by 12Z on the 21<sup>st</sup>, the temperature gradient across the low along with the wind structure near the low indicate that the low was likely extratropical by this time. The only observed gale associated with this system was at 18Z on the 22<sup>nd</sup>, and the low was clearly extratropical. On the 21<sup>st</sup>, there were no observed gales or low pressures, so this system is not added to HURDAT. By the 23<sup>rd</sup>, the low was gone and a ridge of high pressure dominated in the region.

DAY	LAT	LON	STATUS
Sep 21	35.5N	49.5W	Extratropical low
Sep 22	40.0N	46.0W	Extratropical storm
Sep 23			Dissipated

7)

A low formed in the northeastern Atlantic between the Iberian Peninsula and the Azores Islands on 3 October. At first, the low was associated with a weak front, and the low was large and elongated on the 3<sup>rd</sup>. Then the front dissipated, the temperature gradient became more uniform (although temperature were in the 60s), and by the 4<sup>th</sup>, the low had shrunk down in size. It appears as if this was an occluded low, but it could have been a depression. A 40 kt gale in HWM on the 5<sup>th</sup> appears to be dubious since the highest wind speed in COADS on that day is only 20 kt. On the 6<sup>th</sup>, the low moved further east towards the Iberian Peninsula, but weakened and dissipated as it did so.

DAY	LAT	LON	STATUS
Oct 3	40.0N	19.0W	Frontal low
Oct 4	40.0N	18.0W	Occluded low
Oct 5	40.0N	14.5W	Occluded low
Oct 6	37.5N	12.5W	Occluded low
Oct 7			Dissipated

8)

A small area of low pressure developed on 12 October in the vicinity of 28N, 60W. It probably separated from the tail end of an occluded front. The low grew in size, and was not definitely closed until the 14<sup>th</sup>. On the 14<sup>th</sup>, there was not a temperature gradient across the low, but it was large and weak, likely an occluded low. There were no low pressures associated with this system until 12Z on the 15<sup>th</sup> and no observed gales until 18Z on the 15<sup>th</sup>. By 12Z on the 15<sup>th</sup>, the low had moved to near 43N, 42W with a large frontal system approaching from the west. Although there are no observations north or west of the center within a couple hundred miles of the low at this time, other surrounding temperature observations along with the wind structure indicate that this low was extratropical by 12Z on the 15<sup>th</sup>. Therefore, this system is not added to HURDAT. On the 16<sup>th</sup>, it merged with a frontal system.

DAY	LAT	LON	STATUS
Oct 12	Open with lowest pressure near 27.5N 60.0W		
Oct 13	Open trough 37N 50W to 28N, 59W		
Oct 14	29.0N	49.5W	Occluded low
Oct 15	43.0N	42.0W	Extratropical storm
Oct 16			Merged with frontal system

9)

A low developed either from a trough or a decaying front on the 25<sup>th</sup> near 24.5N, 57.0W. Although there are not enough observations to definitely close the low on the 25<sup>th</sup>, a south wind at 06Z (probably east of the center) changed within six hours to a westerly

wind at 12Z (probably south of the center), so the system may have been a tropical depression on this day. Another front approached, and by the 26<sup>th</sup>, the low was extratropical. There was one observed gale associated with this system of 35 kt at 12Z on the 26<sup>th</sup>. There was also one low pressure of 1005 mb at 18Z of the 26<sup>th</sup>, both after the low was extratropical. By the 27<sup>th</sup>, the front had completely absorbed the low and the observed wind structure was frontal in nature.

DAY	LAT	LON	STATUS
Oct 24	Open trough 33N, 56W to beyond 17N, 68W		
Oct 25	24.5N	57.0W	Tropical depression
Oct 26	29.0N	49.0W	Extratropical storm
Oct 27			Absorbed by front

10)

On 25 October, an area of low pressure developed along a NE-SW trough in the Caribbean Sea. On the 27<sup>th</sup>, a front approached from the west and carried the low towards the northeast. Although the temperature gradient across the low was not significant at any portion of its lifetime, the low never attained the wind structure of a tropical cyclone. The wind structure showed a weak and elongated system for its duration, and this system is not analyzed to definitely be a closed low at any point in its lifetime. The first observed low pressure occurred at 00Z on the 31<sup>st</sup>, and the only gale observed with this system came at 18Z of the 31<sup>st</sup>. By early on November 1<sup>st</sup>, winds become extremely light near the area of the low, and there was clearly no TC on this day. The system became even less impressive by 12Z on the 1<sup>st</sup>, and was clearly a remnant trough by then.

DAY	LAT	LON	STATUS
Oct 25	14.0N	71.0W	(not closed) Open trough 22N, 60W to 10N, 77W
Oct 26	15.5N	69.0W	(not closed) Open trough 22N, 58W to 13N, 73W
Oct 27	19.0N	67.5W	(not closed)
Oct 28	19.0N	60.5W	(not closed)
Oct 29	23.0N	53.0W	(not closed)
Oct 30	27.5N	49.0W	elongated low
Oct 31	32.5N	42.0W	elongated low
Nov 1	Open trough 40N, 26W to 33N, 35W		

11)

A weak low, possibly a tropical depression, was first noted near the Lesser Antilles on 28 November. It moved westward, then turned northwestward, passing near the eastern tip of the Dominican Republic. Early on 1 December, it was absorbed by a front in the vicinity of 23N, 69W. There were no observed gales or low pressures with this system.

DAY	LAT	LON	STATUS
Nov 28	15.0N	61.0W	Tropical depression
Nov 29	16.5N	67.0W	Tropical depression
Nov 30	21.0N	69.0W	Tropical depression
Dec 01			Absorbed

12)

MWR, Key West OMR, Florida November Climatological Data, HWM, COADS, Jack Beven's packet of suspects, and Lixion Avila's book containing advisories issued from various Weather Bureau offices indicate that a strong disturbance along a quasi-stationary front moved generally from west to east, or WSW to ENE across the Florida Keys on 28 November. Jack Beven had this suspect highlighted in orange. Orange is for "systems that are not likely to be added (to HURDAT) but need more work to be sure." Winds weakened somewhat over the Keys on the 29<sup>th</sup>, but were still brisk that day. On 29<sup>th</sup>, gales were reported in the western Bahamas according to observations mentioned in advisories issued by the Miami Weather Bureau Office.

At Key West, the minimum pressure and maximum temperature were recorded at 1735Z (1007 mb and 79 degrees respectively). Before that time, there were gales from the E at Key West. By 1801Z, 26 minutes after the minimum pressure at Key West, their maximum wind of 50 kt from the NW occurred. By 1815Z, the temperature at Key West had dropped to 67 degrees. Because the temperature dropped from 79 to 67 degrees in 40 minutes, and because this temperature drop was marked by a wind shift from E to NW, this system is not considered a tropical cyclone and is not added into HURDAT. Further evidence for the extratropical nature of this system is that temperatures at 12Z on the 29<sup>th</sup> in central and northern Florida were in the 40s (Tampa 47, Jacksonville 43).

There were still some more notable highlights with this system. At 18Z, Boca Chica recorded 56 kt NE, 1008 mb, and 79 degrees. Boca Chica's minimum pressure (1008 mb) occurred at 1810Z, 35 minutes after Key West's minimum pressure, and Boca Chica recorded a temperature of 79 degrees at 18Z. It seems as if the front passed Key West at 1735Z and passed Boca Chica at 1810Z. At Key West, after the front passed, the winds increased and the temperature decreased, and this likely occurred at Boca Chica as well. The strongest wind recorded was 65 to 70 kt from the N at Sombrero Key Lighthouse (24.6N, 81.1W), which is an elevated observation, sometime after 21Z. Earlier, at 21Z, the "center" was reported to be over Sombrero Key. Miami reported 35 kt gales from the NE around 2030Z on the 28<sup>th</sup> and again around 06Z on the 29<sup>th</sup>. From the Florida November 1947 climatological data... "On the 28<sup>th</sup>, a small belated tropical storm struck Key West doing damage estimated at \$25,000. The maximum wind for a 5-minute period was 54 (mph) NW, extreme (1-min) 58 (mph). Sombrero Light, 65 miles ENE has winds 75 to 80 mph" (Florida climatological data).

DAY	LAT	LON	STATUS
Nov 28	24.5N	83.0W	Extratropical

Nov 29      24.5N 78.0W      Extratropical  
 Nov 30      Front 30N 65W to 22N, 78W

13)

A low developed in the eastern Atlantic on 16 December. It occluded, became very large in size, and eventually was absorbed and swept away by a front late on 21 December. There were both gales and low pressures observed with this large low, but the gales were only on the side of the low with the largest pressure gradient. Temperatures throughout much of the lifetime of this low were in the upper 60s on the NW side to the lower 70s on the SE side. This low was not a tropical cyclone due to the very large, broad nature of the low throughout its lifetime.

DAY	LAT	LON	STATUS
Dec 16	20.0N	32.0W	Weak low
Dec 17	30.0N	32.0W	Occluded low
Dec 18	33.0N	33.5W	Occluded low
Dec 19	29.0N	35.5W	Occluded low
Dec 20	30.0N	35.0W	Occluded low
Dec 21	32.5N	34.5W	Occluded low
Dec 22			Absorbed

14)

HWM and MWR September tracks of centers of cyclones indicate that a low developed along a frontal system on 29 September in the western Atlantic west of Bermuda. There were four observed gales on the 29<sup>th</sup>, all between 31.3-32.0N, 71.1-76.5W from COADS. But the low was not closed by 12Z on the 29<sup>th</sup>. By the 30<sup>th</sup>, the low was closed, and there was not much of a temperature gradient across the low. Furthermore, there was one gale of 35 kt and one low pressure of 1003 mb on the 30<sup>th</sup> associated with this system, both from HWM. The only thing holding this back from being added into HURDAT is the large size of the low and the elongated wind structure, not typically associated with a tropical cyclone. Also, the gale is located in an area of a strong environmental pressure gradient on the NW side of the low. By 1 October, the low is certainly extratropical, as the temperature gradient across the low is large. The extratropical low continued moving rapidly northeastward, and it combined with another extratropical low late on the 3<sup>rd</sup> between Greenland and Iceland.

Of all the suspects for 1947 that were not added to HURDAT, this was the one that was closest to being added in. This was a difficult call, and it may have been a tropical storm on the 30<sup>th</sup> with the very small temperature gradient, gales, and low pressures. Ultimately, the size and wind structure led to the decision not to add it into HURDAT. However, this suspect should be revisited closely by the Best Track Change Committee.

DAY	LAT	LON	STATUS
Sep 29	Open trough/front 32N, 67W to 31N, 71W to 25N, 80W		
Sep 30	31.5N	67.5W	Extratropical
Oct 01	45.0N	59.5W	Extratropical
Oct 02	54.5N	49.0W	Extratropical
Oct 03	62.5N	32.5W	Extratropical
Oct 04			Absorbed

## 1948

## 1948 Storm 1

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33780 05/22/1948 M= 7 1 SNBR= 750 NOT NAMED XING=0
33780 05/22/1948 M= 8 1 SNBR= 750 NOT NAMED XING=0
*
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33785	05/22*	0	0	0	0*160	750	35	0*182	731	35	0*194	722	35	0*
33785	05/22*	0	0	0	0*171	732	30	0*182	731	30	0*193	730	30	0*
					***	***	**		**		***	***	**	
33790	05/23*205	715	35		0*214	709	35	0*224	703	35	0*235	697	35	0*
33790	05/23*204	729	30		0*214	727	30	0*224	723	30	0*234	716	30	0*
		***	***	**		***	**		***	**		***	***	**
33795	05/24*246	692	35		0*259	687	40	0*269	684	40	0*276	682	40	0*
33795	05/24*244	706	35		0*254	696	30	0*263	690	35	0*272	688	35	0*
		***	***		***	***	**	***	***	**	***	***	**	
33800	05/25*283	681	45		0*290	680	45	0*297	680	45	0*301	680	45	0*
33800	05/25*281	687	40		0*289	689	40	0*294	690	45	0*297	690	45	0*
		***	***	**	***	***	**	***	***		***	***		
33805	05/26*303	680	45		0*307	680	45	0*310	680	45	0*313	680	40	0*
33805	05/26*297	689	45		0*295	688	45	0*295	686	45	0*297	684	40	0*
		***	***		***	***		***	***		***	***		
33810	05/27*315	680	40		0*318	680	40	0*320	680	40	0*328	680	40	0*
33810	05/27*301	682	40		0*306	681	40	0*313	680	40	0*320	682	40	0*
		***	***		***	***		***			***	***		
33815	05/28*337	680	35		0*343	680	30	0*350	680	30	0*379	680	25	0*
33815	05/28*328	685	35		0*337	688	35	0*346	690	35	0*354	690	35	0*
		***	***		***	***	**	***	***	**	***	***	**	

(The 29<sup>th</sup> is new to HURDAT)

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33817 05/29*361 690 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
33820 TS
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Major track changes and minor intensity changes are analyzed for this tropical storm which occurred in the month of May. A major change is also made to the time that this system became a tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database and Monthly Weather Review.

## May 21:

HWM analyzes a closed low of at most 1007.5 mb near 11.3N, 75.4W, with a trough or wave axis extending northward from the low to near 21N, 73W. HURDAT does not list a system on this day. No gales or low pressures.

## May 22:

HWM analyzes a closed low of at most 1007.5 mb near 16.2N, 80.8W with a trough or wave axis extending north-northeastward from the low to near 25N, 77W. HURDAT lists this as a 35 kt tropical storm at 18.2N, 73.1W. The MWR post-season track map shows a 12Z position near 18.3N, 73.6W. No gales or low pressures. "Originating in a widespread low-pressure area southwest of Hispaniola, this storm began a northeastward movement and by 7 am on May 22 was centered over southwestern Haiti accompanied by widespread heavy rains. These rains caused floods throughout much of Hispaniola.

Press reports from the Dominican Republic indicate that 80 persons were drowned in floods associated with this disturbance.” (MWR).

May 23:

HWM analyzes a closed low of at most 1007.5 mb near 22.2N, 73.2W. HURDAT lists this as a 35 kt tropical storm at 22.4N, 70.3W. The MWR tracks of centers of cyclones shows a 12Z position near 21.2N, 75.7W with a 1006 mb pressure. The MWR post-season track map shows a position just west of the HURDAT position near 22.4N, 70.6W. No gales or low pressures.

May 24:

HWM analyzes a tropical storm of at most 1000 mb near 26.8N, 69.2W. HURDAT lists this as a 40 kt tropical storm at 26.9N, 68.4W. The MWR tracks of centers of cyclones shows a 00Z position near 22.9N, 73.0W, and a 12Z position near 24.8N, 70.8W with a 1008 mb pressure. The MWR post-season track map shows a 00Z position near 24.6N, 69.7W, and a 12Z position near 26.9N, 68.9W. No gales or low pressures.

May 25:

HWM analyzes a tropical storm of at most 1000 mb near 29.7N, 69.3W. HURDAT lists this as a 45 kt tropical storm at 29.7N, 68.0W. The MWR tracks of centers of cyclones shows a 00Z position near 26.3N, 69.6W, and a 12Z position near 27.5N, 69.0W with a 997 mb pressure. The MWR post-season track map shows a 00Z position near 28.2N, 69.0W, and a 12Z position near 29.5N, 68.7W. Ship highlights: 30 kt N and 1004 mb at 12Z 30.4N, 72.0W (COA); 30 kt WSW and 1004 mb at 12Z at 28.0N, 69.3W (COA); 25 kt N and 1005 mb at 18Z at 30.7N, 71.5W (COA). Aircraft highlights: 45 kt (MWR). “The storm moved north-northeastward and by May 25 was centered near latitude 30N, longitude 69W where it remained practically stationary for two days. The highest winds reported were about 50 mph observed from a reconnaissance plane which was flown through the storm on the 25<sup>th</sup>” (MWR).

May 26:

HWM analyzes a low of at most 1005 mb near 29.8N, 68.1W. HURDAT lists this as a 45 kt tropical storm at 31.0N, 68.0W. The MWR tracks of centers of cyclones shows a 12Z position near 29.1N, 68.4W. The MWR post-season track map shows a 00Z position near 30.3N, 68.7W, and a 12Z position near 31.0N, 68.8W. No gales or low pressures.

May 27:

HWM analyzes a low of at most 1005 mb near 30.6N, 68.7W. HURDAT lists this as a 40 kt tropical storm at 32.0N, 68.0W. The MWR tracks of centers of cyclones shows a 12Z position near 30.8N, 69.0W. The MWR post-season track map shows a 00Z position near 31.8N, 68.8W, and a 12Z position near 32.3N, 68.8W. No gales or low pressures. “During the afternoon of the 27<sup>th</sup> it began moving northward more rapidly and became an extra-tropical storm” (MWR).

May 28:

HWM analyzes a low of at most 1010 mb near 34.5N, 69.5W. HURDAT lists this as a 30 kt tropical depression at 35.0N, 68.0W. The MWR tracks of centers of cyclones shows a 00Z position near 32.2N, 69.0W, and a 12Z position near 33.9N, 69.3W. The MWR post-season track map shows a 00Z position near 33.7N, 68.9W, and a 12Z position near 35.3N, 68.8W. No gales or low pressures.

May 29:

HWM analyzes a low of at most 1010 mb near 38.3N, 67.4W. HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 00Z position near 35.7N, 69.3W, and a 12Z position near 37.3N, 68.9W with a 1010 mb pressure. No gales or low pressures.

An early-season tropical cyclone formed on 22 May in the north-central Caribbean Sea. It formed in association with an easterly wave. The wave continued moving off towards the west, but the vortex of the newly formed tropical cyclone moved towards the north or north-northeast across western Haiti and into the Atlantic Ocean. No changes were made to the timing of genesis. However, this system was started as a depression and is not analyzed to have reached tropical storm strength until 24 May (two days later than originally), when it was located in the vicinity of 26N, 69W. The position was altered two degrees to the west on the 23<sup>rd</sup> – a major change - when it is was in the vicinity of the Turks and Caicos Islands moving north-northeastward. By the 24<sup>th</sup>, the structure had improved enough to assign a 35 kt intensity (revised downward from 40 kt originally). There were no gales observed for the duration of this cyclone's lifetime, but on the 25<sup>th</sup>, there were low pressures observed simultaneously with 30 kt winds. Furthermore, the structure of the system indicated that it was a tropical cyclone. 1004 mb was observed by a ship at 12Z on the 25<sup>th</sup> with 30 kt of wind. The 1004 mb peripheral pressure implies a maximum sustained wind of at least 36 kt using the Brown et al. north of 25N pressure-wind relationship. HURDAT's intensity of 45 kt is retained at 12Z on the 25<sup>th</sup>. On the 25<sup>th</sup>, HURDAT's previous position was adjusted about a degree to the west-southwest. It was located near 29.4N, 69.0W at 12Z on the 25<sup>th</sup>. The storm was still moving generally towards the north, but its forward motion slowed to a crawl from the 25<sup>th</sup> through the 27<sup>th</sup>. HURDAT's intensity of 45 kt, 45 kt, and 40 kt is retained at 12Z each day from the 25<sup>th</sup> through the 27<sup>th</sup>. Later on the 27<sup>th</sup> and into the 28<sup>th</sup>, the reanalyzed track is over a degree west-southwest of the previous track. On the 28<sup>th</sup>, the cyclone was passing well to the east of the US mid-Atlantic coastline. HURDAT originally showed the storm weakening to a depression at 06Z on 28 May, but tropical storm strength is retained for 18 more hours. HURDAT's final position is at 18Z on the 28<sup>th</sup> at 37.9N, 68.0W as a 25 kt tropical depression. The analysis indicates that it was still a depression on the 29<sup>th</sup> at 00Z, and it is analyzed with a 30 kt intensity for that time. The analyzed position at 00Z on the 29<sup>th</sup> (the final position) is at 36.1N, 69.0W. This dictated a large change in position at 18Z on the 28<sup>th</sup> to the south-southwest of the original HURDAT position. After early on the 29<sup>th</sup>, the low was no longer closed as it degenerated into an open trough which moved towards the north until it was picked up by an extratropical system.

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33825 07/07/1948 M= 5 2 SNBR= 751 NOT NAMED XING=1
33830 07/07* 0 0 0 0* 0 0 0 0* 0 0 0 0*263 906 35 0*
33830 07/07* 0 0 0 0* 0 0 0 0* 0 0 0 0*275 894 30 0*
*** **
33835 07/08*272 900 35 0*276 896 35 0*280 892 35 0*287 881 35 0*
33835 07/08*276 894 30 0*277 894 30 0*280 892 30 0*285 888 30 0*
*** **
33840 07/09*296 869 35 0*302 862 35 0*308 859 35 0*313 858 30 0*
33840 07/09*292 882 35 0*302 874 35 0*308 869 35 0*313 866 30 0*
*** **
33845 07/10*317 858 30 0*322 858 30 0*327 859 25 0*333 860 25 0*
33845 07/10*318 866 30 0*323 865 30 0*327 863 25 0*333 863 25 0*
*** **
33850 07/11*340 861 20 0*346 863 20 0*352 866 15 0*355 868 15 0*
33850 07/11*340 865 20 0*346 866 20 0*352 866 15 0*358 866 15 0*
*** **
33855 TS

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#### U.S. Landfall:

07/09/1948 – 07Z – 30.3N, 87.3W – 35 kt

Minor changes to both track and intensity are analyzed for this minimal tropical storm that struck Florida's panhandle between Pensacola and Florida's border with Alabama. A major change was made to the time that the cyclone attained tropical storm strength. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, and NHC microfilm of synoptic weather maps.

#### July 7:

HWM does not analyze any features of interest. HURDAT first lists this at 18Z as a 35 kt tropical storm at 26.3N, 90.6W. The MWR tracks of centers of cyclones shows a 12Z position near 27.3N, 87.9W. Microfilm shows a 12Z position near 28.0N, 89.6W. No gales or low pressures. "This disturbance formed in an area of unsettled weather in the northern Gulf of Mexico during the afternoon of July 7" (MWR).

#### July 8:

HWM does not analyze a closed low, but analyzes a weak SW-NE trough from the west-central Gulf of Mexico to the SE US, and HWM analyzes a W-E cold front over the SE US. HURDAT lists a 35 kt tropical storm at 28.0N, 89.2W. The MWR tracks of centers of cyclones shows a 12Z position near 29.1N, 88.0W. The MWR post-season track map shows a 00Z position near 27.5N, 90.4W, and a 12Z position near 28.5N, 89.2W. Microfilm shows a SW-NE trough extending from the west-central Gulf of Mexico to the SE US, with a frontal feature extending from NW of the trough, southeastward through the SE US, and then eastward to the GA/SC coast. No gales or low pressures.

#### July 9:

HWM analyzes a closed low of at most 1015 mb near 31.7N, 88.2W with a cold front extending from the low eastward into the Atlantic. HURDAT lists this as a 35 kt tropical storm at 30.8N, 85.9W. The MWR tracks of centers of cyclones shows a 12Z position near 31.0N, 87.6W with a 1010 mb pressure. The MWR post-season track map shows a 00Z position near 29.7N, 87.8W, and a 12Z position near 30.9N, 86.9W. Microfilm analyzes a closed low of at most 1011 mb centered at 12Z near 30.9N, 87.1W with a W-E frontal feature extending from 100 nm east of the low eastward into to Atlantic. Land highlights: 1007 mb (min p) at 0620Z at Pensacola, FL (OMR, climo); 32 kt S (max w/1-min) ~0930Z at Apalachicola, FL (OMR, climo). "It moved northeastward and passed inland over Pensacola, Fla., during the night of July 8. A highest wind of 35 mph was observed during a thunderstorm at the Pensacola station. This disturbance caused heavy rains over extreme northern Florida, southern Alabama, and southern Georgia. Little damage has been reported" (MWR). From the Pensacola OMR... "A minor tropical disturbance that moved inland between Mobile and Pensacola on the night of July 8<sup>th</sup>-9<sup>th</sup> was attended by strong winds and heavy to excessive rains at Pensacola. Extreme (1-minute) wind velocity was 35 mph from the southeast. 7.50 inches of rain fell during the storms, establishing new July records for greatest precipitation for 5, 10, and 15 minutes and 2 hours and 24 hours at Pensacola" (Pensacola OMR). From the July, 1948 Florida Climatological Data summary... "Night of 8-9<sup>th</sup>, Pensacola, minor tropical storm moved in from the Gulf, causing winds up to 32 mph, heavy rain, and damage by water to extent of \$500" (Florida Climatological Data). "On July 9<sup>th</sup> a disturbance, which had developed off the coast, moved northward along the Alabama-Georgia line with very heavy rain in its path. Maximum 24-hour amounts averaged around 7 inches near the border from Lee County southward through Houston County. Heavy rain from this storm was, however, confined mostly to the eastern portion of the state east of the Alabama and Coosa Rivers, and there were areas in the northwest and west portions where little or none was recorded at that time" (Alabama Climatological Data).

July 10:

HWM does not analyze any features of interest on this day. HURDAT lists a 25 kt tropical depression at 32.7N, 85.9W. The MWR tracks of centers of cyclones shows a 00Z position near 32.0N, 87.1W, and a 12Z position near 33.1N, 86.7W with a 1013 mb pressure. The MWR post-season track map shows a 00Z position near 31.8N, 86.4W, and a 12Z position near 32.7N, 86.3W. Microfilm analyzes a closed low at 12Z of at most 1011 mb centered near 32.6N, 87.1W. No gales or low pressures.

July 11:

HWM analyzes a weak trough of low pressure over Tennessee with a NW-SE warm front extending through the trough from NW to SE. HURDAT lists this as a 15 kt tropical depression at 35.2N, 86.6W. The MWR tracks of centers of cyclones shows a 00Z position near 34.3N, 86.2W, and a 12Z position near 35.4N, 85.6W with a 1013 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. The microfilm analysis is similar to the HWM analysis. No gales or low pressures.

A tropical depression formed in the northern Gulf of Mexico at 18Z on 7 July (no change to timing of genesis). The starting position is analyzed to be about a degree and a half northeast of the previous HURDAT position. The depression moved slowly northeastward and became a tropical storm at 00Z on the 9<sup>th</sup> (30 hours later than originally). The tropical storm made landfall near Pensacola, FL (more than 1 degree west of where HURDAT's previous track showed landfall) around 06Z on the 9<sup>th</sup> as a 35 kt tropical storm. It weakened to a tropical depression 12 hours after moving inland (no change to HURDAT) but the analyzed track was still slightly to the left (west) of the previous track. The depression moved north through eastern Alabama and dissipated in Tennessee after 18Z on the 11<sup>th</sup> (no change to timing of dissipation). Although there were no gales or low pressure observations with this system, a 1-minute peak sustained wind of 32 kt at Apalachicola and an 1007 mb pressure at Pensacola warrant keeping this system a tropical storm in HURDAT.

### 1948 Storm 3

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33860 08/26/1948 M=10 3 SNBR= 752 NOT NAMED XING=0
33860 08/26/1948 M=11 3 SNBR= 752 NOT NAMED XING=0
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33865 08/26* 0 0 0 0*195 589 50 0*209 610 65 0*218 626 70 0*
33865 08/26*204 606 60 0*213 616 60 0*222 626 65 0*230 636 70 0*
*** ** ** *** ** ** *** ** ** *** **

33870 08/27*228 641 75 0*238 655 80 0*248 667 85 0*256 676 90 0*
33870 08/27*238 645 75 0*247 654 80 0*255 663 85 0*263 672 90 0*
*** ** ** *** ** ** *** ** ** *** **

33875 08/28*261 684 95 0*265 690 95 0*270 697 100 0*276 704 105 0*
33875 08/28*268 681 95 0*272 689 95 0*276 697 100 0*281 706 105 0*
*** ** ** *** ** ** *** ** *** *** **

33880 08/29*282 712 105 0*286 719 105 0*291 725 100 0*297 734 100 0*
33880 08/29*286 715 105 0*289 723 105 0*291 731 100 0*295 739 100 0*
*** ** ** *** ** ** *** ** *** *** **

33885 08/30*303 743 95 0*308 750 95 0*313 754 90 0*320 754 85 0*
33885 08/30*300 745 95 0*306 749 95 0*312 752 90 0*319 753 85 0*
*** ** ** *** ** ** *** ** *** *** **

33890 08/31*328 751 80 0*334 746 75 0*341 736 70 0*353 716 70 0*
33890 08/31*326 749 80 0*333 744 75 0*342 733 70 0*353 716 70 0*
*** ** ** *** ** ** *** ** *** *** **

33895 09/01E370 687 65 0E390 651 60 0E410 618 60 0E429 594 55 0*
33895 09/01*370 687 65 0E390 651 60 0E410 620 60 0E429 594 60 0*
* *** **

33900 09/02E448 578 50 0E485 553 45 0E517 528 45 0E528 514 40 0*
33900 09/02E450 574 55 0E480 560 55 0E510 540 50 0E528 520 50 0*
*** ** ** *** ** ** *** ** ** *** **

33905 09/03E538 500 40 0E549 475 40 0E560 450 35 0E570 430 35 0*
33905 09/03E538 500 50 0E549 478 50 0E560 455 50 0E570 435 50 0*
** *** ** *** **

33910 09/04E580 410 35 0E589 391 35 0E598 372 35 0E612 348 35 0*
33910 09/04E580 418 45 0E589 400 45 0E598 382 40 0E606 358 40 0*
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(The 5<sup>th</sup> is new to HURDAT.)

33912 09/05E613 325 35 0E619 280 35 0E625 230 30 0E630 170 30 0\*

33915 HR

Major track changes and minor intensity changes are analyzed for this major hurricane that recurved before it reached the east coast of the US. (It is noted that the genesis of this tropical cyclone is not explicitly included above, as it formed east of the Lesser Antilles in the data sparse tropical North Atlantic.) An additional day was added into HURDAT at the end of this system's lifetime as an extratropical cyclone before it was absorbed. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, and NHC microfilm of synoptic weather maps.

August 25:

HWM analyzes a SW-NE trough or wave-like feature extending from 12N, 64W to 23N, 51W. HURDAT does not list a system on this day. No gales or low pressures. "Existence [of 1948 storm 3] had well established by other reports [before August 26<sup>th</sup>]" (AWS).

August 26:

HWM analyzes a low inside in open trough located near 22N, 62W, with the trough axis extending southwestward from the low to beyond 16N, 71W. HURDAT lists a 65 kt hurricane at 20.9N, 61.0W. The MWR tracks of centers of cyclones shows a 12Z position near 23.0N, 62.0W. The MWR post-season track map shows a 12Z position near 20.9N, 61.3W. Microfilm analyzes a low of at most 996 mb centered near 22.0N, 62.1W, although at 06Z, microfilm analyzes a low of at most 993 mb. Ship highlights: 40 kt ESE and 1009 mb at 03Z at 21.4N, 59.7W (micro); 40 kt N and 997 mb at 0330Z at 20.7N, 61.4W (micro). Aircraft highlights: Seven gales between 35-45 kt between 1330Z and 1700Z between 21.5-24.0N, 61.3-64.0W (micro); 90 kt at 1500 feet at 1634Z 15 miles NE of center (AWS); 35\* kt E at 1915Z at 24.5N, 62.8W (micro). "This storm was first reported during the night of August 25-26 by the S.S. Virginia and the S.S. Petrakis Nomikos when they encountered winds of Beaufort force 9 and other signs of a hurricane forming near latitude 20.5N, longitude 60.5W" (MWR).

August 27:

HWM analyzes a closed low of at most 1015 mb near 25.2N, 67.7W. HURDAT lists this as an 85 kt hurricane at 24.8N, 66.7W. The MWR tracks of centers of cyclones shows a 00Z position near 24.0N, 64.2W, and a 12Z position near 25.2N, 66.7W. The MWR post-season track map shows a 00Z position near 22.5N, 64.2W, and a 12Z position near 24.7N, 67.0W. Microfilm analyzes a low of at most 1002 mb centered near 24.8N, 67.5W. Aircraft highlights: center estimate at 1325Z at 24.9N, 67.7W with 100 kt estimated max surface winds (micro); 40 kt SW at 1330Z at 24.4N, 67.1W (micro); center fix at 1852Z at 26.7N, 67.4W (AWS); 40 kt W at 1945Z at 26.2N, 67.5W (micro). "40 kt (wind) radius is 70 miles" (aircraft on 1325Z center fix at 24.9N, 67.7W- micro). "Air Force plane reported center at 1500E (2000Z) at 27.0N, 67.7W on course of north northwest 18 knots. Airplane reported center at 1445E (1945Z) at 26.5N, 67.7W. These

obs corrected in post flight to read 26.8N, 67.4W at 1440E (1940Z) and 27.1N, 67.9W at 1640E (2140Z)” (micro).

August 28:

HWM analyzes a tropical storm of at most 1010 mb near 28.1N, 69.8W. HURDAT lists this as a 100 kt hurricane at 27.0N, 69.7W. The MWR tracks of centers of cyclones shows a 00Z position near 26.6N, 68.5W, and a 12Z position near 27.8N, 69.9W. The MWR post-season track map shows a 00Z position near 25.7N, 68.5W, and a 12Z position near 26.9N, 70.2W. Microfilm analyzes a tropical cyclone of at most 999 mb centered near 28.2N, 70.4W. Aircraft highlights: radar center fix at 1410Z at 28.0N, 70.0W with 110 kt estimated maximum sustained winds (micro); center fix at 1634Z at 28.3N, 70.7W with estimated maximum sustained winds of 100 kt (micro, AWS); center fix at 27.8N, 71.1W (AWS). Eight other gales, two of which are hurricane force. “A highest wind of 120 mph was estimated from reconnaissance aircraft which reconnoitered the storm on August 28 and 29” (MWR). The AWS tech report stated that the lowest observed pressure for this storm by aircraft was 985 mb. It is unknown what day that occurred and it is unknown whether it was a central pressure of a peripheral pressure. “Storm center 0647Z 27.3N, 69.0W- navy radar. Storm center 0804Z 27.6N, 69.4W- navy radar” (micro). “Intense area of storm has radius of 50 miles. Plane swept through edge of eye after center located by radar showing a diffused eye eight miles in diameter centered 28N, 70W at 1410Z. Max winds (encountered) 260 degrees 110 knots” (micro). “Duck report. Air Force plane reports center 28.3N, 70.7W at 1134E (1634Z). Winds near center estimated 100 knots” (micro). “Post flight summary...Hurricane center located at 28.3N, 70.7W at 1634Z. Estimated wind near center in excess of 100 knots; wind within 70 mile radius 60 knots. Moderate to light intermittent turbulence with light to moderate continuous rain and showers near center. Continuous instrument flight near center in the base of clouds 400 feet; tops unknown” (micro). “Post flight summary...In area of NW quadrants experienced wind of over 100 knots with heavy rain at 28.2N, 71.5W. Experienced this condition 13 minutes...intense area of storm has radius 50 miles. Estimated movement in WNW direction. Dead reckoning positions confirmed by loran in southeast and northwest quadrants” (micro).

August 29:

HWM analyzes a tropical storm of at most 1005 mb near 29.5N, 72.3W. HURDAT lists this as a 100 kt hurricane at 29.1N, 72.5W. The MWR tracks of centers of cyclones shows a 00Z position near 28.8N, 71.2W, and a 12Z position near the HWM position. The MWR post-season track map shows a position near the HURDAT position. Microfilm analyzes a tropical cyclone of at most 990 mb centered near 28.8N, 72.9W. Ship highlights: 35 kt WSW and 1012 mb at 1230Z at 27.8N, 71.7W (micro). Aircraft highlights: (992 mb peripheral surface pressure) with strong west wind at 13Z at 28.4N, 72.7W (micro); 85 kt (possibly flight-level wind) W at 28.6N, 73.1W (micro); center fix at 2230Z at 29.3N, 73.3W (AWS). At least 18 other reported aircraft gales. “Here is message we received from plane: 1300Z position 28.5N, 72.6W. Estimated eye position from dead reckoning. Radar fix 28.7N, 72.5W at 13Z when 10 miles from eye. Wind 270 degrees 85 knots plus; pressure 992(?) mbs” (micro). “Post flight summary storm center located at 29.8N, 74.3W at 2130Z. All fixes used in computing location of center

were checked by loran” (micro). Interesting discussion from Aug. 29 20Z microfilm... “We have been digesting, assimilating, and perhaps disgorging the replotted inflights from our plane this morning. The following points will be of interest to you: 1. The observer, Barron, is experienced at the business. 2. The reports along the top of the storm, all reporting 1013 pressure are the good ones for position; that is, they were all based on loran fixes and should be on the button. 3. The other reports are based on dead reckoning and subject to the usual potential error, but have been checked and rechecked until the worst busts are eliminated I think. 4. I deduce from them that we could move the position of the eye up about 20 miles without distorting the reports as plotted. We would move that 85 knot along with it. 5. The longitude looks to be correct judging from the winds on both sides. 6. Does this report mean what it looks like? 7. The worst weather was encountered in the SW quadrant rather than the E and NE. Lt. Ryner reminds me that this was a characteristic of the storm last year which curved into Savannah. He made the last two hops on it. That is the gist of our deductions. Anyone got anything to throw in our grist mill as a result of this flight? -Harding” (micro).

August 30:

HWM analyzes a tropical storm of at most 1005 mb near 30.7N, 75.3W. HURDAT lists this as a 90 kt hurricane at 31.3N, 75.4W. The MWR tracks of centers of cyclones shows a 00Z position near 30.5N, 73.8W, and a 12Z position near 31.6N, 74.8W. The MWR post-season track map shows a position near the HURDAT position. Microfilm analyzes a low of at most 993 mb centered near 31.6N, 75.4W. Ship highlights: 35 kt ESE and 1010 mb at ~1230Z at 31.4N, 72.5W (micro); 40 kt WSW and 1003 mb at ~1830Z at 30.0N, 73.7W (micro). Aircraft highlights: 40 kt W (may be a flight-level wind) at 1245Z at 30.0N, 74.8W (micro); 40 kt N at (13Z?) at 30.4N, 75.5W (micro). “The hurricane moved on a west-northwesterly course to a point about 250 miles south of Cape Hatteras when the forward movement slowed and a turn to the northeast began. This trajectory was some distance east of Hatteras and no dangerous winds occurred on land. Tides, however, were high on the North Carolina coast and justified evacuations and other precautions which were taken in the area” (MWR). “Navy radar fixes: 0406Z- 30.5N, 74.5W; 0435Z- 30.6N, 74.6W; 0615Z- 30.8N, 75.0W. This latter reading corrected to read 30.8N, 75.6W about 0930Z. (Eye was slightly diffused according to report from plane)” (micro). “Loran fix at 1329Z at 31.1N, 74.6W” (micro). “Hurricane positions as reported by navy radar 2032Z position- hurricane eye 32.2N, 75.2W; 2140Z position hurricane eye 31.9N, 75.4W (position based on gadget bearings and loran; 2252Z hurricane eye position 32.3N, 75.2W based on loran (land bearings poor)” (micro).

August 31:

HWM analyzes a tropical storm of at most 1005 mb near 34.4N, 73.6W with a stationary front partially wrapped around the cyclone a couple hundred miles to the west and several hundred miles to the north of the cyclone. HURDAT lists this as a 70 kt hurricane at 34.1N, 73.6W. The MWR tracks of centers of cyclones shows a 00Z position near 33.0N, 74.9W, and a 12Z position near 34.1N, 72.7W with a 962 mb pressure. The MWR post-season track map shows a 00Z position near 32.6N, 75.5W, and a 12Z position near 34.1N, 74.0W. Microfilm analyzes a tropical storm of at most 999 mb

centered near 34.3N, 73.8W with a frontal feature located to the west and the north of the cyclone. Ship highlights: At least 50 kt ENE and 996 mb at 1830Z at 36.1N, 71.8W (micro). At least 30 other gale observations between 35-50 kt, and at least 10 other low pressure observations between 996-1005 mb. Land highlights: 1004 mb (min pressure) at 1045Z At Cape Hatteras (OMR); 20 kt N and 1005 mb at 12Z at Cape Hatteras (HWM, micro). Aircraft highlights: 45\* kt N possibly along with a 994 mb surface pressure at 1615Z at 35.2N, 73.2W (center fix at 1645Z was at 35.1N, 72.1W) (micro); 76 kt SW at 1500 ft at 1658Z at 34.2N, 70.5W (AWS); at least 50 kt (possibly 70 kt?) WSW at 17Z at 34.3N, 75.5W (micro). At least 4 other gales between 35-40 kt. "Hurricane eye 0030Z 32.6N, 74.9W from good land fix" (micro). "D-7 center 1540Z 34.8N, 72.1W; D10 center 1645Z 35.1N, 72.1W" (micro).

#### September 1:

HWM analyzes a low of at most 995 mb near 41.1N, 61.2W with a cold front extending from the low towards the SSW curving towards the WSW to beyond 33N, 75W, and a warm front extending from the low eastward to beyond 42N, 46W. HURDAT lists this as a 60 kt extratropical storm at 41.0N, 61.8W. The MWR tracks of centers of cyclones shows a 00Z position near 36.5N, 69.1W, and a 12Z position near 40.7N, 63.1W. The MWR post-season track map shows a 12Z position close to the HURDAT position. Microfilm analyzes a low of at most 981 mb centered near 40.7N, 62.3W with the NE end of a NE-SW frontal feature located about 300 nm SW of the low. Ship highlights: 45 kt NNE and 995 mb at 08Z at 40.4N, 66.7W (COA); 30 kt NNE and 992 mb at 10Z at 40.8N, 64.3W (micro). At least 23 other gales between 35-45 kt. At least seven other low pressures between 992-999 mb. Aircraft highlights: 40 kt WSW(?) and 992(?) mb at 17Z at 41.1N, 59.8W (micro); 20 kt W and 983 mb at 1830Z at 42.9N, 58.8W (micro); center fix at 1830Z at 44.8N, 58.8W with 60 kt estimated max winds (AWS). Two other gales of 35 kt and one other low pressure of 1002 mb. According to AWS, this cyclone was extratropical on 1 September.

#### September 2:

HWM analyzes an occluded low of at most 990 mb near 50.5N, 54.1W, with an occluded front extending from the low southeastward to a triple point near 48N, 50W, with a cold front extending from the triple point southward and then south-southwestward to beyond 34N, 56W, and a warm front extending from the triple point east-southeastward to beyond 45N, 38W. HURDAT lists this as a 45 kt extratropical storm at 51.7N, 52.8W. The MWR tracks of centers of cyclones shows a 00Z position near 46.0N, 57.3W, and a 12Z position near 49.9N, 55.0W with a 978 mb pressure. Ship highlights: 45 kt E and 993 mb at 12Z at 52.5N, 52.5W (COA, HWM); 35 kt SE and 986 mb at 18Z at 52.5N, 51.5W (COA). Five other gales between 35-45 kt, and six other low pressures between 989-1000 mb. Land highlights: 40 kt WSW and 996 mb at 0630Z at 46.5N, 53.2W (micro); 35 kt WNW and 994 mb at 12Z at 48.5N, 57.5W (HWM).

#### September 3:

HWM analyzes an occluded low of at most 985 mb centered near 56.0N, 45.5W with an occluded front extending from the low, wrapping around on the east side southward to beyond 50N, 33W. HURDAT lists this as a 35 kt extratropical storm at 56.0N, 45.0W.

The MWR tracks of centers of cyclones shows a 00Z position near 53.2, 51.8W, and a 12Z position near 56.1N, 47.2W. Ship highlights: 35 kt SSW and 997 mb at 00Z at 49.5N, 49.0W (COA); 30 kt NNW and 991 mb at 12Z at 54.3N, 51.5W (HWM); 45 kt SSW and 992 mb at 12Z at 53.5N, 44.5W (COA, HWM). Two other gales and one other low pressure below 1000 mb. Land highlights: 35 kt NW and 1016 mb at 12Z at 60.5N, 45.5W (HWM).

#### September 4:

HWM analyzes an occluded low of at most 995 mb near 59.8N, 37.8W with a cold front extending from the low towards the NE for a short distance, then becoming an occluded front and extending towards the east, southeast, and then south to south of 52N, 21W. HURDAT lists this as a 35 kt extratropical storm at 59.8N, 37.2W. The MWR tracks of centers of cyclones shows a 00Z position near 58.8N, 42.4W, and a 12Z position near 61.6N, 35.5W with a 998 mb pressure. Ship highlights: 30 kt SW and 993 mb at 18Z at 57.4N, 35.7W (COA); 35 kt SW and 996 mb at 18Z at 56.4N, 32.5W (COA). Ten other gales of 35 kt, and 12 other low pressures between 997-1000 mb. Land highlights: 10 kt NNE and 999 mb at 12Z at 60.8N, 46.0W (HWM).

#### September 5:

HWM analyzes an occluded low of at most 1000 mb near 62.0N, 21.5W, with an occluded front extending from the low wrapping around to southwest of 50N, 10W. HURDAT does not list a system on this day. Ship highlights: 30 kt SE and 1002 mb at 06Z at 63.5N, 15.5W (COA); 10 kt SE and 998 mb at 10Z at 63.5N, 19.5W (COA); 15 kt SSW and 998 mb at 12Z at 60.0N, 20.0W (HWM, COA); 15 kt N and 1003 mb at 12Z at 62.3N, 33.0W (HWM). Seven other low pressures between 998-999 mb. Land highlights: 15 kt ENE and 998 mb at Reykjavik, Iceland (64.1N, 21.9W).

A tropical storm was first noticed in the Atlantic Ocean a couple hundred miles north-northeast of the Leeward and Virgin Islands around 00Z on 26 August when winds as high as 40 kt and pressures as low as 997 mb were measured from two ships. HURDAT previously started this system at 06Z on the 26<sup>th</sup> at 19.5N, 58.9W with a 50 kt intensity. The new analysis starts this tropical storm six hours earlier (at 00Z) at 20.4N, 60.6W based on the two 00Z ship observations on the Aug 26 0030Z microfilm map. This tropical cyclone is an example of one of the many cases in HURDAT in which the genesis is not captured. All sources were utilized to check for observations during the several days prior to the 26<sup>th</sup>, but neither a closed low nor any gales or low pressures could be found due to a lack of data. The 997 mb peripheral pressure at 00Z on the 26<sup>th</sup> suggests winds of at least 53 kt using the Brown et al. southern pressure-wind relationship. This 997 mb was recorded simultaneously with 40 kt winds. 60 kt is chosen for the intensity at 00Z on the 26<sup>th</sup>. The HURDAT position for 06Z on the 26<sup>th</sup> is too far east, and HURDAT's initial forward speed is too fast. The 06Z position on the 26<sup>th</sup> is shifted more than 2 degrees to the west-northwest of the previous HURDAT position (a major track change). After that, all remaining track changes to this cyclone are minor. The cyclone strengthened to a hurricane at 12Z on the 26<sup>th</sup> (no change). From 12Z on the 26<sup>th</sup> until 12Z on the 1<sup>st</sup>, no intensity changes are made to HURDAT. The main reason for the lack of intensity alterations is because there were no available central



33930 09/01\*139 613 40 0\*141 623 35 0\*142 631 30 1007\*143 640 25 0\*  
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33935 TS

Major track changes but no changes to intensity are analyzed for this tropical storm that passed through the Windward Islands. (It is noted that the genesis of this tropical cyclone is not explicitly included above, as it formed east of the Windward Islands in the data sparse tropical North Atlantic.) Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Weather Bureau Advisories, and articles from The West Indian newspaper.

August 30:

HWM analyzes a closed low of at most 1015 mb near 9.5N, 51.2W. HURDAT does not list a system on this day. Ship highlights: 45 kt ESE and 1009 mb at 21Z at 14.0N, 55.8W (micro). “The first indication of the existence of this storm came from the S.S. *Benjamin H. Grierson*, which transmitted the following report during the afternoon of August 30: ‘Position 2100 (30<sup>th</sup>) G.C.T., 14N, 55.8W; vessel hove to; barometer 29.80; wind ESE 10 (50 kt); very high easterly seas; stratocumulus clouds.’” (MWR).

August 31:

HWM analyzes a large closed low of at most 1015 mb in the general vicinity of 12.5N, 58.7W. HURDAT lists this as a 45 kt tropical storm at 13.8N, 57.0W. The MWR post-season track map shows a 00Z position near 13.7N, 54.1W, and a 12Z position near 13.8N, 57.3W. Microfilm at 18Z shows a closed low of at most 1005 mb near 14.1N, 60.1W. No gales or low pressures. “From the above position this storm, of small diameter, advanced westward passing between St. Lucia and Martinique in the Lesser Antilles during the early evening of August 31” (MWR). “Benjamin H. Grierson position at 13Z (31<sup>st</sup>) 13.2N, 52.2W, wind SE 10 with 1018 pressure and a moderate ESE swell. Vessel experienced force 9 to 10 winds with high seas. Hove to from 2000Z Aug 30 until 0300Z Aug 31. Lowest pressure 29.80 after 0300Z” (micro).

September 1:

HWM analyzes a low (not closed) near 15N, 63.3W, located in a trough of low pressure with a trough or wave-like axis plotted from the low extending northeastward to 20N, 58W. HURDAT lists this as a 30 kt tropical depression at 14.2N, 63.0W. The MWR post-season track map shows a 00Z position near 13.9N, 59.5W, and a 12Z position near 14.1N, 62.1W. Microfilm shows a low of at most 1008 mb near 14.2N, 63.0W. Aircraft highlights: 15 kt WSW at 13Z at 13.8N, 63.9W (micro); center fix at 1340Z at 14.2N, 63.3W with a lowest pressure of 1007 mb and maximum winds of 28 kt (micro). From the Sep 01 0400Z Weather Bureau Advisory... “It is a very small storm with the lowest pressure about 1006 mb (~00Z on the 1<sup>st</sup>)” (San Juan Weather Bureau advisories). “At 8:40 am on September 1, a reconnaissance plane located the center at latitude 14.2N, longitude 63.3W with lowest pressure 1007 millibars (29.74 inches) and highest wind 28 knots. Subsequent reconnaissance failed to locate the center. This storm was minor in character, and it apparently weakened from the time of the report from the S. S. *Grierson* until it dissipated near latitude 15N, longitude 66W. No reports of property destruction

or loss of life from the storm have been received. Resulting heavy rains, especially on the island of Puerto Rico, were very beneficial to crops and water supply and more than offset minor damage caused by floods” (MWR). “Navy report: Position of eye 14.2N, 63.3W at 1340Z. Highest winds 28 kt. Lowest pressure 1007 mb. Definite eye (18?) miles in diameter” (micro). Regarding the storm in Dominica... “Continuous rain yesterday (September 1) for more than eight hours followed by heavy westerly squalls marked the eighteenth anniversary of the last hurricane here. Telephone communication has been disturbed. Small craft were removed to safety but a small yacht ruined its moorings and was wrecked” (The West Indian- a newspaper from September 2, 1948)

#### September 2:

HWM analyzes a low (not closed) near 12.5N, 71.5W at the SW end of a SW-NE trough/tropical wave that extends to beyond 21N, 65W. HURDAT no longer lists a system on this day. Microfilm shows a trough or tropical wave extending from 12N, 71W to beyond 20N, 64W. No gales or low pressures.

A tropical storm was first noticed in the Atlantic when the ship SS Benjamin H. Grierson reported winds up to 50 kt, pressures down to 1009 mb, and rough weather from 20Z on 30 August until 03Z on the 31<sup>st</sup>. At 20Z on the 30<sup>th</sup>, when the rough weather and high winds commenced aboard the ship, the ship was located at 14.0N, 56.0W. At 21Z, the ship was located at 14.0N, 55.8W and was recording ESE winds of 45-50 kt with a concurrent pressure of 1009 mb (the 1009 mb central pressure in HURDAT is removed). The ship was moving east-southeastward, and by 03Z on the 31<sup>st</sup>, when the rough weather ended, the ship was located in the vicinity of 13.7N, 54.5W. HURDAT starts this system at 00Z on the 31<sup>st</sup>, but the ship observations display enough evidence that a tropical storm existed at least six hours before that, so this storm is begun at 18Z on the 30<sup>th</sup> as a 50 kt tropical storm. The ESE wind of 50 kt from the ship at 21Z on the 30<sup>th</sup> indicates that the storm was probably located near 56W at that time. The starting position for this storm at 18Z on the 30<sup>th</sup> is at 12.9N, 55.4W, and the new 00Z position is 13.1N, 56.6W (a major adjustment of over 3 and a half degrees to the west-southwest of the previous HURDAT position for that time). In fact, major track alterations were made to all of the positions at all synoptic times on the 31<sup>st</sup> (all westward adjustments). Genesis was not captured with this storm, and the storm could have formed before the time shown in the analysis. Moving with a moderate forward speed in a direction between west and west-northwest, the cyclone probably passed close to or just north of St. Lucia before 00Z on the 1<sup>st</sup>. Although the microfilm map from 00Z on the 1<sup>st</sup> does not show any high wind or low pressure observations from the islands, sources indicate that this was a small cyclone. At 1340Z on the 1<sup>st</sup>, an aircraft located the center of the cyclone at 14.2N, 63.3W with estimated maximum surface winds of 28 kt and a minimum central pressure of 1007 mb. The 1007 mb central pressure is added into HURDAT for 12Z on the 1<sup>st</sup>. These aircraft observations indicate that the position and intensity at 12Z on the 1<sup>st</sup> need not be changed. The storm weakened to a 30 kt tropical depression at 12Z on the 1<sup>st</sup> in accordance with HURDAT and with the aircraft information. The last point given for this system is at 18Z on the 1<sup>st</sup> (no change to timing of dissipation). However, the position of the last point is adjusted a degree and a half to the east. After 18Z on the 1<sup>st</sup>, the cyclone degenerated into an open tropical wave. This moderately strong to vigorous

tropical wave can be traced with microfilm and HWM all the way across the Caribbean Sea to September 6<sup>th</sup> when HWM shows it near 81W. The strongest observed winds and lowest observed pressure with the wave between the 3<sup>rd</sup> and the 6<sup>th</sup> were 20 kt and 1007 mb respectively. However, the system apparently did not regenerate before reaching Central America on the 7<sup>th</sup> of September.

The following quotes should be noted from the Air Weather Service Tech report on the 1948 hurricane season regarding this cyclone: “Storm [4] (31 August to 2 September) was apparently a strong easterly wave instead of a true tropical storm. It was first discovered at 14N, 58W... a closed center was reported at 14N, 63W by Navy Reconnaissance. This cell, if existent, moved in a WNW direction and filled and dissipated near 16N, 71W over a water area” (AWS). The AWS tech report goes on to mention that all environmental conditions were favorable for further development of this wave. Then, the report says... “Since the storm failed to develop in spite of the above favorable conditions, it is believed that the stage of closed circulation never occurred. Although an “eye” had been reported with winds of 28 knots, a closed investigation revealed that no northwest or west winds were reported in this circulation and the isobars could have been drawn without a closed center. This ‘false’ center was likely the result of a squall which formed on the wave and gradually dissipated in showers. A popular theory at the Air Force Hurricane Office is that every easterly wave is potentially capable of developing into a hurricane. Squalls develop along these waves which in turn causes periods of brief duration when minute cells of closed circulation develop and move along the axis of the wave in a northeast direction. The majority of these cells dissipate in shower activity and no further development occurs unless the wave passes under a stationary or westerly trough. It is therefore concluded by the Air Force Hurricane Office that Storm [4] never existed as a tropical cyclone and it is not further discussed in this report” (AWS).

The Air Weather Service tech report lists information with regards to each tropical cyclone in 1948. If a piece of information contains a high degree of uncertainty, a question mark will follow the piece of information. One of the pieces of information listed is the number of days each system existed as a tropical storm. The AWS lists Storm 4 as having possibly been a tropical storm for 2 days with a question mark. Other information listed is that the maximum observed wind by reconnaissance was 55 mph.

## 1948 Storm 5

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33940 09/01/1948 M= 7 5 SNBR= 754 NOT NAMED XING=1 SSS=1
33940 08/31/1948 M= 7 5 SNBR= 754 NOT NAMED XING=1 SSS=1
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(The 31<sup>st</sup> is new to HURDAT.)

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33942 08/31* 0 0 0 0* 0 0 0 0*243 950 25 0*243 950 25 0*
33945 09/01* 0 0 0 0* 0 0 0 0* 0 0 0 0*238 947 35 0*
33945 09/01*243 949 25 0*243 949 25 0*243 948 25 0*243 948 25 0*
*** ** * ** ** ** ** ** ** ** ** **
33950 09/02*244 944 40 0*247 939 45 0*250 935 50 0*252 932 55 0*
33950 09/02*243 948 30 0*243 948 30 0*243 947 35 0*243 943 40 0*
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33955 09/03*253 930 60 0*255 928 60 0*258 926 65 0*266 919 70 0*
33955 09/03*245 938 40 0*251 932 45 0*259 926 50 998*269 919 60 990*
*** ** **      *** ** **      *** ** **      *** ** **
33960 09/04*277 911 70 990*288 905 65 989*299 900 55 0*311 896 50 0*
33960 09/04*279 913 65 0*289 906 65 986*299 900 60 988*311 894 45 0*
*** ** **      *** ** **      *** ** **      *** ** **
33965 09/05*323 893 45 0*334 891 40 0*345 890 35 0*354 890 30 0*
33965 09/05*323 891 35 0*335 891 30 0*348 892 25 0*358 893 25 0*
*** ** **      *** ** **      *** ** **      *** ** **
33970 09/06*363 889 30 0*373 887 25 0*390 883 25 0*402 875 20 0*
33970 09/06*365 893 25 0*375 891 25 0*388 886 20 0*400 876 20 0*
*** ** **      *** ** **      *** ** **      *** ** **

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(The 7<sup>th</sup> is removed from HURDAT.)

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33975 09/07*413 864 20 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
33980 HR LA1

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### U.S. Landfall:

9/4/1948 – 08Z – 29.2N 90.4W – 65 kt – 986 mb – 1009 mb OCI – 225 nmi ROCI

Minor track changes and major intensity changes are analyzed with this hurricane that made landfall in southeastern Louisiana. A major change to the timing of genesis was made with an additional day added at the beginning of the system. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, U.S. Weather Bureau Advisories, Connor (1956), Jarrell et al. (1992), and Dunn and Miller (1960).

### August 31:

Microfilm analyzes a broad, closed low of at most 1008 mb near 25.2N, 94.7W. No gales or low pressures. “On August 29, 1948 weather conditions became disturbed with an apparent partial circulation in the southwestern Gulf of Mexico” (Louisiana Climatological Data).

### September 1:

HWM analyzes an elongated closed low of at most 1010 mb near 25.8N, 92.7W with the W end of a W-E cold front located a few hundred miles north of the low. HURDAT first lists this at 18Z as a 35 kt tropical storm at 23.8N, 94.7W. Microfilm analyzes a large closed low of at most 1011 mb in the general vicinity of 25.2N, 93.4W. No gales or low pressures.

### September 2:

HWM analyzes a closed low of at most 1005 mb near 25.4N, 92.5W. HURDAT lists this as a 50 kt tropical storm at 25.0N, 93.5W. Microfilm analyzes a large closed low of at most 1008 mb in the general vicinity of 23.5N, 94.8W. Aircraft highlights: 35\* kt SE at 1645Z at 24.1N, 92.7W (micro).

## September 3:

HWM analyzes a closed low of at most 1005 mb centered near 25.4N, 92.9W. HURDAT lists this as a 65 kt hurricane at 25.8N, 92.6W. The MWR tracks of centers of cyclones shows a 12Z position near 26.7N, 93.0W. The MWR post-season track map shows a 12Z position near 25.6N, 92.2W. Microfilm analyzes a low of at most 999 mb centered near 26.0N, 92.6W. Ship highlights: 15 kt NW and 1005 mb at 0030Z at 23.0N, 95.0W (micro); 35 kt NE and 1010 mb at 1830Z at 28.0N, 91.5W (micro). Two other ship gales of 35 kt. Aircraft highlights: calm and 998 mb (center fix) at 1515Z at 26.4N, 92.6W (micro); 40 kt S at 1615Z at 25.9N, 91.0W (micro); eye  $\frac{3}{4}$  formed at 2043Z at 27.3N, 91.4W with 993 mb the lowest surface pressure encountered (micro); center fix at 2054Z at 27.3N, 91.8W with 990 mb central pressure (AWS). Ten other gales and at least six other low pressures between 992 and 1000 mb. "This hurricane developed in an area of unsettled weather that had prevailed for several days in the southwestern Gulf of Mexico. Aircraft reconnaissance reported development of a complete circulation with an ill-defined center on the morning of September 3" (MWR). "Special reports from surface ships were obtained and flights were made through the area by reconnaissance airplanes daily thereafter (after August 29<sup>th</sup>) without showing any definite developments until the morning of September 3<sup>rd</sup>. Reports that morning indicated an ill-defined hurricane center" (Louisiana Climatological Data). "Shortly before attaining hurricane strength, recon reported an eye diameter of 30 miles" (AWS).

## September 4:

HWM analyzes a tropical storm of at most 1005 mb centered near 29.7N, 90.3W with a WNW end of a WNW-ESE warm front located over central Alabama. HURDAT lists this as a 55 kt tropical storm at 29.9N, 90.0W. The MWR tracks of centers of cyclones shows a 00Z position near 28.2N, 91.8W, and a 12Z position near 30.5N, 90.3W with a 991 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a low of at most 987 mb centered near 30.2N, 89.7W. Ship highlights: 45 kt SE and 996 mb at 00Z at 27.8N, 91.2W (micro). Six other gales and three other low pressures. Land highlights: 55 kt (max wind) SSE at 07Z and 990 mb (min pressure) at 08Z at Grand Isle, LA (29.2N, 90.0W) (MWR); 68 kt gust NNE (max wind) at 0950Z at New Orleans Airport (30.0N, 90.3W) (MWR, OMR); 56 kt (max wind, 1-minute) at 1050Z at the top of the Huey Long Bridge in New Orleans (29.9N, 90.2W) (OMR); 989 mb (min pressure, maybe central pressure) at 1217Z at New Orleans (29.9N, 90.2W) (MWR, OMR); 50 kt NW and 993 mb at 1230Z at New Orleans (30.0N, 90.1W) (micro). Seven other gales and about 20 other low pressures. "From a position near 25N, 92.5W, the storm moved north-northeastward and crossed the Louisiana coast line a short distance west of Grand Isle. The lowest pressure at Grand Isle was 990.2 millibars (29.24 inches) at 3 am and the highest winds 63 mph from the south-southeast at 2 am on September 4. Passing over a sparsely settled coastal area, the center reached New Orleans early on the 4<sup>th</sup> of September, with a highest wind velocity of 78 mph from the north-northeast recorded at Moisant Airport at 3:50 am. At Huey Long Bridge a low pressure of 989.2 millibars (29.21 inches) was recorded from 6:15 to 6:20 am with maximum winds of 64 mph at 4:50 am (the center of the hurricane did not pass over either of these 2 points). Continuing with decreasing intensity, (the storm) passed over Picayune, Purvis, and reached Hattiesburg, Miss., at 2 pm on the 4<sup>th</sup> when the lowest

pressure was 29.67 inches (1005 mb) with highest winds 40 mph from the northeast. Thereafter, it decreased steadily in intensity, but the circulation was maintained as it passed near Memphis, Tenn., and Cairo, Ill., reaching Lafayette, Ind., at 6 pm on the 6<sup>th</sup> (MWR). From the New Orleans Weather Bureau advisory issued September 4<sup>th</sup> at 1115Z... “Strongest winds reported so far 65 mph at Moisant Airport at New Orleans with gusts to 85 mph” (Weather Bureau Advisories). Regarding the high tides... “Tides at the Mississippi River at New Orleans rose from 2.0 feet on September 3 to 4.7 feet on September 4 and at Reserve from 2.2 feet on September 3<sup>rd</sup> to 4.7 feet on September 4<sup>th</sup>. The highest tide along the Mississippi coast was about 6 feet. At Mobile, Ala., it reached 5.3 feet and at Pensacola, FL., 3.4 feet” (MWR, Louisiana Climatological Data). “At Buras, Port Sulphur and Chandeler Island, LA the tide reached 4-5 feet early on September 4<sup>th</sup>...at Pensacola Fla. It reached 3.8 feet” (Louisiana Climatological Data). Regarding the damage... “In section along Mississippi River below New Orleans, fall truck was inundated by heavy rains and high tides, and orange crop suffered considerable damage (by high winds). In the region north of Lake Pontchartrain, fall bean crop destroyed by heavy rains and high winds; pecan and tung nut crops in this area and in southeastern Mississippi suffered considerable damage; possibly the heaviest damage to pecans. Sugarcane and corn blown down by high winds, aided by torrential rain in Terrebonne, La Fourche, Jefferson, and St. Charles Parishes. In New Orleans Parish damage was confined to small boats, signs, trees, and power and communication lines, with damage estimated at \$100,000. The heaviest damage occurred near Grand Isle when immovable oil-drilling rigs and equipment in the Gulf of Mexico were demolished by heavy seas. Total property and crop damage was approximately \$900,000 divided among the four states affected as follows: Louisiana \$660,000; Mississippi \$140,000; Alabama \$88,000; and Florida \$12,000” (MWR). From the New Orleans OMR... “The center of a small tropical storm of near hurricane intensity passed over the City of New Orleans on September 4, 1948. The lowest pressure, 29.21 inches (sea-level) occurred at 6:17 am CST; the highest wind velocity recorded at the City Office was 34 mph from the northeast with an extreme (1-min) velocity of 37 (mph) from the north at 3:28 am. These wind velocities are reduced by nearby obstructions, and the maximum wind of 64 mph (average for one minute) at 4:50 am, recorded atop the Huey P. Long Bridge (29.9N, 90.2W) has been accepted as the official maximum wind. The estimated 80 mph from the north-northeast at Moisant International Airport (30.0N, 90.3W) based on instantaneous velocity of 78 mph when the instrument failed is too high, since it does not represent a one minute average” (New Orleans OMR). “No loss of life was directly attributable to the hurricane (but there was at least one indirect death)” (Louisiana Climatological Data). “Center crossed coast near Grand Isle, LA, Estimated lowest (lifetime) pressure – 987 mb, Lowest observed pressure – 989 mb New Orleans, Highest observed winds – 78 mph N “MSY”, Movement NNE 15 mph” (Connor 1956). “Sep, LA, 1, 987 mb” (Jarrell et al. 1992). “Tropical cyclones in Louisiana, Mississippi, and Alabama, Sept. 4, E La. Eastward, Minimal, Damage \$888,000” (“Minimal” indicates winds of 74 to 100 mph, and 983 to 996 mb central pressure- Dunn and Miller).

#### September 5:

HWM analyzes a closed low of at most 1010 mb near 34.8N, 89.8W with the NW end of a dissipating NW-SE warm front about 100 nm NE of the low. HURDAT lists this as a

35 kt tropical storm at 34.5N, 89.0W. The MWR tracks of centers of cyclones shows a 00Z position near 32.6N, 89.4W, and a 12Z position near 35.0N, 90.2W with a 1004 mb pressure. The MWR post-season track map shows a 00Z position near 32.0N, 89.0W, and a 12Z position near 34.1N, 89.1W. Microfilm analyzes a closed low of at most 1005 mb near 34.9N, 89.1W. Land highlights: 35 kt E and 1007(?) mb at 0030Z at Birmingham, AL (33.5N, 86.8W) (micro); 999 mb (min pressure) at 0012Z at Meridian, MS (32.4N, 88.7W) (OMR). At least six other low pressures.

#### September 6:

HWM analyzes a closed low of at most 1010 mb centered near 39.3N, 89.1W. HURDAT lists this as a 25 kt tropical depression at 39.0N, 88.3W. The MWR tracks of centers of cyclones shows a 12Z position near 38.4N, 89.0W with a 1007 mb pressure. The MWR post-season track map shows a 00Z position near 36.4N, 89.3W, and a 12Z position near 38.7N, 88.8W. Microfilm analyzes a closed low of at most 1009 mb centered near 38.6N, 89.0W. Land highlights: 10 kt NNE and 1005 mb at 00Z at Bloomfield, MO (36.9N, 89.9W).

#### September 7:

HWM analyzes a very elongated, but closed low of at most 1010 mb in the Great Lakes region at 12Z with a cold front extending south and west from the low and a warm front extending from the low towards the ENE. HURDAT last lists this at 00Z as a 20 kt tropical depression at 41.3N, 86.4W. The MWR post-season track map last shows a position at 00Z at 41.1N, 86.7W. Microfilm at 00Z shows a small closed low of at most 1008 mb near 40.9N, 87.7W with a front approaching from the west. No gales or low pressures.

A tropical depression formed in the Gulf of Mexico on 31 August at 12Z (the cyclone was begun 30 hours earlier than in the previous HURDAT) at 24.3N, 95.0W with a 25 kt intensity. This tropical cyclone originated from an existing area of low pressure that was present in the western Gulf of Mexico since 28 August. The cyclone was nearly stationary for the first two days of its lifetime. The first observed surface gale was at 1645Z on 2 September by aircraft visual estimate. It is analyzed that the tropical depression strengthened to a 35 kt tropical storm 18 hours later than originally- by 12Z on the 2<sup>nd</sup> (revised down from 50 kt previously for this time). Also, at 12Z on the 2<sup>nd</sup>, the analyzed position is over 1 degree southwest of the previous HURDAT position, and this position places the storm in nearly the same location it was at 48 hours previous in the analysis. On the 3<sup>rd</sup> at 00Z, the position is also adjusted about a degree to the southwest based on a ship observation of 1005 mb at 00Z, and by this time, the storm had begun moving towards the east-northeast. A peripheral pressure of 1005 mb suggests an intensity of at least 37 kt according the Brown et al. south of 25N pressure-wind relationship. 40 kt is chosen for intensity since there is no indication that the storm had strengthened yet and environmental pressures were somewhat low. This is a major intensity change at 00Z on the 3<sup>rd</sup> (down from 60 kt originally) and is the only point for this storm when a major intensity change was made. At 1515Z on the 3<sup>rd</sup>, an aircraft in the center measured a central pressure of 998 mb. 998 mb equals 47 kt using the pressure-wind relationship for north of 25N and 51 kt for south of 25N. This central

pressure value of 998 mb is added into HURDAT for 12Z on the 3<sup>rd</sup>. At 2043Z on the 3<sup>rd</sup>, aircraft encountered a lowest pressure of 993 mb. It is likely but not certain whether the 993 mb is a central pressure reading, but it is treated as a central pressure in the analysis, and it is added into HURDAT for 18Z on the 3<sup>rd</sup>. 993 mb equals 55 kt using the Brown et al. pressure-wind relationship for north of 25N. 50 kt is chosen for 12Z on the 3<sup>rd</sup> and 60 kt is chosen for 18Z. These values have been lowered from the original HURDAT values of 65 and 70 kt for those times. The cyclone is analyzed to have reached hurricane status at 00Z on the 4<sup>th</sup>, 12 hours later than originally. At this time, the cyclone was continuing to move towards the northeast and was approaching the southeast Louisiana coastline. The peak intensity for the lifetime of the cyclone is lowered slightly from 70 kt to 65 kt.

Landfall occurred about 20 nm west of Grand Isle, Louisiana at 08Z on the 4<sup>th</sup>. The lowest pressure measured for the storm was 989 mb at New Orleans simultaneously with 10 kt winds just after 12Z on the 4<sup>th</sup>, suggesting that the central pressure at that time was around 988 mb. Using the Ho et al. inland pressure decay model, it is estimated that the central pressure at landfall was 986 mb. This is consistent with the analysis of Jarrell et al. (1992), who came up with a central pressure of 987 mb at landfall (and was likely derived directly from Connor 1956). A central pressure of 986 mb equals 65 kt using the Brown et al. pressure-wind relationship for north of 25N and 68 kt for his intensifying subset. The speed of the storm was 12 kt, which is about average. The size of the storm was near average as well, but environmental pressures were lower than average. The highest reliable observed 1-minute wind was 56 kt in New Orleans at the Huey Long Bridge at 1050Z on the 4<sup>th</sup>. 55 kt was the maximum observed wind at Grand Isle at 07Z on the 4<sup>th</sup>. 65 kt is chosen for the intensity at 06Z and at landfall (08Z). Runs of the Kaplan and DeMaria (1995) Inland Decay Model yield 54 kt for 12Z on the 4<sup>th</sup>, 41 kt for 18Z, and 30 kt for 00Z on the 5<sup>th</sup>. Highest observed winds within 2 hr of the synoptic times were: 56 kt around 12Z on the 4<sup>th</sup>, 35 kt around 18Z, and 35 kt around 00Z on the 5<sup>th</sup>. Revised winds in HURDAT are 60 kt at 12Z on the 4<sup>th</sup> (up from 55 kt originally), 45 kt at 18Z (down from 50 kt originally), and 35 kt at 00Z on the 5<sup>th</sup> (down from 45 kt originally). Track changes on the 4<sup>th</sup> and 5<sup>th</sup> were all very minor (all less than half of a degree), and weakening occurred as the cyclone traveled northward through eastern Mississippi and extreme western Tennessee. The cyclone is analyzed to have weakened to a tropical depression at 06Z on the 5<sup>th</sup> (12 hours earlier than originally). The circulation stayed closed through the 6<sup>th</sup> of September as it moved through Illinois. HURDAT previously held this cyclone through 00Z on the 7<sup>th</sup>, but observations indicate the by 00Z on the 7<sup>th</sup>, the low was no longer closed so one 6-hourly point is removed from HURDAT. The final point of this tropical cyclone was at 18Z on the 6<sup>th</sup> at 40N latitude near the Illinois-Indiana border with a 20 kt intensity.

## 1948 Storm 6

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33985 09/04/1948 M=13 6 SNBR= 755 NOT NAMED XING=0
33985 09/04/1948 M=14 6 SNBR= 755 NOT NAMED XING=0
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33990 09/04* 0 0 0 0*143 197 50 0*142 208 55 0*142 218 60 0*
33990 09/04* 0 0 0 0*143 202 35 0*142 213 40 0*142 224 40 0*
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33995	09/05*143	230	65	0*144	243	65	0*145	255	70	0*146	268	70	0*	
33995	09/05*143	236	40	0*144	248	40	0*145	260	45	0*146	273	45	0*	
		***	**		***	**		***	**		***	**		
34000	09/06*147	280	70	0*149	291	75	0*150	300	75	0*151	309	75	0*	
34000	09/06*148	287	45	0*150	301	45	0*152	315	50	0*155	329	50	0*	
		***	***	**	***	***	**	***	***	**	***	***	**	
34005	09/07*151	318	75	0*152	329	80	0*153	341	80	0*154	354	80	0*	
34005	09/07*160	343	50	0*166	357	50	0*170	370	50	0*172	383	50	0*	
		***	***	**	***	***	**	***	***	**	***	***	**	
34010	09/08*156	368	80	0*158	384	85	0*160	400	85	0*163	415	85	0*	
34010	09/08*173	396	50	0*173	408	50	0*173	420	50	0*173	432	50	0*	
		***	***	**	***	***	**	***	***	**	***	***	**	
34015	09/09*166	430	85	0*169	445	90	0*172	460	90	0*176	473	90	0*	
34015	09/09*173	443	50	0*173	454	50	0*173	466	50	0*173	479	50	0*	
		***	***	**	***	***	**	***	***	**	***	***	**	
34020	09/10*180	485	90	0*183	496	95	0*187	508	95	0*194	523	95	0*	
34020	09/10*174	492	50	0*176	505	50	0*180	518	50	0*185	531	50	0*	
		***	***	**	***	***	**	***	***	**	***	***	**	
34025	09/11*200	538	100	0*206	549	100	0*213	561	105	0*222	581	105	0*	
34025	09/11*194	545	55	0*204	559	65	0*216	574	80	0*229	590	90	0*	
		***	***	***	***	***	***	***	***	***	***	***	***	
34030	09/12*233	602	105	0*242	616	110	0*254	628	110	0*270	638	110	0*	
34030	09/12*240	610	100	0*246	620	105	0*254	628	110	0*268	636	110	0*	
		***	***	***	***	***	***	***	***	***	***	***	***	
34035	09/13*287	646	115	0*301	654	115	0*316	658	115	0*330	658	110	0*	
34035	09/13*285	644	115	0*298	652	115	0*310	658	115	0*323	658	110	0*	
		***	***	***	***	***	***	***	***	***	***	***	***	
34040	09/14*344	655	105	0*357	649	100	0*370	640	95	0*385	626	85	0*	
34040	09/14*337	655	105	0*351	649	100	0*365	640	95	0*385	626	85	0*	
		***		***		***	***		***		***		***	
34045	09/15*403	604	80	0*423	574	75	0*446	534	70	0E469	488	65	0*	
34045	09/15*403	604	80	0E420	574	75	0E446	534	70	0E471	488	65	0*	
				****		*			***					
34050	09/16E498	442	60	0E533	400	55	0E567	350	45	0E583	329	40	0*	
34050	09/16E498	442	60	0E530	400	55	0E563	350	55	0E583	290	55	0*	
				***		***	**		***	**				

(The 17<sup>th</sup> is new to HURDAT.)

34052	09/17E600	220	60	0E615	140	60	0E625	60	60	0*	0	0	0	0*
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34055 HR

Major changes to both track and intensity are analyzed for this hurricane. In addition, one day was added to the end of this system during the extratropical phase. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, The U.S. Weather Bureau Advisories, and Tucker (1995).

September 3:

HWM does not analyze a closed low on this day. HURDAT does not list a cyclone on this day. No gales or low pressures. "This hurricane, which had an unusually long

history, was first reported on September 3 when it moved off the African mainland near Dakar. It followed a westerly course during the next several days” (MWR).

September 4:

HWM analyzes a low within a trough (almost a closed low) near 15.3N, 19.5W. HURDAT lists this as a 55 kt tropical storm at 14.2N, 20.8W. No gales or low pressures.

September 5:

HWM analyzes a closed low of at most 1015 mb centered near 14.5N, 26.5W. HURDAT lists this as a 70 kt hurricane at 14.5N, 25.5W. No gales or low pressures.

September 6:

HWM analyzes a closed low of at most 1010 mb centered near 16.8N, 30.0W. HURDAT lists this as a 75 kt hurricane at 15.0N, 30.0W. No gales or low pressures.

September 7:

HWM analyzes a closed low of at most 1010 mb centered near 16.8N, 34.3W. HURDAT lists this as an 80 kt hurricane at 15.3N, 34.1W. Ship highlights: 25 kt NE and 1007 mb at 1830Z at 19.5N, 40.0W (micro). “On Tuesday, September 7<sup>th</sup>, there was an unofficial report that a hurricane was in existence one thousand miles S.E. of the colony (Bermuda)” (Tucker).

September 8:

HWM analyzes a closed low of at most 1010 mb centered near 16.6N, 39.5W. HURDAT lists this as an 85 kt hurricane at 16.0N, 40.0W. No gales or low pressures.

September 9:

HWM analyzes a tropical storm of at most 1010 mb centered near 18.1N, 45.2W. HURDAT lists this as a 90 kt hurricane at 17.2N, 46.0W. The MWR post-season track map shows a 12Z position near 16.7N, 46.2W. Microfilm shows a closed low of at most 1008 mb centered near 17.5N, 47.3W (at 15Z). Aircraft highlights: center fix at 1508Z at 17.5N, 47.3W (micro, MWR); 35-40 kt at 1940Z at 19.0N, 48.4W (micro). “On September 9, it was detected by aircraft reconnaissance near latitude 17.5N, longitude 47W. Thereafter, it moved on a broad curving path over the Atlantic...” (MWR). From the San Juan, Puerto Rico Weather Bureau Advisory issued September 9<sup>th</sup> at 2000Z... “A tropical storm of moderate intensity was located by aircraft reconnaissance at 1500Z September 9 at latitude 17.5N, longitude 47.5W” (Weather Bureau Advisories). From the advisory issued September 10<sup>th</sup> at 0100Z... “At 2100Z (on the 9<sup>th</sup>) it was attended by winds of 40 to 45 mph near the center and 30 to 40 mph with a radius of 125 miles from the center” (Weather Bureau Advisories).

September 10:

HWM analyzes a tropical storm of at most 1005 mb centered near 18.7N, 51.4W. HURDAT lists this as a 95 kt hurricane at 18.7N, 50.8W. The MWR post-season track map shows a 00Z position near 17.8N, 48.6W, and a 12Z position near 19.0N, 51.4W.

No gales or low pressures. Aircraft highlights: center fix at 1900Z at 18.5N, 53.5W (Weather Bureau Advisories)

#### September 11:

HWM analyzes a tropical storm of at most 1005 mb centered near 20.8N, 56.6W. HURDAT lists this as a 105 kt hurricane at 21.3N, 56.1W. The MWR tracks of centers of cyclones shows a 12Z position near 23.1N, 59.5W. The MWR post-season track map shows a 00Z position near 20.3N, 54.3W, and a 12Z position near 21.6N, 56.9W. Microfilm at 18Z plots a hurricane of at most 999 mb near 23.9N, 60.7W. Ship highlights: 40 kt ENE and 1011 mb at 12Z at 23.5N, 56.0W (HWM); 35 kt ESE and 1018 mb at 1830Z at 26.5N, 59.2W (micro). Two other gales. Aircraft highlights: radar center fix at 2030Z at 23.5N, 60.5W with 75-100 kt estimated maximum sustained winds (micro); 40 kt WSW and 999(?) mb at 23.8N, 60.3W (micro). Four other gales and two other low pressures. "At 3:30 pm on Saturday (September 11<sup>th</sup>), the preliminary storm warning No. 1 was hoisted. Though a matter of general interest, No. 1 does not really affect the ordinary public, since it merely shows that a storm exists within eight hundred miles, whose direction and movements are still uncertain" (Tucker). "Note: Army recon reported center at 23.5N, 60.5W at 1530 EST (2030Z). Weather extends 100 miles to south and 250 miles to north of center. 75-100 kt winds near center, 50 kt winds extend 100 miles to south and 150 to north; 30 to 40 kt winds 200 miles to north. Center of storm showed on radar...to be approximately 10 miles from the position 23.7N, 60.3W, diameter (of eye) 20 miles..." (micro).

#### September 12:

HWM analyzes a tropical storm of at most 1005 mb near 25.3N, 63.4W. HURDAT lists this as a 110 kt hurricane at 25.4N, 62.8W. The MWR tracks of centers of cyclones shows a 00Z position near 25.0N, 61.7W, and a 12Z position near 26.7N, 63.4W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 996 mb centered near 25.3N, 63.3W. Ship highlights: 40 kt SE and 1019 mb at 1230Z at 25.9N, 58.8W (micro); 40 kt E and 1010 mb at 1830Z at 29.4N, 63.0W (micro). Aircraft highlights: center fix at 1310Z at 25.2N, 62.8W with 120 kt estimated max winds (micro); center fix at 21Z at 27.6N, 64.2W with estimated max winds greater than 100 kt and lowest pressure encountered 992 mb (micro). At least eleven other aircraft gales between 35-45 kt and one other reported low pressure. "By Sunday, September 12, ZBM was broadcasting the warning to the whole island. And by Monday, September 13<sup>th</sup>, the "Royal Gazette" was running the banner headline. 'Hurricane *may* hit this afternoon', with the additional caution that one-hundred-and-fifty-miles-per-hour winds were reported. At 4 pm on Sunday, September 12<sup>th</sup>, the hurricane's 'translation' movement had slowed from eighteen to twelve miles an hour, while its rotatory winds had a velocity of at least one hundred and forty miles per hour within a hundred miles of its centre" (Tucker). "Inflight 121433Z- hurricane center estimate 1310Z position 25.0N, 62.8W, maximum winds 120 knots, radius of 60 knot wind 70 miles, radius 40 knot wind 120 miles (later corrected to 1310Z position 25.2N, 62.8W)" (micro). "Air Force reported hurricane at 2100Z at 27.6N, 64.2W, track 330, speed 18 knots, lowest pressure (encountered) 992 mb, winds estimated in excess of 100 knots" (micro).

## September 13:

HWM analyzes a tropical storm of at most 1005 mb centered near 31.2N, 64.5W, with a dissipating WSW-ENE warm front located about 300 nm NW of the storm and a WSW-ENE cold front extending from the dissipating warm front continuing east-northeastward. HURDAT lists this as a 115 kt hurricane at 31.6N, 65.8W. The MWR tracks of centers of cyclones shows a 00Z position near 28.7N, 64.8W, and a 12Z position near 31.3N, 65.6W. The MWR post-season track map shows a 00Z position near 28.0N, 64.5W, and a 12Z position near 31.9N, 66.1W. Microfilm analyzes a low of at most 996 mb centered in the general vicinity of 30.9N, 65.0W. Land highlights: At least 60 kt SE and 996 mb at 1730Z at Bermuda (micro); at least 50 kt S and 990 mb (min pressure) at 1815Z at Bermuda (micro); at least 60 kt S and 993 mb at 1930Z at Bermuda (micro); 50 kt SSW and 998 mb at 2330Z at Bermuda (micro); at least 87 kt (max wind) at Bermuda (MWR estimate). Aircraft highlights: 40 kt NW and 989(?) mb at 2130Z at 32.1N, 66.0W (micro). Regarding the hurricane at Bermuda... "...passing a short distance west of Bermuda on the 13<sup>th</sup>. Winds at Bermuda exceeded 100 mph, and damage was reported as heavy" (MWR). "By midmorning (13<sup>th</sup>), winds were lashing across the islands at 80-100 miles an hour, with gusts up to one hundred and thirty-five miles. At 3 o'clock, the centre passed fifty miles to the west of Bermuda, and by 3:30 the barometer, which had fallen to 29.23 began to rise again. A rainfall of 4.85 inches for twelve hours was recorded. Owing to the rigid battening down, in the main only superficial damages were suffered. True it was that fifteen hundred telephones were put out of action, that all electric current was cut off, that St. George's was isolated by both a block in the Causeway and the breakdown of the Barge Bridge, that the streets were littered with fallen branches, torn shutters, broken glass and trailing wires. No major disaster and no deaths were suffered anywhere" (Tucker). "Army Duck located hurricane at 2230Z(?) 32.8N, 65.9W, wind 120 knots moving NNW at 17 knots" (micro).

## September 14:

HWM analyzes a tropical storm of at most 1005 mb near 37.0N, 64.1 with an approaching cold front about 300 nm to the NW of the storm. HURDAT lists this as a 95 kt hurricane at 37.0N, 64.0W. The MWR tracks of centers of cyclones shows a 00Z position near 34.0N, 66.0W, and a 12Z position near 37.0N, 64.8W with a 977 mb pressure. The MWR post-season track map shows a 00Z position near 34.4N, 65.7W, and a 12Z position near 37.0N, 64.3W. Microfilm analyzes a low of at most 999 mb with a hurricane symbol plotted near 37.0N, 64.2W. Ship highlights: 40 kt SSE and 999 mb at 11Z at 35.5N, 62.3W (micro); At least 50 kt SE and 1002 mb at 1230Z at 37.3N, 62.7W (micro); 50 kt S and 998 mb at 14Z at 35.0N, 62.0W (micro); 50 kt SSW and 1002 mb at 17Z at 34.8N, 62.1W (micro); 85 kt SW and 998(?) mb at 1830Z at 37.3N, 62.4W (micro). Several other gales and a few other low pressures. Land highlights: 45 kt SSW and 1001 mb at 0030Z at Bermuda (micro); 35 kt SW and 1004 mb at 0130Z at Bermuda; 35 kt WSW and 1009 mb at 0630Z at Bermuda.

## September 15:

HWM analyzes a tropical storm of at most 995 mb near 45.1N, 52.6W with a frontal system starting to interact and surround the storm. HURDAT lists this as a 70 kt

hurricane at 44.6N, 53.4W. The MWR tracks of centers of cyclones shows a 00Z position near 40.6N, 60.3W, and a 12Z position near 44.3N, 55.1W. The MWR post-season track map shows a 00Z position near 40.5N, 61.0W, and a 12Z position near 44.4N, 53.6W. Microfilm analyzes a low of at most 984 mb centered near 44.7N, 53.2W. Ship highlights: 113 kt W at 0030Z at 37.2N, 62.8W (micro); 50 kt NW and 1002 mb at 0030Z at 38.0N, 58.8W (micro); 35 kt NNE and 986 mb at 09Z at 42.7N, 59.4W (micro); 45 kt N and 997 mb at 12Z at 46.0N, 56.0W (COA); 40 kt W and 995 mb at 1230Z at 41.6N, 53.7W (micro); 30 kt NW and 982 mb at 1230Z at 44.9N, 57.5W (micro); 40 kt SW and 994 mb at 43.6N, 48.4W (micro). Twelve other gales and nine other low pressures. Land highlights: 35 kt NW and 1000 mb at 1230Z at St. George's, Newfoundland (48.5N, 58.5W) (micro); 25 kt ENE and 992 mb at 1230Z at Cape Race, Newfoundland (46.6N, 53.1W) (micro). "After passing Bermuda the hurricane continued its broad curve over the North Atlantic, passing south of Cape Race, Newfoundland, on the 15<sup>th</sup>. It is notable that for the second year in a row a hurricane has been traced to a point of origin over West Africa" (MWR).

#### September 16:

HWM analyzes a low of at most 990 mb near 56.7N, 34.8W. HURDAT lists this as a 45 kt extratropical storm at 56.7N, 35.0W. The MWR tracks of centers of cyclones shows a 00Z position near 50.8N, 45.3W, and a 12Z position near 56.5N, 35.2W. Ship highlights: 35 kt N and 985 mb at 04Z at 52.5N, 43.5W (COA); 35 kt S and 983 mb at 12Z at 56.0N, 34.0W (COA); 50 kt SW and 992 mb at 12Z at 53.9N, 33.4W (COA); 50 kt SW and 993 mb at 18Z at 56.2N, 27.9W (COA). Fifteen other gales between 35-50 kt, and fourteen other low pressures between 987-999 mb.

#### September 17:

HWM analyzes a frontal low of at most 985 mb centered near 62.8N, 5.5W with a warm front extending southeastward from the low and a cold front extending from the low southward and then westward. HURDAT does not list a system on this day. Ship highlights: 985 mb at 60.0N, 20.0W at both 00Z and 03Z from the same ship (COA); 50 kt SW and 993 mb at 06Z at 58.7N, 16.5W (COA); 70 kt W at both 12Z and 16Z at 58.7N, 3.2W (COA); 50 kt WNW at 20Z at 58.7N, 3.2W (COA). Twelve other gales between 35-50 kt, and fourteen other low pressures between 994-1005 mb.

HWM indicates that a wave of low pressure within or near the ITCZ trough emerged off of the African coast on the 3<sup>rd</sup> and 4<sup>th</sup> and became a closed low on the 5<sup>th</sup> after it passed just south of the Cape Verde Islands. HURDAT started this as a 50 kt tropical storm at 06Z on 4 September at 14.3N, 19.7W. A 25 kt N wind along with a 1010 mb pressure at a station in the Cape Verde Islands and south-southeast winds from ships along the African coast are enough to justify keeping HURDAT's genesis time for this cyclone. As the tropical cyclone moved westward through the tropical Atlantic, there were no observed gales from pre-genesis until September 9<sup>th</sup>, when the cyclone had moved far west enough for aircraft reconnaissance flights. Even then, the aircraft only found maximum winds of 35 to 40 kt on the afternoon of the 9<sup>th</sup> near 19.0N, 48.4W, at which time HURDAT indicates an intensity of 90 kt. Major track changes are made from late on the 6<sup>th</sup> until the 8<sup>th</sup>. The positions are adjusted more than two degrees to the west-

northwest of the previous HURDAT positions those days. These alterations are based on a ship observation at 18Z on the 7<sup>th</sup> (see September 7<sup>th</sup> paragraph above). The first indication that this cyclone was beginning to increase in intensity (stronger than a 40 kt tropical storm, which was indicated in the 9<sup>th</sup> and 10<sup>th</sup>) was on the 11<sup>th</sup> when the advisory issued at 1715Z by the San Juan Weather Bureau mentioned that the storm “is increasing in intensity” and “strongest winds near the center are 65 to 70 mph.” By the time of the aircraft reconnaissance flight on the afternoon of the 11<sup>th</sup>, the storm was a hurricane, and it was apparently too strong to fly into the eye. Aircraft estimated maximum surface winds of 75-100 kt at 2030Z on the 11<sup>th</sup>. The next day, 12 September, aircraft estimated maximum surface winds of 120 kt at 1310Z and “in excess of 100 kt” at 21Z. By late on the 12<sup>th</sup>, the hurricane had begun to turn to the northwest and north-northwest in the area near 25-30N, 60-65W. The reconnaissance data on the 9<sup>th</sup> until late on the 11<sup>th</sup> indicates that the cyclone had not yet reached hurricane intensity and thus major changes are required to HURDAT’s winds from genesis up until the 11<sup>th</sup>. At 12Z each day from the 4<sup>th</sup> to the 11<sup>th</sup>, the following adjustments were made to intensity: 4<sup>th</sup>- 40 kt (down from 55 kt originally), 5<sup>th</sup>- 45 kt (down from 70 kt originally); a 50 kt intensity is carried from the 6<sup>th</sup> through the 10<sup>th</sup> (a decrease in intensity from 95 kt to 50 kt on the 10<sup>th</sup>- a very large intensity change); 75 kt on the 11<sup>th</sup> at 12Z (down from 105 kt originally). When aircraft estimated 75-100 kt winds at 2030Z on the 11<sup>th</sup>, 85 kt is the analyzed intensity for 18Z on the 11<sup>th</sup> (down from 105 kt originally). At 12Z on the 12<sup>th</sup>, the HURDAT intensity of 110 kt is unchanged due to the aircraft surface wind estimates that day. The HURDAT intensity also remains unchanged for the duration of the tropical phase of this cyclone’s lifetime (through the 15<sup>th</sup> of September). Minor track alterations were made on the 9<sup>th</sup> through early on the 12<sup>th</sup> to adjust the position to the west. On the 13<sup>th</sup> and 14<sup>th</sup> the track was shifted about half a degree to the south of the previous HURDAT positions.

The hurricane recurved and passed just west of Bermuda moving close to due north at the time of closest approach, which was during the early afternoon of 13 September. Winds reportedly exceeded 100 mph at Bermuda according to both MWR and Tucker, but the lowest pressure recorded at Bermuda was 990 mb. It is analyzed that the center of the hurricane passed about 50 nautical miles to the west or west-northwest of the island at closest approach (about the same distance from the island as in HURDAT previously). After passing Bermuda, the hurricane turned towards the north-northeast and northeast on the 14<sup>th</sup>. This system is analyzed to have become extratropical by 06Z on the 15<sup>th</sup> (12 hours earlier than in the original HURDAT). It passed a short distance southeast of the southeastern tip of New Foundland on the 15<sup>th</sup> on a course between northeast and east-northeast. At 12Z on the 16<sup>th</sup>, the intensity is revised upward to 55 kt (45 kt originally). Meanwhile, the cyclone was rapidly accelerating towards the east-northeast. HURDAT’s last position was at 18Z on the 16<sup>th</sup>, but this cyclone was not absorbed until 1 day later. The analyzed position at 12Z on the 17<sup>th</sup> is 62.5N, 6.0W, and the intensity had increased from the previous day’s analyzed intensity to 60 kt. The extratropical cyclone merged with another extratropical cyclone later that day.

The following quotes from the Air Weather Service tech report should be noted: “During [Storm 6’s] early history, its movement and size were constant, about 15 mph and small in size and intensity. This condition changed rapidly (overnight, 10-11 September) from

a small tropical storm to a full fledged hurricane and deepened rapidly” (AWS). According to the AWS report, the estimated peak intensity of this cyclone was 135 mph and 940 mb, but it is doubtful that these values were measured.

#### 1948 Storm 7 (new to HURDAT)

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34060 09/07/1948 M= 4 7 SNBR= 756 NOT NAMED XING=0
34065 09/07* 0 0 0 0* 0 0 0 0E360 580 40 0*358 600 45 0*
34066 09/08*360 615 45 0*363 625 50 0*368 632 50 0*373 637 55 0*
34067 09/09*379 640 55 0*385 640 50 0*391 639 45 0*401 634 45 0*
34068 09/10E413 623 40 0E425 610 40 0E440 585 40 0E460 550 35 0*
34105 TS

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HWM, COADS, MWR, and microfilm indicate that a tropical storm, previously undocumented in HURDAT, existed in the northwestern Atlantic from 7 September to 10 September, 1948.

#### September 5:

HWM analyzes a trough with a SW-NE cold front extending from 30N, 65W to a low at 44N, 48W. HURDAT does not list this system. The MWR tracks of centers of cyclones shows a 12Z position near 34.2N, 56.8W with a 1015 mb pressure. The 12Z microfilm shows an elongated, closed low of at most 1014 mb centered near 34.2N, 57.8W with fronts attached. No gales or low pressures.

#### September 6:

HWM analyzes an elongated, closed low of at most 1015 mb centered in the vicinity of 32N, 58W with a cold front extending from the low towards the west-southwest to 28N, 68W, and a warm front extending from the low towards the east-northeast, becoming a cold front, which extends to another low further northeast. The MWR tracks of centers of cyclones shows a 00Z position near 34.6N, 57.9W, and a 12Z position near 34.6N, 59.3W. The 12Z microfilm shows an elongated, closed low of at most 1014 mb centered in the general vicinity of 33N, 55W. No gales or low pressures.

#### September 7:

HWM analyzes a now more compact closed low of at most 1005 mb centered near 35N, 57.5W with a cold front extending southward and westward from the low to 28N, 63W and a warm front extending east-northeastward from the low to beyond 50N, 38W. The MWR tracks of centers of cyclones shows a 00Z position near 36.0N, 59.0W and a 12Z position near 37.5N, 59.5W with a 1005 mb pressure. The 12Z microfilm shows a closed, but not circularly symmetric low of at most 1008 mb centered near 36.5N, 56.5W with a cold front extending southwestward from the low and a warm front extending eastward from the low. Ship highlights: 35 kt NW at 12Z at 35.2N, 60.4W (micro); 30 kt N and 1003 mb at 18Z at 35.5N, 62.0W (COA); 35 kt ENE and 1010 mb at 18Z at 39.5N, 58.8W (micro); 40 kt NE and 1012 mb at 18Z at 39.1N, 62.1W (micro).

#### September 8:

HWM analyzes a closed low of at most 1005 mb centered near 37.2N, 62.8W, and there are no longer fronts attached to the low. The MWR tracks of centers of cyclones shows a 00Z position near 37.3N, 61.2W and a 12Z position near 37.8N, 62.8W with a 1002 mb pressure. The 12Z microfilm shows a closed low of at most 1002 mb centered near 36.8N, 63.9W, and there are no longer fronts attached to the low. Ship highlights: 35 kt E and 1010 mb at 00Z at 39.5N, 60.6W (micro); 30 kt SE and 1003 mb at 06Z at 38.5N, 63.5W (COA, micro); 25 kt WSW and 1002 mb at 12Z at 35.3N, 62.6W (micro); 40 kt E and 1001 mb at 16Z at 37.4N, 62.7W (micro); 45 kt E and 993 mb at 18Z at 37.8N, 63.1W (micro). Five other low pressures.

#### September 9:

HWM analyzes a closed low of at most 1000 mb centered near 39.7N, 62.9W. The MWR tracks of centers of cyclones shows a 00Z position near 39.1N, 64.4W and a 12Z position near 40.7N, 64.0W with a 996 mb pressure. The 12Z microfilm shows a closed low of at most 999 mb centered near 39.5N, 64.0W. Ship highlights: 30 kt SSE and 1005 mb at 00Z at 39.4N, 60.5W (COA); 30 kt WSW and 997 mb at 06Z at 38.2N, 62.8W (micro).

#### September 10:

HWM analyzes a closed low of at most 1005 mb centered near 44.0N, 58.5W with a mid-latitude cyclone and associated fronts approaching from the west (the cyclone of interest is located in the warm sector of the approaching mid-latitude cyclone). The MWR tracks of centers of cyclones shows a 00Z position near 42.7N, 62.4W and a 12Z position near 45.0N, 59.7W with a 1003 mb pressure. Microfilm at 12Z shows a closed low of at most 1002 mb centered near 44.5N, 58.9W. Ship highlights: 30 kt SW and 1001 mb at 06Z at 41.8N, 59.7W (COA); 35 kt W and 1007 mb at 12Z at 41.9N, 58.9W (COA); 35 kt SSW and 1007 mb at 18Z at 43.3N, 56.2W (COA). Five other low pressures between 1002-1005 mb.

#### September 11:

HWM no longer analyzes the feature of interest. HWM analyzes the mid-latitude cyclone mentioned on September 10<sup>th</sup> as a closed low of at most 1000 mb centered near 53.5N, 58W with a cold front extending south-southwestward from the low to beyond 37N, 72W and a warm front extending eastward from the low to 50N, 41W. Extending from the warm front is an awkwardly plotted decaying front which wraps around from 50N, 41W to 52N, 33W to 55N, 34W to 56N, 45W to 60N, 69W. The former low (former feature of interest) either begins to go off the microfilm map around 00Z or is already absorbed.

On 5 September, a front extended southwestward from a mid-latitude cyclone at 44N, 47W to 30N, 67W. A low began to develop along the front on the 5<sup>th</sup> in the general vicinity of 34N, 57W. On the 6<sup>th</sup>, the low was still elongated and there is not enough evidence that it was closed. On the 7<sup>th</sup>, the low consolidated and became much less elongated. A well-defined, closed cyclone had developed by 12Z on the 7<sup>th</sup>. A moderate temperature gradient still existed, and the wind structure suggests that the cyclone was extratropical at 12Z on the 7<sup>th</sup>. The highest observed wind around 12Z on the 7<sup>th</sup> is 35 kt.

This system is started at 12Z on the 7<sup>th</sup> as a 40 kt extratropical storm at 36.0N, 58.0W. The cyclone continued to lose baroclinicity, and by 18Z on the 7<sup>th</sup>, this system is analyzed to be a tropical cyclone at 35.8N, 60.0W (today this may have been designated a subtropical cyclone at this time). The lowest observed pressure around 18Z is 1003 mb. This observation was reported with 30 kt winds at the same time. A peripheral pressure of 1003 mb corresponds to a wind speed of at least 44 kt using the Landsea et al. pressure-wind relationship for north of 35N, and at least 38 kt using the Brown et al. pressure-wind relationship for 25-35N. The highest observed wind around 18Z was 40 kt. An intensity of 45 kt is chosen for 18Z on the 7<sup>th</sup>. The cyclone, which had been moving westward on the 7<sup>th</sup>, moved northwestward early on the 8<sup>th</sup> and turned northward late on the 8<sup>th</sup>. At 18Z on the 8<sup>th</sup> of September, a 993 mb pressure was observed simultaneously with at least 45 kt winds. A 993 mb peripheral pressure corresponds to at least 59 kt using the north of 35N pressure-wind relationship. The highest observed wind is the 45 kt just previously mentioned. The size of the cyclone is still significantly larger than normal; however, the strongest winds around 18Z on the 8<sup>th</sup> were observed in close proximity to the center, which indicates that this cyclone may have lost any hybrid characteristics by this time. 55 kt is chosen for the intensity at 18Z on the 8<sup>th</sup> with a position of 37.3N, 63.7W. By 12Z on the 9<sup>th</sup>, the tropical storm had moved northward to 39.1N, 63.9W. The analysis and observations indicate that the intensity of the tropical storm had weakened to 45 kt by 12Z on the 9<sup>th</sup>, and it was beginning to undergo extratropical transition as it moved northward. This cyclone is analyzed to have remained tropical through 18Z on the 9<sup>th</sup>, and became extratropical with 40 kt intensity by 00Z on the 10<sup>th</sup>. Around 00Z on the 10<sup>th</sup>, the cyclone turned to the northeast. The center of the cyclone missed Nova Scotia, but it was headed in the direction of New Foundland later on the 10<sup>th</sup>. At 12Z on the 10<sup>th</sup>, the 40 kt extratropical storm is analyzed to have been located at 44.0N, 58.5W. The final point before the system was absorbed by another extratropical cyclone is at 18Z on the 10<sup>th</sup> with a 35 kt intensity.

In summary, this cyclone is analyzed to have been a tropical storm from 18Z on the 7<sup>th</sup> through 18Z on the 9<sup>th</sup>. It attained a peak intensity of 55 kt around 18Z on the 8<sup>th</sup> to 00Z on the 9<sup>th</sup>. The lack of baroclinicity and the symmetry of the cyclone, as well as its track, were the several factors taken into consideration when determining that this cyclone attained tropical cyclone status. The westward motion on the 7<sup>th</sup> and 8<sup>th</sup> followed by the turn to the north on the 9<sup>th</sup> (recurvature) and turn to the northeast on the 10<sup>th</sup> indicates that the direction of motion taken by this cyclone is typical of recurving tropical cyclones. The starting latitude where the westward motion took place (~36N) is a little further north than usual, but this cyclone occurred during the peak of the season in early September. It is possible that at least a portion of the lifetime of this cyclone would have been designated as a subtropical storm during the satellite era. But without the satellite imagery to examine the convective structure, this system is classified as a tropical cyclone.

#### 1948 Storm 8 (originally Storm 7)

34060 09/18/1948 M= 8 7 SNBR= 756 NOT NAMED XING=1 SSS=3  
 34060 09/18/1948 M= 9 8 SNBR= 756 NOT NAMED XING=1 SSS=4

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* * * * *
34065 09/18* 0 0 0 0*182 788 50 0*182 798 55 0*183 804 60 0*
34065 09/18* 0 0 0 0*182 792 40 0*182 798 50 0*183 804 60 994*
*** ** **
34070 09/19*185 808 65 0*188 811 70 0*191 814 75 0*195 816 80 0*
34070 09/19*185 808 70 0*188 811 80 0*192 815 90 0*196 819 105 951*
** ** *** ** ***
34075 09/20*201 818 85 0*208 819 85 0*215 819 90 0*221 819 95 0*
34075 09/20*200 822 110 0*205 823 110 0*212 823 110 0*219 823 110 0*
*** ** *** *** ** ***
34080 09/21*228 820 100 0*235 819 100 0*243 817 105 0*250 815 105 963*
34080 09/21*226 821 110 0*233 819 100 0*240 817 105 0*247 815 110 950*
*** ** *** *** ** ***
34085 09/22*256 812 100 0*262 807 85 0*268 802 75 964*273 797 80 965*
34085 09/22*254 814 115 0*260 812 115 940*266 809 85 0*273 801 80 965*
*** ** *** *** ** *** **
34090 09/23*277 790 80 0*285 776 85 0*298 756 90 0*314 736 90 0*
34090 09/23*279 789 80 0*285 776 85 0*296 757 90 0*310 736 90 0*
*** ** *** **
34095 09/24*332 716 85 0*351 695 75 0E371 669 65 0E398 623 60 0*
34095 09/24*330 716 85 0E351 695 75 0E371 669 65 0E393 620 60 0*
*** * *** **
34100 09/25E420 570 55 0E433 528 50 0E446 486 45 0E469 432 40 0*
34100 09/25E415 575 55 0E433 528 50 0E446 486 45 0E460 437 45 0*
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(The 26<sup>th</sup> is new to HURDAT.)

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34102 09/26E475 390 45 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
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34105 HRBFL3CFL2
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34105 HRBFL4CFL2
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### U.S. Landfalls:

9/21/1948 – 17Z – 24.6N, 81.6W – 110 kt – 950 mb – 10 nmi RMW – 1008 mb OCI – 250 nmi ROCI

9/22/1948 – 05Z – 25.8N, 81.3W – 115 kt – 940 mb – 1007 mb OCI – 300 nmi ROCI

Minor track changes and major changes to intensity are analyzed for this major hurricane that made two landfalls in Cuba and two landfalls in southern Florida. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Ho et al. (1987), Schwerdt et al. (1979), Jarrell et al. (1992), Perez et al. (2000), Dunn and Miller (1960), and Barnes.

### September 14:

HWM analyzes a closed low of at most 1010 mb centered near 12.8N, 61.9W with a wave axis extending northeastward from the low to 18N, 57W. HURDAT does not list a system on this day. Microfilm at 18Z shows a closed low of at most 1008 mb centered near 10.8N, 59.6W. No gales or low pressures.

## September 15:

HWM analyzes a trough or wavelike axis extending from 11N, 68W to 20N, 62W. HURDAT does not list a system on this day. Microfilm does not analyze a closed low on this day. Ship highlights: 35 kt E and 1012 mb at 18Z at 17.5N, 60.7W (COA).

## September 16:

HWM analyzes a low (not quite closed) located in a trough in the general vicinity of 13.6N, 72.0W with a wave axis extending from the low northeastward to 22N, 64W. HURDAT does not list a system on this day. Microfilm does not analyze a closed low. No gales or low pressures.

## September 17:

HWM analyzes a low (not closed) near 17N, 75W with a wave axis extending to beyond 16N, 71W. HURDAT does not list a system on this day. Microfilm analyzes a broad, closed low of at most 1009 mb in the general vicinity of the western Caribbean Sea. No gales or low pressures.

## September 18:

HWM analyzes a slightly elongated closed low of at most 1005 mb near 18.2N, 78.8W. HURDAT lists this as a 55 kt tropical storm at 18.2N, 79.8W. The MWR tracks of centers of cyclones shows a 12Z position near 19.1N, 79.7W. Microfilm analyzes a closed low of at most 1005 mb near 17.2N, 80.8W. "The most destructive hurricane of 1948 developed in the western Caribbean between Jamaica and Grand Cayman Island on September 18. It formed from an easterly wave that had been under observation since it passed through the Lesser Antilles on the 14<sup>th</sup>" (MWR). Ship highlights: 20 kt WSW and 1002 mb at 2130Z at 17.7N, 80.3W (micro). Land highlights: 10 kt ESE and 1003 mb at 12Z at Kingston, Jamaica (HWM, micro); 30 kt NNE and 1005 mb at 1830Z at Grand Cayman (micro). Aircraft highlights: center fix at 1815Z at 18.7N, 80.5W with 60 kt estimated maximum winds and 994 mb pressure (maybe central pressure?). "Note: Navy Hurep #8. Storm centered at 18.7N, 80.5W at 1815Z, lowest pressure 994 mbs, max winds SE 60 knots. Pilot said perfect eye about 15 miles in diameter. Wind about hurricane force in gusts. Position checked by radar from Cayman" (micro).

## September 19:

HWM analyzes a tropical storm of at most 1000 mb centered near 19.5N, 81.4W. HURDAT lists this as a 75 kt hurricane at 19.1N, 81.4W. The MWR tracks of centers of cyclones shows a 00Z position near 19.3N, 80.9W, and a 12Z position near 19.6N, 81.8W with a 997 mb pressure. The MWR post-season track map shows a 00Z position near 18.3N, 81.4W, and a 12Z position near 19.1N, 81.7W. Microfilm analyzes a low of at most 996 mb centered near 18.9N, 81.4W. Ship highlights: 25 kt WSW and 1000 mb at 1830Z at 18.2N, 81.1W (micro). Two other low pressures of 1001 mb and 1002 mb. Land highlights: 40 kt E (55 kt was the maximum 1-minute wind for the previous hour) and 997 mb at 12Z at Grand Cayman (HWM, micro); 45 kt SE (65 kt was the maximum 1-minute wind for the previous hour) and 998 mb at 1430Z at Grand Cayman (micro). Aircraft highlights: radar center fix at 1611Z at 19.5N, 81.8W with estimated maximum

winds of 100 kt (micro); center fix at 2030Z at 20.0N, 82.8W with 951 mb central pressure (micro). Six other gales. “Navy 15- 1611Z- Radar storm fix 19.5N, 81.8W, max wind south 100 knots. Eye only 5 miles in diameter. Hurricane force winds about 60 miles in diameter. Strong easterlies to E and NE of storm seem to be independent of storm circulation” (micro).

#### September 20:

HWM analyzes a tropical storm of at most 1000 mb centered near 21.3N, 82.0W. HURDAT lists this as a 90 kt hurricane at 21.5N, 81.9W. The MWR tracks of centers of cyclones shows a 00Z position near 20.7N, 82.3W, and a 12Z position near 21.9N, 82.4W. The MWR post-season track map shows a 00Z position near 19.8N, 82.0W, and a 12Z position near 21.4N, 82.3W. Microfilm analyzes a low of at most 990 mb centered near the HURDAT position. Ship highlights: 30 kt NE and 1004 mb at 20Z at 24.3N, 83.6W (micro). Land highlights: 45 kt SSW and 1000 mb at 03Z at Grand Cayman (micro); 35 kt NE G 40 kt and 995 mb at 2330Z at 22.9N, 82.6W (micro). Eleven other gales and 26 other low pressures between 995-1005 mb. Aircraft highlights: radar center fix at 21.4N, 82.3W at 1428Z with 85 kt estimated maximum winds (micro); 45 kt E and 1002 mb at 23.6N, 81.0W (micro). At least six other gales and at least two other low pressures. Other highlights: 45 kt SE and 998 mb at 14Z at 21.8N, 81.0W (micro); 35 kt SSW and 995 mb at 2130Z at 21.8N, 81.0W (micro). Six other gales and eight other low pressures. “After a center developed on the 18<sup>th</sup>, it moved very slowly, turned to a northerly direction, and passed over western Cuba with the center moving between Havana and Matanzas on the 20<sup>th</sup>. At this time it was a fully developed hurricane, with winds well over 100 mph, and reports indicate that the city of Matanzas suffered extensive damage. Some damage occurred at Havana where the wind reached 90 mph from the north and some damage occurred. Press reports indicate that 10 persons were killed by the storm in Cuba and that property damage reached ‘several million dollars’” (MWR). “Navy at 10:15 am, EST (1515Z) hurricane center at 9:28E (1428Z) at 21.4N, 82.3W. Max winds at 85 kt” (micro). Station 969 (23.0N, 82.6W) reported NE 9- gusty to 70 knots, squally, at 2030Z” (micro). “‘El Huracan de Matanzas’ – Sep 20-21 – Category 3” (Perez et al. 2000).

#### September 21:

HWM analyzes a tropical storm of at most 995 mb centered near 24.3N, 81.8W. HURDAT lists this as a 105 kt hurricane at 24.3N, 81.7W. The MWR tracks of centers of cyclones shows a 00Z position near 23.7N, 82.5W, and a 12Z position near 24.7N, 82.0W with a 964 mb pressure. The MWR post-season track map shows a 00Z position near 22.8N, 82.0W, and a 12Z position near 23.8N, 81.8W. Microfilm analyzes a tropical storm of at most 987 mb centered near 23.8N, 81.4W. Ship highlights: 65 kt SE and 997 mb at 1230Z at 24.4N, 80.7W (micro). One other gale and five other low pressures. Land highlights: 78 kt N (max wind) at Havana (MWR); 50 kt NNW and 988 mb at 0630Z at Havana (micro); 68 kt (max wind, 1-minute) at 1558Z and 988 mb (min pressure) at 16Z at Dry Tortugas, FL (MWR, clima); 963 mb (min pressure) at 1615Z at Boca Chica (MWR, OMR); 973 mb (min pressure) at 1630Z and 65 kt NW (max wind, 1-minute) at 1708Z at Key West (MWR, clima, OMR); 104 kt (elevated) SE (max wind, 1-minute) and 986 mb (min pressure) at 18Z at Sombrero Key (MWR, clima); 96 kt NW

and 980 mb at 1830Z at Boca Chica (OMR); 66 kt SE (1<sup>st</sup> max wind, 1-minute) at 1943Z at downtown Miami (OMR, MWR). At least 88 other gales and at least 43 other low pressures below 1000 mb. Other highlights: 50 kt E and 992 mb at 1030Z at 24.5N, 81.4W (micro); 85 kt NE at 1230Z at 24.5N, 81.4W (micro). Nine other gales and seven other low pressures. “Leaving Cuba the hurricane crossed the Florida Straits and by noon of the 21<sup>st</sup> the center was very close to Key West and due east of the station. The lowest barometric pressure recorded in the Keys was 963.4 millibars (28.45 inches) observed at the Boca Chica Airport, 8 miles east-northeast of the Key West city office. The wind speed at the same station reached 122 mph (estimated) before the anemometer was blown away. This was the highest reported in the hurricane but undoubtedly higher winds were experienced. Boca Chica was in the western portion of the calm center for a period of 15 minutes beginning at 11 am, September 21” (MWR). “Its forward speed was less than 8 mph as it drifted over the Cuban countryside on the night of September 20. Winds of 100 mph caused widespread but moderate damages just east of Havana. Over the next few hours it made the short journey to Key West, where its ten-mile wide eye passed over Boca Chica airport. Even though the wind howled, tides at Key West only reached six feet above mean low water” (Barnes). “Radar fixes from Key West. 0500Z- (center) 180 degrees and 78 miles (from Key West) movement north 4 mph. 0700Z- 180 degrees 70 miles, horseshoe effect shows axis running almost due N-S moving about 4 mph. 0800Z- 180 degrees 66 miles moving 4 mph. Indications show forward part of horseshoe diminishing slightly while southern part seems to be closing in. 0900Z- 190 degrees 60 miles, movement north 6 mph. Seems to have picked up speed. 1000Z- 190 degrees 54 miles, north motion about 6 knots. Definitions excellent. Diameter about 20 miles outer fringe of heavy wind area about 10 miles from Key. Circulation about  $\frac{3}{4}$  complete. 1100Z- hurricane center bears 185 degrees true distance 48 miles from Boca Chica, course northerly, speed 6 knots, diameter of eye 20 miles, definition excellent. 1200Z- storm center bears 180 degrees 42 miles moving northerly 6 knots. 1300Z radar report #12 from Boca Chica. Hurricane center bears 180 degrees true distance 36 miles course north, speed 6 knots. 1400Z report from Key radar position 180 degrees 26 miles moving due north. 1500Z hurricane center bearing 170 degrees true distance 16 miles from Boca Chica, (movement) accelerated to 10 knots, diameter of eye 10 miles. 1600Z hurricane center bearing 165 degrees true distance 10 miles. Remarks instruments carried away 1615Z, gusty 165 mph. 1700Z hurricane center 60 degrees true distance 7 miles from Boca Chica. Course NNE, speed 10 knots, western edge of eye passed Boca Chica. 1800Z hurricane center bearing 45 degrees true distance 14 miles from Boca Chica, (movement) NNE 6 knots, eye 20 miles diameter” (micro). “9/21/1948 – 935 mb central pressure, based upon 963 measured at Boca Chica Airport, FL, 7 nm RMW, 8 kt movement” (Ho et al. 1987). “9/21/1948 – 1010 mb environmental pressure, 111 kt 1 min surface wind estimate” (Schwerdt et al. 1979). “Sep – FL – 3SW, 2SE, 963 mb” (Jarrell et al.).

#### September 22:

HWM analyzes a tropical storm of at most 985mb centered near 26.8N, 80.7W. HURDAT lists this as a 75 kt hurricane at 26.8N, 80.2W. The MWR tracks of centers of cyclones shows a 00Z position near 25.9N, 81.9W, and a 12Z position near 27.0N, 80.8W with a 964 mb pressure. The MWR post-season track map shows a 00Z position

near 25.8N, 81.6W, and a 12Z position near 26.7N, 81.1W. Microfilm analyzes a low of at most 972 mb centered near the HWM position. Ship highlights: 70 kt and 988 mb at 16Z at 26.4N, 79.4W (micro); 985 mb at 1845Z at 26.4N, 79.2W (micro). Five other gales and seven other low pressures. Land highlights: 104 kt NNW (max wind, 1-minute) at Everglades City (MWR, climo); 95 kt NE and 958 mb at 0430Z at Everglades City (micro); at least 85 kt and at most 948 mb at 0515Z at Everglades City (micro); 83 kt ENE (max wind, 1-minute) at 1004Z at Clewiston, FL (MWR, climo); 50 kt ENE G 85 kt and 964 mb at 1030Z at Clewiston (micro); 965 mb (central pressure) at 1730Z at Stuart (MWR); 71 kt and 976 mb at 20Z at Melbourne (micro). At least ten other hurricane force winds, and at least 25 other low pressures below 980 mb. Other highlights: 50 kt WSW at 0330Z at 25.2N, 80.6W (micro); 45 kt S and 983 mb at 1830Z at 26.7N, 78.7W (micro). ). It should be noted that according to the Air Weather Service tech report, the lowest observed pressure during the hurricane was 951.6 mb from Everglades City, and the highest observed wind was 122 mph from Everglades City (AWS). "After leaving the Keys the center moved onto the mainland a short distance east of Everglades City, crossed Lake Okeechobee between Clewiston and Belle Glade and passed into the Atlantic at Jensen Beach near Stuart. By the time the Lake Okeechobee section was reached, wind velocities had been reduced to about 90 to 95 mph, while on the Atlantic coast where the center passed to sea readings were slightly below hurricane force for sustained velocities, but with gusts above hurricane force" (MWR). "It will be noted that the strongest wind recorded was 122 mph (estimated) at Boca Chica Airport near Key West. The anemometer was blown down at this place, but it is believed this velocity is about correct for sustained wind. A gust recorded showed an extreme of 160 mph, but we believe this reading is open to considerable doubt as to accuracy. The anemometer at Everglades City was blown down after recording about 100 mph, and it was estimated that the maximum at that place was about 120 mph, which seems logical. Lowest pressure 28.45 inches at Boca Chica and 28.47 at Clewiston" (Florida Climatological Data). "An unusual feature of this hurricane was the number of calms and lulls reported from widely separated points. Several stations in the Lake Okeechobee area reported two distinct "eyes" with blue sky and calms in each, spaced several hours apart. Such widely separated places as Tavernier, Boca Chica, Okeechobee City, and Stuart reported lulls. These stations lie 40 to 80 miles apart on an east-west axis. These reports appear to be substantiated by actual records and leave little doubt that the central vortex was distorted, or even divided into several partially or fully developed centers. Mr. Grady Norton, meteorologist in charge of the Miami Office has written a descriptive account of this phase of the hurricane which is quoted below: *'When the hurricane was in Cuba, a news writer called it "a blind behemoth" but we believe a more descriptive character comes from mythology in Cyclops, the one-eyed giant. To carry the simile further, Cyclops must have encountered Ulysses in Cuba, because something happened to his eye! When he came out into the Florida Straits, the eye was distorted and elongated, and to some extent broken up, and it reminded us of Argus, otherwise known as Panoptes, for when it came over Florida on the 21<sup>st</sup> and 22<sup>nd</sup> there was an eye for everybody! There were so many eyes reported at so many widely separated places, and the movement was so slow (about 8 to 10 mph), we were reminded of an oxcart. So Oxcart Panoptes made his leisurely way up through the Florida Everglades ogling every community in the southeastern part of the State'* (Norton)" (MWR). "When the storm came out into the Florida Straits, the

'eye' was distorted and elongated, and to some extent broken up, and when it came over Florida on the 21<sup>st</sup> and 22<sup>nd</sup> there seems to have been several centers. Since it was over the sparsely settled Everglades, it was very difficult to keep accurate track of the main center during the hurricane's progress..." (Florida Climatological Data). "A summary of casualties and estimated damage for Florida follows: deaths, 3; injuries requiring hospital care, 45; homes destroyed, 39; homes damaged severely, 1,161; buildings other than homes destroyed, 40; buildings other than homes damaged, 237; people sheltered in 213 Red Cross shelters, 38,323; property damage (all kinds), \$5,000,000; crop damage (all kinds), \$6,500,000; power and communications, \$300,000; highways, streets, and bridges, \$200,000; total for Florida, \$12,000,000" (MWR). "Property damage in Florida will approximate \$5,000,000 divided somewhat as follows: Key West and Keys about \$1,000,000; Greater Miami and other Dade County communities, around \$2,000,000; all other areas about \$2,000,000" (Florida Climatological Data). Regarding the flooding... "Heavy rainfall, which amounted to a total of 10 to 11 inches in places and averaged about 8 inches for the entire Everglades-Okeechobee area, caused considerable flooding throughout the area. In addition, there was apparently some spillage of water through canal locks at the Lake, and as a result some towns were inundated, as well as the farm and pasture lands. Clewiston was flooded to a depth of 2 or 3 feet, La Belle was under water for several days, while Everglades City got its usual bath of salt water from the Gulf. Flooding of pastures caused loss of some cattle, and required the extensive evacuation of herds to higher ground. In the lower east coast Indian River areas there was considerable loss to citrus and other tropical fruits as well as to fall truck crops" (MWR, Florida Climatological Data). "The flooding, together with the hurricane winds, caused rather heavy damage to sugarcane, and practically all early fall truck crops were destroyed" (Florida Climatological Data). "Hours after its arrival in Key West, the storm struck the mainland near Everglades City. It passed inland through sparsely populated portions of Collier County, moved just below Belle Glade, and eventually emerged over the Atlantic near Jupiter on the morning of September 22" (Barnes). Regarding the multiple lulls reported... "some meteorologists at the time suggested that the storm had several distinct centers; other theorized that the lulls were pockets of dry air between approaching rainbands" (Barnes). "In Miami winds reached 90 mph, and almost 4.5 inches of rain fell. High tides covered portions of the bayfront, and large breakers pounded the shore. The tide was 4.5 feet above mean low water. Boats and small craft were battered by waves; some broke their moorings and were bashed against their docks. Docking facilities at Coconut Grove were badly damaged, and piers and boat houses around the bay suffered from the rising tide. At Miami Beach the ocean road approach to Haulover Bridge was washed away. Palm trees littered the area around Lummus park, and homes and businesses had shattered windows and torn awnings" (Barnes). "SS Morvana 1230Z- 27.4N, 79.5W- SE 70- sea 7- Barometer 29.3- squalls. SS Georgia 1230Z- 26.5N, 79.5W- Barometer 29.22- SE (force) 12- Heavy Sea" (micro). "SS Georgia- a hurricane from the west apparently going to N or NE from latitude 26.4N, 79.3W...reported 1600Z, barometer 988 mb and falling, wind force 12, more at times. South sea rough, heavy swells and torrential rains. S.S. Georgia located 26.3N, 79.2W. Eye of hurricane passed overhead NNE, barometer 29.08 1845Z" (micro). "By telephone at 2022Z: on auto trip from Stuart to Lake Okeechobee- wind SE at Stuart 60 to 70 (mph) estimated; 7 or 8 miles from lake a calm; right at lake wind SW 70 to 80 mph; on return

trip one hour later at lake SW 60 or 70 mph; at Indian town calm; at Stuart SE 60 or 70 mph pressure 28.92; above confirmed by another resident” (micro). Stuart and Jensen Beach...center for 25 minutes between 1735Z and 1800Z. Wind before lull SE 50 (mph) sharp increase to NW 60 (mph) after lull passes. During this same period, winds at Fort Pierce backed from S around thru N to NW” (micro). Telephone at 2020Z: Fellesmere (17 miles NW of Vero Beach)- No high winds or signs of center up to 2000Z; Melbourne wind 82 mph baro. 28.82 rising at 2000Z” (micro). “9/22/1948 – 963 mb central pressure, based upon 965 mb measured at St Lucie Lock, FL, 16 nm RMW, 11 kt movement (exiting the coast)” (Ho et al. 1987). “9/22/1948 – 1007 mb environmental pressure, 87 kt 1 min surface wind estimate (exiting the coast)” (Schwerdt et al. 1979). “Tropical cyclones in Florida, Sept. 22, Southern portion, Major, Key West bar. 28.45 in., wind 122 mph” (Major is equivalent to Saffir-Simpson Hurricane Scale 2 or 3, Dunn and Miller).

#### September 23:

HWM analyzes a low of at most 985 mb centered near 30.1N, 76.1W. HURDAT lists this as a 90 kt hurricane at 29.8N, 75.6W. The MWR tracks of centers of cyclones shows a 00Z position near 28.1N, 79.4W, and a 12Z position near 30.4N, 76.1W with a 968 mb pressure. The MWR post-season track map shows a 00Z position near 27.6N, 78.6W, and a 12Z position near 29.5N, 76.0W. Microfilm analyzes a low of at most 963 mb centered near the HURDAT position. Ship highlights: 50 kt SW and 993 mb at 00Z at 26.0N, 78.4W (micro); at least 50 kt NW at 01Z at 27.8N, 79.5W (micro); 35 kt SE and 970(?) mb at ~0Z to 3Z at 28.1N, 77.7W (micro); 50 kt S and 979 mb at 06Z at 28.2N, 76.3W (micro); 50 kt ENE and 968 mb at 12Z at 30.1N, 76.1W (micro). At least nine other gales, and at least 19 other low pressures below 1000 mb. Land highlights: At least 50 kt SW and 984(?) mb at 00Z at West End, Grand Bahama Island (micro); 35 kt W and 994 mb at 0030Z at Jupiter, FL (OMR); 45 kt S and 990 mb at 06Z at Great Abaco Island (micro); 998 mb (min pressure) at 2010Z at Cape Hatteras, NC (OMR). One other gale and six other low pressures. Aircraft highlights: 40 kt W and 979 mb at 16Z at 29.8N, 65.8W (micro). Three other gales of 40 kt and one other low pressure of 981 mb. “There was some intensification of the hurricane after it moved northeastward between Hatteras and Bermuda, finally reaching a point south of Newfoundland on September 25” (MWR). Navy estimated position of storm center at 1630Z to be 30.0N, 74.2W (good loran fixes)” (micro).

#### September 24:

HWM analyzes a low of at most 985 mb centered near 36.5N, 66.9W with the NE end of a NE-SW cold front located about 150 nm SW of the low, and the W end of a W-E warm front located about 200 nm north of the low. HURDAT lists this as a 65 kt extratropical storm at 37.1N, 66.9W. The MWR tracks of centers of cyclones shows a 00Z position near 33.1N, 72.7W, and a 12Z position near 36.5N, 67.6W with a 969 mb pressure. The MWR post-season track map shows a 00Z position near 33.4N, 71.6W, and a 12Z position near 37.1N, 67.4W. Microfilm analyzes a low of at most 981 mb centered near 36.8N, 67.7W with a frontal analysis similar to the HWM analysis. Ship highlights: 50 kt ESE and 977 mb at 04Z at 34.5N, 70.1W (micro); at least 50 kt NNE around ~12Z at 36.8N, 69.3W (micro). About six other gales of at least 50 kt, and about eight other low

pressures below 990 mb. Land highlights: 25 kt SW and 1004 mb at 12Z at Bermuda (micro). Aircraft highlights: At least 50\*\* kt SSW at 06Z at 34.0N, 65.1W (micro); 45 kt SW and 980 mb at 2045Z at 37.8N, 61.0W (micro); at least 50\*\* kt SSW at 2115Z at 37.9N, 59.1W (micro). "Radar recon reported indefinite center at 0500Z- estimated center position 34.6N, 70.3W" (micro).

#### September 25:

HWM analyzes a closed low of at most 985 mb centered near 44.0N, 48.3W with a cold front extending from a few hundred nm SSW of the low southwestward to beyond 35N, 62W. Another cold front extends from several hundred nm ENE of the low northeastward to several hundred nm south of another low (the other low is of at most 980 mb and is located near 55N, 35W), and a warm front extends from the NE end of that cold front southeastward to 46N, 26W. HURDAT lists this as a 45 kt extratropical storm at 44.6N, 48.6W. The MWR tracks of centers of cyclones shows a 00Z position near 41.7N, 58.7W, and a 12Z position near 45.7N, 49.6W. The MWR post-season track map shows a 00Z position near 42.2N, 57.2W, and a 12Z position near 44.2N, 48.9W. Microfilm analyzes a closed low of at most 984 mb centered near 44.0N, 49.5W. Ship highlights: At least 50 kt SSW and 987 mb at 00Z at 40.3N, 55.0W (micro); 45 kt SW and 984 mb at 06Z at 40.9N, 52.9W (COA); 45 kt W and 997 mb at 12Z at 40.0N, 52.2W (COA); 40 kt NW and 987 mb at 18Z at 43.3N, 47.3W (micro). Six other gales of 40 to 50 kt and about 20 other relevant low pressures below 1000 mb.

#### September 26:

HWM analyzes three closed lows- two of at most 975 mb located near 54N, 36W and 51N, 27W respectively, and one of at most 970 mb located near 57N, 21W. These three closed lows are all encircled by a single 980 mb isobar. An occluded front extends from the 3<sup>rd</sup> low towards the east, and then wraps around to the south and south-southwest to 48N, 16W. A cold front is plotted from 45N, 27W to west of 36N, 49W. HURDAT does not list a system on this day. The MWR tracks of centers of cyclones last shows a position at 00Z near 48.0N, 39.3W. Ship highlights: 45 kt NW and 979 mb at 00Z at 45.9N, 40.4W (COA). Several other gales and low pressures.

HURDAT originally started this system at 06Z on 18 September (no change to timing of genesis). This system was tracked as an easterly wave from 14 September when it crossed the Lesser Antilles. Aircraft reconnaissance first investigated the wave on the 16<sup>th</sup>, and they did not find a closed low. As the system moved westward into the central to western Caribbean, there were no flights on the 17<sup>th</sup>. There is a chance that the low that spawned this hurricane could have been closed by the 17<sup>th</sup>, but there are no observed west winds that day. Observations from Jamaica and the Cayman Islands at 12Z on the 18<sup>th</sup> suggest that the timing of genesis in HURDAT is good. The intensity at the first point (06Z on the 18<sup>th</sup>) is revised downward to 40 kt (from 50 kt originally). The largest track change for this storm between the 18<sup>th</sup> and the 21<sup>st</sup> of September is only half of a degree. Aircraft center fixes as well as the land-based radar at Boca Chica were important for the track changes made. (It is noted that this likely was the first operational use of land-based radar for hurricane analysis and forecasting.) At 1815Z on the 18<sup>th</sup>, aircraft performed a center fix. A central pressure of 994 mb was measured and

maximum surface winds of 60 kt were estimated. A 994 mb central pressure corresponds to a 58 kt intensity using the Brown et al. southern pressure-wind relationship. The 60 kt previously in HURDAT at 18Z the 18<sup>th</sup> is maintained, and a central pressure of 994 mb is added into HURDAT. On the 18<sup>th</sup> through the 19<sup>th</sup>, the tropical cyclone rapidly intensified. On the morning of the 19<sup>th</sup>, Grand Cayman recorded a 1-minute sustained wind of 65 kt. A couple of hours later, aircraft estimated maximum surface winds of 100 kt. Apparently, forecasters and the aircraft reconnaissance crew did not realize how quickly this system was intensifying, because an aircraft decided to fly into the eye at 2030Z on the 19<sup>th</sup> (usually they would not fly into the eye of major hurricanes). The aircraft measured a central pressure of 951 mb inside the eye. It should be noted that this value of 951 mb obtained from the aircraft center fix is by far the lowest central pressure observation from any aircraft between the years 1944-1948. A central pressure of 951 mb corresponds to an intensity of 110 kt using the southern pressure-wind relationship, and 112 kt for intensifying systems. 105 kt is chosen for 18Z on the 19<sup>th</sup> (up from 80 kt originally), and 110 kt is chosen for 00Z on the 20<sup>th</sup> (up from 80 kt originally). Major upward intensity revisions were made from 18Z on the 19<sup>th</sup> through 12Z on the 20<sup>th</sup>. A central pressure of 951 mb is added into HURDAT at 18Z on the 19<sup>th</sup>. By 00Z on the 20<sup>th</sup>, the slow-moving hurricane had made a gradual turn towards the north and was located between the Cayman Islands and the Isle of Youth. The hurricane passed just to the east of the Isle of Youth around midday on the 20<sup>th</sup>. It made its first landfall in Cuba a 22Z on the 20<sup>th</sup> at 22.3N, 82.1W with an intensity of 110 kt (a category 3). The cyclone made a 2<sup>nd</sup> Cuban landfall about three hours later (01Z on the 21<sup>st</sup>) at 22.7N, 82.0W, also with an intensity of 110 kt at 00Z the 21<sup>st</sup> (100 kt originally). The highest wind recorded at Havana was 78 kt from the N, but the hurricane passed well to the east of Havana. The analysis here of a category 3 at Cuban landfall is consistent with the analysis of Perez et al. (2000). The hurricane moved off the northern coast of Cuba and into the Straits of Florida around 04Z on the 21<sup>st</sup>. The hurricane may have weakened to a category 2 while it traversed Cuba, but by 06Z on the 21<sup>st</sup>, it is analyzed that the hurricane had re-intensified over water to 100 kt (no change to HURDAT). On the 21<sup>st</sup>, the hurricane moved in a direction just east of due north towards the lower Florida Keys.

The hurricane made its first Florida landfall in the lower Florida Keys approximately seven miles east-northeast of Boca Chica around 17Z on the 21<sup>st</sup>. The lowest pressure recorded in the Keys was 963 mb at Boca Chica at 1615Z but the wind speed at Boca Chica at the time of the lowest pressure is not known. The distance of the closest approach of the center of the eye to Boca Chica was probably around six nautical miles. The landfall RMW is analyzed to be 10 nautical miles. Text (above in the September 21<sup>st</sup> paragraph) indicates that Boca Chica Airport was in the western portion of the "calm center" for 15 minutes. Although the analysis indicates that Boca Chica experienced the RMW, the analysis does not indicate that Boca Chica experienced the calm eye. The 963 mb observation at Boca Chica is not treated as a central pressure. Therefore, the 963 mb central pressure previously in HURDAT at 18Z the 21<sup>st</sup> is removed from HURDAT. Utilizing the Schloemer (1954) equation to obtain a central pressure given a peripheral pressure, the peripheral pressure's radius, and the RMW, we obtain an estimate at 18Z on the 21<sup>st</sup> 949 mb- we chose 950 and added it into HURDAT. A central pressure of 950 mb equals 111 kt south of 25N and 105 kt north of 25N, and 110 kt is chosen for 18Z on

the 21<sup>st</sup> (up from 105 kt originally). After passing through the Keys, the hurricane continued north-northeastward and made landfall just a few nautical miles southeast of Everglades City, FL around 05Z on the 22<sup>nd</sup>. A note on the 0530Z microfilm map from September 22<sup>nd</sup> indicates that at 0515Z, Everglades City recorded a pressure of less than 948 mb along with a wind speed of more than 100 mph. Using the 1 mb per 10 kt rule inside the RMW, the central pressure at landfall was at most 940 mb. Everglades City likely experienced the RMW on the left (weak side of the storm). (See next paragraph for more on why 940 mb was chosen as the central pressure.) A central pressure of 940 mb is added into HURDAT at 06Z on the 22<sup>nd</sup>. A central pressure of 940 mb equals 115 kt north of 25N and 120 kt S of 25N. Although the forward motion of the hurricane was still slow, the RMW was smaller than average, and the storm may have been intensifying before landfall. An intensity of 115 kt is analyzed for landfall. An intensity of 115 kt is analyzed for both 00Z and 06Z on the 22<sup>nd</sup> (up from 100 and 85 kt originally; the latter is a major intensity change). Although 06Z on the 22<sup>nd</sup> is about one hour after landfall, part of the RMW is still analyzed to be over water, so the landfall intensity of 115 kt is kept at 06Z on the 22<sup>nd</sup> as well. At 12Z on the 22<sup>nd</sup>, the center of the hurricane is analyzed to be located at 26.6N, 80.9W (26.8N, 80.2W originally), or just south of Lake Okeechobee. The cyclone is analyzed to have emerged into the Atlantic at 18Z on the 22<sup>nd</sup> near Stuart, FL. A run of the Kaplan and DeMaria Inland Decay Model for 12Z on the 22<sup>nd</sup> yields an intensity of 68 kt. The highest reliable observed wind within two hours of the 12Z synoptic time is 83 kt, and 85 kt is chosen for the 12Z intensity (up from 75 kt originally). The MWR text indicates that the maximum winds were 90 to 95 mph when the cyclone was in the Lake Okeechobee region (around 12Z), so the intensity of 85 kt is slightly above that. It is not appropriate to run the Kaplan and DeMaria model to obtain the intensity at 18Z on the 22<sup>nd</sup> since the center was crossing the coastline of eastern Florida at that time. The highest observed wind within two hours of the 18Z synoptic time is 71 kt. However, a 965 mb central pressure was observed at Stuart, FL at 1730Z. A central pressure of 965 mb equals 90 kt using the north of 25N relationship and 86 kt for weakening systems. Using a combination of the 71 kt observed wind speed, the pressure-wind relationship, and consideration that the cyclone was beginning to emerge off of the coast, 80 kt is chosen for the intensity at 18Z on the 22<sup>nd</sup> (unchanged from HURDAT).

The observation from Everglades City of the pressure lower than 948 mb found on microfilm was surprising. Of all the sources utilized, microfilm was the only source to contain any pressure observations from Everglades City. Microfilm shows that the pressure decreased at Everglades City from 972 mb (and 85 kt NE winds) at 0315Z to 958 mb (and 95 kt NE winds) at 0430Z to less than 948 mb (and winds above 85 kt) at 0515Z. It was uncertain whether a central pressure of 940 mb was a good estimate (or too high since the observation precisely said that "Pressure less than 28 in. wind 100+") because it was uncertain whether Everglades City was inside the RMW at the 0515Z observation. Since there is a central pressure observation from Stuart at 1730Z, the Ho et al. Inland Pressure Decay Model was run to determine whether a central pressure of 940 mb was too high for the central pressure at landfall. A value of 947 mb was obtained for landfall using the model which is in the same ballpark, so it was decided to keep to the 940 mb central pressure for the mainland Florida landfall.

After the hurricane emerged into the Atlantic, it accelerated and moved northeastward. Again, on the 23<sup>rd</sup>, only very small track changes are made. At 12Z on the 23<sup>rd</sup>, a ship observed a pressure of 968 mb with 50 kt winds. A peripheral pressure of 968 mb corresponds to a wind speed of at least 87 kt using the north of 25N relationship. The 90 kt intensity in HURDAT is unchanged. The cyclone passed about halfway between Cape Hatteras and Bermuda on its northeastward course. It is analyzed that this cyclone became extratropical around 06Z on the 24<sup>th</sup> (6 hours earlier than originally) while the analyzed intensity of 75 kt is unchanged for that time due to an observed peripheral pressure of 977 mb and applying the pressure-wind relationship (although the relationship is not applicable after extratropical transition). On the 25<sup>th</sup>, the largest track changes are only half of a degree and the only intensity change made was to raise the 18Z intensity by 5 kt. HURDAT's last 6-hourly position is at 18Z on the 25<sup>th</sup>. Observations indicate that the cyclone was not absorbed until after 00Z on the 26<sup>th</sup>, so one six-hourly point is added to HURDAT at 47.5N, 39.0W with a 45 kt intensity.

### 1948 Storm 9 (originally Storm 8)

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34110 10/03/1948 M=14 8 SNBR= 757 NOT NAMED XING=1 SSS=2
34110 10/03/1948 M=14 9 SNBR= 757 NOT NAMED XING=1 SSS=2
*

34115 10/03* 0 0 0 0* 0 0 0 0* 0 0 0 0*153 818 40 0*
34115 10/03* 0 0 0 0* 0 0 0 0* 0 0 0 0*167 835 30 0*174 843 30 0*
*** ** ** *** ** **

34120 10/04*168 839 50 0*181 850 55 0*194 851 65 0*204 845 75 0*
34120 10/04*181 847 35 0*188 850 45 0*195 852 55 0*202 850 70 991*
*** ** ** *** ** ** *** ** **

34125 10/05*214 838 90 0*222 833 105 0*233 825 115 0*244 814 110 975*
34125 10/05*212 842 90 0*223 833 110 0*235 823 105 0*247 813 90 963*
*** ** ** *** ** ** *** ** **

34130 10/06*257 801 90 979*267 786 85 0*277 772 75 0*287 756 75 0*
34130 10/06*258 803 80 979*268 792 85 0*277 779 85 0*287 764 85 0*
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34135 10/07*297 738 80 0*306 716 85 0*314 690 90 0*319 660 90 0*
34135 10/07*297 747 85 0*307 728 85 0*314 700 90 0*319 670 90 0*
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34140 10/08*322 630 85 0*325 601 80 0*327 572 75 0*325 543 70 0*
34140 10/08*324 636 90 971*325 601 80 0E324 566 75 0E321 532 70 0*
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34145 10/09*322 513 70 0*320 485 60 0*319 463 60 0*319 447 60 0*
34145 10/09E318 510 65 0E314 492 60 0*310 475 55 0*310 458 55 0*
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34150 10/10*319 433 60 0*320 420 55 0*321 408 55 0*321 400 50 0*
34150 10/10*312 441 50 0*315 424 50 0*318 410 45 0*318 400 50 0*
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34155 10/11*320 393 50 0*318 387 50 0*315 382 45 0*310 380 45 0*
34160 10/12*306 382 45 0*303 385 45 0*302 390 45 0*302 396 40 0*
34165 10/13*302 403 40 0*302 407 40 0*303 413 40 0*305 426 40 0*
34165 10/13*303 403 40 0*305 407 35 0*308 413 35 0*312 426 40 0*
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34170 10/14*309 439 40 0*316 452 40 0*326 464 40 0*337 472 40 0*
34170 10/14*316 439 45 0*321 452 50 0*326 464 55 0*334 470 60 0*

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34175	10/15*348	478	40	0*357	480	40	0*367	480	40	0*385	479	35	0*
34175	10/15*344	475	60	989*354	478	55	0*364	477	55	0*380	479	50	0*
	***	***	**	***	***	***	***	***	**	***	***	**	
34180	10/16*415	466	35	0*	0	0	0*	0	0	0*	0	0	0*
34180	10/16*407	466	50	0E437	430	45	0E465	375	40	0*	0	0	0*
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34185	HRCFL2												
34185	HRBFL2CFL2												
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#### U.S. Landfalls:

10/05/1948 – 18Z – 24.7N 81.2W – 90 kt – 963 mb – 1009 mb OCI – 225 nmi ROCI – 13 nmi RMW

10/05/1948 – 21Z – 25.1N, 80.9W – 90 kt – 1009 mb OCI – 225 nm ROCI

Major changes to both track and intensity are analyzed for this October hurricane that made landfall in Cuba, Florida, and Bermuda. A major change additionally was to add a transient extratropical phase on the 8<sup>th</sup> and 9<sup>th</sup> of October. A final major change is to indicate an extratropical stage at the last 12 hr of its existence. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, the Original Monthly Records from NCDC, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Dunn and Miller (1960), Schwerdt et al. (1979), Ho et al. (1987), Jarrell et al. (1992), Tucker (1995), Perez et al. (2000), and Barnes (1998).

#### October 1:

HWM analyzes a very large, weak, elongated closed low along the ITCZ of at most 1010 mb with the “L” plotted near 13N, 70.5W with a trough or wavelike axis extending from the low northeastward to beyond 19N, 58W. HURDAT does not list a system on this day. Microfilm does not analyze a closed low. No gales or low pressures.

#### October 2:

HWM analyzes a large, weak closed low of at most 1010 mb along the ITCZ centered in the general vicinity of 13.4N, 76.6W with a trough or wavelike axis extending northeastward to 17N, 74W. HURDAT does not list a system on this day. Microfilm does not analyze a closed low. No gales or low pressures.

#### October 3:

HWM analyzes a closed low of at most 1010 mb near 16.5N, 81.8W with a trough or wavelike axis extending north-northeastward from the low to 23N, 79W. HURDAT first lists this system at 18Z as a 40 kt tropical storm at 15.3N, 81.8W. Microfilm shows a trough in the western Caribbean, but no closed low at 12Z. No gales or low pressures.

#### October 4:

HWM analyzes a closed low of at most 1007.5 mb centered near 19.7N, 83.8W with a cold front well north of the low extending from 26N, 93W to 27N, 82W to 29N, 78W. HURDAT lists this as a 65 kt hurricane at 19.4N, 85.1W. The MWR tracks of centers of cyclones shows a 12Z position near 18.9N, 85.1W with a 1006 mb pressure. The MWR post-season track map shows a 12Z position near 19.0N, 85.5W. Microfilm analyzes a closed low of at most 996 mb centered near 20.1N, 85.3W. Ship highlights: 40 kt S and 995 mb at 1830Z at 20.0N, 85.2W (micro); 40 kt NNW and 1004 mb at 1830Z at 19.7N, 85.9W (micro). Three other low pressures between 996-1005 mb. Land highlights: 15 kt ENE and 1005 mb at 20Z at 21.8N, 84.8W (micro). Aircraft highlights: 50 kt NE at 1545Z at 20.6N, 85.6W (micro); center fix at 1730Z at 20.1N, 85.2W with 992 (central?) pressure. Two other gales and one other low pressure. "Forming in the western Caribbean Sea this hurricane was first reported as an organized storm at 10:45 am on October 4, near latitude 19.6N, longitude 85W" (MWR). "It must be assumed that previous to this time the disturbance may have been an easterly wave from the Windward Islands. This disturbance was estimated to contain winds of 40 to 50 mph in squalls within 60 miles of the center. It was expected to move northward over western Cuba during the night. As soon as a reconnaissance plane reached the spot it was found the storm was very small and intense, containing winds of 90 mph at the center. It was still moving northward at 12 mph at 1:15 pm and was expected to increase in intensity and forward speed. By 5:30 pm of the 4<sup>th</sup>, it was definitely determined that the storm was of full hurricane strength. At this time, the storm was near lat 21 and lon 85, still moving northward at 12 mph" (Key West OMR). "Navy reports fix on center 1645Z 20.2N, 85.2W. Ship reports 1730Z passed through center at 20.1N, 85.2W. Winds force 4. Confused seas. Barometer 992.5 mb" (micro). From the Miami Weather Bureau Advisory issued at 1815Z, October 4... "The tropical disturbance in the northwestern Caribbean Sea has intensified rapidly to full hurricane force. Aircraft estimated highest winds near center at about 90 mph" (Weather Bureau Advisories).

October 5:

HWM analyzes a tropical storm of at most 1000 mb centered near 23.2N, 81.9W. HURDAT lists this as a 115 kt hurricane at 23.3N, 82.5W. The MWR tracks of centers of cyclones shows a 00Z position near 21.2N, 83.8W, and a 12Z position near 24.1N, 81.8W with a 977 mb pressure. The MWR post-season track map shows a 12Z position close to the HURDAT position. Microfilm analyzes a tropical storm of at most 993 mb centered near 23.7N, 82.4W. Ship highlights: 40 kt E and 995 mb at 1230Z at 23.5N, 82.1W (position uncertain) (micro); 40 kt N and (992?) mb at 1230Z at 23.0N, 84.2W (micro). Three other gales of 35 kt and two other low pressures of 1005 mb. Land highlights: 105 kt SSE at 1026Z at Havana (micro); 975 mb (min pressure) at 1815Z at Sombrero Key (24.6N, 81.1W) (MWR); calm and 975 mb (central pressure) at ~2250Z at Homestead, FL (micro); 63 kt SE at ~2330Z at downtown Miami (OMR). Ten other winds of between 60-100 kt (although many of them are estimated or uncertain), and 27 other low pressures between 979-1000 mb. Aircraft highlights: 45 kt SW G 60 kt and 990 mb at 1430Z at 23.1N, 80.9W (micro). At least three other gales and at least five other low pressures. According to the Air Weather Service tech report, the highest wind observed during this hurricane was 126 mph at Havana and the lowest observed pressure was 975 mb at Havana (AWS). "It increased rapidly in intensity during the night and

moved northeastward across Cuba with the center passing a short distance west of Havana at 6 am of the 5<sup>th</sup>. The highest wind at Havana was 132 mph. Considerable damage resulted in the city and crop losses were heavy in Havana and Pinar Del Rio provinces. There were 11 deaths and 300 injuries in Cuba, with property damage estimated at \$6,000,000. By noon the 5<sup>th</sup> the center was over the Keys. At Bahia Honda Bridge and Marathon a lull of about 45 minutes occurred. Winds were well over 100 mph in this area of the Keys” (MWR). “The hurricane moved up to the Keys, where winds were estimated at around 100 mph” (Barnes). “By 11:00 pm (4<sup>th</sup>, 4Z the 5<sup>th</sup>) it appeared to be at a standstill indicating a turn to the northeastward. By 6:15 am of Oct. 5<sup>th</sup>, it was known that this was a very severe storm; Havana reported over 100 mph winds and gusts to 130 mph. As the storm passed Havana near 6 am winds of 132 mph occurred. The storm was at this time entering the Florida Straits just west of Havana and on a northeast course which would pass near Key West and impinge on the Florida coast in the Miami area. At 8:30 am, the storm was 60 miles south-southwest of Key West. At noon, the storm was nearest Key West and the 12:30 pm advisory stated that at noon the storm was 18 miles ESE of Boca Chica; this would place it about 26 miles ESE of Key West. It was continuing to move rapidly northeastward. By 2:30 pm it was apparently over the Keys. At Marathon, Fla., a lull of some 45 minutes occurred near 2:30 pm. The storm continued to move northeastward and was over and west of Homestead at 5:30 pm, over Miami between 8 and 9 pm and passed off the coast near Pompano between 9 and 10 pm. Highest winds at Miami were 82 mph from the NW with gusts to 90 mph. Subsequently, the storm moved rapidly northeastward into the Atlantic passing over Bermuda” (Key West OMR). From the Key West OMR... “The highest wind velocity for a 5-minute period (at the city office) was 45 mph, true, at 12:12 pm. This wind was from the north. Previous to that time and at 11:35 am, 43 mph true was recorded and during the passage of a squall then, the extreme velocity (1 mile) occurred and was 56 mph, true, from the northeast. The lowest pressure was at noon and from the barograph trace it appears to have been 29.25 inches (city office), sea-level. At Boca Chica Airport station, the highest wind was estimated to have been 85+ mph from the north at 12:25 pm. During the progress of the storm gusts were estimated at 120 mph. The only recorded in operation at the station was a Selsyn, untested for some time. This instrument records velocity up to 80 mph and the needle of the instrument was seen to pass this point on occasions. The lowest pressure at Boca Chica was 29.16 inches, sea-level, and this occurred at or near 12:25 pm. The maximum and extreme velocities occurring were recorded by a 3-cup anemometer. The velocities cited before as being true would therefore have been 48 mph and 60 mph respectively, both uncorrected. By a 4-cup anemometer they would have been 55 mph and 72 mph, respectively, both uncorrected. The path of the hurricane was nearest Key West about noon when it bore approximately southeast from the station and distant some 25 miles. The storm passed over Pinar del Rio province of western Cuba and then moved off the northern Cuban coast a short distance west of Havana at which place a velocity of 132 mph from the south was reported. From the position just mentioned the storm moved in a nearly straight line, passing over Miami and off the coast in the vicinity of Pompano. The hurricane was situated west of Havana about 5:00 am; it was near Key West at noon, over Miami between 8 and 9 pm and off the coast about 10:30 pm. The approximate forward speed of the disturbance therefore was 16 to 18 mph, unusually fast for this locality, a

fact which materially reduced the damage. The storm in question was undoubtedly a very severe, small hurricane; the area of hurricane winds scarcely covered a diameter of 50 miles. The center probably contained winds well over 100 mph until it struck the southern tip of the mainland (FL peninsula). By barometric and wind indications at the city office at 10:00 am, it was determined that the center would pass some distance eastward and would cross the line of Florida Keys in the vicinity of the Bahia Honda bridge. The center passed over Bahia Honda bridge; at Marathon a few miles east of the center when the storm was over Bahia Honda, a lull of 45 minutes occurred. The distance from Bahia Honda bridge to Marathon is approximately 10 miles and so it seems that this was the true area of the path. On Cudjoe and Big Pine Keys the wind was severe. At Big Pine Key there is conflicting testimony as to whether a calm period existed or not; however we believe it did exist although it must have been rather brief. From Cudjoe Key and keys to the westward, heavy winds began to from the east but backed thru north and west and continued from the west and southwest. Reports from the vicinity of Marathon, Big Pine, Cudjoe and Sugar Loaf Keys indicate this storm was fully as intense as its predecessor two weeks ago with the difference that the former storm was slow moving and gales lasted many hours. This storm, the intensity built up rapidly, was of short duration and subsided even faster than it grew and had moved from the area all within the period of a day. As we receive delayed reports from the area, we conclude that this storm was fully as great as the hurricane of September 21<sup>st</sup> although in the presently mentioned storm the most violent winds were from the north and northwest. Heavy northeasterly gales were experienced prior to the storm; in the disturbance of two weeks previous, heavy gales began from the northeast and intensified from the east and southeast" (Key West OMR). "Winds were well over 100 mph in this area of the Keys (referring to the area near Bahia Honda bridge)" (Florida Climatological Data). Regarding the hurricane in Cuba... "heavy rains caused flash floods that swept away homes and cattle" (Barnes). "The storm surge in Biscayne Bay matched that of the September storm- about 4.5 feet above mean low tide. Rainfall at the Miami Airport exceeded 9.5 inches, and once again streets and alleyways around Miami were submerged under deep standing water. Streets in Homestead, Miami Springs, Hialeah, and portions of Miami Beach were turned into flowing streams. In Hialeah, so troubled by floods in recent years, Mayor Henry Milander reported that the depth of standing water in many streets surpassed 3.5 feet. In Miami the Southeast Second Avenue bridge, near the mouth of the Miami River, was damaged when it was rammed by a banana boat during the height of the storm. Numerous airplanes were flipped over and damaged by high winds at the Tamiami airport. And two tornadoes were reported- one at Fort Lauderdale and another near Opa-Locka, where numerous cars were overturned and considerable damages were inflicted at the Royal Palm dairy farm" (Barnes). "Radar report #12- 052130Z- storm center bears 40 degrees true distance 66 miles from Boca Chica, course 10 degrees true speed 8 knots. Scope of definition: poor. Storm appears to be losing form. This is the last radar report from Boca Chica Field. Unable to track due to poor definition" (micro). "Florida City fire (department?) reported at 6 pm (23Z) calm between 5:40 – 5:50 pm (2240-2250Z)- wind changed from SSE to SW and W. Barometer dropped to 28.94 and is back to 29.00. Wind east 40 mph" (micro). "Homestead 2316Z- W 30 (mph), barometer 28.92; calm from 2240Z – 2300Z. Richmond, FL calm center at 2315Z" (micro). "10/5/1948 – 963 mb central pressure,

based upon 975 measured at Sombrero Key, FL, 13 nm RMW, 16 kt movement, 24.8N, 81.0W landfall point” (Ho et al. 1987). “10/5/1948 – 1010 mb environmental pressure, 74 kt 1 min surface wind maximum estimate” (Schwerdt et al. 1979). “Oct, FL, 2SE, 975 mb” (Jarrell et al. 1992). “‘Sin Nombre’ – Oct 5 – Category 3” (Perez et al. 2000). “Tropical Cyclones in Florida, Oct. 5, S Fla., Minimal, Miami bar. 28.92 in., wind 86 mph” (Dunn and Miller – “Minimal” has maximum winds of 74 to 100 mph and central pressure 983 to 996 mb).

October 6:

HWM analyzes a tropical storm of at most 1000 mb centered near 27.8N, 75.2W with a separate mid-latitude cyclone centered near 38N, 73W, with a cold front extending from that low down to 31N, 73W, and a warm front extending from that low to beyond 33N, 62W. HURDAT lists this as a 75 kt hurricane at 27.7N, 77.2W. The MWR tracks of centers of cyclones shows a 00Z position near 26.1N, 79.8W, and a 12Z position near 27.7N, 77.5W. The MWR post-season track map shows a 00Z position near 26.0N, 80.3W, and a 12Z position near 27.5N, 77.7W. Microfilm analyzes a tropical storm of at most 984 mb centered near 27.8N, 77.5W. Ship highlights: 30 kt S and 998 mb at 11Z at 26.8N, 74.7W (HWM, micro); 15 kt SE and 1005 mb at 23Z at 30.9N, 73.4W (micro). Land highlights: 3 kt N and 979 mb (central pressure) at 0030Z at Miami (OMR, micro); 75 kt NW (max wind, 1-minute) G 78 kt at 0205Z at downtown Miami (MWR, OMR); 981 mb peripheral pressure at 08Z at West End, Grand Bahama Island (micro); 57 kt (max wind) G 75-80 kt at West End, Grand Bahama Island (micro). Five other winds of between 50-78 kt (one of these was estimated), and 14 other low pressures between 979-998 mb. Aircraft highlights: 40 kt NW and 995(?) mb at 19Z at 28.5N, 77.0W (micro). Five other gales and one other low pressure. “By 7:25 pm (5<sup>th</sup>- 0025Z 6<sup>th</sup>) the calm center was over Miami. The Miami Airport Station was apparently very near the center of the storm, with lowest pressure 979.3 millibars (28.92 inches) with the wind dropping to 3 mph. At the airport the lull lasted from 7 pm to 7:35 pm and at the City Office 7 miles to the east, from 7 pm to 7:45 pm. However, at the City Office the wind did not drop below 19 mph and the lowest pressure was 980.7 millibars (28.96 inches). Because of a better exposure the highest wind, 86 mph, from the northwest with several gusts of 15 seconds above 90 mph, occurred at the City Office. Over Florida the hurricane moved at a fairly rapid rate of about 18 to 20 mph until it passed into the Atlantic in the Fort Lauderdale-Pompano area about 9:30 pm of the 5<sup>th</sup>. Since the lull lasted 35 to 45 minutes at Miami, the center of the storm was about 15 miles in diameter. The sky remained overcast with low stratus clouds during the passage of the center. Three tornadoes were reported along the advancing edge of this hurricane; one at Opa Locka destroyed several houses, another at Fort Lauderdale caused minor damage, and a third at Pompano destroyed about 25 houses, many of which were occupied at the time. A characteristic tornado dip and recovery in pressure recorded on barograph traces from the Keys to Hillsboro Lighthouse seems to indicate that a single tornado may have dipped to earth at several places as it progressed northeastward in advance of the hurricane vortex. An unusual occurrence during this storm was reported from a small summer colony situated on Cudjoe Key. A home was unroofed during the September hurricane and the roof blown or floated northwestward for a distance of about 200 yards. Two weeks later, during the October hurricane, the same roof was floated back across the highway and

came to rest in almost the exact location in which it had been originally constructed. No deaths or critical injuries have been reported from Florida as a result of this hurricane. It is extremely unusual for a hurricane of such intensity to pass over heavily populated areas without loss of life. A summary of casualties and estimated damage (for Florida) follows: deaths, none; injured, 42; homes destroyed, 36; homes damaged severely, 638; buildings other than homes destroyed, 45; buildings other than homes damaged, 50; persons sheltered in 143 Red Cross shelters, 21,663; property damage (includes flooding), \$3,500,000; crop damage, \$1,500,000; power and communications, \$400,000; highways, streets, etc., \$100,000; total, \$5,500,000. After leaving Florida there was an acceleration in the forward movement of the hurricane as it passed north of Grand Bahama Island, with West End reporting winds of near hurricane force" (MWR). "This is the first hurricane in Florida history, to my knowledge, in which there was no loss of life" (Grady Norton quoted in Florida Climatological Data). "Once the storm left the Florida coast, it steered out to sea, but not before taking over Grand Bahama Island with gusts estimated near 110 mph" (Barnes). "Miami airport center of hurricane over station. Lowest pressure 979.3 mb 0006Z" (micro). "Received from observer westend, (Grand Bahama Island). The hurricane passed over Grand Bahama about 3 am EST (08Z). Highest winds 65 mph gusts 85-90 mph. Lowest barometer pressure 28.96 lowest mercurial reading 29.02. No damages in the area of westend" (micro). "Army reported center of storm 28.9N, 76.3W at 1930Z" (micro). "DH10- Storm apparently enlarging and intensifying. SE quad appears to be most violent sector. Severe turbulence made drift readings impossible at times" (micro). "10/6/1948 - 977 mb central pressure, based upon 979 mb measured at Miami, FL, 16 nm RMW, 13 kt movement (exiting the coast)" (Ho et al. 1987).

#### October 7:

HWM analyzes a low of at most 1000 mb centered near 31.6N, 70.3W. HURDAT lists this as a 90 kt hurricane at 31.4N, 69.0W. The MWR tracks of centers of cyclones shows a 00Z position near 29.2N, 73.8W, and a 12Z position near 30.7N, 69.2W with a 971 mb pressure. The MWR post-season track map shows a 00Z position near 29.4N, 74.7W, and a 12Z position near 31.9N, 68.5W. Microfilm analyzes a low of at most 987 mb centered near 31.6N, 68.5W. Ship highlights: 40 kt S and 994 mb at 13Z at 31.0N, 68.5W (micro); 45 kt S and 994 mb at 20Z at 32.0N, 64.4W (COA). Three other low pressures of 1003-1004 mb between 02-04Z between 30.5-31.7N, 73.4-74.8W (micro). Land highlights: 50 kt SSW and 981 mb at 2130Z at Bermuda (micro); 976 mb at 2145Z at Bermuda (micro); 972 mb at Bermuda (Tucker); at least 87 kt at Bermuda (MWR estimate); 25 kt NW and 976 mb at 2230Z at Bermuda (micro). Seven other gales at Bermuda between 35-65 kt and five other low pressures at Bermuda between 990-1004 mb. Aircraft highlights: 50\*\* kt NNE and (996?) mb at 1740Z at 32.8N, 66.5W (micro); at least 50\*\* kt NE and (997?) mb at 1745Z at 32.5N, 67.6W (micro); 50 kt WSW and 1003 mb at 1915Z at 31.0N, 66.3W (micro); 50 kt S and 1005 mb at 1930Z at 31.8N, 64.7W (micro). Four other gales. "Continuing a rapid northwestward and later eastward movement, the center passed almost directly over Bermuda during the later afternoon of the 7<sup>th</sup>, where winds in excess of 100 were experienced. The storm later dissipated in mid-Atlantic in the vicinity of latitude 32N, longitude 48W" (MWR). "A vicious storm struck the islands between 5 and 7 o'clock on Thursday. A ship report was turned in that

the transit movement of the hurricane had tuned up from 22 to 40 miles an hour – which in all probability meant that its course had recurved. The barometer began to fall rapidly. At 2:40 pm No. 5 Warning was hoisted; by 5:30 the barometer registered 28.70 inches (972 mb). The storm blew by, its centre skirting the islands' coastline extremely closely, heading east north-east. By five o'clock, Bermuda was getting winds of 65 miles per hour, and after the lull during which winds dropped to 12 mph, the winds blew from the north with tremendously increases velocity, gusts being registered at 110 mph. Though these high winds raged for a comparatively brief time, the damage done was much greater than in the September storm. Driving down the North Shore Road at any time during the next few days, one could not but be aware of the dreadful number of houses partly or wholly unroofed. And all the public utility services suffered severely" (Tucker). "It tracked toward Bermuda, which would become its last victim. On October 7, it raced over the island with winds that topped 100 mph and a forward speed that approached 30 mph. It then went on for over a week, carving a large clockwise loop in the open Atlantic before finally dissipating over cooler waters" (Barnes). "Recon report 0621Z storm at 31.0N, 73.1W" (micro). "Navy fix at 1610Z (Loran fix) lat 31.8N, long 68.5W. Eye 30 miles in diameter (later said 10 miles south of this position)" (micro). "Edge of center of hurricane observed by Air Force Bermuda Weather Station at 2145Z. Barometer beginning to level off at lowest pressure of 28.81 inches. Wind shifting from SSE to SSW to SW. Sky condition overcast at estimated 200 feet. Light rain is falling" (micro). "Associated press reported that the center was at Bermuda at 5:00 pm. ½ hour calm, hurricane winds for 45 minutes. Highest winds estimated 110 mph" (micro). "Air force plane put center at 32.4N, 64.8W at 22Z moving NE at 32 mph" (micro).

October 8:

HWM analyzes a low of at most 1005 mb centered near 32.4N, 57.6W with a trough axis plotted extending from the low southwestward to beyond 23N, 69W. HURDAT lists this as a 75 kt hurricane at 32.7N, 57.2W. The MWR tracks of centers of cyclones shows a 00Z position near 32.2N, 63.4W, and a 12Z position between the HURDAT and HWM positions. The MWR post-season track map shows a 00Z position near 32.4N, 64.0W, and a 12Z position just west of the HURDAT position. Microfilm analyzes a large, closed low of at most 1005 mb centered in the general vicinity of 32.5N, 56.7W. Ship highlights: 35 kt WNW and 1009 mb at 1830Z at 29.4N, 57.4W (micro); 35 kt ENE and 1008 mb at 21Z at 34.0N, 53.0W (COA). One other gale. Land highlights: 30 kt NNE and 996 mb at 0030Z at Bermuda (micro). Aircraft highlights: at least 50\*\* kt WSW at 31.2N, 65.5W (micro). "By 10 am on Friday, October 8<sup>th</sup>, the hurricane was 500 miles away in a north-easterly direction petering out across the Atlantic. Thankfully, there was no loss of life (at Bermuda) to record" (Tucker).

October 9:

HWM analyzes a low of at most 1005 mb centered near 31.7N, 45.8W with a trough axis extending from about 100 nm SW of the low southwestward to beyond 25N, 58W. HURDAT lists this as a 60 kt tropical storm at 31.9N, 46.3W. The MWR tracks of centers of cyclones shows a 00Z position near 32.1N, 52.3W. The MWR post-season track map shows a 00Z position near 32.6N, 53.0W. Ship highlights: 35 kt NE and 1008

mb at 00Z at 34.0N, 52.0W (COA); 40 kt NE and 1011 mb at 03Z at 35.0N, 34.0W (COA). Two other gales of 35 kt.

October 10:

HWM analyzes a low of at most 1000 mb centered near 31.9N, 40.7W with the NE end of a NE-SW trough axis located just south of the low center. HURDAT lists this as a 55 kt tropical storm at 32.1N, 40.8W. Ship highlights: 35 kt W and 1006 mb at 12Z at 29.3N, 41.8W (HWM); 35 kt SW and 1012 mb at 12Z at 31.9N, 36.6W (HWM).

October 11:

HWM analyzes a large, closed low of at most 1005 mb centered in the general vicinity of 31.6N, 37.1W. HURDAT lists this as a 45 kt tropical storm at 31.5N, 38.2W. No gales or low pressures.

October 12:

HWM analyzes a closed low of at most 1000 mb centered near 30.3N, 39.7W and a radius of outer closed isobar of at least 1015 mb with radius of 1015 isobar about 325 miles. HURDAT lists this as a 45 kt tropical storm at 30.2N, 39.0W. No gales or low pressures.

October 13:

HWM analyzes a low of at most 1000 mb centered near 30.5N, 40.8W. HURDAT lists this as a 40 kt tropical storm at 30.3N, 41.3W. No gales or low pressures.

October 14:

HWM analyzes a low of at most 1000 mb centered near 32.3N, 47.0W. HURDAT lists this as a 40 kt tropical storm at 32.6N, 46.4W. Ship highlights: 35 kt SW and 1000 mb at 12Z at 32.1N, 46.2W (HWM); 45 kt N and 998 mb at 18Z at 33.0N, 48.2W (COA); 35 kt NW and 992 mb at 18Z at 32.9N, 47.7W (COA). One other low pressure.

October 15:

HWM analyzes a low of at most 1000 mb centered near 37.0N, 48.5W with a mid-latitude low pressure system (with associated warm and cold fronts) closely approaching from the west. HURDAT lists this as a 40 kt tropical storm at 36.7N, 48.0W. The MWR tracks of centers of cyclones shows a 00Z position near 33.3N, 47.0W, and a 12Z position near 36.4N, 48.1W with a 993 mb pressure. Ship highlights: 25 kt SE and 992 mb at 00Z at 33.9N, 47.2W (COA); 50 kt S and 1005 mb at 06Z at 34.0N, 46.7W (COA). Two other gales and two other low pressures.

October 16:

HWM analyzes a closed low of at most 1005 mb centered near 46.8N, 37.6W with a warm front extending from the low east-southeastward, and a cold front extending from the low west-southwestward. This cold front becomes a stationary front, continuing west-southwestward to a baroclinic low of at most 1000 mb centered near 42N, 55.5W. There is also a cold front extending from this baroclinic low southward to beyond 31N, 55W. HURDAT last lists this at 00Z as a 35 kt tropical storm at 41.5N, 46.6W. The

MWR tracks of centers of cyclones shows a 00Z position near 41.6N, 45.3W, and a 12Z position near 46.5N, 36.6W with a 997 mb pressure. Ship highlights: 25 kt N and 997 mb at 12Z at 46.7N, 38.5W (COA, HWM); 35 kt S at 12Z at 46.2N, 35.7W (COA).

A tropical cyclone developed in the southwestern Caribbean Sea on 3 October. HURDAT previously began this system at 18Z on the 3<sup>rd</sup> as a 40 kt tropical storm. However, evidence exists that there was a closed low by 12Z on the 3<sup>rd</sup>, and a 30 kt tropical depression is analyzed at 12Z on the 3<sup>rd</sup>. There is evidence that the cyclone remained a depression on the 3<sup>rd</sup>, so a 30 kt depression is maintained for that time (down from 40 kt originally). Observations also indicate that the position of the tropical cyclone at 18Z on the 3<sup>rd</sup> was well northwest of the original HURDAT position at that time, about three and a half degrees northwest of the previous HURDAT position (a major track change). This track change is the only major track change for the entire lifetime of the cyclone; all other track changes are minor. The new position has the depression centered a short distance northwest of Swan Island at 18Z on the 3<sup>rd</sup>. The cyclone moved slowly towards the north-northwest until 12Z on the 4<sup>th</sup> when it reached its westernmost point of 19.5N, 85.2W. Then it turned towards the northeast. It is analyzed that the cyclone strengthened to a 35 kt tropical storm at 00Z on the 4<sup>th</sup> (50 kt originally at 00Z; reached tropical storm intensity 6 hours later than originally shown). Later on the 4<sup>th</sup>, at 1730Z, an aircraft measured a central pressure of 992 mb. Another aircraft observation estimated that maximum surface winds were about 80 kt. At 1830Z, a ship recorded 40 kt winds along with a pressure of 995 mb. A central pressure of 991 mb is added into HURDAT at 18Z on the 4<sup>th</sup>. A central pressure of 991 mb corresponds to an intensity of 62 kt according to the Brown et al. southern pressure-wind relationship. The cyclone was small (based on the reconnaissance report), its forward motion was 13 kt, and it was also intensifying. Taking all of the above information into consideration, an intensity of 70 kt is chosen for 18Z on the 4<sup>th</sup> (down from 75 kt originally). HURDAT originally had this becoming a hurricane at 12Z on the 4<sup>th</sup>, but it is analyzed that the cyclone reached hurricane strength at 18Z. The hurricane made landfall on the south coast of western Cuba at 07Z on 5 October at 22.4N, 83.2W. The hurricane continued northeastward and passed a short distance west of Havana. The highest sustained wind at Havana was 105 kt from the SSE at 1026Z on the 5<sup>th</sup>. Some sources claim that Havana's highest wind was 115 kt, but this observation is believed to be a gust since one of the sources said that it was a gust and that wind speed is much too high for the pressures observed. 110 kt is the analyzed intensity for 06Z on the 5<sup>th</sup> (up from 105 kt originally) and for landfall (07Z). This is in agreement with the assessment of Category 3 landfall in Cuba by Perez et al. In the 24-hour period from 06Z on the 4<sup>th</sup> to 06Z on the 5<sup>th</sup>, it is analyzed that the tropical cyclone rapidly intensified from 45 kt to 110 kt (55 kt to 105 kt originally). The peak intensity for the lifetime of the hurricane is reduced slightly from 115 kt to 110 kt. The hurricane reached the Gulf of Mexico north of Cuba around 11Z. The analyzed intensity for 12Z on the 5<sup>th</sup> is 105 kt (down from 115 kt originally) allowing for some weakening during its four hours over land.

Only several hours later, the hurricane made a U.S. landfall around 1820-1830Z (~18Z rounded to the nearest hour) on the 5<sup>th</sup> at the location where the Seven Mile Bridge stands today in the Florida Keys. Sombrero Key Lighthouse (24.6N, 81.1W) measured a

pressure of 975 mb (the lowest pressure for that station) at 1815Z. This station recorded its maximum wind (87 kt S estimated and elevated) at 1800Z (just 15 minutes before the minimum pressure was recorded). Moving at 15 kt, the cyclone could have traveled 4 nautical miles in 15 minutes. The RMW was analyzed by Ho et al. (1987) to be 13 nautical miles, which looks reasonable in the analysis. It is also analyzed that the center of the eye was somewhere between 6 to 8 nautical miles west-northwest of Sombrero Key at 1815Z (closest approach/time of lowest pressure). Since there is no available wind observation at the time of the lowest pressure, and since the hurricane force maximum winds occurred just 15 minutes before the minimum pressure, the 975 mb minimum pressure recorded at Sombrero Key Lighthouse is not treated as a central pressure. Another reason to believe that the 975 mb observation is not a central pressure is due to the 105 kt winds observed at Havana eight hours earlier. Ho et al. (1987) determined in his analysis that the central pressure at landfall in the Keys was 963 mb, and this value is chosen as the central pressure at landfall in the Keys as it is reasonable given the information available. The pressure value in HURDAT at 18Z on the 5<sup>th</sup> is changed from 975 mb to 963 mb. For weakening systems, 963 mb corresponds to intensities of 95 and 88 kt for south of 25N and north of 25N, respectively. The RMW was smaller than normal (13 nmi vs. 17 nmi climatology for given location and central pressure). The highest reliable, non-estimated, non-elevated, sustained wind observed in the Florida Keys was 74 kt at Boca Chica at 1637Z. Undoubtedly, higher winds occurred farther east near the center. An intensity of 90 kt is analyzed for 18Z and landfall in the Keys, a major change downward from the 110 kt indicated in HURDAT originally. Next, the hurricane made landfall on southern tip of the mainland Florida peninsula just east of Flamingo near 25.1N, 80.9W at 21Z. The 90 kt intensity is maintained for this landfall (there were no central pressures or other data in the Everglades). The eye passed over Homestead, which recorded calm and 975 mb at 2250Z. The eye then passed over Miami International Airport, which recorded 3 kt N and 979 mb at 0006Z on the 6<sup>th</sup>, so the 979 mb central pressure in HURDAT at 00Z on the 6<sup>th</sup> is retained. The highest reliable observed wind in mainland Florida was 75 kt at the downtown Miami weather office at 0205Z on the 6<sup>th</sup>. The intensity at 00Z on the 6<sup>th</sup> is analyzed to be 80 kt (down from 90 kt originally). Both southwest Florida (BFL) and southeast Florida (CFL) are analyzed to have received Category 2 winds from this hurricane, as the landfall point in the Keys was just west of the dividing line between the two regions.

Early on the 6<sup>th</sup>, the hurricane moved into the Atlantic Ocean east of southern Florida on a northeastward course. The cyclone then accelerated and turned towards the east-northeast and east. At 08Z on the 6<sup>th</sup>, West End, Grand Bahama Island recorded a minimum pressure of 981 mb, which may or may not be a central pressure. The wording in the microfilm text does not suggest strongly enough that this was a central pressure, so it is not treated as a central pressure in the analysis. A 981 mb peripheral pressure corresponds to winds of at least 71 kt using the Brown et al. wind-pressure relationship for north of 25N. The HURDAT intensity of 85 kt is retained for 06Z on the 6<sup>th</sup>. The analyzed intensity of 85 kt is maintained through 06Z on the 7<sup>th</sup>, so some minor upward intensity adjustments were made to HURDAT late on the 6<sup>th</sup> and early on the 7<sup>th</sup>. On the 7<sup>th</sup>, the positions are adjusted slightly to the west. The cyclone approached Bermuda, and the eye passed over the northern portions of the islands of Bermuda around 22Z on the

7<sup>th</sup>. The lowest pressure recorded at Bermuda was 972 mb, and it is analyzed that the central pressure was 971 mb. 971 mb is added into HURDAT as a central pressure at 00Z on the 8<sup>th</sup>. A central pressure of 971 mb corresponds to an intensity of 83 kt using the pressure-wind relationship for north of 25N. The forward motion of the hurricane was 25 kt, but the hurricane had grown somewhat in size from a few days before. 90 kt is chosen as the analyzed intensity for 00Z on the 8<sup>th</sup> (up from 75 kt originally). By 12Z on the 8<sup>th</sup>, the wind and temperature structure of the cyclone indicates that it had become an extratropical cyclone. The cyclone is analyzed to have been extratropical from 12Z on the 8<sup>th</sup> to 06Z on the 9<sup>th</sup>, and then to have transitioned back to a tropical cyclone around 12Z on the 9<sup>th</sup>. One reason why the cyclone may have displayed this behavior is because there is a possibility that a weak extratropical low or occluded low, which had been located to the north or northwest of the hurricane, may have been absorbed by the circulation of the hurricane on the 8<sup>th</sup>. This could have caused the hurricane to increase in size and weaken somewhat. It may also have caused the map analysts some confusion. (More details about this extratropical or occluded low can be found in note 14 of the additional notes section.) By 12Z on the 9<sup>th</sup>, when the cyclone had regained tropical characteristics, it was located at 31.0N, 47.5W with a 55 kt intensity. The tropical storm then greatly slowed its forward motion, and it did a small clockwise loop between the 9<sup>th</sup> and the 14<sup>th</sup> of October as indicated in HURDAT (with minor track changes each day except for no alterations on the 11<sup>th</sup> and 12<sup>th</sup>). On some of those days, although observations are sparse, there are enough observations to be confident that the cyclone remained closed throughout the period indicated in HURDAT and to make the appropriate track alterations. On the 14<sup>th</sup> at 18Z, a ship measured a peripheral pressure of 992 with 35 kt winds. On the 15<sup>th</sup> at 00Z, a ship measured a peripheral pressure of 992 mb with 25 kt winds. Based upon these observations, at 00Z on the 15<sup>th</sup>, it is analyzed that the central pressure is 989 mb, and this value is added into HURDAT. 989 mb equals 61 kt using the north of 25N pressure-wind relationship. The highest observed winds around that time were 45 kt at 18Z on the 14<sup>th</sup> and 50 kt at 06Z on the 15<sup>th</sup>. 60 kt is chosen for the intensity at 18Z on the 14<sup>th</sup> and 00Z on the 15<sup>th</sup> (both up from 40 kt originally- major intensity changes). After the cyclone performed a loop, it moved northward on the 15<sup>th</sup>. The final position listed in HURDAT is at 00Z on the 16<sup>th</sup> at 41.5N, 46.6W as a 35 kt tropical storm. The analysis indicates that HURDAT's position for 00Z on the 16<sup>th</sup> is reasonably accurate, and that the cyclone is still a tropical storm at that time. However, the intensity is raised from 35 kt to 50 kt at 00Z on the 16<sup>th</sup>. After 00Z on the 16<sup>th</sup>, it is analyzed that the cyclone became extratropical, but was still closed. Two 6-hourly points are added as an extratropical cyclone. The new final point is at 12Z on the 16<sup>th</sup> at 46.5N, 37.5W as a 40 kt extratropical cyclone. After this time, it is analyzed that the cyclone became absorbed within a larger extratropical storm.

#### 1948 Storm 10 (originally Storm 9)

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34190 11/08/1948 M= 4 9 SNBR= 758 NOT NAMED XING=0 L
34190 11/08/1948 M= 4 10 SNBR= 758 NOT NAMED XING=0 L
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34195 11/08* 0 0 0 0* 0 0 0 0* 0 0 0 0*246 633 60 0*
34195 11/08* 0 0 0 0* 0 0 0 0* 0 0 0 0*258 660 45 0*
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34200	11/09*254	668	60	0*259	688	65	0*263	708	70	0*273	724	70	0*
34200	11/09*262	678	50	996*266	695	50	0*271	712	55	0*278	728	60	994*
	***	***	**	***	***	***	**	***	***	**	***	***	**
34205	11/10*288	736	70	0*301	744	65	0*314	747	60	0*331	745	60	0*
34205	11/10*289	739	65	990*301	744	65	0*314	748	65	0*336	750	60	0*
	***	***	**	***			***	**		***	***		
34210	11/11E352	739	55	0E368	725	50	0*	0	0	0	0*	0	0
34210	11/11*357	739	55	994E368	725	40	0*	0	0	0	0*	0	0
	****			***		**							

34215 HR

Major track changes and minor intensity changes are analyzed for this November hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### November 8:

HWM analyzes a closed low of at most 1010 mb centered near 21.3N, 65.6W. HURDAT first lists this at 18Z as a 60 kt tropical storm at 24.6N, 63.3W. Ship highlights: 35 kt N and 1000 mb at 21Z at 26.4N, 67.0W (COA); 30 kt NNE and (1003?) mb at 23Z at 27.8N, 68.6W (micro). "A tropical disturbance was detected on the afternoon of November 8 over the Atlantic, in the vicinity of latitude 26N, longitude 67.5W. At that time it had a small area of winds of about hurricane force. Estimates made from reconnaissance planes indicated highest winds of about 60 to 70 knots which were maintained during the next 2 days as the storm moved on a curving course to the northwest and north" (MWR).

#### November 9:

HWM analyzes a tropical storm of at most 1010 mb centered near 27.2N, 71.4W. HURDAT lists this as a 70 kt hurricane at 26.3N, 70.8W. The MWR tracks of centers of cyclones shows a 00Z position near 24.8N, 67.5W, and a 12Z position near 27.2N, 71.7W with a 1004 mb pressure. The MWR post-season track map shows a 00Z position near 25.6N, 67.5W, and a 12Z position near 26.6N, 71.1W. Microfilm analyzes a low of at most 1002 mb centered near the HWM position. Ship highlights: 45 kt S and 1006 mb at 00Z at 26.5N, 67.4W (COA); 45 kt E and 1004 mb at (1145Z?) at 28.2N, 71.2W (micro); 40 kt W and (1000?) mb at 2030Z at 28.2N, 73.5W (micro); 15 kt NNW and 992 mb at 21Z at 28.4N, 73.5W (micro). One other gale and four other low pressures. Aircraft highlights: center fix at 1815Z at 27.8N, 72.8W with 65 kt estimated max winds and 994 mb (central?) pressure (micro); center fix at 22Z at 29.1N, 73.5W with 65 kt estimated max winds and 990 mb (central?) pressure. Two other gales and two other low pressures. "Navy recon plane 1815Z storm position 27.8N, 72.8W, max winds by quadrants: SW- 45 kt, E- 65 kt, NE- 60 kt, S- 55 kt. Min pressure 994 mbs" (micro). Air force plane reported: center (22Z) 29.1N, 73.5W. Min pressure 989.9 mb, strongest winds south of center 38 kt; strongest wind N and NE of center 65 kt; hurricane winds 20 miles across; storm winds 100 miles N-NE-E of center; very little S and SW" (micro).

#### November 10:

HWM analyzes a tropical storm of at most 1010 mb centered near 32.2N, 77.0W with a N-S cold front approaching a few hundred nm to the west of the storm. HURDAT lists this as a 60 kt tropical storm at 31.4N, 74.7W. The MWR tracks of centers of cyclones shows a 00Z position near 29.4N, 74.1W, and a 12Z position near 31.8N, 75.4W with a 994 mb pressure. The MWR post-season track map shows a 00Z position near 28.8N, 73.6W, and a 12Z position near 31.6N, 75.2W. Microfilm analyzes a tropical storm of at most 996 mb centered near 32.2N, 75.2W. Ship highlights: 45 kt S and 1002 mb at 1630Z at 32.1N, 74.4W (micro). Five other gales between 35-45 kt, and one other low pressure of 1005 mb. Aircraft highlights: center fix at 1355Z at 31.8N, 74.9W with 70 kt estimated max winds (micro); 75-80 kt estimated max winds and a 994 central pressure at 2130Z (micro). Seven other gales between 35-45 kt and one other low pressure of 994 mb. "By the late afternoon of the 10<sup>th</sup> the organized center began to disintegrate and the wind rapidly lost force, so that by the time it passed east of Hatteras it had dissipated into an area of squalls to the east of the original center. No damage has been reported in connection with this storm" (MWR). "Navy fix 31.8N, 74.9W at 1355Z, max wind 70 knots" (micro). "The flight aerologist said that the storm is somewhat similar to yesterday except that the weak side on the SW is even weaker today insofar as the radar picture is concerned. The bad weather and heavy squalls are concentrated on the NE and E side. There was a fairly well marked wind shift out the SW side, as though a cold front might be trying to form in there. However, the cloud structure hadn't followed through as of yet. The eye was about 20 miles across, but not well formed on W and SW side. No evidence of frontal structure in E or NE quadrants" (micro). (Late on the 10<sup>th</sup>): Post flight summary (transmitted at 0215Z on the 11<sup>th</sup>): Entered through SE quadrant, left through NE quadrant. Estimate maximum winds in NE quadrant 75 to 80 knots. Pressure in eye 994 mb. Storm has well defined eye with...low scattered cumulus and high scattered cirrus. NE quadrant has stronger winds, more turbulence, more precipitation, and lower ceilings than SE quadrant. Pressure gradient not exceptionally strong near eye" (micro). "Duck position of storm 2130Z 34.8N, 74.2W" (micro).

November 11:

HWM analyzes a NNE-SSW cold front extending from north of 49N, 60W, to SW of 29N, 78W. HURDAT last lists this at 06Z as a 50 kt extratropical storm at 36.8N, 72.5W. The MWR tracks of centers of cyclones shows a 00Z position near 35.4N, 74.4W, and a 12Z position near 41.6N, 68.3W with a 1001 mb pressure. The MWR post-season track map last shows this system at 00Z near 35.3N, 74.0W. The microfilm analysis is similar to the HWM analysis. Ship highlights: 20 kt S and 1004 mb at 06Z at 40.5N, 66.4W (COA); 25 kt S and 1002 mb at 12Z at 40.7N, 64.0W (COA). One other low pressure.

A sharp trough existed in the Atlantic in the area north of Puerto Rico at 18Z on 7 November. The lowest pressure was 1009 mb, the highest wind was 30 kt, and there was a 10 kt SW wind at 12Z. However, there is not enough evidence to close off the low on the 7<sup>th</sup>. There are not any consistent indications of a closed low or the existence of a tropical storm until 21Z on the 8<sup>th</sup>. Three observations from COADS ship #1413 at 18Z on the 8<sup>th</sup>, 21Z, and 00Z on the 9<sup>th</sup>, respectively, indicate that the ship passed through or near the center of a tropical storm. HURDAT starts this tropical storm at 18Z on the 8<sup>th</sup>

with an intensity of 60 kt. Although no changes are made to the timing of genesis, the true genesis may not have been captured (i.e. this system may have been a tropical storm or tropical depression earlier). If a depression or storm started earlier, it may have originated from the south and moved northward, followed by a west-northwestward turn around the time of genesis in HURDAT. 45 kt is the new analyzed starting intensity at 18Z on the 8<sup>th</sup> (down from 60 kt originally). The ship previously mentioned was inside the RMW at 21Z on the 8<sup>th</sup>. At 21Z, the ship recorded 35 kt N winds with a pressure of 1000 mb. The reason why it is assumed that this observation is inside the RMW is because three hours later, the ship recorded 45 kt winds with a higher pressure- 1006 mb. A central pressure of 996 mb is added into HURDAT for 00Z on the 9<sup>th</sup>. A central pressure of 996 mb corresponds to an intensity of 54 kt (50 kt) using the Brown et al. pressure wind relationship for south of 25N (north of 25N). 50 kt is chosen for 00Z on the 9<sup>th</sup> (down from 60 kt originally). A major track adjustment was made at the first point at 18Z on the 8<sup>th</sup>. The position is shifted about 3 degrees to the west-northwest of the previous HURDAT position. On the 9<sup>th</sup>, the positions are also shifted to the north and west of the previous HURDAT positions, but the changes are all minor. The first aircraft center fix was at 1815Z on the 9<sup>th</sup> at 27.8N, 72.8W. The aircraft estimated maximum surface winds of 65 kt while measuring a central pressure of 994 mb. 994 mb is added into HURDAT as a central pressure for 18Z on the 9<sup>th</sup>. A central pressure of 994 mb equals 53 kt using the north of 25N pressure-wind relationship. 60 kt is chosen for the intensity at 18Z on the 9<sup>th</sup> (down from 70 kt originally). At 22Z on the 9<sup>th</sup>, there was another aircraft center fix at 29.1N, 73.5W. The aircraft measured a central pressure of 990 mb and maximum surface winds of 65 kt were estimated. 990 mb is added into HURDAT as a central pressure for 00Z on the 10<sup>th</sup>. 990 mb equals 59 kt using the north of 25N pressure-wind relationship. 65 kt is chosen for the intensity at 00Z on the 10<sup>th</sup> (down from 70 kt originally). The next day, an aircraft performed a center fix at 1355Z on the 10<sup>th</sup> at 31.8N, 74.9W and estimated maximum winds of 70 kt. There was another aircraft center fix on the 10<sup>th</sup> at 2130Z at 34.8N, 74.2W with a central pressure of 994 mb and estimated maximum surface winds of 75-80 kt. A central pressure of 994 mb is added into HURDAT for 00Z on the 11<sup>th</sup>. A 994 mb central pressure corresponds to an intensity of 53 kt using the Brown et al. pressure-wind relationship for north of 25N and 58 kt using the Landsea et al. north of 35N pressure-wind relationship. 65 kt is analyzed for the intensity at both 12 and 18Z on the 10<sup>th</sup> (both up from 60 kt originally), and 55 kt is the analyzed intensity at 00Z on the 11<sup>th</sup> (no change). Previously, HURDAT analyzed the peak intensity of this hurricane to be 70 kt from 12Z on the 9<sup>th</sup> through 00Z on the 10<sup>th</sup>. This analysis has the peak intensity at 65 kt from 00Z on the 10<sup>th</sup> though 18Z on the 10<sup>th</sup>. Track changes on the 10<sup>th</sup> were all very minor (the largest factor in the track adjustments were the aircraft center fixes). Early on the 11<sup>th</sup>, as the storm moved towards the north-northeast off the mid-Atlantic coast of the United States, a strong cold front approached from the west and began to absorb the cyclone. HURDAT previously had the cyclone becoming extratropical at 00Z on the 11<sup>th</sup>, but the analysis indicates that it did not become extratropical until 06Z on the 11<sup>th</sup>. The final point in both HURDAT and in this analysis is at 06Z on the 11<sup>th</sup> at 36.8N, 72.5W as an extratropical storm. HURDAT's previous intensity of 50 kt is adjusted down to 40 kt for the last point at 06Z on the 11<sup>th</sup>. Shortly thereafter, the low became extremely elongated, and it was completely absorbed into the powerful frontal system.

The following quotes from the Air Weather Service tech report should be noted regarding this cyclone: “[Storm 10 (was Storm 9)] (7-11 November 1948) originated on an easterly wave passing under a westerly trough near 28N, 72W. It moved NW with no change in intensity into a frontal structure off the coast of Cape Hatteras and rapidly dissipated due to the introduction of cold polar air into the system” (AWS). The AWS tech report claims that this storm “deepened to near hurricane force” and in the table at the end of the report, the AWS claims that this was a hurricane for one day and a tropical storm for 4 days.

#### 1948 additional notes

1)

In January, a small low was noted in HWM starting on the 16<sup>th</sup> which formed from a westward moving trough on the 15<sup>th</sup>. The low was pretty far south. There is no doubt that the low had a closed circulation from the 16<sup>th</sup> to the 18<sup>th</sup>. On the 16<sup>th</sup>, both air temperatures and sea-surface temperatures were in the upper 60s. On the 17<sup>th</sup> and 18<sup>th</sup>, they were in the 70s. There were no observed gales or low pressures with this system, although the data was rather sparse. The highest observed wind was 25 kt and the lowest observed pressure was 1008 mb. It is possible that this system could have been a tropical cyclone on the 17<sup>th</sup> and 18<sup>th</sup>, but it is not added into HURDAT since there are no observed gales or low pressures.

DAY	LAT	LON	STATUS
Jan 15			Open trough 26N, 42W to 18N, 46W
Jan 16	24N	48W	Extratropical low
Jan 17	24N	50W	Occluded Low/Tropical depression?
Jan 18	23N	56W	Occluded Low/Tropical depression?
Jan 19			Dissipated

2)

A low developed north of The Dominican Republic on 19 February. It moved generally eastward through the 24<sup>th</sup> of February. The designation of a tropical depression may be generous. On the 19<sup>th</sup> and 20<sup>th</sup>, while the low was probably closed, it appears very weak. On the 21<sup>st</sup> through the 23<sup>rd</sup>, it might not have had a closed, compact circulation typical of a tropical cyclone. Temperatures were in the lower to middle 70s and there was a slight temperature gradient across the low, but it still may have been a tropical depression. On the 24<sup>th</sup>, a combination of HWM and COADS observations indicates that it was probably closed on that day. There were no observed gales or low pressures associated with this system between the 19<sup>th</sup> and 24<sup>th</sup>. The first low pressures are observed on the 25<sup>th</sup> and the first gales are observed on the 26<sup>th</sup>, but it is analyzed that the low became extratropical by the 25<sup>th</sup>. The extratropical low continued moving northeastward until 29 February when

it was absorbed by another extratropical low. There were no observed gales or low pressures during the tropical portion of the low's lifetime.

DAY	LAT	LON	STATUS
Feb 19	20N	68W	Low/Tropical depression?
Feb 20	23N	63W	Low/Tropical depression?
Feb 21	24N	61W	Low/Tropical depression?
Feb 22	23N	58W	Low/Tropical depression?
Feb 23	20N	52W	Low/Tropical depression?
Feb 24	20N	50W	Low/Tropical depression?
Feb 25	25N	49W	Extratropical
Feb 26	27N	46W	Extratropical
Feb 27	38N	33W	Extratropical
Feb 28	39N	26W	Extratropical
Feb 29			Absorbed

3)

A weak broad low developed on 5 April that was associated with a trough that extended on the 5<sup>th</sup> from 22N, 51W to 5N, 58W. HWM shows that the low moved northeastward for the next few days, but there is no evidence of a closed low and there were no gales or low pressures for the first several days. From the 8<sup>th</sup> to the 11<sup>th</sup>, the low slowed down and moved slowly towards the north, but it still could not be closed off. On the 12<sup>th</sup>, the low ran into a weak, dissipating front which had approached from the west. The weak front may have provided some fuel for the low, which spun up and was closed from the 12<sup>th</sup> through the 17<sup>th</sup>. On the 13<sup>th</sup> at 12Z, there were two separate highlight observations. One was a gale of 35 kt and another was a low pressure of 1004 mb. But the low was clearly extratropical on this day. The low began to occlude on the 14<sup>th</sup> and may still be considered an occluded low on the 15<sup>th</sup> or perhaps a tropical depression. From the 15<sup>th</sup> to 17<sup>th</sup>, it may have been a tropical depression. There was one more low pressure observation of 1005 mb on the 15<sup>th</sup> (the only highlight observation for this system's lifetime when it may have been a TC) but without another piece of information, this system cannot be added into HURDAT. From the 18<sup>th</sup> to the 24<sup>th</sup> of April, HWM shows that the low meandered around the Atlantic, but observations do not indicate that the low was closed these days. On the 24<sup>th</sup>, the low merged with a front and attained extratropical characteristics, and it was absorbed by another extratropical cyclone on the 26<sup>th</sup>.

DAY	LAT	LON	STATUS
Apr 5	13N	55W	Broad low/trough
Apr 6	16N	50W	Broad low/trough
Apr 7	19N	46W	Broad low/trough
Apr 8	22N	42W	Broad low/trough
Apr 9	23N	41W	Broad low/trough
Apr 10	26N	41W	Broad low/trough

Apr 11	28N	42W	Broad low/trough
Apr 12	33N	46W	Extratropical low
Apr 13	32N	48W	Extratropical storm
Apr 14	27N	58W	Occluded low
Apr 15	24N	45W	Tropical depression
Apr 16	26N	44W	Tropical depression
Apr 17	26N	44W	Tropical depression
Apr 18	26N	43W	Broad low/trough
Apr 19	22N	46W	Broad low/trough
Apr 20	23N	51W	Broad low/trough
Apr 21	26N	54W	Broad low/trough
Apr 22	27N	51W	Broad low/trough
Apr 23	30N	44W	Broad low/trough
Apr 24	34N	44W	Broad low/trough
Apr 25	40N	40W	Extratropical
Apr 26			Dissipated

4)

The MWR post-season Atlantic tropical cyclone summary and track map, Tannehill (1952), the Charleston, SC May 1948 OMR, the South Carolina May climatological data summary, and Jack Beven's list of suspects indicate that a possible tropical storm may have made landfall on either the Georgia coast or the lower South Carolina coast on 12 May. HWM and COADS were utilized as well to analyze this suspect. A low (or possibly just a trough) was found on 10 May near the Bahamas. It moved northwards very near the east coast of Florida on the 11<sup>th</sup>, and moved inland on the 12<sup>th</sup>. Charleston, SC recorded a 1-minute sustained wind of 35 kt from the SE around 0830Z on the 12<sup>th</sup>. The winds at Charleston were under the influence of the circulation of the low from approximately 01Z on the 12<sup>th</sup> to 18Z on the 13<sup>th</sup>. Hourly averaged winds at Charleston of over 20 mph were experienced every hour from 05Z on the 12<sup>th</sup> through 13Z on the 12<sup>th</sup>. The South Carolina May climatological data summary shows that the eastern half of South Carolina received a lot of precipitation on the 11<sup>th</sup> through the 13<sup>th</sup> of May (although some of the precipitation on the 13<sup>th</sup> could have been more associated with an approaching front). There were no observed pressures lower than 1012 mb associated with this system until well after landfall when it was extratropical. The delta p between the cyclone and the environment appears to be 3 to 4 mb, but the central pressure of the cyclone is not really known. The only gale was the one gale observed at Charleston. The HWM map from May 12<sup>th</sup> clearly shows that the low was closed and that the low displayed a compact circulation- typical of tropical cyclones. There was barely any temperature gradient across the low. Since there was only one observed gale and no observed low pressures, this system is not added into HURDAT since two pieces of evidence are needed to add a suspect into HURDAT. The cyclone moved northward and became extratropical on the 13<sup>th</sup>. It moved northeastward and continued as an extratropical cyclone until it merged with another extratropical cyclone on 17 May.

DAY	LAT	LON	STATUS
May 10			Open trough
May 11	26N	79W	Open trough
May 12	32N	81W	Tropical storm???
May 13	39N	78W	Extratropical
May 14	41N	73W	Extratropical
May 15	44N	62W	Extratropical
May 16	49N	47W	Extratropical
May 17			Absorbed

5)

HWM shows that a tropical wave moving westward through the Caribbean Sea on 27 and 28 July started to develop a circulation that turned northward into the eastern Gulf of Mexico on the 29<sup>th</sup> and 30<sup>th</sup>. By the 31<sup>st</sup>, a tropical depression had formed, and it persisted through August 1<sup>st</sup>, with a well-defined, closed, warm-core circulation. It dissipated on August 2<sup>nd</sup>, and a detailed analysis was not performed to determine whether it moved inland as a tropical cyclone late on the 1<sup>st</sup> or early on the 2<sup>nd</sup>. There were no gales or low pressures observed with this system. However, the July, 1948 Florida climatological data summary indicates that on the 31<sup>st</sup> of July, Tampa, FL recorded a maximum 5-minute averaged wind of 34 mph (30 kt) from the south (with the cyclone located west of Tampa on that day).

DAY	LAT	LON	STATUS
Jul 27	21N, 73W to 11N, 77W		Broad low/trough
Jul 28	21N, 83W to 13N, 85W		Broad low/trough
Jul 29	26N, 85W to 22N, 88W		Broad low/trough
Jul 30	27N	86W	Weak low/trough
Jul 31	28N	86W	Tropical depression
Aug 01	29N	86W	Tropical depression
Aug 02			Dissipated

6)

An area of troughiness appeared in the northeastern Gulf of Mexico on 11 August. It moved across northern Florida and was located in the Atlantic off the coast of Georgia on the 12<sup>th</sup>. It continued to move quickly northeastward, and likely attained a closed circulation on the 13<sup>th</sup> when a pressure of 1003 mb was observed by a ship at 12Z on the 13<sup>th</sup>. The temperatures around the low were very warm on the 13<sup>th</sup>, and the low was likely a tropical cyclone on this day. The highest winds observed on the 13<sup>th</sup> were only 25 kt, and the 1003 mb observation was the only low pressure observation until a gale and a much lower pressure were observed at 06Z on the 14<sup>th</sup>. By 06Z on the 14<sup>th</sup>, it is more likely that the cyclone had already become extratropical, but it still may have been tropical at 00Z on the 14<sup>th</sup>. Since there is only one piece of evidence while this cyclone

was likely tropical, this system is not added into HURDAT. At 06Z on the 14<sup>th</sup>, a ship reported 25 kt SW winds and a pressure of 995 mb with a temperature of 60 degrees. Assuming the temperature reported is accurate, then this cyclone can no longer be considered a tropical cyclone at 06Z on the 14<sup>th</sup>. Interestingly, for the analysis at 12Z on the 14<sup>th</sup>, with the cyclone located near 47N, 61W, temperatures all around the low are in the 60s, and there is not a temperature gradient across the low. These relatively warm temperatures for the given latitude and time of day suggest that this system may have still been tropical at 00Z on the 14<sup>th</sup>. And given that a pressure of 995 mb was observed at 06Z on the 14<sup>th</sup>, and a 1003 mb pressure was observed at 12Z on the 13<sup>th</sup> when the cyclone was definitely tropical, there is a decent chance that this system was a tropical cyclone. A lack of observations prevent this system from being added into HURDAT.

DAY	LAT	LON	STATUS
Aug 11	28N	85W	Broad low/trough
Aug 12	32N	78W	Broad low/trough
Aug 13	37N	69W	Tropical depression/storm
Aug 14	47N	61W	Tropical/Extratropical storm
Aug 15	54N	54W	Extratropical
Aug 16	58N	42W	Extratropical
Aug 17			Absorbed

7)

A low apparently developed along a frontal boundary on 16 August off the coast of South Carolina. It moved northeastward, staying off of the United States coast. On the 17<sup>th</sup>, although there was not much of a temperature gradient across the low, the wind structure was still asymmetric and frontal in nature. On the 18<sup>th</sup>, the wind structure was more circularly symmetric, but the temperature gradient across the low increased and was too great to be considered a tropical cyclone. After that, it accelerated in the mid-latitude westerlies. There was one observed gale of 35 kt with this system at 12Z on the 18<sup>th</sup> and there was one observed low pressure of 1004 mb at 06Z on the 19<sup>th</sup>. Although it is possible that this system may have been a tropical depression for a short time late on the 17<sup>th</sup> and early on the 18<sup>th</sup>, this system is not added into HURDAT as there is little to no evidence that this system was a tropical storm.

DAY	LAT	LON	STATUS
Aug 16	33N	75W	Broad low/trough; extratropical
Aug 17	35N	70W	Extratropical
Aug 18	41N	63W	Extratropical
Aug 19	45N	53W	Extratropical
Aug 20			Absorbed

8)

Two different newspaper articles – provided by Mike Chenoweth, both from *The West Indian*, indicate the possibility that a disturbance progressed westward across the southern Caribbean Sea from 29 August to 1 September. The newspaper describes bad weather in Trinidad on 29 August. The newspaper also describes “a hurricane” that sunk a ship in the southwestern Caribbean on 1 September. HWM, COADS, and microfilm were utilized to search for indications of a tropical cyclone. There were no observed gales or low pressures from any of the sources, and a closed circulation was not found either. Thus, this suspect is not added into HURDAT. The following are quotes from the newspaper articles: Regarding the suspect disturbance in Trinidad... “When the worst squall to hit Trinidad in thirteen years, according to reports, bore down on Port of Spain harbor last Sunday morning (August 29, 1948) the Grenada schooner *Elody F.*...sank as she was being towed out from alongside Queen’s wharf jetty by a launch. Other schooners...fought a strong southwest wind to take refuge in the open harbour and most of them got clear. A Government launch and three lighters were sunk while several other small craft sustained damage. Landslides occurred in various parts of Trinidad, houses were damaged in some districts and there were losses in livestock and poultry in resulting floods brought on by rains accompanying the squall” (The West Indian from Wednesday, September 1, 1948). On September 1<sup>st</sup>, a small ship which had been enroute from Cuba to Cartagena, Colombia sunk approximately “130 miles off the Colombian coast, 200 miles from Panama, and about 30 hours from port” (The West Indian from September 9<sup>th</sup>). “A tiny Circus ship was swallowed up by a hurricane which swept the Caribbean in the dark morning of September 1. Forty-four of the number of persons aboard and thirty-nine trained animals are missing and are feared to be lost. The Norwegian motor vessel ‘Caribe’ radioed yesterday that she had picked up twelve survivors in a lifeboat, 770 miles south of Miami. Naval experts in Havana piecing together bits of information in by the ‘Caribe’ said that they thought the Circus ship, a 140-foot Honduran motor vessel ‘Euzkera’ probably capsized in heavy seas because she was overladen. The ‘Euzkera’ was carrying the Razzore Circus from Cuba to Cartagena, Colombia. There were fifty-six persons aboard, forty-six of them passengers. Circus officials, performers, and labourers with their wives and families. There also were fifty-nine trained animals- lions, tigers, monkeys, horses and dogs. Those rescued by the ‘Caribe’ were three crew members and nine passengers” (The West Indian from September 9<sup>th</sup>). “The ‘Caribe’ arrived yesterday with twelve survivors of the Circus ship ‘Euzkera’ which were down in a storm off Columbia, September 1<sup>st</sup>. All twelve survivors had been injured and had gone without food or water for a week. The crew member said he was told that the ‘Euzkera’ broke her steering cable, went out of control, and capsized because of a heavy deck load; she sunk stern first” (The West Indian from September 9<sup>th</sup>).

DAY	LAT	LON	STATUS
Aug 28	11N	58W	Open wave
Aug 29	11N	63W	Open wave
Aug 30	11N	68W	Open wave
Aug 31	12N	73W	Open wave
Sep 01	12N	79W	Open wave
Sep 02	13N	85W	Open wave

9)

HWM, the MWR September tracks of centers of cyclones, and microfilm indicate that a low developed off the Georgia coast on 2 September associated with a frontal boundary and moved east-northeastward and then northeastward at a rapid pace. Observations indicate that this low may have possibly become a tropical cyclone from approximately 12Z on the 3<sup>rd</sup> through 06Z on the 4<sup>th</sup> before becoming extratropical again. The first observed gale occurred at 00Z on the 4<sup>th</sup>, during the period of time when the cyclone was closest to being a tropical cyclone. At 12Z on the 4<sup>th</sup>, another gale was observed, but the cyclone appears to be extratropical again by 12Z on the 4<sup>th</sup>. The lowest observed pressure during the time it may have been tropical is 1008 mb, and 1006 mb was observed at 12Z on the 4<sup>th</sup>. Since there is only one piece of evidence (the one gale of 35 kt at 00Z on the 4<sup>th</sup>) during the time that this cyclone may have possibly been tropical, this system is not added into HURDAT. Even though the wind and temperature structure indicates that this cyclone may have been a tropical cyclone for a short period of time, the fast forward motion in an east-northeasterly direction is a more typical motion for an extratropical cyclone rather than a tropical cyclone. Thus, the analysis indicates that this system never did attain tropical status. It is worth mentioning that the one new storm which was added into HURDAT in 1948 (1948 Storm 7) started to develop its circulation on 5 September along the cold front that extended southwestward from the extratropical cyclone mentioned here. At 12Z on the 5<sup>th</sup>, the developing circulation of 1948 storm 7 was located about 700 nautical miles southwest of this extratropical cyclone along the cold front.

DAY	LAT	LON	STATUS
Sep 02	31N	77W	Extratropical
Sep 03	32N	70W	Extratropical
Sep 04	34N	62W	Extratropical
Sep 05	43N	47W	Extratropical
Sep 06	52N	33W	Extratropical
Sep 07			Absorbed

10)

The microfilm map from 12Z on September 8<sup>th</sup> indicates that a Navy Aircraft intercepted extremely bad weather at 17Z on the 8<sup>th</sup> near 14.1N, 81.8W. The following is a text from microfilm: "081702Z: Report from Navy Plane: Extremely bad weather. Wind to 50 kt in gusts. High Sea. Visibility zero. 14.1N, 81.8W" (micro). COADS does not contain any relevant observations in the area on the 8<sup>th</sup>. There were no observed gales or low pressures besides the text from the aircraft, and there is no evidence of a closed low. Thus, this system is not added into HURDAT.

DAY	LAT	LON	STATUS
Sep 08	14N	82W	Open wave

11)

HWM, the MWR September tracks of centers of cyclones, the MWR September river section (p 208, paragraph 4), the September 1948 Louisiana climatological data summary, microfilm, and Jack Beven's list of suspects indicate that a low formed along a frontal boundary in the western Gulf of Mexico on 11-12 September and moved northeastward to the Louisiana coast on 13 September. It made landfall in Louisiana just after 12Z on the 13<sup>th</sup> before stalling and dissipating over extreme southern Louisiana by the afternoon of the 14<sup>th</sup>. It is uncertain from the analysis whether the system became a tropical cyclone or stayed extratropical. There were no observed gales at any point with this system, although there were three 30 kt wind observations and one low pressure of 1003 mb, all on the 13<sup>th</sup>. The following is a quote from the Louisiana climatological data summary: "...Rainfall was 3.26 inches above normal (for the month). This excess resulted from unusually heavy rains in the southeast (part of the state) on the 3<sup>rd</sup>-4<sup>th</sup> and on the 12<sup>th</sup>-13<sup>th</sup> (of the month); the first in connection with the hurricane on the 4<sup>th</sup>, and the latter in connection with squalls of tropical origin; 8.00" were recorded at Morgan City and 7.47" at Houma during the 24 hours ending at 7:00 am on the 13<sup>th</sup>" (September, 1948 Louisiana Climatological Data). Regarding the flooding in Louisiana... "Atchafalaya Basin: Light flooding occurred on the Atchafalaya River at Morgan City, LA on the 13<sup>th</sup> due to strong south and southeast winds caused by the passage of a small cyclonic disturbance over southwestern Louisiana. These winds caused the water to back up the river to slightly above bank-full stage from 6:15 am to 2:50 pm. No damage was reported" (MWR).

DAY	LAT	LON	STATUS
Sep 11			Broad low/trough
Sep 12	27N	95W	Extratropical?
Sep 13	29N	93W	Extratropical/tropical depression/storm ?
Sep 14			Dissipated

12)

On 15 September, a trough of low pressure was located in the Gulf of Mexico. A 35 kt gale from the ESE was observed at 18Z on the 15<sup>th</sup> from a ship at 27.9N, 91.3W, but there was not a closed low at that time. A closed low formed from the trough on the 16<sup>th</sup>, but since there are no gales or low pressures on the 16<sup>th</sup>, a tropical depression is analyzed for this day. On the 17<sup>th</sup>, the depression quickly dissipated as environmental conditions quickly became unfavorable. Even if the low was closed when the gale occurred, this system cannot be added into HURDAT with only one piece of evidence.

DAY	LAT	LON	STATUS
Sep 15	28N, 92W to 23N 94W		Broad low/trough
Sep 16	26N	94W	Tropical depression

Sep 17

Dissipated

13)

HWM, the MWR September tracks of centers of cyclones, microfilm, and Jack Beven's list of suspects show that a low, which was first apparent on 24 September in the northwestern Caribbean Sea, moved slowly across the northern Yucatan Peninsula and into the eastern Gulf of Mexico. After that, it moved northward and made landfall between 00Z and 06Z on the 28<sup>th</sup> in the Florida Panhandle close to Apalachicola. The highest observed wind with this system from any source is 25 kt. There was one observed low pressure of 1005 mb at 18Z on the 27<sup>th</sup> when the system was approaching the Florida Panhandle. Pressures of 1006 mb were observed on the 24<sup>th</sup> and again on the 27<sup>th</sup> at 12Z. This system never appeared to attain the structure of a tropical cyclone. It may have become extratropical as soon as it was a closed low.

DAY	LAT	LON	STATUS
Sep 24	18N	86W	Broad low/trough
Sep 25	19N	86W	Broad low/trough
Sep 26	21N	88W	Broad low/trough
Sep 27	26N	86W	Extratropical
Sep 28	34N	87W	Extratropical
Sep 29	36N	89W	Extratropical
Sep 30	43N	87W	Extratropical
Oct 01			Absorbed

14)

A westward moving tropical wave appeared near the Lesser Antilles on 25 September in both HWM and microfilm. When the wave had reached the central Caribbean on the 27<sup>th</sup>, aircraft flew the wave and found that it was a moderately strong wave with wind gusts to 45 kt and heavy squalls, but a closed circulation was not found. However, there was one aircraft observation that day of 1005 mb with estimated surface winds of 35 kt. But the first relevant wind with a westerly component does not appear until 12Z on the 28<sup>th</sup> (15 kt SW), but this appears not to be enough to call it a closed low yet. On the 29<sup>th</sup>, when it had reached the northwestern Caribbean Sea, an aircraft reconnaissance investigation found the following: "Complete search of area shows well-organized circle of storm but open to west and northwest; wind SE 30 (mph)" (micro). The same plane measured a lowest surface pressure of 1004 mb. Given some westerly winds from the aircraft, this system may have been a tropical depression or close to being a depression on the 29<sup>th</sup>. On the 30<sup>th</sup>, the disturbance moved into the northern Yucatan Peninsula, and on 1 October it moved slowly north into the southern Gulf of Mexico. Available wind observations indicate very light winds and an ill-defined circulation on the 30<sup>th</sup> and 1<sup>st</sup>, and it is possible that the land interaction with the Yucatan Peninsula disrupted the circulation. By the 2<sup>nd</sup> of October whatever was left of the weak area of low pressure

started to elongate and open into a trough. On the 3<sup>rd</sup> and 4<sup>th</sup>, cold air moving southward over the central/eastern part of the United States along with the formation of a hurricane in the western Caribbean Sea acted to prevent any opportunity for redevelopment of this system as a tropical entity. The area of disturbed weather apparently moved northeastward across the northern Florida Peninsula and it deepened as an extratropical cyclone on the 5<sup>th</sup> as it moved along the coastlines of North Carolina and Virginia producing strong gales. Several ships and US cities reported sustained winds of between 35-50 kt along and near the mid-Atlantic coast between 12Z on the 5<sup>th</sup> and 00Z on the 6<sup>th</sup>, but this cyclone was clearly extratropical on the 5<sup>th</sup>. On the 6<sup>th</sup>, it turned eastward but slowed down, and by the 8<sup>th</sup>, it had either dissipated or was absorbed by the circulation of storm 9, which was a hurricane moving eastward by Bermuda at the time. The system indicated here from September 25<sup>th</sup> through October 8<sup>th</sup> may not have been one coherent system. On the 1<sup>st</sup> or 2<sup>nd</sup> of October, the system may have dissipated altogether and it is possible that a new trough appeared and became the extratropical cyclone that plagued the east coast on the 5<sup>th</sup>. Another scenario is that the remnants of the system in the northeastern Gulf of Mexico on the 2<sup>nd</sup> combined with a separate trough to generate the extratropical cyclone on the 5<sup>th</sup>.

There were no observed gales with this system between 28 September and 4 October. The system was not closed until the 29<sup>th</sup> of September. It was extratropical on the 5<sup>th</sup> of October. The only time this system could have possibly been a tropical storm is on the 29-30<sup>th</sup> before landfall in the Yucatan Peninsula, but the evidence is not strong enough so this system is not added into HURDAT.

#### Highlights/recap:

27th Aircraft ob of 35 kt and 1005 mb but not a closed low

28th: Ship with SW wind 15 kt (first relevant westerly wind component)

29th: Aircraft- 1004 mb; aircraft report implies it may be a closed TD

Last observed gale in Caribbean Sea: 9/27 18Z (not yet closed)

Next observed gale: 10/05 ~1030ZZ (extratropical)

DAY	LAT	LON	STATUS
Sep 25	13N	58W	Open wave
Sep 26	14N	64W	Open wave
Sep 27	15N	70W	Open wave
Sep 28	16N	76W	Open wave
Sep 29	18N	84W	Tropical depression
Sep 30	21N	88W	Tropical depression
Oct 01	24N	90W	Tropical depression
Oct 02	26N	87W	Tropical depression
Oct 03	28N	85W	Broad low/trough
Oct 04	30N	81W	Broad low/trough
Oct 05	35N	76W	Extratropical storm
Oct 06	38N	73W	Extratropical
Oct 07	38N	71W	Broad low
Oct 08			Dissipated or absorbed by the hurricane (storm 9)

15)

A closed low formed just off the southeast coast of the United States on 23 October. At 12Z on the 23<sup>rd</sup>, the temperature southwest of the low in Jacksonville, FL was 51 degrees and the temperature east of the low from a ship with 69 degrees with a south wind. Therefore, this low was likely extratropical from the time it formed on the 23<sup>rd</sup>. HWM and the MWR October tracks of centers of cyclones were utilized to track this cyclone. The combination of this cyclone and a strong pressure gradient from high pressure over the Great Lakes region produced a 5-minute maximum wind of 50 kt at Block Island on the 24<sup>th</sup>. MWR p 236 states that Nantucket, Marthas Vineyard, Cape Cod, and southern Rhode Island experienced gales and rain from 10Z on the 24<sup>th</sup> to 04Z on the 26<sup>th</sup>. Regarding the storm in eastern MA and RI... "Northeast storm of unusually long duration, accompanied by winds of gale force and resulting high seas, caused moderate damage to small craft and shore property, and electric power failures in southeastern Massachusetts and the Narragansett area of Rhode Island. Heavy rain interrupted traffic and caused numerous highway accidents throughout eastern Massachusetts" (MWR). On the 26<sup>th</sup>, the extratropical cyclone moved eastward and away from the United States. It continued moving slowly (for an extratropical system) eastward through the Atlantic and turned northeastward on the 29<sup>th</sup>. It was absorbed on 3 November over the far northeastern Atlantic.

DAY	LAT	LON	STATUS
Oct 23	33N	74W	Extratropical
Oct 24	37N	70W	Extratropical
Oct 25	37N	70W	Extratropical
Oct 26	37N	66W	Extratropical
Oct 27	37N	58W	Extratropical
Oct 28	37N	54W	Extratropical
Oct 29	39N	53W	Extratropical
Oct 30	42N	48W	Extratropical
Oct 31	47N	41W	Extratropical
Nov 01	52N	32W	Extratropical
Nov 02	58N	20W	Extratropical
Nov 03			Absorbed

## 1949

## 1949 Storm 1

34220 08/21/1949 M= 8 1 SNBR= 759 NOT NAMED XING=0 SSS=1  
 34220 08/21/1949 M=10 1 SNBR= 759 NOT NAMED XING=0 SSS=1

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34225 08/21\* 0 0 0 0\*213 626 60 0\*223 647 65 0\*232 663 70 0\*  
 34225 08/21\*212 615 55 0\*219 632 60 0\*226 649 65 0\*233 666 70 993\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\* \*\*\* \*\* \*\*\*

34230 08/22\*243 678 75 0\*249 693 80 0\*254 707 85 0\*260 723 85 0\*  
 34230 08/22\*240 683 75 0\*247 700 75 0\*254 716 80 984\*262 731 85 974\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\* \*\*\*

34235 08/23\*265 739 85 0\*274 752 85 0\*286 759 90 0\*297 762 90 0\*  
 34235 08/23\*272 743 85 0\*282 753 85 0\*292 761 90 0\*302 766 90 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\*

34240 08/24\*309 762 95 0\*326 760 95 0\*343 757 95 977\*355 745 95 0\*  
 34240 08/24\*315 767 95 0\*329 766 95 0\*343 761 90 977\*357 745 90 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\*

34245 08/25\*365 729 90 0\*376 685 85 0\*378 642 75 0\*385 598 65 0\*  
 34245 08/25\*367 717 85 0\*374 677 85 0E382 608 80 963E396 567 75 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\*\* \*\* \*\* \*\*\*\*\* \*\* \*\*

34250 08/26E402 555 65 0E422 519 65 0E442 493 65 0E460 470 60 0\*  
 34250 08/26E413 540 70 0E430 519 65 0E447 500 65 0E461 475 60 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\*

34255 08/27E477 447 60 0E495 423 60 0E512 400 60 0E530 376 55 0\*  
 34255 08/27E474 450 60 0E492 425 55 0E512 400 50 0E528 378 50 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\* \*\*\* \*\* \*\* \*\*\* \*\*

34260 08/28E547 353 50 0E565 326 45 0E584 300 45 0E600 274 40 0\*  
 34260 08/28E542 357 50 0E560 330 45 0E580 300 40 0E600 274 40 0\*  
 \*\*\* \*\* \*\* \*\*\* \*\* \*\*\* \*\* \*\*\* \*\*

(The 29<sup>th</sup> and 30<sup>th</sup> are new to HURDAT.)

34262 08/29E615 247 50 0E629 219 45 0E640 190 40 0E650 160 40 0\*  
 34263 08/30E660 130 35 0\* 0 0 0 0\* 0 0 0 0\* 0 0 0 0\*

34265 HR NC1

## U.S. Landfall (closest approach):

8/24/1949 12Z – 34.3N, 76.1W – 70 kt – 977 mb – 1016 mb OCI – 175 nmi ROCI (note that 70 kt is estimate of peak 1 min winds along NC coast – stronger winds remained offshore)

Major track changes and minor intensity changes are introduced for this August hurricane that passed close to the Outer Banks of North Carolina. 30 hours is added to the end of this system during the extratropical phase, as it was not yet absorbed. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, monthly climatological summaries from NCDC, NHC microfilm of synoptic weather maps, Washington, D.C. Weather Bureau Daily Weather Maps, the U.S. Weather Bureau operational advisories, Ho et al. (1987), Jarrell et al. (1992), and Dunn and Miller (1960).

August 17:

HWM analyzes a closed low of at most 1010 mb near 12N, 44.5W. HURDAT did not previously list a system on this day. No gales or low pressures.

August 18:

HWM analyzes a closed low of at most 1010 mb near 10N, 47W. HURDAT did not previously list a system on this day. No gales or low pressures.

August 19:

HWM analyzes a closed low of at most 1010 mb near 10N, 51.5W. HURDAT did not previously list a system on this day. No gales or low pressures.

August 20:

HWM analyzes a closed low of at most 1012.5 mb near 15N, 54.5W. HURDAT did not previously list a system on this day. No gales or low pressures.

August 21:

HWM analyzes an open trough with a "T" plotted near 21.5N, 62.5W. "T" probably stands for "Tropical." HURDAT lists this as a 65 kt hurricane at 22.3N, 64.7W. The MWR tracks of centers of cyclones shows a 12Z position near 24.3N, 65.9W with a 1012 mb pressure. Microfilm shows a closed low of at most 1005 mb centered near 23.2N, 66.7W at 12Z. Ship highlights: 45 kt WNW and 1005 mb around ~21Z at 23.6N, 67.9W (micro). Aircraft highlights: 50 kt E at 24.2N, 66.8W (micro); center fix at 17Z at 23.2N, 66.4W with estimated surface winds of 80 kt and lowest pressure of 993 mb [probably a central pressure, but not certain that plane flew inside eye; treated as central pressure] (micro). "Note: Army post flight report from storm center. Estimate hurricane winds 35-40 miles radius from center. Precipitation and turbulence heaviest in northern quadrants. Lowest pressure 993.4 (mb). Center at 23.2N, 66.4W at 12 EST [17Z], wind velocity 80 knots, no direction given" (micro). "The first disturbance [of the season] was discovered on August 21, 300 miles north of San Juan, Puerto Rico, moving WNW at 18 mph. Six hours after discovery the storm was well developed with winds of 80 mph reported by surface vessels in its path" (MWR).

August 22:

HWM analyzes a closed low of at most 1000 mb near 25.8N, 71.0W. HURDAT lists this as an 85 kt hurricane at 25.4N, 70.7W. The MWR tracks of centers of cyclones shows a 00Z position near 24.8N, 68.9W, and a 12Z position near 25.7N, 71.9W with a 984 mb pressure. The MWR post-season track map shows a 00Z position near 24.2N, 67.7W, and a 12Z position near 25.6N, 71.2W. Microfilm analyzes a closed low of at most 1008 mb near 25.8N, 72.0W at 12Z. Ship highlights: 45 kt ENE and 1006 mb at 01Z at 25.3N, 69.1W (micro); 45 kt WSW and 1011 mb at 06Z at 23.9N, 69.5W (COA); possible center fix at 19Z at 26.3N, 73.3W with 974 pressure [probably central pressure; treated as central pressure] (micro). At least four other gales; 2 other low pressures from same ship that encountered the 974 mb. Aircraft highlights: center fix at 1515Z at 25.6N, 72.0W with 984 central pressure and 70 kt winds on the weak side (micro); center fix at 2107Z at 26.4N, 73.6W with estimated max winds of at least 75 kt (micro). At least eight other gales and one other low pressure. "Navy 1015E (1515Z) location: center 25.6N, 72.0W –

well-defined eye 25 miles in diameter; strongest wind on weak side 70 kt” (micro). “Lowest pressure was 984 mb and it stayed that way all through the eye. They stayed in it for better than half an hour taking pictures. The rain was so intense in western part they couldn’t get through it with radar to fix the eye. Heavy rain all around. Coming out of eye to south they hit some very heavy rain and severe turbulence, which is when they hauled out to the 1013 mb isobar and went around. Sully figures they might have had around 80 – 90 knots just south of the eye, but the turbulence makes it hard to estimate. The navigator hit the overhead twice. Otherwise that 70 knots in western quadrant was estimate of highest wind. The squall lines around the eye were characteristic and well formed all around the storm. The SW sector was about as strong as the others so far as precip was concerned” (micro). “Air Force gives center at 2107Z at 26.4N, 73.6W. Max wind [encountered] 35 miles from the center was 75 kt” (micro). “Camche [a ship] believes it passed thru center at 1900Z at 26.3N, 73.3W. Winds... shifting from NNE to W and SW in 20 minutes. Barometer fell from 29.3 at 1500(Z) to 28.75 at 1900(Z), rising to 29.50 at 2000(Z)” (micro). [I believe they may have meant 29.3 inches at 1800Z instead of 15Z.]

August 23:

HWM analyzes a closed low of at most 1000 mb centered near 28.6N, 75.6W, with a SW-NE stationary front over the southeastern United States a few hundred miles northwest of the low. HURDAT lists this as a 90 kt hurricane at 28.6N, 75.9W. The MWR tracks of centers of cyclones shows a 00Z position near 27.1N, 74.2W and a 12Z position near 28.8N, 75.9W with a 996 mb pressure. The MWR post-season track map shows a 00Z position near 26.3N, 74.0W and a 12Z position near 28.0N, 75.5W. Microfilm analyzes a low of at most 1005 mb centered near 29.0N, 75.8W at 12Z. Ship highlights: 90 kt SW and 999 mb at 1630Z at 29.9N, 75.9W (micro); 68 kt S and 999 mb at 18Z at 29.8N, 75.9W (micro). Four other gales. Aircraft highlights: Navy radar center fixes at 0439Z, 0725Z, and 0830Z between 27.2-27.8N, 75.2-75.4W (micro); center fix at 1420Z at 29.3N, 75.8W with max winds estimated 100 kt (micro); 80 kt (max wind observed on flight 25 miles west of eye) N and 1005 mb at 1421Z at 29.4N, 76.2W (micro); center fix at ~1845Z at 30.5N, 76.8W (micro). At least 13 other gales and five low pressures. “Navy position 1420Z 29.3N, 75.8W; eye 28 miles diameter; max winds estimated 100 knots” (micro). “Navy 10 notes: max wind observed at 29.4N, 76.2W at 1421Z- 80 kt N with lowest pressure [encountered] 1005.1 mb 25 miles west of eye” (micro). “Air Force plane found hurricane winds 40 miles from center in NE quadrant and 30 miles from center in other quadrants. Estimate maximum velocity at 85 knots. Encountered only moderate rainfall and turbulence” (micro). “Duck at 1345E (1845Z) reports: Passed thru light squall line (box pattern completed). Center is at 30.5N, 76.8W. Duck 11 at 30.5N, 77.3W ‘over the Sun [a ship]’” (micro). “The hurricane moved WNW from the point of discovery to the position 27.5N, 75W, where it began to curve northward” (MWR).

August 24:

HWM analyzes a closed low of at most 1000 mb centered near 33.8N, 75.7W with a dissipating SSW-NNE stationary front located just to the west. HURDAT lists this as a 95 kt hurricane at 34.3N, 75.7W. The MWR tracks of centers of cyclones shows a 00Z

position near 31.4N, 76.6W and a 12Z position near 34.8N, 76.5W with a 980 mb pressure. The MWR post-season track map shows a 00Z position near 31.0N, 76.0W, and a 12Z position near 33.8N, 76.0W. Microfilm at 12Z analyzes a hurricane of at most 999 mb centered near 34.7N, 75.8W with a frontal boundary located just to the west. Ship highlights: 45 kt NNE and 1006 mb at 06Z at 33.0N, 77.0W (micro); 40 kt NW and 999 mb at 10Z at 33.0N, 77.0W (micro); 45 kt SW at 18Z at 34.0N, 74.1W (micro). At least five other gales. Land and station highlights: 100 kt ESE at Diamond Shoals Lightship [35.2N, 75.3W] (WB advisories); 60 kt NNE and 993 mb at 1430Z at Cape Hatteras (min pressure at Cape Hatteras was 992 mb) (micro, climo); 977 mb (central pressure) and calm at 1445Z at Diamond Shoals Lightship (MWR); 977 mb (min pressure) during lull at 1445Z at Diamond Shoals Lightship (micro); 63 kt NNW (max wind; 1-minute) and 996 mb at 1530Z at Cape Hatteras (climo, micro); 100-105 kt NW and 986 mb at 1545Z at Diamond Shoals Lightship (micro). Two other gales and two other low pressures at Cape Hatteras. Aircraft highlights: 3 good radar center fixes between 0416Z – 0620Z (micro); radar center fix at 21Z at 36.3N, 73.3W (micro). “From Norfolk: Diamond Shoals Lightship 1045E (1545Z) NW 115-120 mph and 29.12 inches (986 mb) (barometer) rising rapidly; storm lull at 0945E (1445Z)” (micro). “Moving at a speed of 15 to 18 mph, the hurricane passed over Diamond Shoals Lightship located off Cape Hatteras, NC. As the eye of the storm passed over the Lightship, a 15-minute calm and a minimum pressure of 977.3 mb were recorded. Shortly afterward, the storm curved northeastward and finally eastward in the Atlantic” (MWR). “The first hurricane of this season passed close to the North Carolina coast on the morning of the 24<sup>th</sup> bringing heavy rain and violent winds to the outer banks, but had almost no effect a few miles inland. The hurricane inflicted a considerable amount of damage particularly to forests on the outer banks. One man was drowned and an estimated \$50,000 damage was inflicted on housing in Buxton.” (August 1949 North Carolina climatological data). “As the eye of the hurricane passed over the Lightship, a 15-minute calm was reported with a minimum pressure of 980.7 mb” (back of Oct. 31 Washington, D.C. Weather Bureau Daily Weather Map). “Aug 24, bypass hurricane, 977 mb central pressure at 35.1N, 75.2W measured at Diamond Shoals Lighthouse, NC, 24 nmi RMW, 22 kt translational speed” (Ho et al. 1987). “Aug – NC 1 – 980 mb” (Jarrell et al. 1992). “Tropical Cyclones in the South Atlantic States – Carolinas and Georgia: 1949 Aug. 24, NC coast, Minimal, Center off coast” (Minimal has maximum winds of 74 to 100 mph and central pressure 983 to 996 mb, Dunn and Miller).

#### August 25:

HWM analyzes a closed low of at most 995 mb centered near 38.3N, 62.2W, with a WSW-ENE frontal system located on the NW side of the low interacting with the low. HURDAT lists this as a 75 kt hurricane at 37.8N, 64.2W. The MWR tracks of centers of cyclones shows a 00Z position near 37.4N, 72.4W and a 12Z position near 38.3N, 62.3W with a 994 mb pressure. The MWR post-season track map shows a 00Z position near 36.5N, 72.5W, and a 12Z position near 37.5N, 64.2W. Microfilm analyzes a low of at most 999 mb centered near 38.0N, 63.0W at 12Z. Ship highlights: 55 kt SW and 1002 mb at 00Z at 35.4N, 71.1W (micro); 50 kt E and 997(?) mb at 12Z at 38.2N, 63.0W (micro); 74 kt NE and 1007(?) mb at 12Z at 40.2N, 58.8W (micro); 963 mb (min pressure encountered for ship Marseille with short interval of almost calm winds) at 12Z at 38.0N,

60.3W (MWR); 55 kt NW and 1001 mb at 21Z at 39.8N, 57.8W (micro). 14 other gales and five other low pressures. Aircraft highlights: 45 kt WSW and 1001 mb at 14Z at 37.3N, 61.3W (micro). Four other gales. “2300 E [0400Z] radar fix on land 36.7N, 70.1W. 0020E [0520Z] radar fix on land 36.7N, 69.4W” (micro). “By 1:30 am, the center had already moved away from the North Carolina coast after having passed close to Cape Hatteras” (back of Oct. 31 Washington, D.C. Weather Bureau Daily Weather Map). “The French ship Marseille passed through the center of this hurricane on August 25 at 1200 G.M.T. At this time the ship was at 38.0N, and 60.3W, and the lowest pressure recorded on the ship’s barograph was 962.6 mb. The captain of the ship reports as follows: ‘At first we experienced extremely strong southwest winds, overcast skies and rough seas. Next these winds brought heavy rain reducing the visibility to almost zero. Afterwards, there was a short interval of almost calm, a small clearing at the zenith, and an enormous confused swell. Finally, the wind shifted to the northeast, blew with practically the same force, and gradually became a northwest wind’” (MWR).

#### August 26:

HWM analyzes a closed low of at most 985 mb centered near 45.2N, 49.5W with a cold front extending from the low southward and then southwestward, and a warm front extending from the low northeastward to another low located near 58N, 39W. HURDAT lists this as a 65 kt extratropical cyclone at 44.2N, 49.3W. The MWR tracks of centers of cyclones shows a 00Z position near 42.0N, 52.4W, and a 12Z position near 44.4N, 49.6W with a 980 mb pressure. The MWR post-season track map last shows a position at 00Z near 39N, 52W. Microfilm at 00Z shows a closed low of at most 993 mb centered near 40.5N, 52.5W, but by 12Z, the low is moving off the edge of the microfilm map. Ship highlights: 50 kt S and 986 mb at 06Z at 42.2N, 51.8W (micro); 55 kt SSW and 994 mb at 18Z at 45.0N, 45.0W (COA). 15 other gales and 15 other low pressures.

#### August 27:

HWM analyzes a closed low of at most 990 mb centered near 51.5N, 40.1W with a cold front extending from the low southward to beyond 33N, 42W, and a warm front extending from the low northeastward to another low centered near 58N, 32W. HURDAT lists this as a 60 kt extratropical storm at 51.2N, 40.0W. The MWR tracks of centers of cyclones shows a 00Z position near 46.9N, 45.6W, and a 12Z position near 50.7N, 40.1W with a 989 mb pressure. Ship highlights: 25 kt S and 991 mb at 00Z at 46.2N, 44.4W (COA); 45 kt SW and 1005 mb at 12Z at 46.4N, 39.5W (HWM, COA); 5 kt SSE and 992 mb at 18Z at 53.2N, 37.9W (COA); 45 kt W and 1013 mb at 18Z at 45.4N, 41.5W (COA). Two other gales and 23 other low pressures.

#### August 28:

HWM analyzes a closed low of at most 995 mb centered near 58.1N, 29.5W with a cold front extending southward from the low and a warm front extending northeastward, becoming a cold front extending to another low near 61.5N, 24W. HURDAT lists this as a 45 kt extratropical storm at 58.4N, 30.0W. The MWR tracks of centers of cyclones shows a 00Z position near 54.9N, 35.6W, and a 12Z position near 58.4N, 28.5W with a 990 mb pressure. Ship highlights: 20 kt SW and 992 mb at 00Z at 52.7N, 35.5W (COA);

45 kt W and 1019 mb at 00Z at 44.8N, 42.8W (COA); 35 kt W and 1002 mb at 06Z at 52.7N, 35.5W (COA). 17 other low pressures.

August 29:

HWM analyzes a closed, occluded low of at most 995 mb centered near 62.5N, 20.0W with an occluded front extending from the low northeastward to a triple point near 66N, 13W, with a warm front extending from the triple point eastward and then southeastward to beyond 63N, 8E, and a cold front extending from the triple point southeastward and then southward and south-southwestward to beyond 52N, 8W. HURDAT did not previously list a system on this day. Ship highlights: 10 kt NE and 995 mb at 11Z at 63.5N, 16.5W (COA); 40 kt WNW and 1022 mb at 18Z at 49.5N, 21.6W (COA). 13 other low pressures. Land highlights: 15 kt N and 994(?) mb at 64.0N, 22.6W (HWM); 10 kt SSE and 996 mb at 12Z at 65.2N, 13.8W (HWM).

This tropical cyclone apparently formed from a westward moving tropical wave in mid-August. Due to the lack of ship data in the tropical Atlantic, genesis was not captured. HURDAT previously started this system at 06Z on 21 August at 21.3N, 62.6W. However, HWM first plots a closed low on 17 August at 12.5N, 44.5W. All available ship observations over the eastern and central Atlantic were obtained from the 17<sup>th</sup> to the 20<sup>th</sup> of August. Although it is very likely that genesis occurred well before the time shown in HURDAT, there are no observed gales or low pressures, and there is not enough evidence of a closed circulation to extend the track back in time more than six hours. This system is started at 00Z on 21 August (originally started at 06Z on 21 August) as a 55 kt tropical storm. Around midday on the 21<sup>st</sup>, an Army aircraft reported a pressure of 993 mb in the storm center, and a central pressure of 993 mb is added into HURDAT at 18Z on the 21<sup>st</sup>. The maximum wind velocity reported on that flight was 80 kt. A central pressure of 993 mb equals 59 kt according to the Brown et al. southern pressure-wind relationship. The 70 kt intensity in HURDAT at 18Z on the 21<sup>st</sup> is unchanged. From the 21<sup>st</sup> to the 23<sup>rd</sup> the hurricane moved west-northwestward. Then it recurved, passing very near the Outer Banks of North Carolina on 24 August. All track changes for this portion of the track (through the 24<sup>th</sup>) are minor. On the 22<sup>nd</sup>, with the cyclone passing well north of the Turks and Caicos Islands, aircraft measured a central pressure of 984 mb in the eye at 15Z. At 19Z, a ship "believed" that they passed through the center, and a pressure of 974 mb was measured (treated as a central pressure in the analysis). A central pressure of 984 mb is added into HURDAT at 12Z on the 22<sup>nd</sup> and 974 mb is added at 18Z. A central pressure of 984 mb yields wind speeds of 73 and 72 kt respectively for the southern and north of 25N subsets of the pressure-wind relationship for intensifying systems. The 85 kt intensity in HURDAT is lowered 5 kt to 80 kt at 12Z on the 22<sup>nd</sup>. A central pressure of 974 mb yields wind speeds of 86 and 84 kt respectively for the southern and north of 25N subsets of the pressure-winds relationship for intensifying systems. The 85 kt intensity in HURDAT at 18Z on the 22<sup>nd</sup> is unchanged. On the 23<sup>rd</sup> at 1420Z, an aircraft estimated maximum winds of 100 kt and measured winds of 80 kt with a pressure of 1005 mb 25 miles west of the eye at 1421Z. There was also a 90 kt ship observation at 1630Z, and another aircraft max wind estimate of 85 kt later the same day. It is known that this last plane did not penetrate the center, but it is not known how close it flew to the RMW. The intensity in HURDAT at all times on the

23<sup>rd</sup> is unchanged. On the 24<sup>th</sup>, the hurricane approached the vicinity of Cape Hatteras from the south. Diamond Shoals Lightship, located not far offshore from Cape Hatteras, contained a weather station. 100 kt ESE was measured before the center passed and 100-105 kt NW and 986 mb was measured after the center passed. The height of the anemometer was unknown during this analysis. Diamond Shoals recorded a minimum pressure of 977 mb. MWR states clearly that a 15 minute calm was observed as the center passed, and this was also the time when the minimum pressure of 977 mb was recorded. However, a note on microfilm states that a “lull” was observed. A lull could mean calm winds, but not necessarily. Lull means that the winds decreased for a period of time before increasing again. Therefore, Diamond Shoals was definitely inside the RMW, so the central pressure had to have been some value between 968-977 mb at the time. However, with the advanced communication that existed by then, along with the clear wording in MWR, it is more likely that Diamond Shoals did experience the eye, and the 977 mb central pressure that appears in HURDAT at 12Z on the 24<sup>th</sup> is maintained. A central pressure of 977 mb equals 76 kt according to the pressure-wind relationship for 25-35N and 76 kt for north of 35N. The 95 kt intensity in HURDAT is lowered to 90 kt at both 12 and 18Z on the 24<sup>th</sup> even though Diamond Shoals observed 100 kt winds because the anemometer is probably elevated. During this time, it is analyzed that the OCI was 1016 mb and the ROCI was 175 nmi. The center of the eye did not make landfall on the coast. However, the positions from 18Z on the 23<sup>rd</sup> to 12Z on the 24<sup>th</sup> are adjusted slightly westward (closer to the coast). Diamond Shoals is analyzed to have been in the western edge of the eye, and by that time, the hurricane was turning towards the northeast and east-northeast soon after. Since Cape Hatteras recorded a 1-minute maximum wind of 63 kt it is very likely that 1 min Category 1 winds occurred nearby along the North Carolina coast, the Category 1 impact for North Carolina is maintained. On the 25<sup>th</sup>, the cyclone turned to the east-northeast and accelerated. At 12Z on 25 August, a ship ventured into the eye and recorded a central pressure of 963 mb at 38.0N, 60.3W. This location is 3.9 degrees east of the HURDAT position. Therefore, the HURDAT position at 12Z on the 25<sup>th</sup> is moved from 37.8N, 64.2W to 38.0N, 60.3W (a major track change). At 18Z on the 25<sup>th</sup>, the analyzed position is 2.9 degrees east of the previous HURDAT position (still a major track change). A 963 mb central pressure is added into HURDAT at 12Z on the 25<sup>th</sup>. It is also analyzed that this cyclone became extratropical at 12Z on the 25<sup>th</sup>, 12 hours earlier than in HURDAT previously. By 18Z on the 25<sup>th</sup>, a 19 degree temperature gradient is separated by just 3 degrees of longitude across the low. While the 963 mb would support 88 kt from the north of 35N pressure-wind relationship, this may provide too high a wind estimate as the cyclone had become extratropical. The highest observed wind on the 25<sup>th</sup> is 74 kt (from a ship) at 12Z. The 75 kt intensity in HURDAT is increased to 80 kt at 12Z on the 25<sup>th</sup>. Both the 74 kt wind observation and the 963 mb observation support some increase in intensity. Observed winds of 55 kt occurred at 21Z on the 25<sup>th</sup> and again at 18Z on the 26<sup>th</sup>. Due to these observations, the 60 kt intensity in HURDAT at 18Z on the 26<sup>th</sup> is unchanged. The 80 kt analyzed intensity at 12Z on the 25<sup>th</sup> is analyzed to have decreased to 60 kt by 18Z on the 26<sup>th</sup>. Only minor track changes are analyzed on the 26<sup>th</sup>, and by 12Z on the 26<sup>th</sup>, the cyclone was located at 44.7N, 50.0W. On the 27<sup>th</sup> and 28<sup>th</sup>, the cyclone moved northeastward. All track changes on the 27<sup>th</sup> and 28<sup>th</sup> were less than 1 degree changes. Sufficient observational coverage on the 27<sup>th</sup> suggests that the HURDAT intensity should

be decreased slightly since the highest observed wind on the 27<sup>th</sup> is 45 kt. The 60 kt intensity at 12Z on the 27<sup>th</sup> is lowered to 50 kt. A 45 kt wind was also observed at 00Z on the 28<sup>th</sup>, and the 50 kt intensity in HURDAT at 00Z on the 28<sup>th</sup> is maintained. At 06Z on the 28<sup>th</sup> a gale of 35 kt was recorded. The next observed gale (40 kt) does not occur until the 29<sup>th</sup> at 18Z, and that gale may not have been considered part of the cyclone. Again, since there were many ships in the area, the HURDAT intensity of 45 kt at 12Z on the 28<sup>th</sup> is decreased to 40 kt. The final position listed in HURDAT is at 18Z on the 28<sup>th</sup> at 60.0N, 27.4W. Evidence shows that this cyclone was not dissipated or absorbed until after 00Z on the 30<sup>th</sup>, and 30 hours are added into HURDAT at the end of this system as an extratropical cyclone. The position at 12Z the 29<sup>th</sup> is 64.0N, 19.0W (over Iceland) with a 40 kt intensity. A 35 kt intensity is analyzed for 00Z on the 30<sup>th</sup>.

## 1949 Storm 2

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34270 08/23/1949 M= 9 2 SNBR= 760 NOT NAMED XING=1 SSS=3
34270 08/23/1949 M=10 2 SNBR= 760 NOT NAMED XING=1 SSS=4
      **
34275 08/23* 0 0 0 0*182 600 50 0*184 620 50 0*186 631 50 0*
34275 08/23* 0 0 0 0*180 600 50 0*182 614 50 0*185 627 55 0*
      ***
34280 08/24*189 643 55 0*194 656 55 0*200 669 55 0*207 681 60 0*
34280 08/24*190 642 60 0*197 658 60 0*205 673 65 0*213 686 70 0*
      *** **
34285 08/25*214 693 60 0*227 711 60 0*234 730 65 0*237 740 70 0*
34285 08/25*221 698 75 0*230 711 80 0*236 724 85 0*240 737 90 0*
      *** **
34290 08/26*240 750 85 0*246 764 100 0*252 778 115 0*261 790 130 0*
34290 08/26*242 750 95 0*246 764 100 0*252 778 105 0*259 790 110 0*
      *** **
34295 08/27*268 801 130 954*276 812 100 965*283 822 65 974*293 827 55 982*
34295 08/27*266 801 120 954*273 812 85 965*282 822 70 974*291 828 70 980*
      *** **
34300 08/28*303 829 50 987*315 829 45 992*330 827 40 996*346 820 40 1000*
34300 08/28*303 829 65 984*318 829 65 988*332 827 55 996*347 822 50 1000*
      ** *** **
34305 08/29*364 808 40 1002*384 789 40 1000*408 761 35 1000E438 719 35 0*
34305 08/29*364 806 50 1002*386 782 50 1000*408 766 50 998E438 725 45 0*
      *** **
34310 08/30E472 676 35 0E499 653 30 0E522 628 30 0E541 587 30 0*
34310 08/30E468 682 45 0E495 649 45 0E522 625 45 0E541 592 45 0*
      *** **
34315 08/31E548 547 25 0E548 510 25 0E549 472 25 0E547 436 25 0*
34315 08/31E548 547 40 0E548 510 40 0E549 469 35 0E547 420 35 0*
      ** **
(The 1st is new to HURDAT.)
34317 09/01E540 350 40 0E535 250 45 0E532 190 50 0E530 170 50 0*
34320 HRCFL3
34320 HRCFL4BFL1AFL1DFL1 GA1

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U.S. Landfall:

8/26/1949 23Z – 26.6N, 80.0W – 120 kt – 954 mb – 23 nmi RMW – 1011 mb OCI – 225 nmi ROCI

Minor track changes and major intensity changes are analyzed for this major hurricane that made landfall just south of West Palm Beach, FL. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, state monthly climatological summaries from NCDC, local monthly climatological summaries from NCDC, Washington, D.C. Weather Bureau Daily Weather Maps, U.S Weather Bureau Operational Advisories, Schwerdt et al. (1979), Ho et al. (1987), Jarrell et al. (1992), Dunn and Miller (1960), and Barnes et al. (2007).

August 22:

HWM analyzes a closed low of at most 1010 mb centered near 12.6N, 60.9W. HURDAT does not list a system on this day. No gales or low pressures.

August 23:

HWM analyzes a broad, closed low of at most 1010 mb near 16.8N, 61.7W. HURDAT lists this as a 50 kt tropical storm at 18.4N, 62.0W. The MWR tracks of centers of cyclones first shows a position at 18Z near 19.6N, 62.7W. Microfilm at 12Z analyzes a closed low of at most 1005 mb near 18.7N, 61.7W. Ship highlights: 55 kt and 1008 mb at 2050Z at 19.3N, 62.8W (micro). Aircraft highlights: 40\* kt SE and 1530Z at 19.5N, 61.1W (micro); 50\* kt SE at 1615Z at 19.0N, 61.4W (micro). From ship Mataroa at 2050Z... “Mountainous seas. Pressure 1007.8 and falling. Very long, heavy swells” (micro). “The Delray Beach hurricane, as weather observers would later call it, most likely began as a tropical wave from the Cape Verde region” (Barnes). “This hurricane was discovered in its formative stages on August 23 about 125 miles northeast of St. Martin, Leeward Islands, at latitude 19N, longitude 61.5W. It moved on a west-northwestward course for a time as a partially developed easterly wave, and some characteristics of the wave could be observed until the storm moved into the Bahama Islands two days later (the 25<sup>th</sup>). “The first Weather Bureau advisory for this storm was issued from San Juan, Puerto Rico at 4:00 pm EST, August 23<sup>rd</sup>, locating the center at 19.0N, 62.5W. The Air Force and the Navy sent hurricane reconnaissance aircraft to scout the storm and report its location and movement” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps).

August 24:

HWM analyzes a closed low of at most 995 mb centered near 20.1N, 67.0. HURDAT lists this as a 55 kt tropical storm at 20.0N, 66.9W. The MWR tracks of centers of cyclones shows a 00Z position near 19.8N, 63.8W, and a 12Z position near 20.9N, 67.2W with a 990 mb pressure. The MWR post-season track map shows a position near the HWM and HURDAT positions. Microfilm analyzes a closed low of at most 1002 mb at 12Z centered near 20.5N, 67.4. Ship highlights: 45 kt ENE and 1003 mb at 12Z at 21.1N, 67.7W (HWM, micro); 65 kt ESE and 1006 mb at 15Z at 21.0N, 67.3W (micro); 50 kt E and 998 mb at 18Z at 21.6N, 68.6W (COA, micro). 14 other gales and one other low pressure. Aircraft highlights: 40\* kt SW and 1001 mb at 18Z at 20.5N, 68.4W

(micro); 45 kt SE and 1006 mb at 2045Z at 22.3N, 68.3W (micro). At least three other gales and one other low pressure. “Duck eight: storm center 21.8N, 69.1W (2010Z). Very light winds SW and S of center” (micro). “Duck 14 reports scattered showers and overcast entire course to... Winds very light 110 miles SW of storm” (micro).

August 25:

HWM analyzes a closed low of at most 995 mb centered near 23.8N, 71.9W. HURDAT lists this as a 65 kt hurricane at 23.4N, 73.0W. The MWR tracks of centers of cyclones shows a 00Z position near 22.2N, 69.6W, and a 12Z position near 23.5N, 72.0W, with a 986 mb pressure. The MWR post-season track map shows a 00Z position near 21.4N, 69.0W, and a 12Z position near 23.5N, 71.3W. Microfilm analyzes a closed low of at most 1002 mb centered near 23.7N, 72.9W. Ship highlights: 60 kt SE and 1006 mb at 01Z at 22.5N, 68.3W (micro); 45 kt ESE and 1001 mb at 21Z at 25.5N, 72.6W (micro). Five other gales. Land highlights: 20 kt NW and 995 mb at 21Z at San Salvador (24.1N, 74.5W) (micro); 45 kt NE and 1003 mb at 22Z at Cat Island (24.3N, 75.4W) (micro); 45 kt SSW and 998 mb at 23Z at San Salvador (micro). Two other gales and four other low pressures. Aircraft highlights: 55 kt SE and 1000 mb at 1415Z at 23.7N, 72.6W (micro); center fix at ~1422Z at 23.7N, 72.8W with maximum surface winds encountered of 75 kt NE (micro); center fix at 2045Z at 24.3N, 74.0W with estimated maximum winds of 100 kt and lowest pressure encountered of 993 mb (not central pressure) (micro); 993 mb with 800 ft flight level winds of 80 kt SSE at 21Z at 24.7N, 73.8W (micro). At least five other gales and three other low pressures. “By August 25<sup>th</sup> at 1:30 am, the center is shown about 200 miles north of Puerto Rico moving NW at 12-15 mph. At this time, it was estimated that gales extended over an area of 150 miles north and east of the center with winds at 75 mph near the center” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “It moved rapidly toward the northwest but did not reach hurricane strength until the twenty-fifth, when it entered the Bahama Islands. It stayed on a course with a steady forward speed of almost 20 mph and threatened the Florida coast on the morning of the following day” (Barnes). “The eye situation is odd. He started around the eastern side of the storm as per reports you have. He came on around the north side, intending to circle into the center from the NW quadrant. As he reached that report with the 75 NE he was breezing along according to the book, when he hit a wind shift to NW 50. Report 8 I think the shift was even very noticeably on the water surface with waves blowing into each other from these converging winds. He put the wind on his plane to head in and didn’t get any change. He flew SE from that number 8 report with the NW 50 and kept getting the same wind in part where he expected the eye. The lowest pressure was at the wind shift where he turned toward the supposed center. He went back almost to where he had S to SE winds and gave up the ghost and came home. There was no visual evidence of an eye, nor would radar show one. The ceiling was good all the way, and he said it was exceptionally smooth all the way. Visibility was good, and there were some thunderheads in the NW flow which he did not enter. He was very definite about the 75 knots. This was his first hurricane flight, and the pilot of plane thought they were above this. He is old timer. Aerologist kept them 75 to keep us from getting alarmed. I imagine that personally, from above... I theorize that the thing is still in a formative stage from the original strong easterly we had in Lesser Antilles. The wave is easily followed to the south, and that wind shear he hit is probably the remnants to the

wave north of the eye which is trying to form. There was lots of rain but no turbulence. Rain was in south side. Also, those cumulonimbus in NW quadrant apparently not so pronounced as the first hurricane (storm 1)" (micro). "Position of storm at 2045Z (1545E) at 24.3N, 74.0W, accurate within 15 miles, established by visual fixes- north quadrant roughest with pressure 993 and winds estimated 100 kts" (micro). "Air Force plane reports located storm east of Salvador Island. Winds in excess of 90 knots. Lowest pressure (encountered) 989.3 mb" (micro).

August 26:

HWM analyzes a low of at most 990 mb centered near 25.1N, 77.8W. HURDAT lists this as a 115 kt hurricane at 25.2N, 77.8W. The MWR tracks of centers of cyclones shows a 00Z position near 24.6N, 74.7W, and a 12Z position near the HURDAT position with a 982 mb pressure. The MWR post-season track map shows a 12Z position just east of the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 987 mb centered near 25.3N, 77.6W. Ship highlights: 50 kt N and 999(?) mb at 18Z at 26.2N, 79.4W (micro). Two other gales and one other low pressure. Land highlights: 70 kt ENE and 995 mb at 00Z at Cat Island (24.3N, 75.4W) (micro); 95 kt at Cat Island (WB maps); 70 kt S and 1003 mb at 06Z at Cat Island (micro); 982 mb (min p) at 1015Z at Nassau (25.1N, 77.4W) with no lull (center passed to NE of Nassau) (climo); 974 mb (min p) at 1930Z at Bimini (25.7N, 79.4W); 85-95 kt (max wind; 1-minute) ESE at 2120Z at West End, Grand Bahama Island (26.7N, 79.0W) (climo); center fix with calm winds at Del Ray Beach, FL (26.5N, 80.1W) at ~2307Z (micro); 969 mb (min pressure, uncorrected pressure) at 2330Z at Hillsboro Light, FL (26.3N, 80.1W); 133 kt NE (max wind; 1-minute; elevated observation) at 2333Z at Jupiter Light (26.9N, 80.1W) (climo). Seven other hurricane force wind obs and three other pressures below 1000 mb. "By August 25<sup>th</sup> at 7:30 pm EST, the winds were 95 mph. Surface winds in southern Florida changed from NNE 5 mph to ENE 25 mph between 6Z the 25<sup>th</sup> and 00Z the 26<sup>th</sup>. The high north of the Great Lakes eventually moved southeastward to a position immediately off the North Carolina coast. This action blocked any recurving to the north of this hurricane while it was over the ocean. A continued WNW movement would carry it inland near West Palm Beach. The winds at Miami, Key West, and Havana were influenced by the approaching hurricane. The wind at Miami at 700 mb was ENE 25 mph at 10 am EST on the 25<sup>th</sup> indicating low pressure to the SE of Miami. There was already a steady increase in the wind velocity at all levels over the Florida peninsula as the hurricane moved closer. Later reports showed that winds at the three stations mentioned above all backed from ENE through N to NW and later to W or SW as the hurricane moved inland to the north of Miami" (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). At 11 pm EST on the 25<sup>th</sup>, the hurricane was centered near 24.5N, 75.7W and was moving WNW at 12-15 mph. The weather station at Cat Island in the Bahamas reported winds of 95 mph. Aircraft estimated winds in the center over 100 mph. At this time, the area of hurricane winds was small, but was increasing in size and intensity. By 1:30 pm EST on the 26<sup>th</sup>, the hurricane had moved close enough to the Florida coast to cause coastal winds up to 45 mph. Winds in the NW quadrant of the hurricane were onshore and added the danger of high tides to the danger of high winds. Winds at Cat Island previously reported at 95 mph had increased to 110 mph. The hurricane moved over the Florida east coast at Delray Beach, about 20 miles south of West Palm Beach,

where the winds diminished rapidly from hurricane force to calm at 23Z on the 26<sup>th</sup>. Winds were reported up to 125 mph with gusts to 150 mph at Stuart. In many cases, wind instruments were blown down and maximum winds could not be recorded.” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “The storm was well-developed by the time its center passed a short distance north of Nassau at about 5 am of the 26<sup>th</sup>. It was over West Palm Beach Airport from 6:37 to 7:57 pm (2337Z 26<sup>th</sup> to 0057Z 27<sup>th</sup>), and a calm was experienced for 22 minutes from 7:20 pm to 7:42 pm (0020Z to 0042Z on the 27<sup>th</sup>). The lowest sea-level pressure was 28.17 inches recorded at the Weather Bureau Airport Station, West Palm Beach. The wind instrument was blown down when the velocity reached 110 mph with gusts of 125 mph. The official in charge at the station estimated the highest wind at 120 mph with gusts to 130 mph. A privately owned anemometer on Palm Beach, the accuracy of which is unknown, recorded gusts of 155 mph. The strongest wind occurred, as usual, some distance to the right of the center in the vicinity of Jupiter and Stuart, Florida. The anemometer failed at Jupiter Lighthouse after reaching a velocity of 153 mph. The observer reported that winds were somewhat stronger thereafter, but he felt unable to make a reliable estimate of the peak strength” (MWR). “It swept inland at Delray Beach” (Barnes). “It crossed the coastline near Delray Beach at 6:00 pm on August 26 (23Z) and delivered vicious winds and tides to much of the coast from Miami to the Georgia line” (Barnes). “Prior to the arrival of the eye at the airport (West Palm Beach), northeasterly gusts of 125 mph destroyed the tower’s anemometer, so the highest winds at that location were never recorded. Several higher readings were reported, including a one-minute maximum of 153 mph measured at Jupiter Lighthouse just before the wind instrument was also carried away. Earlier, the same instrument had recorded a 5-minute maximum of 132 mph. Unofficial reports included a gust of 155 mph at a residence in Palm Beach and a reading of 160 mph at a fire station in downtown Stuart. Neither of these instruments survived the storm either” (Barnes).

#### August 27:

HWM analyzes a closed low of at most 990 mb near 28.2N, 82.3W. HURDAT lists this as a 65 kt hurricane at 28.3N, 82.2W. The MWR tracks of centers of cyclones shows a 00Z position near 26.5N, 80.3W, and a 12Z position near 28.4N, 82.0W with a 987 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a low of at most 987 mb centered near 28.3N, 82.5W. Ship highlights: 20 kt W and 1004 mb at 00Z at 24.4N, 81.2W (COA); 45 kt ESE and 1011 mb at 00Z at 29.2N, 80.3W (COA); 50 kt ESE and 1008 mb at 18Z at 30.4N, 80.6W (micro). Six other gales. Land highlights: center fix with calm and 954 mb (central pressure) at 0026Z at West Palm Beach (26.7N, 80.1W) (micro, climo); 955 mb (min p) at 0045Z at Lake Worth Inlet (26.8N, 80.0W) (climo); 956 mb (min p, central p(?)) at 02Z at Canal Point (26.9N, 80.6W) (climo); 87 kt NNW (max wind; 1-minute) at 0205Z at Belle Glade (26.7N, 80.7W) (climo); 960 mb (min p) with lull at 0330Z at Okeechobee (27.3N, 80.9W); 68 kt SE (max wind; 1-minute) at 0812Z at Melbourne (28.1N, 80.6W) (climo); 970 mb at 0950Z and 13 kt at 1000Z at Lakeland (28.0N, 81.9W) (both obs inside RMW) (climo); 986 mb (min p) at 1137Z and 36 kt W and 12Z at Tampa (climo); 983 mb (min p) at 1845Z at Cedar Keys (29.2N, 83.0W) (climo); 60 kt SE (max wind; 1-minute) gust to 75 kt SE at 2226Z at Jacksonville Airport (climo). Many other gales and

low pressures. “After leaving the coast of Florida, the center of the storm crossed the northern part of Lake Okeechobee during the early part of the night of the 26<sup>th</sup>. The storm was the worst felt in that section since the disastrous hurricane of September 1928. The highest winds registered around the lake ranged from 100 to 126 mph on instruments of the U.S. Army Engineers. The water of the lake rose 12 feet or more at places on the southeast and east side of the lake (Belle Glade and Clewiston), but the levees held and there was no flooding from the lake. After leaving the Lake Okeechobee area, the center passed northwestward through the heart of Florida’s main citrus belt, where much fruit was destroyed, and upon reaching the west coast north of Tampa it turned northward” (MWR). “The general path of this storm was almost the same as the great disaster of 1928. As the storm carved northward through the peninsula, its wide swath spread winds of at least 50 mph over much of the state. Extreme winds of hurricane force were felt as far south as Miami Beach and as far north as St. Augustine” (Barnes). The deluge (rainfall) at Belle Glade measured 8.18 inches, Okeechobee City 7.10 inches, and 9.51 inches fell at St. Lucie Lock near Stuart. The storm remained powerful as it turned across the central portion of the state and curved northward above Tampa Bay. Pressure readings on the east side of the storm remained below 29.00 inches as far north as Levy County, above Cedar Key. Winds gusted to 75 mph in Clermont, and other communities in central Florida experienced significant wind damage. The storm’s forward speed slowed as it churned through the state” (Barnes). Regarding the damage... “At Palm Beach, Jupiter, and Stuart, high winds and high waters tested every structure. In some areas, the trunks of palm trees were snapped off just a few feet above the ground, leaving boulevards lined with sticks and stumps. Hundreds of apartments, homes, stores, and warehouses lost their roofs, their windows, and in some cases their furnishings, which were sucked out into the street by the force of the winds. In Stuart, officials estimated that 40% of the residential and commercial buildings were severely damaged and 90% were in need of at least some repair. The city’s black neighborhoods were especially devastated, with many homes leveled by the ferocious winds. Among the landmarks that were totally destroyed were the Macedonia Baptist Church, the Little Dixie baseball park, and the Olympia Ice Company. The storm’s incredible winds carried large timbers through the air like missiles. At a car dealership in West Palm Beach, automobiles were overturned inside the showroom after winds smashed the building’s plate glass windows. Large airplanes were toppled at the nearby airport, and in some locations, utility poles were carried upward onto second-story balconies. The roof of the Stuart City Hall was peeled away by the wind and scattered in the streets across town. High tides lifted piers and fish houses off their pilings and tossed them onto the shore. At Palm Beach the storm surge carried sand into the streets and left wreckage piled high. Heavy rains across the region added to the flooding problems, and many portions of Palm Beach and Martin Counties were under water following the storm. Days afterward, residents reported finding snakes in their homes, and the plague of mosquitoes that swarmed over the area was said to have been ‘the worst infestation ever witnessed.’ Heavy damages were reported to citrus crops, and in many groves, up to a third of the trees were uprooted. Total agricultural losses in Florida were estimated at \$20 million, which included the estimated loss of 14 million boxes of fruit. Property damages were placed at \$25 million, most of which occurred within a few hours of landfall. Damages totaling another \$7 million were reported in states that endured the remnants of the storm, placing the total

cost of the disaster at \$52 million. Even though dozens of injuries were reported, only two deaths resulted, both of which occurred in Florida. In Miami, damages were limited to downed trees and power lines” (Barnes). “Damage to the four southeastern states- FL, GA, SC, NC was set at \$52,350,000 by reports summarized by the American Red Cross. Of this, \$45,000,000 occurred in Florida. A breakdown of the damage follows: property damage: \$18,000,000; crop damage (including 14,000,000 boxes of citrus fruits): \$20,000,000; power and communication: \$4,000,000; highways, bridges and city streets: \$500,000; other damage: \$2,500,000. Of the remaining \$7,350,000 damage, \$4,000,000 occurred in Georgia. The Carolinas were far enough north to be spared the full force of the hurricane winds. In all, 265 dwellings were destroyed and 24,338 other damaged. There were also deaths to livestock, with 112 cattle reported killed and poultry deaths placed at 2,000” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “The hurricane diminished in intensity after its center moved inland. Further curving to the north was noted as the hurricane moved over the Florida peninsula. The hurricane had moved on the coast with a forward movement of 12-15 mph, and increased to about 17 mph over Florida and Georgia. The course of the hurricane changed from WNW to a NW direction later curving north into Georgia. The center took a course that kept it east of the Appalachian Mountains, and so insured a supply of warm, moist air in its journey up the coast. As the storm moved northward, it diminished in intensity and lost its identity as a hurricane. It then assumed more and more of the characteristics of an extra-tropical cyclone” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “The 700 mb conditions, for 03Z on the 27<sup>th</sup>...Miami reported a wind at this level with a direction of 220 degrees and a velocity of 40 to 45 mph. Tampa reported a wind from 50 degrees with a velocity of 55 to 60 mph, while the wind at Key West was 280 degrees at 25 to 30 mph. At this time, a cyclonic circulation of the winds at 300 mb was present. Also at this time, 3Z on the 27<sup>th</sup>, the hurricane was located between Miami and Tampa. Winds at Miami at all levels were from the SW at approximately 50 mph, while those over Tampa were from the NE at 55 to 60 mph” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “August 27<sup>th</sup> 0630Z: center was over central Florida near Lake Placid, SE of Tampa. Precipitation near the center of the hurricane was very heavy, with several stations reporting 7 to more than 9 inches of rain. A sectional chart of the southeastern US placed the center just east of Tampa at 0930Z on the 27<sup>th</sup>. Winds had already diminished somewhat, now being 75 mph as the hurricane approached the west coast of Florida. Of interest is the barometric tendency recorded at Tampa, FL, showing a fall of 9.9 mb during the previous 3 hours. The central pressure at this time (0930Z on the 27<sup>th</sup>) was 969 mb, as contrasted to the central pressure of 954 mb as the hurricane passed over West Palm Beach earlier. The lowest pressure for the storm was 953.9 mb at West Palm Beach. The highest winds were recorded to the right of the center of the eye” (Back of Oct 31-Nov 1 Washington, D.C. Weather Bureau Daily Weather Maps). “8/27/1949 – 1011 mb OCI, 95 kt equivalent 1 min max wind at US landfall” (Schwerdt et al. 1979). “Aug 27, 954 mb central pressure at landfall based upon 954 mb measured at West Palm Beach, FL, 23 nmi RMW, 14 kt translational speed, landfall point – 26.9N, 80.0W” (Ho et al. 1987). “Aug – FL – SE3, 954 mb” (Jarrell et al. 1992). “Tropical Cyclones in Florida: 1949 Aug. 26-27, Extreme, 2 killed, damage \$45,000,000” (“Extreme” is equivalent to 136 mph and higher, 948 mb or lower, Dunn and Miller).

August 28:

HWM analyzes a closed low of at most 995 mb centered near 33.3N, 82.7W. HURDAT lists this as a 40 kt tropical storm at 33.0N, 82.7W. The MWR tracks of centers of cyclones shows a 00Z position near 30.2N, 82.8W, and a 12Z position near 33.2N, 82.7W with a 992 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a closed low of at most 1002 mb centered near 33.2N, 82.9W. Ship highlights: 40 kt S and 1011 mb at 00Z at 28.8N, 80.2W (COA); 55(?) kt SE and 1006 mb at 12Z at 31.9N, 80.4W (micro). Two other gales. Land highlights: 986 mb (min p) at 0428Z at Alma, GA (31.5N, 82.5W); 65 kt SE (max wind; 1-minute) at 05Z at Brunswick (31.2N, 81.5W); 40 kt ESE and 1001 mb at 12Z at Augusta, GA (33.5N, 82.0W (micro); 41 kt S at Wilmington, NC (climo). Four other gales and 17 other low pressures. "It moved through Georgia and the Carolinas as a weakened disturbance" (MWR). "It finally passed into Georgia as a storm tropical storm around 8:00 pm on August 27, just over 24 hours after it had made landfall. In Georgia and the Carolinas, heavy rains overfilled rivers and caused widespread flooding. At least four tornadoes touched down in central North Carolina, causing millions of dollars in damages" (Barnes). Regarding the storm in North Carolina... "Heavy rain fell on the 28<sup>th</sup> as a dying hurricane moved across the State accompanied also by destructive tornadoes... On the 28<sup>th</sup>, the remnants of a hurricane that had lashed Florida earlier moved across the State [North Carolina]. The center of the storm moved in a northeasterly direction passing near Charlotte and Winston-Salem. Heavy rain amounting to 3 or more inches fell over the central part of the State. All rivers rose sharply at the end of the month as a result of the heavy rain produced by the hurricane. Even the Tar River, which floods infrequently, overflowed its banks in the upper portions of its channel. The Neuse, Cape Fear and Catawba Rivers reached the highest stages since November, 1948. The Neuse rose to a crest about 6 feet above flood level at both Smithfield and Goldsboro. The Cape Fear River reached 41 feet at Fayetteville or 6 feet above flood level and went 11 feet above flood level at Elizabethtown. At Catawba the Catawba River crested at 18 feet on the 29<sup>th</sup> or 10 feet above its banks at that point. Flood stages on a number of streams in the extreme western part of the State were the highest since August, 1940. While crests well above flood stage were reached in Virginia, flood levels were only slightly exceeded, if at all, in North Carolina. A considerable amount of crop damage was inflicted by these floods, but it is believed that very little other property damage resulted. The hurricane caused considerable damage in the central part of the State. Winds with gusts up to 40 and 50 mph accompanied the storm and evidence indicates that several small tornadoes developed in various parts of the eastern Piedmont. These twisters totally or partially destroyed many farm buildings, including a few residences, but no one was killed. Much damage was done to communication and power lines and the heavy rain severely damaged smaller roads and caused considerable field erosion" (August 1949 North Carolina Climatological Data). "Tropical Cyclones in the South Atlantic States – Carolinas and Georgia: 1949 Aug. 28, Interior sections, Minor, Overland from Fla." (Minor indicates winds less than 74 mph and a central pressure above 996 mb, Dunn and Miller).

August 29:

HWM analyzes a closed low of at most 1000 mb centered near 40.6N, 75.7W with an approaching cold front very near the low and already starting to interact with the low. HURDAT lists this as a 35 kt tropical storm at 40.8N, 76.1W. The MWR tracks of centers of cyclones shows a 00Z position near 36.9N, 80.6W, and a 12Z position near 41.4N, 76.0W with a 1000 mb pressure. The MWR post-season track map shows a 00Z position near 36.1N, 81.0W, and a 12Z position near 41.1N, 76.0W. Microfilm analyzes a closed low of at most 1002 mb centered near 41.0N, 75.8W with an approaching front close to the low. Ship highlights: 35 kt S and 1012 mb at 00Z at 33.6N, 77.5W (micro); 25 kt S and 1001 mb at 12Z at 36.9N, 74.7W (COA). Six other low pressures. Land highlights: 20 kt SSE and 1003 mb at 06Z at Washington, D.C. (micro); 15 kt SSW and 1001 mb at 12Z at Harrisburg, PA (micro); 15 kt NNW and 1000 mb at 18Z at Burlington, VT (micro); 35 kt S and 1007 mb at 18Z at Nantucket, MA (micro). Six other low pressures. “Another twister was spawned in the Tidewater region of Virginia. The decaying storm tracked through Maryland, Pennsylvania, New York, and New England, where damaging floods ended an extended drought” (Barnes).

#### August 30:

HWM analyzes a closed low of at most 995 mb centered near 52.0N, 62.8W with a warm front extending from the low towards the ESE and a cold front extending from the low towards the SSE-S-SSW. HURDAT lists this as a 30 kt extratropical cyclone at 52.2N, 62.8W. The MWR tracks of centers of cyclones shows a 00Z position near 47.5N, 68.4W, and a 12Z position near 52.7N, 62.3W with a 992 mb pressure. The MWR post-season track map last shows a position at 00Z near 47.0N, 67.0W. By 12Z, the low is off the microfilm map, but at 06Z, microfilm analyzes a closed low of at most 996 mb centered near 59.4N, 65.9W with a warm front extending from the low eastward and a cold front extending from the low towards the S-SSW. Ship highlights: 40 kt SW and 1009 mb at 12Z at 47.4N, 61.9W (micro); 30 kt SSE and 1004 mb at 18Z at 52.5N, 52.5W (COA). One other gale of 35 kt. Land highlights: 40 kt S and 1004 mb at 06Z at Harbour Island (47.3N, 61.9W) (micro); 15 kt NNE and 995 mb at 06Z at 49.0N, 64.7W (micro). Three other low pressures.

#### August 31:

HWM analyzes a closed low of at most 1000 mb centered near 55.1N, 45.7W with a warm front extending from the low southeastward and a cold front extending from the low towards the SSE-S-SSW. HURDAT lists this as a 25 kt extratropical cyclone at 54.9N, 47.2W. The MWR tracks of centers of cyclones shows a 00Z position near 54.5N, 55.7W and a 12Z position near 56.3N, 45.4W with a 992 mb pressure. Ship highlights: 30 kt ENE and 999 mb at 06Z at 56.5N, 51.0W (COA); 30 kt WSW and 999 mb at 53.5N, 49.5W (COA). Five other low pressures.

#### September 1:

HWM analyzes a closed low of at most 990 mb centered near 52.3N, 20.2W with a warm/occluded front extending from the low wrapping around southward to a triple point near 47N, 19W. From the triple point, a warm front extends southward and then southeastward to southeast of 43N, 17W, and a cold front extends southwestward and then westward to west of 44N, 41W. HWM also analyzes a separate extratropical low of

at most 990 mb centered near 61N, 19.5W. HURDAT no longer lists a system on this day. Ship highlights: 45 kt W and 1011 mb at 06Z at 48.2N, 29.1W (COA); 20 kt NE and 992 mb at 12Z at 53.7N, 18.7W (COA); 45 kt NW and 1011 mb at 12Z at 48.4N, 26.7W (COA); 45 kt WSW and 1012 mb at 18Z at 45.0N, 16.0W (COA). Several other gales of 35-40 kt and several other low pressures of 992-1005 mb.

HURDAT starts this system at 06Z on 23 August as a 50 kt tropical storm at 18.2N, 60.0W. No changes were made to timing of the beginning of this system in HURDAT. However, the genesis of this cyclone was not captured. Available data on the 21<sup>st</sup> and 22<sup>nd</sup> is sparse. This cyclone moved west-northwestward passing just north of the northern Virgin Islands late on the 23<sup>rd</sup> and through the Bahamas on the 25<sup>th</sup> and 26<sup>th</sup>. It made landfall as a category 4 hurricane in Palm Beach County, FL around 23Z on the 26<sup>th</sup>. On the 27<sup>th</sup> and 28<sup>th</sup>, the cyclone moved through Florida and northward through the eastern United States. The largest track change from the 23<sup>rd</sup> through the 28<sup>th</sup> of August was only about six-tenths of a degree at various times from the 23<sup>rd</sup> to the 25<sup>th</sup>. Some intensity changes were also made. At 2050Z on 23 August, a ship in the storm area reported an ESE wind of 55 kt. The HURDAT intensities at 18Z on the 23<sup>rd</sup> and 00Z on the 24<sup>th</sup> are each raised by 5 kt because of the ship observation. On the 24<sup>th</sup> at 15Z, a different ship recorded a wind of 65 kt from the ESE. The HURDAT intensity at 12Z and 18Z on the 24<sup>th</sup> is increased by 10 kt to 65 and 70 kt respectively. From the 23<sup>rd</sup> at 2050Z until the 24<sup>th</sup> at 18Z there were six different observations of winds between 50-65 kt from five different ships. This cyclone is analyzed to have become a hurricane by 12Z on the 24<sup>th</sup> (12Z on the 25<sup>th</sup> previously), which is 24 hours earlier than in HURDAT previously. On the 25<sup>th</sup> at 2045Z, maximum winds of 100 kt were estimated by aircraft reconnaissance, and the plane did not fly into the center. The hurricane passed very near Cat Island in the Bahamas, where hurricane force winds were experienced from 00Z on the 26<sup>th</sup> until at least 06Z, with a highest reported wind of 95 kt. One source says that the 95 kt observation was estimated while other sources say it was measured. Regardless, the winds in HURDAT are boosted due to the combination of the aircraft estimate along with the Cat Island observations. The HURDAT winds are increased by 20 kt on the 25<sup>th</sup> at 06Z, 12Z, and 18Z (all major intensity changes) to 90 kt at 18Z on the 25<sup>th</sup> (up from 70 kt originally at that time). HURDAT previously showed a quick increase in the winds on the 26<sup>th</sup>, but observations from the Bahamas indicate that this hurricane likely did not intensify as rapidly as indicated in HURDAT.

The hurricane made landfall in Palm Beach County, Florida around 23Z on the 26<sup>th</sup> at 26.6N, 80.0W between Boynton Beach and Lake Worth. The highest official wind observation at standard observing height was 110 kt with a gust to 130 kt at Lake Worth (26.8N, 80.0W) (time unknown). The highest official elevated wind observation was 133 kt (1-minute wind) from the northeast. This observation occurred at Jupiter Lighthouse (26.9N, 80.1W) at 2333Z on the 26<sup>th</sup>. Converting this wind down to the standard measuring height of 10 m yields a value of approximately 120 kt. Hillsboro Lighthouse (26.3N, 80.1W) recorded a maximum 1-minute elevated wind of 120 kt from the west at 2347Z on the 26<sup>th</sup>. The lowest pressure of 954 mb was measured at West Palm Beach (26.7N, 80.1W) on the 27<sup>th</sup> at 0026Z with simultaneous calm winds. West Palm Beach recorded 22 minutes of calm winds from 0020Z to 0042Z on the 27<sup>th</sup>. Del Ray Beach

(26.5N, 80.1W) recorded 15 minutes of calm winds from 2300Z to 2315Z on the 26<sup>th</sup>, but Del Ray Beach did not report a pressure value. It is possible that the central pressure at landfall at 23Z was less than the measured central pressure at West Palm Beach at 0026Z, which was more than 1 hour after landfall. Del Ray Beach experienced the left part of the calm eye and West Palm Beach experienced the right portion of the calm eye an hour later as the hurricane moved northwestward at about 13 kt. 954 mb is the analyzed central pressure for landfall and for 00Z. A central pressure of 954 yields an intensity of 109 kt and 104 kt respectively using the Brown et al. southern and north of 25N pressure-wind relationships for intensifying systems. The analyzed RMW is 23 nmi, which is slightly larger than the climatological value of 18 nmi for this location. 120 kt is chosen for the landfall intensity and the intensity at 00Z on the 27<sup>th</sup> based primarily on the 120 kt 1 min wind obtained by adjusting the Jupiter Lighthouse observations to the surface. HURDAT previously listed a 130 kt intensity at 18Z on the 26<sup>th</sup> and 00Z on the 27<sup>th</sup>. A combination of factors including the numerous wind and pressure observations at landfall, accounts and descriptions of the damage, and analyses of this storm in previous publications all support reducing the winds previously listed in HURDAT. From 12Z on the 26<sup>th</sup> through 00Z on the 27<sup>th</sup>, intensities of 105, 110, and 120 kt are analyzed (down from 115, 130, and 130 kt respectively). This hurricane was previously listed as a category 3 hurricane landfall for Florida, but it is increased to a category 4 hurricane for southeast Florida. The new track around the time of landfall is about one to two-tenths of a degree to the left of the previous track. After landfall, the cyclone moved towards the north-northwest, passing over the northeastern edge of Lake Okeechobee and moving towards the Gulf coast near Cedar Keys. By the time it reached the shoreline near Cedar Keys, the cyclone turned towards the north and moved further inland again over the southeastern U.S. A second U.S. landfall is not analyzed since there is not evidence that the center moved into the Gulf of Mexico. Runs of the Kaplan and DeMaria Inland Decay Model after landfall in Palm Beach County yield 73 kt for 06Z on the 27<sup>th</sup>, 58 kt for 12Z, 56 kt for 18Z, 37 kt for 00Z on the 28<sup>th</sup>, and 29 kt for 06Z on the 28<sup>th</sup>. Highest observed winds within 2 hr of synoptic times were 84 kt (Vero Beach official observation) around 06Z on the 27<sup>th</sup>, 50 kt around 12Z, 50 kt around 18Z, 60 kt around 00Z on the 28<sup>th</sup>, and 65 kt around 06Z on the 28<sup>th</sup>. Revised winds in HURDAT are 85 kt at 06Z the 27<sup>th</sup> (down from 100 kt originally), 70 kt at 12Z (up from 65 kt), 70 kt at 18Z (up from 55 kt), 65 kt at 00Z the 28<sup>th</sup> (up from 50 kt), and 65 kt at 06Z the 28<sup>th</sup> (up from 45 kt). A category 1 impact is analyzed for southwest Florida, northeast Florida, and northwest Florida. At 06Z the 28<sup>th</sup>, the cyclone (still a hurricane) is analyzed to be located at 31.8N, 82.9W (31.5N, 82.9W originally). The central pressures listed in HURDAT from 00Z to 12Z on the 27<sup>th</sup> of 954, 965, and 974 mb are unchanged. The central pressures listed in HURDAT from 18Z on the 27<sup>th</sup> to 06Z on the 28<sup>th</sup> were changed based on observations. The new analyzed pressures for these times are 980 mb at 18Z on the 27<sup>th</sup> (982 mb originally), 984 mb at 00Z on the 28<sup>th</sup> (987 mb originally), and 988 mb at 06Z on the 28<sup>th</sup> (992 mb originally). For 12Z on the 28<sup>th</sup>, the highest observed wind within 2 hr of synoptic time is 55 kt from a ship about 50 nmi offshore of Savannah, GA. While it is possible that this wind is correct and accurate, the wind seems slightly unrepresentative of the other observations close to the ship. However, a wind of 49 kt was observed at Charleston, SC, so 55 kt is chosen for 12Z on the 28<sup>th</sup> (up from 40 kt originally). Later on the 28<sup>th</sup>, 45 kt was observed at Greenville, NC, and 41 kt was

observed at Wilmington, NC. A 50 kt intensity is analyzed for 18Z on the 28<sup>th</sup> (up from 40 kt originally). The pressures listed in HURDAT from 12Z on the 28<sup>th</sup> through 06Z on the 29<sup>th</sup> are unchanged. After passing through Georgia and the Carolinas on the 28<sup>th</sup>, the cyclone moved through Virginia, Maryland, Pennsylvania, New York, Vermont, northern New Hampshire, and Maine on the 29<sup>th</sup>. Late on the 28<sup>th</sup> and early on the 29<sup>th</sup> the new track is slightly to the right of the previous track, but later on the 29<sup>th</sup>, the new track is slightly to the left of the previous track. The largest track change on the 29<sup>th</sup> was seven tenths of a degree. The intensity is analyzed to have remained at 50 kt through 12Z on the 29<sup>th</sup> (up from 35 kt originally at 12Z the 29<sup>th</sup>). The central pressure listed in HURDAT at 12Z on the 29<sup>th</sup> of 1000 mb is changed to 998 mb. No change is made to the timing of extratropical transition, which occurred at 18Z on the 29<sup>th</sup> with the center located in the Vermont/New Hampshire area, and the analyzed intensity for that time is 45 kt (35 kt originally). On the 30<sup>th</sup>, the cyclone moved northeastward through eastern Canada and then made a turn towards the east along 55N around 00Z on the 31<sup>st</sup>. By 18Z on the 31<sup>st</sup>, it was in the vicinity of 55N, 43W. The largest track change on the 30<sup>th</sup> through the 31<sup>st</sup> was about 1 degree at 06Z on the 30<sup>th</sup>. The last point in HURDAT previously was at 18Z on the 31<sup>st</sup> as 25 kt and extratropical, but the analysis indicates that the cyclone was not absorbed or dissipated until after 18Z on 1 September, so 24 hours are added to this system as an extratropical cyclone. By 12Z on 1 September, the cyclone was centered near 53.2N, 19.0W, and it was rotating counterclockwise in conjunction with another, separate, closed extratropical low located near 61N, 19W. The two cyclones finally merged after 18Z on 1 September. After a 40 kt observation at 12Z on 30 August, there were no more observed gales associated with this cyclone until an observation of 45 kt at 06Z on 1 September. However, there were several 30 kt observations from 12Z on the 30<sup>th</sup> through 12Z on the 31<sup>st</sup>. On the 31<sup>st</sup>, there was very sparse data coverage on the right (south) side of the cyclone. The intensity on the 30<sup>th</sup> is analyzed to be 45 kt at all times (an increase of 10 to 15 kt from HURDAT previously), and on the 31<sup>st</sup> intensities of 40, 40, 35, and 35 kt are analyzed (25 kt at all times originally). The analyzed intensities on 1 September are 40, 45, 50, and 50 kt respectively.

### 1949 Storm 3

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34325 08/30/1949 M= 5 3 SNBR= 761 NOT NAMED XING=0
34330 08/30* 0 0 0 0* 0 0 0 0* 0 0 0 0*119 558 35 0*
34330 08/30* 0 0 0 0* 0 0 0 0* 0 0 0 0*119 558 30 0*
*** **
34335 08/31*122 569 40 0*124 577 45 0*127 587 45 0*129 594 45 0*
34335 08/31*122 565 30 0*126 573 30 0*130 581 30 0*133 590 30 0*
*** ** *** ** *** ** *** ** *** **
34340 09/01*134 605 45 0*138 613 45 0*142 620 40 0*147 632 40 0*
34340 09/01*136 600 35 0*139 610 35 0*142 620 35 0*147 632 40 0*
*** ** *** ** *** ** *** **
34345 09/02*150 644 40 0*152 651 35 0*153 657 35 0*153 666 30 0*
34345 09/02*150 644 40 0*152 652 40 0*153 660 40 0*153 669 30 0*
*** ** *** ** *** **
34350 09/03*153 677 25 0*153 684 25 0* 0 0 0 0* 0 0 0 0*
34350 09/03*153 680 25 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*

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34355 TS

Minor changes to both track and intensity are analyzed for this tropical storm. A major change is made to the timing of when the cyclone first attained tropical storm strength, with a 30 hr delay in reaching tropical storm intensity. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, and U.S. Weather Bureau Operational Advisories.

#### August 30:

HWM does not analyze any features of interest on this day. HURDAT first lists a 35 kt tropical storm at 18Z at 11.9N, 55.8W. Ship highlights: 25 kt SW and 1008 mb at 18Z at 8.6N, 56.8W (COA). "This storm was discovered by reconnaissance aircraft early on the afternoon of August 30" (MWR).

#### August 31:

HWM analyzes a closed low of at most 1005 mb centered near 11.7N, 58.2W. HURDAT lists this as a 45 kt tropical storm at 12.7N, 58.7W. The MWR post-season track map shows a 00Z position near 12.0N, 56.5W and a 12Z position near 12.7N, 58.3W. Microfilm analyzes a low of at most 1008 mb centered near 12.5N, 59.5W, although it is on the edge of the map so it is difficult to tell. Land highlights: 10 kt NE and 1005 mb at 18Z at 13.8N, 60.9W (micro). Aircraft highlights: center fix at 1530Z at 13.1N, 58.5W (micro).

#### September 1:

HWM analyzes a low of at most 1005 mb centered near 14.7N, 62.3W. HURDAT lists this as a 40 kt tropical storm at 14.2N, 62.0W. The MWR post-season track map shows a 00Z position near 14.0N, 60.3W and a 12Z position near 14.5N, 62.2W. Microfilm analyzes a low of at most 1008 mb centered in the general vicinity of 14.7N, 63.1W. Land highlights: 15 kt S and 1005 mb at 06Z at 14.0N, 61.0W (micro); 35 kt E and 1008 mb at 18Z at Montserrat (16.7N, 62.2W) (Caribbean obs). Aircraft highlights: 35\* kt S at ~18Z at ~14.5N, 61.9W (micro). From the aircraft flight... "Hurep Duck Note: 13.8N and 63.0W wind shift to 220 degrees. Sea calm, wind constant in direction and velocity to present location. Lowest pressure (encountered) 1008.2 mbs... no indication of hurricane" (micro).

#### September 2:

HWM analyzes a closed low of at most 1005 mb centered near 15.3N, 66.0W. HURDAT lists this as a 35 kt tropical storm at 15.3N, 65.7W. The MWR post-season track map shows a 00Z position near 15.1N, 64.2W and last shows a position at 12Z near 15.5N, 65.4W. Microfilm analyzes a closed low of at most 1008 mb centered near 15.6N, 65.6W. Ship highlights: 35 kt E and 1011 mb at 14Z at 20.5N, 67.5W (COA); 35 kt E and 1010 mb at 20Z at 22.5N, 68.5W (COA). Aircraft highlights: 40 kt ESE (at the surface) and 40 kt ESE (at flight level of 1,000 feet) at 1230Z at 16.0N, 64.5W (micro); 60 kt SE (at flight level of 1,000 feet) (max wind encountered by aircraft on flight) at

1315Z at 16.0N, 62.9W (micro). From the aircraft flight... "Turning SE parallel to diffused easterly wave. Max wind 145 degrees, 60 kt in squall area 180 miles wide." (micro). From the next flight... "Calm 60 miles west of forecast storm center position. No storm evident. Winds calm, sea calm. Entered line of cumulus 2035Z, calm in area, no swell or sea" (micro). "Although aircraft encountered winds as high as 50 to 60 knots at 1,000 feet and estimated surface winds as high as 45 to 50 knots in the eastern semicircle of the storm, no surface winds were reported higher than 31 knots recorded at Caravelle, Martinique. Aircraft reported the location of the eye of this storm on several occasions, but apparently it never was well developed. Winds in the western semicircle never were very strong, and on the afternoon of September 2 there no longer appeared to be a definite center. The storm, having weakened considerably, moved westward as part of the easterly wave" (MWR).

### September 3:

HWM no longer shows any features of interest on this day pertaining to storm 3, but instead analyzes a closed low of at most 1005 mb pertaining to storm 4 centered near 19.3N, 66.6W. HURDAT last lists 1949 Storm #3 at 06Z as a 25 kt tropical depression at 15.3N, 68.4W. No gales or low pressures associated with storm #3. "[Storm 4] apparently formed on the same easterly wave with which the storm of August 30 – September 2 was associated. On the night of September 2 when the storm in the Caribbean had apparently weakened into an area of squalls, indications of a closed circulation north of the Virgin Islands began to appear. After passage of the wave the surface wind in the islands gradually veered to south-southwest and increased in velocity to Beaufort force 5 to 7. At 8:30 pm of September 2 (0130Z September 3) the surface winds at San Juan was easterly but shifted to light westerly 3 hours later. The upper air at this time had westerly winds at all levels up to 25,000 feet" (MWR).

A tropical cyclone formed from an easterly wave on 30 August at 18Z near 11.9N, 55.8W, according to HURDAT. The 28<sup>th</sup> and 29<sup>th</sup> were searched, but a closed low was not found. No changes are made to the timing of genesis. There was not much data available on the 30<sup>th</sup>, but the track is moved slightly to the ENE at 12Z and 18Z on the 31<sup>st</sup> due to an aircraft center fix on the 31<sup>st</sup> at 1530Z. The aircraft confirmed the existence of a closed low, and this confirmation is supported by observations from the Windward Islands as the cyclone passed through the islands early on the 1 September. It is noted that there were no strong winds reported from any of these islands or from any ship until 18Z on the 1<sup>st</sup>, when 35 kt gales were recorded at Montserrat and from aircraft. There are three observations of 1005 mb pressures from 18Z on the 31<sup>st</sup> of August to 06Z on the 1<sup>st</sup> of September but these pressures were observed along with 10 to 15 kt winds. However, there was one 30 kt wind observation from a ship at 00Z on the 1<sup>st</sup>. The cyclone is analyzed to have started as a tropical depression. A 30 kt intensity is analyzed from genesis at 18Z on 30 August through 18Z on 31 August (down from 45 kt originally at 18Z on the 31<sup>st</sup>). This cyclone is analyzed to have attained tropical storm strength 30 hours later than in HURDAT originally, at 00Z on 1 September. The first 35 kt gales were observed at 18Z on the 1<sup>st</sup>, and the intensity is analyzed to be 40 kt at that time with the storm located at 14.7N, 63.2W. The weak tropical cyclone continued moving westward at about 8 kt, and on the 2<sup>nd</sup> of September, aircraft flying at 1000 feet reported

40 kt surface winds with flight-level winds as high as 60 kt between 12Z and 15Z. Due to the numerous reports of 40 kt winds from aircraft, the 35 kt intensity in HURDAT is changed to 40 kt on the 2<sup>nd</sup> at 06Z and 12Z. The microfilm map from 12Z on 2 September indicates that the precipitation around this storm was extremely asymmetric, and the system was likely experiencing strong, westerly shear. This shear prevented any further organization or strengthening and likely contributed to the quick demise of this tropical cyclone. The tropical storm is analyzed to have weakened to a tropical depression by 18Z on the 2<sup>nd</sup> (no change to HURDAT intensity) as it continued slowly westward. By 00Z on the 3<sup>rd</sup>, the winds around the circulation had significantly weakened, and a closed low barely existed. The last point in HURDAT (06Z on the 3<sup>rd</sup>) is eliminated from HURDAT. Even though the observations at 06Z are sparser than at 00Z, the extremely weak circulation at 00Z continued to weaken, and it is analyzed that a closed low no longer existed by 06Z.

It should be noted that genesis of 1949 storm 4 occurred very close in space and time to the dissipation of 1949 Storm 3. There are three scenarios regarding Storms 3 and 4. Scenario 1 is that Storm 3 dissipated on the 3<sup>rd</sup> well to the south of where the genesis of storm 4 occurred the same day, and they are two separate storms, as in HURDAT. Scenario 2 is that Storm 3 and Storm 4 are actually the same storm. In this scenario, Storm 3 would have moved northwards on September 2<sup>nd</sup> 06Z from 15.2N, 65.1W to the Storm 4 genesis location on September 3<sup>rd</sup> at 06Z (18.4N, 65.0W). Scenario number 3 is that the center of Storm 3 underwent a reformation, and although it was actually the same storm, analysts at the time thought that a new storm had developed.

Analyses were performed to determine which scenario is correct. The analyses indicate that the most likely case is scenario 1, as in HURDAT. Storm 3 maintained its own identity through its lifetime, moving almost due west on the 2<sup>nd</sup>. Although Storm 4 formed from the same easterly wave as Storm 3, there is no evidence that a reformation of the center of Storm 3 took place. The formation of Storm 4 might have been aided by the westerly wind shear in the environment of Storm 3 pushing increased moisture to the area where the genesis of storm 4 took place.

#### 1949 Storm 4

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34360 09/03/1949 M= 9 4 SNBR= 762 NOT NAMED XING=0
34365 09/03* 0 0 0 0*184 650 35 0*195 663 55 0*209 666 65 0*
34365 09/03*185 654 30 0*189 659 40 0*198 663 55 0*210 666 70 987*
*** ** ** *** ** ** *** ** **
34370 09/04*220 668 70 0*228 669 75 0*235 670 80 0*243 670 80 0*
34370 09/04*221 668 70 0*230 670 65 995*235 672 65 994*241 674 65 994*
*** ** ** *** ** ** *** ** ** *** ** **
34375 09/05*251 670 85 0*256 669 90 0*258 667 95 0*259 662 95 0*
34375 09/05*247 674 70 0*252 672 75 0*256 670 75 0*259 667 80 982*
*** ** ** *** ** ** *** ** ** *** ** **
34380 09/06*260 657 100 0*260 653 105 0*261 650 105 0*263 648 105 0*
34380 09/06*260 664 90 974*260 659 95 0*261 653 100 0*263 649 100 0*
*** ** ** *** ** ** *** ** ** *** ** **
34385 09/07*265 646 100 0*267 645 100 0*272 644 95 0*284 642 100 0*

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34385	09/07*265	647	100	0*267	645	100	0*272	644	100	0*284	644	105	0*
		***						***		***	***		
34390	09/08*297	640	100	0*307	638	105	0*317	635	110	0*330	630	110	0*
34390	09/08*297	643	110	0*307	641	110	0*317	638	110	0*330	632	110	0*
		***	***		***	***		***		***			
34395	09/09*344	621	110	0*360	610	105	0*378	598	95	0*399	587	85	0*
34395	09/09*344	621	110	0*358	610	105	0*376	598	95	0*399	587	85	0*
				***			***						
34400	09/10*424	572	75	0E455	551	65	0E489	530	60	0E533	509	55	0*
34400	09/10*424	578	75	0E450	563	65	0E489	532	60	0E533	509	60	0*
		***		***	***			***				**	
34405	09/11E568	488	50	0E587	477	45	0E605	472	45	0*	0	0	0*
34405	09/11E568	488	60	0E587	477	50	0E610	469	45	0*	0	0	0*
			**			**	***	***					

34410 HR

Minor track changes and major intensity changes are analyzed for this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Weather Bureau Operational Advisories, and Tucker (1995).

### September 3:

HWM analyzes a closed low of at most 1005 mb centered near 19.3N, 66.6W. HURDAT lists this as a 55 kt tropical storm at 19.5N, 66.3W. The MWR tracks of centers of cyclones shows a 12Z position near 19.8N, 66.9W with a 1000 mb pressure. The MWR post-season track map first shows a position for this storm at 12Z near the HURDAT position. Microfilm shows a low of at most 1008 mb near 19.7N, 66.3W. Ship highlights: 45 kt and 1001 mb at 18Z at 21.2N, 67.0W (micro). Aircraft highlights: center fix at 2025Z at 21.7N, 67.1W with a 987 mb central pressure and estimated maximum winds of 65 kt (micro). From the aircraft flight... "Navy Hurep- 2025Z: Max wind 65 kt near center. Position of center is 21.7N, 67.1W. Eye diameter 26 miles. Lowest pressure 987 mbs (note to Andrew: treat as central pressure). Position reliable. Conservative wind estimate. 50 kt winds within 25 miles of center" (micro). "This storm apparently formed on the same easterly wave with which the storm of August 30 – September 2 was associated. On the night of September 2 when the storm in the Caribbean had apparently weakened into an area of squalls, indications of a closed circulation north of the Virgin Islands began to appear. After passage of the wave the surface wind in the islands gradually veered to south-southwest and increased in velocity to Beaufort force 5 to 7. At 8:30 pm of September 2 (0130Z September 3) the surface winds at San Juan was easterly but shifted to light westerly 3 hours later. The upper air at this time had westerly winds at all levels up to 25,000 feet. The storm rapidly developed to hurricane force and by late afternoon, September 3, aircraft estimated winds of 75 mph" (MWR). "Spotted early on Saturday morning, September 3<sup>rd</sup>, the hurricane was believed to have originated 250 miles due north of San Juan" (Tucker).

### September 4:

HWM analyzes a low of at most 1000 mb centered near 23.7N, 67.2W. HURDAT lists this as an 80 kt hurricane at 23.5N, 67.0W. The MWR tracks of centers of cyclones

shows a 00Z position near 22.1N, 67.9W and a 12Z position near 24.0N, 68.0W with a 992 mb pressure. The MWR post-season track map shows a 00Z position near 22.2N, 66.9W and a 12Z position near 24.1N, 67.1W. Microfilm analyzes a low of at most 1008 mb near 24.0N, 67.2W. Ship highlights: center fix at 07Z at 23.3N, 67.1W with calm winds and a 995 mb central pressure (micro); 70 kt (max w encountered) at ~07Z at ~23.3N, ~67.1W (micro); 15 kt SSE and 996 mb at 15Z at 23.9N, 67.2W (micro); 35 kt S and 999 mb at 18Z at 23.7N, 66.9W (micro). Aircraft highlights: center fix at 1257Z at 24.2N, 67.2W with a 994 mb central pressure and 80 kt max (flight level of 700 ft?) winds (micro); center fix at ~1502Z at 23.8N, 68.2W with a 992 mb central pressure and 80 kt max winds (micro); center fix at 2022Z with 996 mb central pressure (micro). From ship... "Position 0700Z 23.3N, 67.1W. Pass about 20 miles closed center. Hurricane moving NNW about 16 knots with winds force 12 near center. Absolutely calm in the hurricane center. Heavy rain and winds force 10 thirty miles to eastern side. Barometer lowest pressure 994.6 mbs" (micro). From aircraft... "Navy 6- lowest pressure at 1257Z 994 mbs. Position 24.2N, 67.2W. Max winds 80 knots" (micro). From aircraft... "Navy: Entered eye from west side at 23.8N, 68.4W at 1500Z. Middle of eye diameter 20 miles. Light variable winds. Surface pressure 992 mbs. Max NW winds 80 knots..." (micro). From aircraft... "Entered eye 2020Z. Position 24.3N, 67.9W, wind and sea calm, low pressure 995.5. Left eye 2025Z, enter CB, winds in south quadrant less than 40 kt" (micro). "Rapid intensification continued as the storm moved north-northwestward on the 4<sup>th</sup> and 5<sup>th</sup> to about latitude 26N, longitude 67 to 68W, where it remained at nearly a standstill for 2 days, probably with a slow eastward drift" (MWR). "By Sunday night (the 4<sup>th</sup>), it was 500 miles SSW of [Bermuda]" (Tucker).

#### September 5:

HWM analyzes a low of at most 995 mb centered near 25.3N, 67.5W. HURDAT lists this as a 95 kt hurricane at 25.8N, 66.7W. The MWR tracks of centers of cyclones shows a 00Z position near 25.4N, 68.6W and a 12Z position near 26.7N, 67.9W with a 982 mb pressure. The MWR post-season track map shows a 00Z position near 25.0N, 67.0W and a 12Z position near 25.8N, 66.5W. Microfilm analyzes a low of at most 996 mb centered near 25.6N, 67.3W. Ship highlights: 40 kt W and 1005 mb at 00Z at 24.4N, 68.5W (micro). At least seven other gales (all of 35 kt) and at least five other low pressures between 1003-1005 mb. Aircraft highlights: center fix from Navy plane [storm position estimate; no penetration] at 1513Z at 25.8N, 66.9W with strongest winds encountered of 90 kt [13 miles west of center or eye edge?] and lowest pressure encountered [peripheral] of 982 mb (micro); center fix by Air Force at 2124Z at 26.2N, 65.8W with 974 mb central pressure simultaneously with winds of between 0 to 8 knots, and the maximum winds encountered by the aircraft were 100 kt 40 miles south of center (micro). At least 12 other gales and at least nine other low pressures. From the Navy plane... "Unable penetrate storm. Circled west since due to 90 knots wind. Severe turbulence, no radar and common sense. Life raft door carried away. Life raft protruding. Within 13 miles of eye at 1510Z 25.8N, 67.3W. Some storm! Cleared storm 1532Z. Lowest pressure [encountered] 982 mb at 1513Z. SW side of storm no longer soft. Estimate center of storm at 1513Z 25.8N, 66.9W" (micro). "Received dispatch from Air Force plane saying 'We are in eye of the storm 2124Z 26.2N, 65.8W.' At 2130Z, Duck Hurep in the eye at

26.2N, 65.8W. Highest measured wind (in eye) 8 knots. Forty miles to south wind as high as 100 kt. Diameter of eye 20 miles. NE and SE quadrants have most activity” (micro).

#### September 6:

HWM analyzes a low of at most 995 mb centered near 26.1N, 65.4W. HURDAT lists this as a 105 kt hurricane at 26.1N, 65.0W. The MWR tracks of centers of cyclones shows a 00Z position near 27.2N, 66.7W and a 12Z position near 26.6N, 65.8W with a 970 mb pressure. The MWR post-season track map shows a 00Z position near 26.2N, 65.7W and a 12Z position near 26.6N, 64.8W. Microfilm analyzes a low of at most 999 mb centered near 26.0N, 65.3W. Ship highlights: At least 60 kt SE and 996 mb at 20Z at 25.6N, 64.0W (micro). At least seven other gales between 35-45 kt and at least 12 other low pressures between 998-1005 mb. Aircraft highlights: 45 kt W (65 kt WSW at flight level of 800 feet) and 989 mb at 1330Z at 25.2N, 65.0W (micro); Air Force center fix (did not penetrate center) at 1340Z at 26.0N, 65.2W (below average position accuracy) with max winds of 100 to 120 kt (micro); center fix at 2105Z at 26.6N, 65.0W with max winds of 80 kt and max gusts of 100 kt (micro). At least nine other gales and at least three other low pressures between 993-994 mb. “0225Z Air Force radar fix (based on Loran) on center 26.3N, 66.8W” (micro). “Duck special: Center at 1340Z 26.0N, 65.2W located by drift. Some storm winds 100/120 knots” (micro). “Duck four: Storm center 26.4N, 64.8W at 2105Z; max winds 80 kt, gusts 100 kt. Duck five: position (of aircraft), winds (flight level?), and pressure (surface) follow (between 2215Z and 2245Z)- 27.2N, 65.0W, NE 74 kt, 993 mb; 26.1N, 65.6W, NNW 60 kt, 993 mb; 25.7N, 64.4W, SW 74 kt, 994 mb. Duck six remarks: correct storm center to 26.6N, 65.0W at 2105Z (replot from loran)” (micro). “By Tuesday [September 6<sup>th</sup>], the Miami Weather Bureau had estimated that the eye of the hurricane would pass as close as fifty miles to the west of Bermuda with a hurricane radius of more than a hundred miles and a velocity of 175 mph near the center” (Tucker).

#### September 7:

HWM analyzes a low of at most 990 mb centered near 26.7N, 64.5W. HURDAT lists this as a 95 kt hurricane at 27.2N, 64.4W. The MWR tracks of centers of cyclones shows a 00Z position near 26.3N, 65.0W and a 12Z position near 27.4N, 64.9W with a 994 mb pressure. The MWR post-season track map shows a 00Z position near 27.2N, 64.4W and a 12Z position near 28.2N, 64.0W. Microfilm shows a low of at most 1005 mb centered near 27.5N, 64.0W. Ship highlights: 60 kt WSW and 993 mb at 00Z at 25.2N, 64.7W (micro); 40-65 kt at 01Z at 27.8N, 62.8W (micro); 50-65 kt at 12Z at 28.0N, 62.3W (micro, HWM); at least 50 kt ESE and 1000-1001 mb around 18Z from three ships at 29.3N, 62.3W, 29.9N, 62.6W, and 29.7N, 63.0W (micro); at least 60 kt SE and 1006 mb at 20Z at 28.7N, 62.5W (micro). At least seven other gales and at least five other low pressures. Aircraft highlights: center fixes at 2000Z at 28.4N, 64.3W and 28.6N, 64.5W (micro); 120 + kt and 988 mb at ~ 20Z at 28.4N, 63.3W (micro). From ship Sharf & Mead... “Whole gale hurricane force 0100Z” (micro). From Air Force plane... “Duck 3- hurricane located by radar and loran fix estimated at 26.2N, 64.6W at 0540Z. Max error 20 miles. Diameter of eye 50 miles” (micro). “Air Force plane center 28.6N, 64.5W at 2000Z. Wind estimated 120 knots plus on east side. Heavy turbulence east and

southeast” (micro). “Message at 2005Z: Storm center at 1910Z approximately 250 miles due south of Bermuda. Message at 2037Z: Storm center 28.6N, 64.5W at 1930Z. Estimated winds 120 knots plus on east side. Heavy turbulence from 50 miles southeast to 150 miles north” (micro). “By afternoon of September 7 it had become a hurricane of great size and severity, and a north to north-northeastward movement was resumed” (MWR).

#### September 8:

HWM analyzes a low of at most 985 mb centered near 31.6N, 64.2W. HWM also analyzes a weak extratropical cyclone located several hundred miles to the northwest of the tropical cyclone near 39N, 71W with a warm front extending eastward from the extratropical low to beyond 41N, 56W and a cold front extending southwestward from the extratropical low to beyond 36N, 75W. HURDAT lists this as a 110 kt hurricane at 31.7N, 63.5W. The MWR tracks of centers of cyclones shows a 00Z position near 29.8N, 64.8W and a 12Z position near 31.8N, 64.7W with a 988 mb pressure. The MWR post-season track map shows a 00Z position near 29.2N, 63.9W and a 12Z position near 31.5N, 63.2W. Microfilm analyzes a low of at most 990 mb centered near the HURDAT position with an extratropical low analyzed well northwest of the tropical cyclone similar to the HWM analysis. Ship highlights: 35 kt NNW and 996 mb at 12Z at 30.2N, 65.8W (HWM). At least four other gales of 35 kt and at least six other low pressures between 999 and 1004 mb. Land highlights: 55 kt NE and 990 mb at 1630Z at Bermuda (micro). Aircraft highlights: (Eye edge or center fix?) at 0104Z at 29.8N, 64.4W (micro). “Entered eye 0104Z at 29.8N, 64.4W” (micro). “Radar center fix 1320Z near 31.8N, 63.8W” (micro). “The center passed 60 to 70 miles east of Bermuda about 11 am of September 8. Bermuda experienced strong gale winds but escaped hurricane force, since hurricane winds did not extend very far west of the center” (MWR). “The ‘Royal Gazette’ of Thursday, September 8<sup>th</sup> carried flaring headlines: HURRICANE WITH 140 MPH WINDS TO STRIKE BERMUDA EARLY TODAY and the colony entered its fifth day of hurricane tension. The hurricane had indeed changed course and when 400 miles due south of Bermuda had become almost stationary. The hurricane passed 65 miles to the east (of Bermuda) at 11:30 am on Thursday (September 8<sup>th</sup>) and not only was the colony unscathed but, as the Meteorological Station commented: ‘We hardly had a gale’. At the dockyard, the floating dock had been submerged... 250 telephones were out of operation owing to salt spray, but not a single tree had fallen and only one house had lost one tile” (Tucker).

#### September 9:

HWM analyzes a low of at most 990 mb centered near 37.5N, 60.0W with a complex frontal system approaching from the west located from 31N, 73W to 33N, 69W to 37N, 67W to 41N, 64W to 45N, 59W to 46N 55W to east of 45N, 49W. HURDAT lists this as a 95 kt hurricane at 37.8N, 59.8W. The MWR tracks of centers of cyclones shows a 00Z position near 34.1N, 63.0W and a 12Z position near 37.7N, 60.1W with a 988 mb pressure. The MWR post-season track map shows a 00Z position near 33.9N, 61.6W and a 12Z position near 37.5N, 59.6W. Microfilm analyzes a low of at most 978 mb centered near 38.2N, 59.6W. Ship highlights: 20 kt N and 993 mb at 18Z at 40.1N, 61.2W (COA); 35 kt SW and 1013 mb at 18Z at 32.1N, 57.4W (COA). At least 31 other low pressures

between 993-1005 mb. Land highlights: 30 kt WNW and 1003 mb at 0130Z at Bermuda (micro). Aircraft highlights: Radar center fix at 0704Z at 36.0N, 60.7W (micro); 45 kt SW (50 kt WSW at flight level of 9,500 feet) and 1001 mb at 22Z at 38.6N, 56.2W (micro); 991 mb at 2215Z at 40.1N, 55.5W (micro); radar center fix at 2230Z at 41.8N, 56.7W (micro). “Air Force: storm center located by radar 0704Z 35.9N, 60.6W” (micro). “Radar fix 0704Z 36.0N, 60.7W” (micro). “Position given by Navy radar ship at 1200Z 38.3N, 59.0W” (micro). “Duck 7 reports center at 2230Z at 41.8N, 56.7W by radar” (micro).

#### September 10:

HWM analyzes a low of at most 975 mb centered near 49.4N, 51.6W with a WNW-ESE warm front extending from 49.5N, 48W to 45N, 36W and a cold front extending from 48N, 51W to southwest of 36N, 57W. Also, another cold front is approaching several hundred miles to the west. HURDAT lists this as a 60 kt extratropical cyclone at 48.9N, 53.0W. The MWR tracks of centers of cyclones shows a 00Z position near 42.3N, 57.1W and a 12Z position near 49.7N, 53.2W with a 970 mb pressure. The MWR post-season track map last shows a position at 00Z near 42.5N, 57.4W. Microfilm analyzes a large low centered just off the map, but probably in the vicinity of 48.5N, 52.5W of at most 990 mb with a front to the west. Ship highlights: 40(?) kt W and 984 mb at 00Z at 42.1N, 60.0W (micro); 55 kt S and 980(?) mb at ~06Z at 44.3N, 56.3W (micro); 20 kt N and 979 mb at 18Z at 53.5N, 51.5W (COA); 45 kt E and 993 mb at 18Z at 55.5N, 46.5W (COA). At least four other gales and at least 19 other low pressures below 1000 mb. Land highlights: 40 kt WNW and 1007 mb at 18Z at 47.3N, 61.9W (micro). At least 3 other low pressures between 987-998 mb. “Hurep Duck received 1117Z: hurricane center 41.8N, 54.7W at 2230Z (9<sup>th</sup>?) by radar” (micro) [maybe they meant 0330Z on the 10<sup>th</sup>]. “SS Tabinta- 0800Z: 44.2N, 55.7W [position of ship]. High SSW swell. 992.3 mbs. Wind WNW, force 8” (micro). “North-northeast movement continued and the center passed very near Cape Race, Newfoundland, on the early morning of September 10, but by this time the storm had lost much of its force and it was becoming extratropical in character. There were no reports of damage” (MWR).

#### September 11:

HWM analyzes a low of at most 990 mb centered near 61.2N, 47.0W with an occluded front wrapping around from the low well to the east and then south connecting to a triple point near 55N, 34W. A warm front extends from this triple point south-southeastward to 51N, 33W, and a cold front extends from the triple point southwestward to 50N, 40W. Another cold front extends from a couple hundred miles south of the low southward to beyond 45N, 48W. Another low of at most 995 mb is plotted near 75N, 40W. HURDAT last lists this at 12Z as a 45 kt extratropical cyclone at 60.5N, 47.2W. The MWR tracks of centers of cyclones shows a 00Z position near 57.2N, 48.1W and a 12Z position near 64.3N, 41.5W with a 988 mb pressure. Ship highlights: 20 kt NW and 986 mb at 00Z at 56.5N, 51.0W (COA); 60 kt S and 998 mb at 00Z at 55.5N, 44.5W (COA). About 20 other gales between 35-40 kt and at least eight other low pressures between 987-1000 mb. Land highlight: 25 kt N and 994 mb at 12Z at 61.6N 49.6W (HWM). “SS Woenodrecht – 10370 – 35503 – 1111 046/32 – course 230 degrees. Storm probably 2 or

3 points starboard bow. Wind veering southward force 7. Overcast with heavy rain. Barometer is at lowest point” (micro).

September 12:

HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones last shows a position at 00Z near 68.3N, 33.0W.

This storm apparently formed from the same easterly wave as 1949 storm 3. HURDAT starts this storm on 3 September at 06Z as a 35 kt tropical storm just east of Puerto Rico. Available observations indicate that a low was beginning to form near eastern Puerto Rico at 18Z on the 2<sup>nd</sup>. Sufficient evidence exists that a closed circulation was present by 00Z on the 3<sup>rd</sup> at 18.5N, 65.4W, so genesis is analyzed to have occurred 6 hours prior to genesis in HURDAT as a 30 kt tropical depression. The cyclone moved north-northwestward and the analysis indicates that it rapidly intensified from a 30 kt tropical depression to a 70 kt hurricane from 00Z 3 September to 00Z 4 September. The previous HURDAT position at 06Z on the 3<sup>rd</sup> is too far to the southeast by about 1 degree. No change is made to the timing that this cyclone attained tropical storm strength (35 kt by 06Z on the 3<sup>rd</sup>). At 12Z on the 3<sup>rd</sup>, a ship reported a 35 kt gale with a 1003 mb pressure (the ship was analyzed to have a low bias of 1 to 2 mb). A peripheral pressure of 1004-1005 mb corresponds to a wind speed of greater than 37 to 39 kt according to the Brown et al. southern pressure-wind relationship. The 55 kt intensity in HURDAT at 12Z on the 3<sup>rd</sup> is not changed. Later on the 3<sup>rd</sup>, at 2025Z, a Navy aircraft performed a center fix and measured a central pressure of 987 mb, which corresponds to 68 kt using the southern pressure-wind relationship. 65 kt maximum winds were estimated on the flight. A central pressure of 987 mb is added into HURDAT at 18Z on the 3<sup>rd</sup>, and 70 kt is analyzed for the intensity in HURDAT at 18Z on the 3<sup>rd</sup>, up from 65 kt originally. At 07Z on the 4<sup>th</sup>, a ship was in the center and measured a central pressure of 995 mb with calm winds, and the ship also reported maximum winds of force 12 (hurricane force) near the center (force 12 is treated generally as 70 kt in the reanalysis). A central pressure of 995 mb equals 56 kt using the southern pressure-wind relationship, and the 995 mb central pressure value is added into HURDAT at 06Z on the 4<sup>th</sup>. 65 kt is chosen for 00Z and 06Z on the 4<sup>th</sup> (70 kt and 75 kt originally). There were also three aircraft center fixes later on the 4<sup>th</sup>, and central pressures between 992-996 mb were reported with each fix along with maximum winds of 80 kt. Central pressures of 994 mb are added into HURDAT at both 12Z and 18Z on the 4<sup>th</sup>. The latter value was determined by taking an average of the 992 and 996 mb central pressures reported at 1502Z and 2022Z respectively. From 18Z on the 3<sup>rd</sup> to 12Z on the 4<sup>th</sup>, the central pressure rose from 987 mb to 994 mb. During that time, HURDAT shows an increase in intensity from 65 kt to 80 kt. 70 kt is chosen for 18Z on the 3<sup>rd</sup> and 00Z on the 4<sup>th</sup> with a slight weakening to 65 kt for the remainder of the 4<sup>th</sup>. The cyclone decelerated on the 4<sup>th</sup>, and its forward motion slowed to about 3 kt by the 5<sup>th</sup> with the storm located near 25-26N, 67W. There were two aircraft center fixes on the 5<sup>th</sup>. The in-flight summary message from the first fix (1513Z) says that the lowest pressure encountered by the aircraft was 982 mb at 1513Z, but it does not say the location of the aircraft at that time. It is unclear whether the aircraft penetrated the center on this fix, but – given the subsequent pressure measurement in the eye – the 982 mb is likely a central pressure value and is treated as

such. 982 mb suggests winds of 76 and 74 kt from the south and north of 25N intensifying subset of the pressure-wind relationships, respectively. Given the subsequent small inferred RMW size, the intensity is analyzed to be 80 kt at 18Z on the 5<sup>th</sup>. The next center fix on the 5<sup>th</sup> was made by an Air Force plane at 2124Z. This plane clearly penetrated the center and measured a central pressure of 974 mb. A central pressure of 974 mb is added into HURDAT at 00Z on the 6<sup>th</sup>. A central pressure of 974 mb from the 2124Z fix on the 5<sup>th</sup> yields a wind speed of 83 kt using the north of 25N and intensifying relationship. The aircraft estimated maximum winds at this time of 100 kt. The climatological RMW for this case is 20 nmi, and the radius of the eye was reported to be 9 nmi, which means that the RMW was likely less than the climatological value. 90 kt is chosen for the intensity at 00Z on the 6<sup>th</sup> (down from 100 kt originally). The HURDAT intensity is decreased by between 10 – 20 kt all times between 12Z on 4 September and 06Z on 6 September. No more central pressure values were reported after the 974 mb at 2124Z on the 5<sup>th</sup>. There were, however, several more center fixes and a few more maximum wind estimates. The peak maximum wind estimate occurred at the fix on 7 September at 1930Z at 28.6N, 64.5W. Maximum winds were estimated in excess of 120 kt along with an eye radius of 22 nmi. HURDAT lists a peak intensity of 110 kt for this storm, and there is no evidence to change the value of the peak intensity in HURDAT. However, the time of the peak intensity is changed due to the previously mentioned wind estimate from aircraft. The peak intensity of 110 kt is now listed from 00Z on the 8<sup>th</sup> to 00Z on the 9<sup>th</sup> (previously 12Z on the 8<sup>th</sup> to 00Z on the 9<sup>th</sup>). On the 7<sup>th</sup>, after the storm had moved very slowly for 3 days, it accelerated towards the north-northeast, passing east of Bermuda on the 8<sup>th</sup>. It passed far enough to the east of Bermuda that gale winds were barely felt there. The largest track change between the 4<sup>th</sup> and the 9<sup>th</sup> of September was only seven-tenths of a degree (at 00Z on the 6<sup>th</sup>). There were no intensity changes made from September 8<sup>th</sup> at 12Z through the 10<sup>th</sup> at 12Z. On the 9<sup>th</sup> and 10<sup>th</sup>, the hurricane accelerated towards the north-northeast. The cyclone became extratropical at 06Z on the 10<sup>th</sup> (no change to timing of extratropical transition) with a 65 kt intensity (no change to HURDAT intensity). The cyclone made landfall in extreme eastern Newfoundland around 10Z on the 10<sup>th</sup> as a 65 kt extratropical cyclone on a track shifted slightly to the west of the previous HURDAT track. As the cyclone continued moving rapidly towards the north-northeast, the HURDAT intensity is raised slightly from 18Z on the 10<sup>th</sup> to 06Z on the 11<sup>th</sup> due to ship observations of higher winds. Just before the cyclone was absorbed, it made its final landfall on the southern coast of Greenland at 12Z on 11 September with a 45 kt intensity. No changes are made to the timing of when this cyclone was absorbed, and 12Z on the 11<sup>th</sup> is the final point in HURDAT.

### 1949 Storm 5

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34415 09/03/1949 M= 3 5 SNBR= 763 NOT NAMED XING=1
34420 09/03* 0 0 0 0*237 890 40 0*242 890 40 0*248 893 40 0*
34420 09/03* 0 0 0 0*237 890 35 0*242 890 40 0*250 893 45 0*
*** **
34425 09/04*259 896 40 0*276 901 40 0*293 906 40 1008*303 908 40 0*
34425 09/04*263 898 50 0*278 902 50 0*293 906 50 0*303 908 40 0*
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34430	09/05*313	906	40	0*325	901	40	0*337	891	35	0*357	879	30	0*
34430	09/05*313	906	35	0*323	901	30	0*334	894	25	0*348	885	20	0*
			**		***	**		***	***	**	***	***	**

34435 TS

## U.S. Landfall:

09/04/1949 – 12Z – 29.3N, 90.6W – 50 kt

Minor track and intensity changes are analyzed for this tropical storm that made landfall in Louisiana. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, monthly (state and local) climatological data summaries from NCDC, NHC microfilm of synoptic weather maps, Conner (1956), and Dunn and Miller (1960).

## September 3:

HWM analyzes a broad, closed low of at most 1010 mb centered in the general vicinity of 22.5N, 88.5W. HURDAT lists this as a 40 kt tropical storm at 24.2N, 89.0W. No gales or low pressures.

## September 4:

HWM analyzes a more compact closed low of at most 1005 mb centered near 28.0N, 89.6W. HURDAT lists this as a 40 kt tropical storm at 29.3N, 90.6W. The MWR tracks of centers of cyclones shows a 00Z position near 26.5N, 90.3W and a 12Z position near 28.0N, 90.6W with a 1000 mb pressure. The MWR post-season track map shows 00Z and 12Z positions near the HURDAT positions. Microfilm analyzes a closed low of at most 1005 mb centered near 28.9N, 90.5W at 12Z. Ship highlights: 45 kt SE and 1004 mb at 00Z at 27.2N, 89.5W (micro). Two other gales. Station highlights: 37 kt (max wind) ESE and 1005 mb at 12Z at Grand Isle (micro, climo); center fix around ~14Z (guess) at Houma, LA (29.6N, 90.7W) with calm winds (max winds at Houma were estimated to be 50-60 kt from the east before the arrival of the center) (micro); 25 kt E and 1003 mb at 15Z at New Orleans (micro). Four other gales and two other low pressures between (1004-1005 mb). Aircraft highlights: 45 kt S (flight-level gust 80 kt) at 1345Z at 28.7N, 89.1W (micro). One other gale of 40 kt. "The following reports were taken about 0630Z... Reports from Grand Isle... [oil] rig 36 [wind] east 35 mph, 10 ft waves; [oil] rig 40 [wind] east 50 mph, 15 ft waves; [oil] rig 38 [wind] ENE 34 mph shifted from SE about 1130 [pm central time- 0530Z]. Radar reports [from which land radar? Assume Grand Isle?]: Line of strong echoes 130 deg 40 mi to 105 deg 60 mi to 110 deg 30 mi (5 mi wide). Line of strong echoes 45 deg 40 mi to 60 deg 55 mi to 80 deg 10 mi. Area of moderate echoes 55 deg 30 mi, 85 deg 70 mi (20 mi wide). Area of moderate echoes 320 deg 20 mi, 205 deg 50 mi, 150 deg 55 mi, 130 deg, 70 mi, 140 deg 40 mi, 90 deg 15 mi, 20 deg, 29 mi" (micro). "50 mi frontal system located between 89-90 W oriented N-S, Torrential rains. Average winds 55 knots, gusts 80 knots in severe squalls. Request instruction" (micro). "Severe squall line located between 89-90 degrees west extending north and south between 29N and 26N. 50 miles wide north limit, 10 miles wide south limit. Winds east-northeastern portion 60 knots with 80 knots in heavy squalls. Weather west of this squall line scattered showers; winds south-southwest to southwest 25 to 30 knots, gusts 45 knots. Weather east of this squall line is overcast with

moderate rain and moderate squalls. Winds south to southeast 35 to 45 knots with gusts to 55 to 65 knots in squalls. Moderate squalls extend to 30 north, 88 west. No alignment of squalls evident. Secondary weak squall line 10 miles side arranged northeast-southwest from position 28.6N, 90.5W” (micro). “About 1120 [Z, local am, or local pm?] or earlier Texas Co. at Houma reported wind had become calm. Had been easterly estimated at 60 to 70 mph” (micro). “This storm originated in the Gulf of Mexico on the night of September 3-4. It took a northerly course and its center passed inland to the west of New Orleans on September 4 and to the east of Vicksburg, MS on the night of September 4-5. The highest wind reported was 45 mph about 10 am September 4 at Bay St. Louis, MS. Damage was reported in both Louisiana and Mississippi but it was small, probably less than \$50,000. No lives were lost” (MWR). “The tropical disturbance which moved inland near Grand Isle during the night of September 3<sup>rd</sup>-4<sup>th</sup> moved northward into central Mississippi on the 5<sup>th</sup> and eastward into Alabama on the 6<sup>th</sup> before dissipating entirely. It formed rapidly in an area of squally weather located just off the coast and developed as it moved inland, as evidenced by the .08 inch lower pressure at New Orleans than Grand Isle. It was attended by a small area of high winds and an extensive area of rain, much of it heavy. The winds which accompanied this disturbance reached a speed of 42 mph at Grand Isle and 40 mph at New Orleans (Moisant Airport). The tide rose at Grand Isle to a height two feet above mean low water. It moved across both ends of the island, rendering the highway to the mainland impassible for several hours. A few beach cottages were damaged but the beach itself suffered considerable erosion from wave action. There were some reports of damage to sugar cane in Terrebonne parish but it was mostly negligible. Total damages have been estimated at not to exceed \$12,500” (Louisiana climatological data). “The wind on the Mississippi coast reached 45-50 mph in the Bay St. Louis-Pass Christian area. High tides and winds damaged or destroyed several piers in this area and there was some damage to the pecan and tung crops in the southwest [Mississippi] coastal counties. The heavy rains ruined considerable cut hay in eastern Mississippi and caused some deterioration in quality of open cotton. Altogether, it is not believed that damages exceeded \$12,500. Heavy rains attending this disturbance resulted in sharp rises in the Pearl, Leaf, Chickasawhay and Pascagoula Rivers” (Mississippi climatological data). From the Meridian, MS local climatological data... “By far the greatest amount fell on the 4-5<sup>th</sup> when excessive rain at the rate of 2.50 inches in 24 hours occurred. We had 3.26 inches in 17 hours. Some of the smaller streams overflowed their banks but no damage was reported” (Meridian, MS local climatological data). “Sep 4, landfall near Grand Isle, estimated lowest (lifetime) pressure 29.65 inches (1004 mb)” (Connor 1956). “Tropical cyclones in Louisiana, Mississippi, and Alabama, Sept. 4, Louisiana, Minor” (“Minor” indicates winds less than 74 mph and central pressure above 996 mb) (Dunn and Miller 1960).

#### September 5:

HWM analyzes a closed low of at most 1010 mb centered over Mississippi near 33N, 90W with an approaching cold front extending from central Indiana to southwestern Illinois to southwestern Missouri to southwestern Oklahoma. HURDAT lists this as a 35 kt tropical storm at 33.7N, 89.1W. The MWR tracks of centers of cyclones shows a 00Z position near 31.8N, 91.1W and a 12Z position near 33.4N, 91.1W with a 1008 mb pressure. The MWR post-season track map shows a 00Z position near HURDAT’s 00Z

position but it shows a 12Z position near 33.2N, 89.6W. Microfilm analyzes a closed low of at most 1011 mb centered near 33.3N, 90.0W at 12Z. No gales or low pressures.

#### September 6:

HWM analyzes an open trough over Mississippi, Alabama and southeastern Tennessee, which may have been the remnants of the tropical cyclone with the frontal system approaching very near the trough. HURDAT no longer lists this tropical cyclone on this day. The MWR tracks of centers of cyclones shows a 00Z position near 34.5N, 89.1W and a 12Z position near 34.4N, 87.0W with a 1013 mb pressure. No gales or low pressures.

A tropical storm formed in the south-central Gulf of Mexico on 3 September at 06Z, according to HURDAT. On the 3<sup>rd</sup>, there are no observations of gales, low pressures, or west winds south of the center, so it is possible that genesis occurred later than indicated in HURDAT. Although a tropical cyclone could not be confirmed on the 3<sup>rd</sup>, a tropical storm was confirmed on the 4<sup>th</sup>. Since there is little data in the area on the 3<sup>rd</sup>, no changes are made to the HURDAT track on the 3<sup>rd</sup>. On the 4<sup>th</sup> at 00Z a ship reported a wind of 45 kt. The HURDAT intensity at 00Z on the 4<sup>th</sup> is raised from 40 kt to 50 kt, and the position is moved slightly to the north-northwest of the original position based on that observation along with a few other ship observations in the area. The cyclone moved north-northwestward and made landfall 30 to 35 nmi west of Grand Isle, LA at 12Z on the 4<sup>th</sup>. The 1008 mb central pressure in HURDAT at 12Z on the 4<sup>th</sup> is removed since there are several observations of lower pressures both prior to and following landfall. Peripheral pressure observations suggest that the central pressure at landfall was not higher than 1000 mb, but a precise central pressure value for landfall cannot be determined. Within a couple of hours after landfall, the center of the cyclone passed directly over Houma, LA (the only center fix for this storm). No pressure was reported from Houma, and winds prior to the arrival of the center were estimated at 50 to 60 kt from the east. The highest official measured wind from a land station was 40 kt from the east-southeast at Grand Isle at 12Z with a pressure of 1005 mb. The lowest sea-level pressure observed from a land station was 1003 mb at New Orleans at 15Z with 25 kt east winds. 50 kt is chosen for the landfall intensity and for 12Z (up from 40 kt originally). The position at landfall (12Z) is unchanged. 50 kt is also the new peak intensity of the tropical storm from 00Z to 12Z on the 4<sup>th</sup>, up from 40 kt originally. The storm moved northward and weakened as it moved inland. The HURDAT intensity at 00Z on the 5<sup>th</sup> is lowered from 40 kt to 35 kt, and at 06Z on the 5<sup>th</sup>, the intensity is lowered from 40 kt to 30 kt. The previous HURDAT shows no weakening for the first 18 hours after landfall, but observations clearly show that the winds had significantly weakened. There are no changes made to the timing of dissipation, which occurred after 18Z on the 5<sup>th</sup>, but the position at that time is adjusted a degree to the southwest and the intensity is lowered from 30 kt to 20 kt.

#### 1949 Storm 6

34440 09/05/1949 M= 7 6 SNBR= 764 NOT NAMED XING=0  
 34440 09/05/1949 M=12 6 SNBR= 764 NOT NAMED XING=0

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34445	09/05*	0	0	0	0*273	404	35	0*283	412	35	0*292	421	35	0*
34445	09/05*	0	0	0	0*273	404	35	0*283	412	35	0*295	421	35	0*
											***			
34450	09/06*302	430	40		0*316	442	40	0*329	447	40	0*337	447	40	0*
34450	09/06*310	430	40		0*325	442	40	0*334	447	40	0*341	447	40	0*
	***				***			***			***			
34455	09/07*344	444	40		0*350	438	40	0*355	432	40	0*358	426	40	0*
34455	09/07*347	443	40		0*352	435	40	0*355	424	40	0*358	416	40	0*
	***	***			***	***		***			***			
34460	09/08*360	420	40		0*361	415	40	0*360	410	40	0*355	407	40	0*
34460	09/08*360	412	40		0*361	410	40	0*360	410	40	0*355	407	40	0*
	***				***									
34465	09/09*348	407	40		0*341	419	40	0*344	433	40	0*348	438	40	0*
34465	09/09*348	407	40		0*341	419	40	0*342	433	40	0*343	438	40	0*
								***			***			
34470	09/10*352	442	40		0*355	445	40	0*359	447	40	0*367	448	40	0*
34470	09/10*344	442	40		0*346	445	40	0*352	445	40	0*360	446	40	0*
	***				***			***	***		***	***		
34475	09/11*375	446	40		0*383	442	40	0*390	438	40	0*416	420	40	0*
34475	09/11*371	446	40		0*383	442	40	0*396	438	40	0*414	430	45	0*
	***							***			***	***	**	

(The 12<sup>th</sup> to the 16<sup>th</sup> are new to HURDAT.)

34475	09/12*436	411	55	996E460	390	55	0E478	375	55	0E485	370	55	0*
34476	09/13E484	372	60	0E480	382	60	0E474	395	60	0E467	405	60	0*
34477	09/14E459	413	65	0E452	419	65	0E447	422	65	0E442	418	65	0*
34478	09/15E437	408	65	0E432	394	55	0E428	380	45	0E428	368	40	0*
34479	09/16E430	358	35	0E437	349	35	0E450	340	35	0E465	332	30	0*

34480 TS

Minor alterations to both track and intensity are analyzed for this storm. Also, major changes are made to the end of this cyclone's lifetime, with five days added primarily as an extratropical cyclone. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

#### September 5:

HWM analyzes a closed low of at most 1005 mb centered near 28N, 41W. HURDAT lists this as a 35 kt tropical storm at 28.3N, 41.2W. No gales or low pressures.

#### September 6:

HWM analyzes a low of at most 1000 mb centered near 33N, 45W. HURDAT lists this as a 40 kt tropical storm at 32.9N, 44.7W. Ship highlights: 35 kt WSW and 1007 mb at 06Z at 32.2N, 43.7W (COA).

#### September 7:

HWM analyzes a low of at most 1010 mb centered near 35N, 42W. HURDAT lists this as a 40 kt tropical storm at 35.5N, 43.2W. No gales or low pressures.

#### September 8:

HWM analyzes a low of at most 1005 mb centered near 35.8N, 41.3W. HURDAT lists this as a 40 kt tropical storm at 36.0N, 41.0W. No gales or low pressures.

September 9:

HWM analyzes a low of at most 1005 mb centered near 35N, 42.9W. HURDAT lists this as a 40 kt tropical storm at 34.4N, 43.3W. Ship highlight: 30 kt N and 1010 mb at 12Z at 35.0N, 44.3W (COA). No gales or low pressures.

September 10:

HWM analyzes a low of at most 1005 mb near 35.5N, 44.2W with a NNE-SSW cold front approaching, but still several hundred miles away extending from north of 46N, 51W to 40N, 53W to 35N, 58W to southwest of 32N, 62W. HURDAT lists this as a 40 kt tropical storm at 35.9N, 44.7W. Ship highlights: 30 kt N and 1007 mb at 18Z at 35.9N, 45.2W (COA). No gales or low pressures.

September 11:

HWM analyzes a closed low of at most 1010 mb centered near 38.8N, 43.8W, with a cold front now only about 100 nautical miles away from the low extending from a separate extratropical low (1949 Storm #4), near 44N, 45W, southward and then southwestward from the extratropical low to 40N, 45W to 38N, 46W to 35N, 50W to southwest of 32N, 54W. HWM also analyzes another cold front just behind the aforementioned cold front. HURDAT lists this as a 40 kt tropical storm at 39.0N, 43.8W. The MWR tracks of centers of cyclones shows a 00Z position near 36.5N, 46.1W and a 12Z position near 40.6N, 43.7W with a 1010 mb pressure. No gales or low pressures.

September 12:

HWM analyzes a closed low of at most 995 mb centered near 48N, 37.1W with a dissipating warm front extending from just northwest of the low, at 49N, 38W, northeastward to 55N, 36W to east-northeast of 60N, 25W. HWM also analyzes a warm/stationary front from 46N, 34W eastward to 46N, 25W and a cold front from 46N, 34W southward and then southwestward to 40N, 34W to 35N, 38W to southwest of 33N, 42W. HURDAT no longer lists this system. The MWR tracks of centers of cyclones shows a 00Z position near 44.1N, 41.2W and a 12Z position near 47.6N, 36.8W with a 993 mb pressure. Ship highlights: 35 kt E and 1000 mb at 00Z at 44.0N, 41.0W (COA); 50 kt WNW and 1005 mb at 03Z at 44.0N, 41.0W (COA); 40 kt W and 1003 mb at 18Z at 46.8N, 38.6W (COA). Twenty other gales between 35-45 kt.

September 13:

HWM analyzes a low of at most 980 mb centered near 48N, 38.4W. The MWR tracks of centers of cyclones shows a 00Z position near 50.1N, 36.7W and a 12Z position near 49.7N, 39.7W with a 982 mb pressure. Ship highlights: 50 kt WNW and 1002 mb at 12Z at 45.0N, 41.3W (COA); at least 40 kt WNW and 984 mb at 46.5N, 40.0W (HWM); 60 kt NW and 999 mb at 18Z at 45.0N, 41.4W (COA); 45 kt W and 986 mb at 18Z at 46.6N, 41.2W (COA); 50 kt WNW and 998 mb at 21Z at 44.3N, 41.9W (COA). 26 other gales between 35-50 kt, and one other pressure of 995 mb.

## September 14:

HWM analyzes a closed low of at most 990 mb centered near 45.5N, 41.2W. The MWR tracks of centers of cyclones shows a 00Z position near 47.5N, 40.1W and a 12Z position near 45.4N, 41.2W with a 989 mb pressure. Ship highlights: 60 kt W and 998 mb at 00Z at 44.7N, 41.7W (COA); 35 kt SSW and 985 mb at 06Z at 45.9N, 41.2W (COA); 50 kt NW and 988 mb at 09Z at 45.2N, 42.7W (COA); 45 kt NE and 991 mb at 18Z at 44.8N, 41.8W (COA). 24 other gales between 35-50 kt and 16 other low pressures between 987-999 mb.

## September 15:

HWM analyzes a low of at most 995 mb centered near 43.3N, 38.2W. HWM also analyzes a WNW-ESE cold front extending from 40N, 33W to ESE of 36N, 21W and a cold front extending from 40N, 33W to 33N, 36W. The MWR tracks of centers of cyclones shows a 00Z position near 44.4N, 40.1W and a 12Z position near 42.9N, 38.4W with a 987 mb pressure. Ship highlights: 60 kt E and 998 mb at 00Z at 45.5N, 40.0W (COA); 35 kt N and 990 mb at 18Z at 43.2N, 38.8W (COA). Four other gales between 35-40 kt and five other low pressures between 995-999 mb.

## September 16:

HWM analyzes a closed low of at most 1000 mb centered near 47.5N, 32W with an occluded front extending from the low wrapping around to a triple point at 45N, 23W. A warm front extends from the triple point to south-southeast of 36N, 20W, and a cold front extends from the triple point to 41N, 26W where it becomes a warm front that extends to 41N, 32W, and a continued complex frontal system extends from this southward to another low near 31N, 40W. The MWR tracks of centers of cyclones shows a 00Z position near 44.3N, 36.9W and a 12Z position near 46.5N, 35.1W with a 1001 mb pressure. Ship highlights: 30 kt S and 1000 mb at 00Z at 42.2N, 35.0W (COA); 20 kt NW and 998 mb at 06Z at 43.3N, 36.9W (COA); 30 kt SW and 1006 mb at 12Z at 42.3N, 35.7W (COA, HWM); 25 kt NNE and 1005 mb at 18Z at 47.0N, 34.1W (COA); 20 kt W and 1000 mb at 18Z at 44.5N, 34.0W (COA). Nine other low pressures between 1000-1005 mb. No gales on this day.

## September 17:

The MWR tracks of centers of cyclones last shows a position at 00Z near 48.7N, 32.3W.

A tropical storm formed in the eastern Atlantic Ocean on 5 September near 27N, 40W. No changes are made to the timing of genesis, and no changes are made to the track or intensity on the 5<sup>th</sup>. The storm moved northwest until the 6<sup>th</sup>, when it reached a location near 33N, 45W. On the 6<sup>th</sup>, the position is adjusted slightly to the north of the previous HURDAT position because more plentiful ship observations on that day showed that the HURDAT position was slightly too far south. From the 7<sup>th</sup> to the 10<sup>th</sup>, the cyclone completed a small, clockwise loop during which time the cyclone moved very slowly. This loop is shown both in the analysis and in the original HURDAT. Minor changes are made to the positions and no changes to the intensities on the 8<sup>th</sup> and 9<sup>th</sup>. On September 10<sup>th</sup> at 18Z, a pressure of 1007 mb was observed simultaneously with a 30 kt N wind. A peripheral pressure of 1007 mb yields a wind speed of at least 35 kt according to the

pressure-wind relationship for north of 35N. The HURDAT intensity of 40 kt is unchanged. The HURDAT position at 18Z is half a degree east and nearly one degree north of that observation, so the HURDAT position is moved southward a bit. After completing the clockwise loop on the 10<sup>th</sup>, the cyclone assumed a north-northeastward course on the 11<sup>th</sup> near 39N, 44W. The final position listed in HURDAT is at 18Z on the 11<sup>th</sup> as a 40 kt tropical storm. HURDAT is extended five days through the 16<sup>th</sup> of September (a major change to HURDAT) as analyses show that the cyclone remained a closed low and did not combine with any other system. This cyclone is analyzed to have remained a tropical storm until after the 12<sup>th</sup> at 00Z (6 hours later than originally). On the 12<sup>th</sup> at 00Z, a detailed analysis was performed to locate the center. Just north of the center, a ship recorded a 35 kt E wind with a pressure of 1000 mb. An analysis of the ship track observations reveals a high likelihood that this observation occurred near or inside the RMW. This suggests a central pressure of about 996 mb, utilizing the rough 10 kt ~ 1 mb rule. A central pressure of 996 mb yields a wind speed of 55 kt using the north of 35N pressure-wind relationship. A wind of 55 kt is chosen and a central pressure of 996 mb is added into HURDAT. The cyclone is analyzed to have become extratropical by 06Z on the 12<sup>th</sup>. The cyclone was still moving towards the north-northeast, and the analyzed position at 12Z on the 12<sup>th</sup> is 47.8N, 37.5W as a 55 kt extratropical storm. At that time, the north-northeastward motion came to an abrupt halt since high pressure to the northeast of the cyclone prevented it from moving farther in that direction. From the 12<sup>th</sup> to the 15<sup>th</sup>, the cyclone traveled in a counterclockwise loop, reaching its peak extratropical intensity of 65 kt from 18Z on the 13<sup>th</sup> through 00Z on the 15<sup>th</sup>. By the 14<sup>th</sup> of September, the temperature gradient had disappeared, and it is analyzed as an occluded low on the 14<sup>th</sup>. On the 15<sup>th</sup>, the occluded low started to weaken, and the winds were down to 45 kt by 12Z on the 15<sup>th</sup> with an analyzed position of 42.8N, 38.0W. On the 16<sup>th</sup>, the low moved towards the northeast and continued to weaken, but it was still closed. The position at 12Z on the 16<sup>th</sup> is 45.0N, 34.0W, with an intensity of 35 kt. The final position before dissipation is at 18Z on the 16<sup>th</sup>.

#### 1949 Storm 7 (new to HURDAT)

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34485 09/11/1949 M= 4 7 SNBR= 765 NOT NAMED XING=0
34486 09/11* 0 0 0 0* 0 0 0 0* 0 0 0 0E310 728 40 0*
34487 09/12E320 725 40 0E327 730 40 0*332 740 40 0*336 751 45 0*
34488 09/13*339 763 40 0*342 776 35 0*344 787 30 0*345 791 25 0*
34489 09/14*349 791 25 0*353 787 25 0*358 780 25 0*366 773 25 0*
34489 TS

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#### U.S. Landfall:

9/13/1949 08Z – 34.3N, 77.8W – 35 kt

HWM, COADS, the MWR tracks of lows, and NHC microfilm of synoptic weather maps indicate that a tropical storm, previously undocumented in HURDAT, occurred from 11 September to 14 September and made landfall near Wilmington, NC on 13 September as a 35 kt tropical storm. This new storm was also noted in Jack Beven's list of suspects.

#### September 10:

HWM analyzes a closed low of at most 1010 mb centered near 30.8N, 76.9W with a stationary front extending eastward from the low to 31N, 65W and a cold front extending from the low southwestward and then west-southwestward to 28N, 80W to 27N, 83W. The MWR tracks of centers of cyclones shows a 12Z position near 30.8N, 77.8W with a 1010 mb pressure. Microfilm at 12Z does not analyze a closed low, but instead analyzes a weak low located in a trough with some fronts analyzed. No relevant gales or low pressures.

#### September 11:

HWM analyzes a closed low of at most 1010 mb centered near 29.7N, 72.6W with a warm front extending from the low eastward to 30N, 64W and a cold front extending from the low southwestward and then westward to 26N, 76W to 25N, 83W. The MWR tracks of centers of cyclone shows a 00Z position near 30.1N, 74.7W and a 12Z position near 30.4N, 72.0W with a 1010 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 30.5N, 71.6W with a frontal analysis similar to the HWM analysis. Ship highlights: 35 kt E and 1016 mb at 12Z at 32.4N, 72.5W (micro); 40 kt E and 1014 mb at 18Z at 32.0N, 72.4W (micro).

#### September 12:

HWM analyzes a closed low of at most 1010 mb centered near 33N, 74.5W with an occluded front plotted from 33.5N, 75W to 34.5N, 74W to a triple point at 35N, 73W. A warm front extends southeastward from this triple point to 31N, 63W and a dissipating cold front extends from the triple point to 32N, 71W to 28N, 72W to 26N, 74W to 23N, 79W. The MWR tracks of centers of cyclones shows a 00Z position near 32.2N, 71.8W and a 12Z position near 33.6N, 73.9W with a 1005 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 32.3, 74.5W with a front extending from 32N, 75W to 34N, 73W to 31N, 68W and another front extending from 32N, 75W to 30N, 73W to 27N, 74W to 24N, 80W. Microfilm at 18Z analyzes a closed low of at most 1008 mb centered near 33.7N, 75.2W with an occluded front extending from the low to 35N, 73W to a triple point at 32N, 70W. One front extends southeastward from the triple point and another front extends southwestward from the triple point. Ship highlights: 35 kt E and 1011 mb at 12Z at 34.0N, 72.8W (COA, micro); 40 kt ENE at 18Z at 35.1N, 75.3W (micro); 25 kt NNE and 1008 mb at 18Z at 33.9N, 75.5W (micro); 30 kt SSE and 1012 mb at 18Z at 34.7N, 74.1W (micro). Nine other gales of 35 kt. Lowest pressure was the 1008 mb (mentioned above).

#### September 13:

HWM analyzes a closed low of at most 1010 mb centered near 34.2N, 78.1W with a warm front plotted extending from the low to 37N, 76W to 37N, 71W to 36N, 68W. The MWR tracks of centers of cyclones shows a 00Z position near 34.7N, 76.0W and a 12Z position inland in North Carolina near 34.8N, 78.0W with a 1008 mb pressure. Microfilm at 00Z analyzes a closed low of at most 1008 mb centered near 33.5N, 75.8W with a front extending from the low to 36N, 75W to 37N, 73W to 36N, 71W to 33N, 69W. Microfilm at 06Z analyzes a closed low of at most 1008 mb centered near 33.5N, 77.0W with no fronts analyzed. Microfilm at 12Z analyzes a closed low of at most 1009.5 mb centered near 34.3N, 78.6W. Ship highlights: 35 kt W and 1008 mb at 00Z at

32.8N, 75.9W (COA, micro); 35 kt N and 1010 mb at 00Z at 33.6N, 77.5W (micro); 35 kt E and 1015 mb at 00Z at 36.6N, 74.2W (COA); 25 kt SE and 1007 mb at 00Z at 33.8N, 75.0W (COA, micro). Two other gales of 35 kt. Land/station highlights: 30 kt SSW at 06Z at 34.5N, 76.9W (micro); 10 kt NE and 1006 mb at 06Z at 34.3N, 77.9W (micro); 15 kt E and 1009 mb at 06Z at 34.9N, 76.8W (micro).

September 14:

HWM analyzes a closed low of at most 1015 mb centered near 36.1N, 77.8W located in a warm sector with a cold front approaching from the west. The MWR tracks of centers of cyclones shows a 00Z position near 35.0N, 79.6W and last shows a position at 06Z near 34.5N, 80.0W. Microfilm analyzes a closed low of at most 1014 mb centered near 36.0N, 77.4W with a frontal analysis somewhat similar to the HWM analysis. No gales or low pressures.

On 10 September, an area of low pressure formed associated with a frontal system just off the southeast coast of the U.S. A closed low formed by 18Z on 11 September. This system is started as a 40 kt extratropical cyclone at 31N, 73W at 18Z on 11 September, as the cyclone's structure was still frontal on that date. It is analyzed that this system became a 40 kt tropical storm by 12Z on 12 September near 33N, 74W, as the frontal features had dissipated. Also, stronger winds observed simultaneously with the lowest observed pressures were observed not far from the center. One of these is a 35 kt gale from the west-northwest with 1008 mb about 40 nmi south of the analyzed position of the center at 00Z on the 13<sup>th</sup>. The peak intensity of 45 kt is analyzed at 18Z on 12 September. Several gales were observed within 100 nmi of the center. The cyclone moved towards the west-northwest and made landfall in North Carolina near Wilmington at 08Z on the 13<sup>th</sup> as a 35 kt tropical storm at 34.3N, 77.8W. After landfall, the storm weakened to a tropical depression by 12Z on the 13<sup>th</sup>. By 18Z on the 13<sup>th</sup>, the analyzed position is 34.5N, 79.1W as a 25 kt tropical depression. The depression then turned to the north-northeast but moved very slowly. The last point is at 18Z on the 14<sup>th</sup> as a 25 kt tropical depression at 36.6N, 77.3W, which is inland near the NC/VA border. After that, the circulation was absorbed by a front as it was dissipating. While satellite imagery is not available to confirm the convective structure, it is likely that today this system would have been classified as a subtropical on the 12<sup>th</sup> and early on the 13<sup>th</sup>. By the time of landfall, the cyclone contained many characteristics of a true tropical cyclone at landfall, including strong winds with low pressures near the center, no temperature gradient across the low, and the substantial symmetry to the wind field.

#### 1949 Storm 8 (originally Storm 7)

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34485 09/13/1949 M= 5 7 SNBR= 765 NOT NAMED XING=0
34485 09/13/1949 M= 5 8 SNBR= 766 NOT NAMED XING=0
*          ***

34490 09/13* 0 0 0 0*155 337 35 0*170 331 35 0*178 329 35 0*
34490 09/13* 0 0 0 0*160 320 35 0*170 326 35 0*178 329 35 0*
          *** ***          ***

34495 09/14*188 326 40 0*200 323 40 0*211 320 45 0*220 319 45 0*
34495 09/14*188 326 40 0*200 325 40 0*211 323 45 0*218 321 50 0*
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					***				***				***	***	**
34500	09/15*229	318	45	0*237	317	50	0*245	315	50	0*254	313	50	0*		
34500	09/15*227	318	50	0*236	317	50	0*245	315	50	0*254	313	50	0*		
	***	**		***											
34505	09/16*264	310	45	0*276	306	40	0*287	301	40	0*294	298	35	0*		
34510	09/17*300	297	30	0*305	297	30	0*310	297	25	0*315	297	25	0*		
34510	09/17*300	297	30	0* 0	0	0	0* 0	0	0	0* 0	0	0	0*		
				***	***	**	***	***	**	***	***	**			

34515 TS

Minor track changes and minor intensity changes are analyzed for this tropical storm in the eastern Atlantic Ocean. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, NHC microfilm of synoptic weather maps, and McAdie et al. (2009).

#### September 11:

HWM does not show any features of interest on this day. HURDAT did not previously list a system on this day. No gales or low pressures.

#### September 12:

HWM plots a spot low (not closed) near 10N, 33W located in a trough. HURDAT did not previously list a system on this day. No gales or low pressures.

#### September 13:

HWM analyzes a closed low of at most 1010 mb centered near 16.8N, 32.7W. HURDAT lists this as a 35 kt tropical storm at 17.0N, 33.1W. No gales or low pressures.

#### September 14:

HWM analyzes a low of at most 1005 mb centered near 21.1N, 32.1W. HURDAT lists this as a 45 kt tropical storm at 21.1N, 32.0W. Ship highlights: 45 kt NW at 18Z at 20.5N, 33.7W (COA).

#### September 15:

HWM analyzes a low of at most 1005 mb centered near 24.6N, 31.1W. HURDAT lists this as a 50 kt tropical storm at 24.5N, 31.5W. Ship highlights: 45 kt NNW and 1004 mb at 00Z at 21.3N, 34.0W (micro)

#### September 16:

HWM analyzes a low of at most 1010 mb centered near 28.4N, 29.9W. HURDAT lists this as a 40 kt tropical storm at 28.7N, 30.1W. No gales or low pressures.

#### September 17:

HWM analyzes a low of at most 1015 mb centered near 30.3N, 29.9W with an approaching cold front extending from 40N, 28W to 35N, 31W to 30N, 36W to west-southwest of 31N, 43W; however, the portion of the cold front southwest of 33N, 33W is analyzed as a dissipating cold front. HURDAT lists this as a 25 kt tropical depression at 31.0N, 29.7W. No gales or low pressures.

A tropical storm formed, according to HURDAT, at 06Z on 13 September in the eastern Atlantic at 15.5N, 33.7W. The 11<sup>th</sup> and 12<sup>th</sup> of September were searched. Although a closed circulation was not found, it is possible that there could have been a closed circulation on the 11<sup>th</sup> and/or the 12<sup>th</sup>, but data in the area is sparse. No changes are made to the timing of genesis. However, some track changes are made on the 13<sup>th</sup>. The position at 06Z on the 13<sup>th</sup> is moved about 1.8 degrees to the east-northeast of the previous HURDAT position. Also, climatological tracks for mid-September indicate that the north-northeastward motion for the beginning of the track in this location is a significant outlier in the entire HURDAT database from 1851-2006 inclusive (McAdie et al. 2009). Therefore, an initial motion in a north-northwest direction is shown with a slight curve to the north-northeast by 18Z on the 13<sup>th</sup>. The HURDAT position at 18Z on the 13<sup>th</sup> is unchanged. The track changes from the remainder of this system's lifetime were all less than half of a degree. A number of observations by the same ship between 06Z on the 14<sup>th</sup> and 00Z on the 15<sup>th</sup> confirmed the existence of this tropical storm. At 18Z on the 14<sup>th</sup>, the ship recorded 45 kt winds with an unknown pressure, and at 00Z on the 15<sup>th</sup>, 45 kt winds with a 1004 mb pressure was recorded. Since a central pressure of less than 1004 mb yields a wind speed of greater than 39 kt using the Brown et al. southern pressure-wind relationship, and the highest observed wind was 45 kt, the 45 kt intensity in HURDAT is increased to 50 kt at both 18Z on the 14<sup>th</sup> and 00Z on the 15<sup>th</sup>. It is possible that this storm could have been a hurricane, but observations were limited, and there were no observations of the peak intensity of the storm. The extremely minor track change at 18Z on the 14<sup>th</sup> pushes the storm slightly closer to the ship observation at that time. No more track or intensity changes are made for this storm after 06Z on the 15<sup>th</sup> since data are sparse. The cyclone continued to move north-northeastward, and by the 17<sup>th</sup>, observations of pressures near 1020 mb with weak winds near the HURDAT position indicate that the low had likely dissipated. Dissipation is analyzed to have occurred 18 hours earlier than in HURDAT previously. The reanalyzed final position is at 00Z on the 17<sup>th</sup>, with the HURDAT track and intensity unchanged. Hurricane Fred of 2009 is perhaps a decent analog for this storm.

#### 1949 Storm 9 (originally Storm 8)

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34520 09/20/1949 M= 7 8 SNBR= 766 NOT NAMED XING=0
34520 09/20/1949 M= 7 9 SNBR= 767 NOT NAMED XING=0
*          ***

34525 09/20* 0 0 0 0* 0 0 0 0*260 920 35 0*266 923 35 0*
34525 09/20* 0 0 0 0* 0 0 0 0*260 918 35 0*264 923 35 0*
***          ***

34530 09/21*269 930 40 0*268 933 40 0*266 935 45 0*263 940 45 0*
34530 09/21*266 928 40 0*266 933 45 0*266 935 50 0*266 940 55 0*
*** ***          *** **          *** **

34535 09/22*260 950 50 0*267 952 50 0*271 941 55 0*263 940 55 0*
34535 09/22*262 944 55 0*258 945 55 0*256 945 55 0*255 943 55 0*
*** *** **          *** *** **          *** ***

34540 09/23*255 940 60 0*248 943 60 0*240 946 60 0*230 949 70 0*
34540 09/23*253 940 55 0*248 941 55 0*240 942 60 0*228 946 60 0*
**          *** **          ***          *** *** **

34545 09/24*222 952 75 0*220 955 80 0*219 959 85 0*217 961 85 0*

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34545	09/24*222	952	65	0*220	957	65	0*219	961	70	0*219	965	75	0*
			**		***	**		***	**	***	***	**	
34550	09/25*216	961	85	0*214	961	80	0*210	960	80	0*206	958	75	0*
34550	09/25*216	967	80	0*212	968	80	0*209	966	75	0*206	964	65	0*
		***	**		***	***		***	***	**	***	**	
34555	09/26*203	958	65	0*197	959	55	0*188	962	35	0*181	965	20	0*
34555	09/26*203	962	55	0*197	963	45	0*190	963	35	0*181	965	20	0*
		***	**		***	**		***	***				

34560 HR

Minor track and intensity changes are analyzed for this hurricane in the western Gulf of Mexico. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, the U.S. Weather Bureau Operational Advisories, Cry et al. (1959), and Tannehill (1956).

#### September 19:

HWM analyzes an “L” in a trough (not a closed low) near 25.5N, 92.0W. HURDAT does not yet list a system on this day. Microfilm does not analyze a closed low. Aircraft highlights: 35\* kt SE (30 kt at flight level) and 1010 mb at 23Z at 23.9N, 90.9W (micro). From aircraft late in the day... “Passed through heavy rain area 10 miles wide near 24.7N, 89.5W” (micro). “A weak wave passed from the extreme northwest Caribbean Sea into the Gulf of Mexico during the morning of September 18, moving west-northwestward. Reconnaissance flights on September 19 and 20 found no evidence of a closed circulation” (MWR).

#### September 20:

HWM analyzes a closed low of at most 1010 mb centered near 26.2N, 93.4W. HURDAT lists this as a 35 kt tropical storm at 26.0N, 92.0W. The MWR tracks of centers of cyclones shows a 00Z position near 23.9N, 93.0W and a 12Z position near 25.7N, 93.6W. Microfilm analyzes a closed low of at most 1011 mb centered near 26.7N, 92.5W at 12Z. Aircraft highlights: 35\* kt N (30 kt at flight level of 1000 feet) at 15Z at 27.9N, 93.4W (micro); 40\* kt S (35 kt at flight level of 600 feet) at 17Z at 24.7N, 91.1W (micro). Two other flight-level gales of 35-40 at 1000 feet.

#### September 21:

HWM analyzes a low of at most 1005 mb centered near 25.4N, 94.8W. HURDAT lists this as a 45 kt tropical storm at 26.6N, 93.5W. The MWR tracks of centers of cyclones shows a 00Z position near 26.0N, 95.0W and a 12Z position near 24.8N, 95.3W with a 1002 mb pressure. Microfilm at 12Z is not sure where the tropical cyclone is but at 18Z puts the position near 26.6N, 94.1W inside a low of at most 1002 mb. Ship highlights: 50(?) kt ENE and 1010 mb at 00Z at 25.8N, 94.0W (micro). Aircraft highlights: radar center fix at 1758Z at 26.6N, 94.1W (micro); 50 kt SE (not sure whether surface wind or flight level wind) and 998 mb at 1758Z at 26.8N, 94.0W (micro). From aircraft... “Entered storm NE side; [wind] to 50 knots from 140 degrees. [1758Z] lat 26.8N, [lon] 94.0W. Radar eye estimated 26.6N, 94.1W. Engine out; departing [for] Corpus Christi. Lowest pressure [encountered] 998 mb (1758Z)” (micro). “Reconnaissance flights on September 21, however, placed the center at latitude 26.4N, longitude 94.0W at noon.

The seas were rough along the Louisiana and Texas coasts and heavy squalls occurred locally along the Texas coast September 21-23. The highest wind reported at a coastal station was 51 mph (44 kt) at Port Isabel. Tides along the Texas coast were generally 2 to 2.5 feet above normal” (MWR).

#### September 22:

HWM analyzes a closed low of at most 1005 mb centered near 26.6N, 95.5W. HURDAT lists this as a 55 kt tropical storm at 27.1N, 94.1W. The MWR tracks of centers of cyclones shows a 00Z position near 26.7N, 94.6W and a 12Z position near 27.5N, 95.0W. The MWR post-season track map shows a 00Z position near 26.0N, 93.5W and a 12Z position near 26.5N, 94.1W. Microfilm at 12Z analyzes a low of at most 1005 mb near 27.0N, 93.6W. Ship highlights: 25 kt S and 1005 mb at 00Z at 22.3N, 95.8W (COA); 45 kt SE and 1007 mb at 22Z at 25.8N, 92.4W (micro). From post flight report of Air Force in the western Gulf (likely late afternoon on the 21<sup>st</sup> or around 00Z on the 22<sup>nd</sup>)... “Just talked to weather man from ship that flew Gulf. He says that the furthest west position they went to was 94W and that west of them the sky appeared to be clearing and that nothing showed on their radar scope to the west from there. He also says that he wanted to investigate the area south of their course about 92 to 94 west but it was too dark. True enough that the sun was high in the heavens but that under the clouds and rain it was dark as pitch. Awfully sorry they didn’t get out there earlier. They seemed to think that the radar was slightly confusing as at one time they had two centers on their scope- one to north and one on course. Flew through one of these and no wind shift no nothing seemed to think that radar not too useful with all the interference from clouds, rain, etc. More weather and rain than he has seen before ever. Also seems to think that most likely place for storm to be is somewhere near 25 or so. But could be a degree any way from that except north” (micro). “[0530Z or 0830Z?] Navy Radar: No hurricane indications visible. Crescent shaped storm indications only lying 030 true approximately 150 miles long varying 10-50 miles thick. Best approximation of geographical center of storm 27N, 94W. Indications not solid. Contains heavy thunderstorms. No estimate winds. Will remain in area to obtain whether further information is possible” (micro).

#### September 23:

HWM analyzes a low of at most 1005 mb near 26.0N, 94.8W. HURDAT lists this as a 60 kt tropical storm at 24.0N, 94.6W. The MWR tracks of centers of cyclones shows a 00Z position near 28.4N, 94.6W. Microfilm at 12Z does not analyze a closed low (maybe because they did not know where the storm was located). Ship highlights: 35 kt S and 1009 mb at 00Z at 27.6N, 92.4W (COA); 45 kt NNW and 1024 mb at 18Z at 19.4N, 95.5W (should we throw out this ob completely, or is the 45 kt believable?) (COA). Aircraft highlights: 50\* kt (45 kt at flight level of 9,500 feet) probably around midday at some point on a straight line path from 26N, 97.5W to 19N, 92W (micro). “0515Z: Extensive squalls erratic in pattern covering area approximately 150 mile square. Approximate center 27.5N, 93.2W. No indication of cyclonic formation at present. 0640Z: No definite radar confirmation of a cyclonic disturbance. Entire area appears to be under influence of frontal activity. 0835Z: Radar reconnaissance... area reveals no actual hurricane circulation. Presence all necessary weather less circulation indicates

storm did not deepen or form. Actual weather squalls, fronts, rain are present in area with no definite center” (micro). On a flight from Brownsville, TX (26N, 97.5W) to 19N, 92W on a straight line path... “SE 50 mph (45 kt) at 9,500 feet. Surface [wind] estimated 60 mph (50 kt)” (micro). “2215Z: Squall line E to W 100 miles either direction (24.6N, 94.3W)” (micro). “On September 23 reports by radar and by plane indicated that this hurricane had dissipated” (MWR).

#### September 24:

HWM analyzes a low of at most 1000 mb centered near 21.7N, 95.4W. HURDAT lists this as an 85 kt hurricane at 21.9N, 95.9W. The MWR post-season track map shows a separate system from the system it showed on the 22<sup>nd</sup>. It shows a 00Z position near 21.8N, 94.9W and a 12Z position near 22.4N, 95.4W. Microfilm at 00Z analyzes a tropical storm of at most 999 mb centered near 21.7N, 95.6W, and at 12Z, microfilm analyzes a tropical storm of at most 1005 mb centered near the HURDAT position. Ship highlights: At least 50 kt NW and 1004 mb at 12Z at 22.0N, 96.0W (HWM); 60 kt S and 1006 mb at 18Z at 22.1N, 96.5W (COA). Three other gales between 35-45 kt and one other low pressure of 1005 mb. Aircraft highlights: center fix at 0012Z at 21.8N, 95.7W with highest measured winds of 52 kt (assume at flight level), estimated max (surface or flight level?) winds of 65 kt, and lowest pressure encountered 997 mb (at the edge of the eye?) (micro); radar center fix at 0733Z at 21.9N, 95.8W (micro); radar center fixes around ~18Z at 22.0N, 96.3W (position approximate) and 22.0N, 96.0W (maybe more accurate) with max wind encountered (assume flight level?) 75 kt from the SE (micro); 40 kt NW at 2315Z(?) at 21.6N, 96.9W (micro). Three other gales of 40 kt between 1715Z-1745Z between 22.2-22.7N, 95.5-96.8W (micro). “Storm definitely fixed by radar at 21.8N, 95.7W at 0012Z. Center 20 miles across. Highest measured winds 52 knots (but max) estimated to 65 knots. Pressure on [rim?] of eye 997 mbs. Moderate rain and light turbulence” (micro). From Navy radar plane... “0600Z: Only widely scattered indications remaining of storm covered last two nights. Proceeding to new storm area. Plan to land and standby. 0840Z: Center of storm 0733Z 21.9N, 95.8W. Has appearance of forming hurricane. Eye not completely formed. Storm diameter approximately 100 miles but still irregular in shape. 60 miles to NW turbulence and precipitation. Winds undetermined” (micro). “Estimate center bearing 65 degrees and 68 miles from Cape Rojo, Mexico (Cape Rojo is located at 21.6N, 97.3W). Estimate center 20 miles southwest of closest penetration which was 22.2N, 95.8W. Rain moderate to occasionally heavy. Max winds encountered 140 degrees 75 knots” (micro). “This hurricane developed within an easterly wave which had been stagnant over the western Gulf for the previous 3 days. A center was definitely located by airborne radar at 6 pm September 24 [or 6 pm September 23?] at latitude 21.8N, longitude 95.7W and a wind of 52 knots was reported” (MWR).

#### September 25:

HWM analyzes a low of at most 1000 mb centered near 20.8N, 95.9W. HURDAT lists this as an 80 kt hurricane at 21.0N, 96.0W. The MWR post-season track map shows a 00Z position near 22.0N, 96.3W and a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a tropical storm of at most 999 mb centered near 21.1N, 96.3W. Ship highlights: 60 kt WSW and 999 mb at 00Z at 20.7N, 96.7W (micro); 50 kt

S and 1002 mb at 06Z at 21.7N, 96.4W (COA); 70 kt SW and 998 mb at 06Z at 20.4N, 96.7W (MWR, micro); 40(?) kt WSW and 1003 mb at 12Z at 20.4N, 96.2W (micro). Three other ship gales between 35-50 kt and two other low pressures of 1001 and 1005 mb. Land/station highlights: 35 kt WNW at 18Z at Nautla, Mexico (20.3N, 96.8W) (micro); 35-50 kt at Nautla, Mexico for many hours on the 25<sup>th</sup> (MWR). Aircraft highlights: 40\* kt S at 0030Z at 21.5N, 95.4W (micro); 40\* kt SW at 01Z at 20.7N, 95.4W (micro); radar center fix at 0531Z at 20.8N, 95.8W (micro); radar center fixes at 0620Z and 08Z at 20.8N, 96.0W (micro); radar center fix at 2251Z at 20.2N, 96.2W (micro). "Navy radar plane: First report... fix estimated eye 20.8N, 95.8W at 0531Z. Storm is well-developed. Second report... aircraft radar fix over Cape Rojo. Eye of storm at 20.8N, 96.0W at 0620Z. Believe this fix is accurate. Third report... radar fix eye 0800Z 20.9N, 96.0W. Estimated radius of storm extends from eye to NW 70 miles, NE 90 miles, SE 60 miles, SW 65 miles. Including outer wall, there are 44 well-defined miles extending from the eye. Final report storm tonight. Believe position of (ship) P. Llano to be one degree too far west" (micro). "Storm located by radar 2251Z 20.2N, 96.2W. Definitely 20 miles across. North quadrant appears strongest; west [quadrant] weakest" (micro). "During the night of the September 24 the SS Potrero del Llano reported winds as high as 80 mph. The storm weakened during the 25<sup>th</sup>. Winds at Nautla, Mexico during a large part of September 25 were 40-60 mph (35-50 kt)" (MWR).

#### September 26:

HWM no longer analyzes a closed low on this day. HURDAT lists this as a 35 kt tropical storm at 18.8N, 96.2W. The MWR post-season track map last shows a position at 00Z near 20.0N, 95.9W. Microfilm at 06Z shows a tropical storm of at most 999 mb centered near 19.9N, 96.2W and by 12Z microfilm no longer shows the deep, compact, closed low that it showed previously. Aircraft highlights: center fix at 0550Z at 19.8N, 96.3W (micro); center fix around ~0815Z at 19.7N, 96.3W (position approximate) (micro). No gales or low pressures. "0550Z: Storm position 19.8N, 96.3W. Eye not complete; probably partly over land; approximately 15 miles diameter. Weather 45 miles north of storm- moderate rain and turbulence. Weather [extends?] to north and northeast approximately 150 miles. Will investigate to south. [Sent at 0815Z]: Storm becoming too confused to obtain accurate fix on eye. Believe it has moved approximately 5 miles SSW. Eye flattening out and almost completely over coastline. Rest of storm very irregular in shape and [cloud] density. No indication storm recurving or reforming. Cannot accomplish anymore tonight- departed for base" (micro). "By the morning of the 26<sup>th</sup> its remains had passed inland between Nautla and Vera Cruz, Mexico. Nautla was the only coastal station that reported high winds" (MWR).

This system was interesting in that all publications prior to Cry et al. (1959) including the Monthly Weather Review list this as two separate storms. The earlier publications show the first of these storms forming on 20 or 21 September near the location where HURDAT shows this storm forming. That system is shown to have moved towards the Texas coast by 22 September, dissipating on that date. The earlier publications also show another storm developing in the southern Gulf of Mexico on the 23<sup>rd</sup> or 24<sup>th</sup> making landfall in southern Mexico as a hurricane on the 26<sup>th</sup>. Publications since Cry et al. (1959) including HURDAT show this as one system. HURDAT does not show that this

storm moved very near the Texas coast. The track shows a southward motion from the 22<sup>nd</sup> through landfall on the 26<sup>th</sup>. Upon conducting the reanalysis for this storm, it was found that there is not enough evidence to discredit the scenario in HURDAT that there was only one tropical cyclone.

The presence of a trough was apparent in the central Gulf of Mexico on 19 September. This trough became a closed low and a tropical storm at 12Z on 20 September (no change to timing of genesis or intensity at genesis). The cyclone moved slowly westward at first early on the 21<sup>st</sup> in the west-central Gulf of Mexico. HURDAT previously showed a clockwise loop in the track from the 18Z the 21<sup>st</sup> to 12Z the 22<sup>nd</sup>. The HURDAT position on the 22<sup>nd</sup> at 12Z is too far north, and is adjusted 1.6 degrees to the south-southwest of the previous position (the largest track change analyzed for this storm). Therefore, the loop indicated in HURDAT appears unrealistic and is eliminated. The new track shows a turn to a southerly direction by 00Z on the 22<sup>nd</sup>, and the cyclone is analyzed to have continued in a general southerly direction until landfall on the 26<sup>th</sup>. An important observation that somewhat supports the one storm scenario (described above) is a ship observation at 22Z on the 22<sup>nd</sup> of 45 kt SE and 1007 mb at 25.8N, 92.4W. This observation, along with the commentary on the 22<sup>nd</sup> suggest the existence of a tropical cyclone on the 22<sup>nd</sup> and 23<sup>rd</sup> well to the south of where other sources such as MWR showed the first storm approaching the Texas coast. It is still possible that the circulation on the 21<sup>st</sup> moved towards Texas and that a new circulation developed and moved south, but there is not enough evidence to support this scenario. Because of the observation at 22Z on the 22<sup>nd</sup>, the HURDAT position at 00Z on the 23<sup>rd</sup> is unchanged. On the 21<sup>st</sup> at 00Z, a ship observed winds of 50 kt ENE with a 1010 mb pressure about 90 nmi west-northwest of the analyzed center. The intensity of 00Z on the 21<sup>st</sup> is increased from 40 kt to 50 kt. A Navy aircraft performed a center fix at 1758Z on the 21<sup>st</sup>, but it did not fly into the center. It flew to the 50 kt isotach before circumnavigating the storm. A surface pressure of 998 mb with 50 kt winds from the SE was measured on this flight while flying at an altitude of 1000 feet at 26.8N, 94.0W at 1758Z on the 21<sup>st</sup>. The aircraft at this location was 13 nmi from the center of the eye, as seen on the plane radar. The Schloemer equation was used to obtain the central pressure [using the assumption that the RMW was 12 nmi]. This yields a value of 991 mb for the central pressure. Due to the uncertainty in the exact central pressure value, the value of 991 mb is not added into HURDAT. However, there is enough information to increase the HURDAT intensity at 18Z on the 21<sup>st</sup>. A 991 mb central pressure would yield a wind speed of 58 kt according to the Brown et al. pressure-wind relationship for north of 25N. The RMW is less than 13 nmi while the climatological RMW for this latitude and intensity is 20 nmi. However, the storm was slow-moving. An intensity of 55 kt is chosen for 18Z on the 21<sup>st</sup> (up from 45 kt originally). The strongest observed wind on the 22<sup>nd</sup> was 45 kt with a pressure of 1007 mb from a ship at 22Z. There is very little data available near the cyclone on the 23<sup>rd</sup> as there was no aircraft reconnaissance sent out because the Weather Bureau did not realize that a tropical cyclone still existed on that day. At 0012Z on the 24<sup>th</sup>, aircraft located the cyclone (now a hurricane, or at least a strong tropical storm) at 21.8N, 95.7W, and this was confirmed by several more center fixes later the same day. Therefore, the cyclone is analyzed to have moved towards the south on the 23<sup>rd</sup>. The aircraft reconnaissance crew and the meteorologists at the U.S. Weather Bureau believed that this

was a new hurricane, and advisory number one was issued on this hurricane at 0230Z on the 24<sup>th</sup>. HURDAT indicates that this hurricane is still the same cyclone that existed on the 22<sup>nd</sup>, as first published by Cry et al. (1959). On the flight on the 24<sup>th</sup> at 0012Z, a maximum (flight level?) wind of 52 kt was measured and maximum surface winds of 65 kt were estimated. The aircraft measured a lowest peripheral pressure of 997 mb very close to the eye, likely near the RMW. Moderate rain and light turbulence were reported. The HURDAT intensity at 00Z on the 24<sup>th</sup> is decreased from 75 to 65 kt. The maximum wind encountered by an aircraft on a midday flight on the 24<sup>th</sup> was 75 kt 25 miles from the eye. A pressure of 1005 mb was measured at this time/location. The HURDAT intensity at 18Z on the 24<sup>th</sup> is lowered from 85 to 75 kt. Ships reported winds of 50 kt at 12Z on the 24<sup>th</sup>, 60 kt at 18Z and 00Z on the 25<sup>th</sup>, and 70 kt at 06Z on the 25<sup>th</sup>. There is no evidence that any of these observations occurred at or inside the RMW. The 70 kt was observed simultaneously with a 998 mb pressure. On the 24<sup>th</sup>, the cyclone meandered slowly westward, but it resumed a slow southward course on the 25<sup>th</sup> and made landfall on the 26<sup>th</sup> at 08Z at 19.5N, 96.3W (between Nautla and Veracruz). On the 25<sup>th</sup>, the track is shifted about half a degree to the west of the previous track. The highest observed wind from a coastal station in Mexico was 50 kt at Nautla late on the 25<sup>th</sup>, while the cyclone was still over water. The analyzed closest approach of the cyclone to Nautla (around 00Z on the 26<sup>th</sup>) was about 30 nmi (Nautla was on the right side of the storm). The landfall point at 08Z on the 26<sup>th</sup> is about 20 nmi from Veracruz (Veracruz was on the left side of the storm). No strong winds or any damage was reported from Veracruz (MWR). Therefore, the cyclone likely began weakening prior to landfall, which is consistent with what HURDAT showed originally. The maximum intensity for this cyclone listed in HURDAT previously was 85 kt from the 24<sup>th</sup> at 12Z through the 25<sup>th</sup> at 00Z. The revised maximum intensity is 80 kt on the 25<sup>th</sup> at 00Z and 06Z. The largest downward intensity adjustment for this storm is 15 kt (on the 24<sup>th</sup>), and the largest upward intensity adjustment for this storm is 10 kt (on the 21<sup>st</sup>). The intensity at 00Z on the 26<sup>th</sup> is only lowered by 5 kt (adjusted downward from 65 kt to 60 kt) because descriptions from looking at the cyclone on radar indicate that the center was still well-defined. However, by 06Z, descriptions of the cyclone from looking at radar indicate that the center was becoming less defined and was beginning to “flatten out” and weaken. The HURDAT intensity at 06Z on the 26<sup>th</sup> is lowered from 55 kt to 50 kt. The analyzed landfall intensity is 50 kt. Available information indicates that the cyclone rapidly weakened after landfall over mountainous terrain, and the HURDAT intensities at 12 and 18Z on the 26<sup>th</sup> of 35 and 20 kt respectively are unchanged. The last point in HURDAT is at 18Z on the 26<sup>th</sup> at 18.1N, 96.5W as a 20 kt tropical depression, and no changes to the position, intensity, or timing of dissipation were made at 18Z on the 26<sup>th</sup>. The cyclone dissipated after 18Z on the 26<sup>th</sup>.

#### 1949 Storm 10 (originally Storm 9)

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34565 09/21/1949 M= 2 9 SNBR= 767 NOT NAMED XING=0
34565 09/20/1949 M= 3 10 SNBR= 768 NOT NAMED XING=0
      **          * **          ***
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(The 20th is new to HURDAT.)

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34568 09/20* 0 0 0 0* 0 0 0 0*142 608 40 0*147 618 45 0*
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34570	09/21*	0	0	0	0*162	625	60	0*164	653	65	0*169	666	70	0*
34570	09/21*	152	629	50	0*158	641	60	0*164	653	65	0*171	666	70	0*
		***	***	**		***	***				***			
34575	09/22*	173	678	70	0*178	688	70	0*182	699	65	0*185	720	35	0*
34575	09/22*	175	676	70	0*178	686	65	0*182	695	55	0*185	706	35	0*
		***	***			***	**		***	**		***		

34580 HR

Minor track changes and minor intensity changes are analyzed for this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, the U.S Weather Bureau Operational Advisories, and Perez (1971).

#### September 19:

Microfilm at 18Z analyzes a trough or wave axis extending from 16N, 60W south-southwestward to 10N, 63W. No gales or low pressures. From aircraft... "Passed through strong easterly wave near Antigua. Encountered severe squalls" (micro).

#### September 20:

HURDAT does not yet list this as a system on this day. Microfilm at 12Z shows a low, not closed, near 15.5N, 59.5W with several easterly aircraft gales north of the low and a trough or wave axis extending from 18N, 59W to 11N, 64W. Microfilm first shows a closed low at 18Z of at most 1008 mb near 15N, 62W. Ship highlights: 35 kt ENE and 1014 mb at 00Z at 18.5N, 56.3W (micro). Aircraft highlights: several observations of 40 kt E-ESE and 1014-1015 mb between 1230-1530Z between 16.4-19.0N, 58.3-61.4W (micro). A couple of other gales. From aircraft... "Crossed extensive squall line 40 miles long, 2 miles wide at 16.6N, (58-59W). Severe line squall near (~16.4N, ~59.3W). Heavy rain and turbulence but no drop in pressure; max [flight-level?] wind 55 knots. No evidence of circulation; strong winds and severe squalls throughout" (micro). "Recon reports strong easterly wave centered (near 15.2N, 61.3W) with a 1007 mb surface pressure at 1815Z" (micro). "On September 20 a rather strong easterly wave was crossing the Lesser Antilles. Two reconnaissance flights searched for suspicious areas for a possible tropical storm but no closed circulation was found that day" (MWR).

#### September 21:

HWM analyzes a closed low of at most 1005 mb centered near 15.9N, 64.4W. HURDAT lists this as a 65 kt hurricane at 16.4N, 65.3W. Microfilm analyzes a closed low of at most 1008 mb centered near the HURDAT position. Ship highlights: 35 kt WSW and 1005 mb at 11Z at 16.5N, 64.5W (COA); 51 kt WSW and 1006 mb at 12Z at 15.7N, 64.0W (micro, MWR, COA); 40 kt SE and 1010 mb at 15Z at 15.5N, 64.5W (COA); 35 kt SE and 1010 mb at 18Z at 14.5N, 63.5W (COA). Three other gales from the same ship. All 7 ship gale observations on this day were from the same ship. Land/station highlights: 40 kt E and 1011 mb at 06Z at Ponce, Puerto Rico (18.0N, 66.6W) (micro); at least 65 kt (max w) at St. Croix (17.7N, 64.7W) (Perez); 56 kt (max w) at Ramey Air Force Base (18.5N, 67.1W) (Perez); 36 kt E (max w) at San Juan, Puerto Rico (Perez). Aircraft highlights: center fix at 1406Z at 16.4N, 65.6W with max surface winds of 45 kt and surface gusts to 65 kt and a 1006 mb peripheral pressure reported (micro); center fix at 1728Z at 17.1N, 65.9W with 65 kt winds (surface or flight level?) NW of center with

max winds estimated at 75 kt (surface or flight level?) at 18Z at 17.7N, 65.6W with an 1009 mb pressure at this location (micro). About eight other gales. "Navy recon: center 1406Z 16.4N, 65.6W. Lowest pressure 1006 mbs (I would have assumed central pressure, but ship data says cp is lower). Squalls to NE and E of center. Surface wind gusts to 65 kt; average surface winds 45 kt. No strong winds W-SW-or NW-center. Torrential rain NNE and E" (micro). "Navy position (of aircraft) 17.5N, 65.1W at 1445Z. Surface gusts to 60 knots N and E sector. Average (flight level) winds 65 knots with gusts to 80 kt" (micro). "Hurricane center 1728Z 17.1N, 65.9W. Estimate winds 65 kt NW of center. 1800Z: aircraft position 17.7N, 65.6W winds estimated 75 knots" (micro). "[This cyclone] formed the night of September 20 from an easterly wave in the Caribbean some 150-200 miles southeast of St. Croix. [It] passed a short distance south of St. Croix on the 21<sup>st</sup>, moved west-northwest at 12 mph and passed 50 miles off the south coast of Puerto Rico from 4:00 pm to 10:00 pm on Sept. 21<sup>st</sup> [21Z 21<sup>st</sup> to 03Z 22<sup>nd</sup>], much closer to Cabo Rojo, and dissipated in the mountains of central Dominican Republic on the 22<sup>nd</sup>. St. Croix experienced hurricane force winds and great damages. Highest winds were in southern and southwestern Puerto Rico, and Ramey AFB recorded winds east 64 mph (56 kt). San Juan recorded winds east at 38 mph (33 kt) at 10:00 pm (September 21<sup>st</sup>/03Z 22<sup>nd</sup>); lowest bar. 29.83 (1010 mb) at 4:30 pm (21<sup>st</sup>/2130Z 21<sup>st</sup>). Most rivers were in flood, including the rivers of northern Puerto Rico. Damages were reported in Yabucoa, Santa Isabel, Ponce, Guayanilla, Cabo Rojo, Mayaguez, Cidra, Jayuya, and Toa Alta. Ponce experienced high gusts. Damages were minor. San Juan rainfall, 1.41 inches; max wind east 41 mph. 48 hour rainfall, Sept. 21-22: Yauco 8.70 inches; Coamo 7.55 inches; Santa Rita 9.07; Carite 9.81; San Lorenzo 13.56" (Perez 1971). "During the night of September 20-21 a closed circulation centered about 100 miles south-southeast of St. Croix, Virgin Islands, developed on the wave. This followed a report from the U.S.S President Adams, at 15.7N, and 64.0W indicating a surface wind of 51 knots from 250 degrees. Aircraft flying in the storm area on September 21 reported hurricane winds in the northeast quadrant; but no strong winds, other than those by the aforementioned vessel, were reported in the western quadrants" (MWR).

#### September 22:

HWM analyzes a closed low of at most 1005 mb centered near 17.3N, 69.2W. HURDAT lists this as a 65 kt hurricane at 18.2N, 69.9W. The MWR post-season track map shows a 00Z position near 17.4N, 67.6W and a 12Z position near 18.5N, 69.4W. Microfilm analyzes a closed low of at most 1008 mb centered in the general vicinity of 16.4N, 69.9W, and also a trough or wave axis extending from 20N, 68W through the low south-southwestward to 12N, 72W. Ship highlights: 50 kt ESE at 13Z at 17.0N, 67.8W (micro); 35 kt SSE and 1006 mb at 15Z at 15.7N, 69.3W (micro). Three other gales of 35-40 kt. Land/station highlights: 33 kt at San Juan, Puerto Rico at 03Z. Aircraft highlights: 40\* kt E and 1004 mb at 2145Z at 16.9N, 70.7W (micro). Two other gales of 40 kt and 2 other low pressures of 1003 and 1005 mb. "Plane at 17.2N, 69.1W around ~2230Z: Radar continuously indicated worse weather to south of [forecast?] track in Caribbean" (micro). "This small hurricane moved west-northwestward to the southeastern coast of the Dominican Republic and dissipated as it moved inland in the vicinity of Ciudad Trujillo. The storm caused damages to the extent of \$1,000,000 in Puerto Rico although the center did not pass over the island. The damage was mostly to

the coffee industry and to buildings. No lives were lost in Puerto Rico. In the Dominican Republic only \$12,000 damage was reported but 15 lives were lost” (MWR).

September 23:

HWM analyzes a wave axis from 26N, 76W to 14N, 75W and a closed low of at most 1010 mb located in the ITCZ near 13N, 75W. HURDAT no longer lists this system. Microfilm no longer analyzes a closed low on this day but analyzes a general large area of troughiness over the west-central Caribbean Sea. No gales or low pressures.

September 24:

HWM analyzes a wave axis from 28N, 77W to 14N, 82W with a closed low of at most 1010 mb located in the ITCZ near 11.5N, 81W. Microfilm analyzes a general area of weak troughiness over the western Caribbean Sea. No gales or low pressures.

September 25:

HWM analyzes a wave axis from 27N, 80W to 15N, 85W. Microfilm at 00Z analyzes a low, not closed, near 16.5N, 82.5W within a general area of troughiness. No gales or low pressures. From 9/25 18Z microfilm... “Duck-7 remarks: 18.2N, 85.9W. No evidence of closed circulation in this area” (micro).

A tropical storm formed from a strong easterly wave near the Leeward Islands on 20 September. HURDAT starts this system as a 60 kt tropical storm at 06Z on the 21<sup>st</sup>. Available observations first indicate a closed low at 12Z on the 20<sup>th</sup>, with an east wind near Dominica and a weak west-southwest wind near Barbados. Numerous easterly gales of between 35 and 45 kt were observed two to four degrees north of the analyzed position at 12Z on the 20<sup>th</sup>, and the pressures with those gales were three to four mb higher than the pressure of the observation closest to the analyzed center. Although 12Z on the 20<sup>th</sup> is the first time for which evidence of a closed low was found, and genesis may have been captured, but it is possible that genesis occurred east of the Lesser Antilles on an earlier date. This system is started at 12Z on the 20<sup>th</sup> (18 hours before HURDAT originally) as a 40 kt tropical storm at 14.2N, 60.8W. The tropical cyclone moved west-northwestward and intensified. Positions were analyzed at 18Z on the 20<sup>th</sup> and then again at 12Z on the 21<sup>st</sup>. Interpolating the analyzed positions for 06Z on the 21<sup>st</sup> would indicate a position at that time about a degree and a half west of the previous HURDAT position (the largest track change made to HURDAT for this storm). Although aircraft reconnaissance performed two center fixes on the 21<sup>st</sup>, no central pressure values were reported. Estimated maximum winds of 65-75 kt were reported at the 1728Z fix. St. Croix reported maximum winds of 65 kt on the 21<sup>st</sup> as the storm passed to the south of the island. No ship reported a wind stronger than 51 kt during this storm. No changes are made to the HURDAT intensity on the 21<sup>st</sup>. The cyclone passed south of Puerto Rico, and on a west-northwest course, it was headed towards Hispaniola. A ship observation at 05Z on the 22<sup>nd</sup> of 1010 mb with 25 kt of wind located very close to the HURDAT position indicates either that the system had weakened or that the HURDAT position was in error. From the analysis on the 22<sup>nd</sup>, it was difficult to determine whether the storm had weakened by 06Z and 12Z or whether the HURDAT position was in error. Perhaps the storm was breaking up as it approached Hispaniola. Because of the uncertainty in the

analysis on the 22<sup>nd</sup>, only slight changes are made to HURDAT. For 06Z on the 22<sup>nd</sup>, the position is moved two-tenths of a degree further away from the observation of 1010 mb with 25 kt, and the intensity is also reduced in HURDAT from 70 to 65 kt. The cyclone does not make landfall in the Dominican Republic until 15Z on the 22<sup>nd</sup>, but by 12Z on the 22<sup>nd</sup>, the strongest observed winds and the lowest available pressures are quite a distance south of the HURDAT position. It is highly uncertain whether this cyclone made landfall in the Dominican Republic, but there is not enough evidence of a closed circulation further south where the higher winds and lower pressures are located, so no large changes are made to HURDAT. The 65 kt intensity in HURDAT at 12Z on the 22<sup>nd</sup> is reduced to 55 kt since the highest observed wind (including the winds that may not be directly associated with the circulation) is 50 kt. If the HURDAT position (and the analyzed position) is correct, then the intensity may have been much weaker. The cyclone is analyzed to have made landfall in the Dominican Republic at 15Z on the 22<sup>nd</sup> as a 55 kt tropical storm. The intensity at 18Z on the 22<sup>nd</sup> of 35 kt in HURDAT is unchanged, but the position at that time is analyzed to be 1.4 degrees east of the previous HURDAT position. The cyclone dissipated after 18Z on the 22<sup>nd</sup>, and there are no changes to the timing of dissipation. It should be noted that the easterly wave associated with this disturbance can be followed to the western Caribbean through 25 September, and this wave may have possibly played a role in the formation of 1949 storm 10 (now storm 11- see metadata for more details).

#### 1949 Storm 11 (originally Storm 10)

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34585 09/27/1949 M=10 10 SNBR= 768 NOT NAMED XING=1 SSS=2
34585 09/27/1949 M=11 11 SNBR= 769 NOT NAMED XING=1 SSS=3
      ** **          ***
34590 09/27* 0 0 0 0*125 895 35 0*133 901 35 0*134 902 35 0*
34590 09/27* 0 0 0 0*132 900 35 0*133 901 35 0*134 902 35 0*
      *** ***
34595 09/28*135 902 35 0*137 902 35 0*140 902 35 0*142 903 35 0*
34600 09/29*144 905 35 0*146 907 35 0*150 911 35 0*156 909 35 0*
34600 09/29*144 905 35 0*146 907 35 0*150 911 35 0*155 909 35 0*
      ***
34605 09/30*163 909 35 0*168 908 35 0*173 906 40 0*179 905 40 0*
34605 09/30*160 909 35 0*165 908 35 0*170 906 35 0*175 905 35 0*
      ***          ***          *** **          *** **
34610 10/01*185 905 40 0*188 907 45 0*191 912 45 0*195 918 50 0*
34610 10/01*180 907 35 0*186 915 35 0*191 920 40 0*195 923 45 0*
      *** *** **          *** *** **          *** **          *** **
34615 10/02*200 925 50 0*206 932 55 0*213 938 60 0*220 943 65 0*
34615 10/02*200 927 50 0*206 935 55 0*213 939 60 0*220 943 65 0*
      ***          ***          ***
34620 10/03*227 946 75 0*235 949 85 0*245 952 95 0*260 955 100 0*
34620 10/03*227 946 75 0*235 950 85 0*247 954 95 970*263 955 100 0*
      ***          *** ***          *** ***          *** ***
34625 10/04*276 956 110 0*291 954 115 0*303 950 60 0*310 946 55 0*
34625 10/04*278 956 100 0*291 956 100 960*301 952 60 982*310 950 45 0*
      ***          *** ***          *** ***          *** ***          *** **
34630 10/05*316 941 50 0*323 936 45 0*330 931 40 0*339 925 35 0*

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34630 10/05*316 948 35 998*321 944 30 0*330 939 25 0*341 929 25 0*
      *** ** *** *** *** **      *** **      *** *** **
34635 10/06*354 917 35 0*375 907 30 0*396 896 30 0*422 884 25 0*
34635 10/06*354 917 25 0*377 907 25 0*398 896 25 0E419 886 25 0*
      **      *** **      *** **      **** ***
(The 7th is new to HURDAT.)
34637 10/07E439 875 25 0* 0 0 0 0* 0 0 0 0* 0 0 0 0 0*
34640 HRCTX2
34640 HRCTX3BTX1
      *****

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#### U.S. Landfall:

10/04/1949 - 05Z – 28.8N, 95.6W – 100 kt – 960 mb – RMW 15 nmi – OCI 1009 mb –  
 ROCI 200 nmi – speed 11 kt

Minor changes to both track and intensity are analyzed for this major hurricane that struck Texas just west of Freeport. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, the Texas monthly climatological data summary for October, 1949 from NCDC, the U.S. Weather Bureau Operational Advisories, Schwerdt et al. (1979), Ho et al. (1987), Connor (1956), Jarrell et al. (1992), Dunn and Miller (1960), Wiggert et al. (1986), Cry et al. (1959), and Tannehill (1956).

#### September 26:

HWM analyzes the westward moving tropical wave which had been responsible for spawning storm 9 [now Storm 10] from 25N, 81W to 16N, 87W. HURDAT does not list a system on this day. No gales or low pressures. [Of note is that storm 8 (now storm 9) was dissipating inland on the 26<sup>th</sup> near 19N, 96.3W.]

#### September 27:

HWM analyzes a closed low of at most 1005 mb centered near 13.9N, 89.9W. HURDAT lists this as a 35 kt tropical storm at 13.3N, 90.1W. Microfilm analyzes a broad closed low of at most 1008 mb centered in the general vicinity of 20.0N, 91.5W. No gales or low pressures. “On 27 September 1949, a weak low pressure area began to develop off the Pacific coast of El Salvador. The area moved northward, across Guatemala and into the Gulf of Mexico” (Wiggert et al. 1986).

#### September 28:

HWM analyzes a low of at most 1005 mb centered near 14N, 90W. HURDAT lists this as a 35 kt tropical storm at 14.0N, 90.2W. Microfilm analyzes a weak closed low of at most 1008 mb centered in the general vicinity of 15.5N, 86W. No gales or low pressures.

#### September 29:

HWM analyzes a low of at most 1005 mb centered near 14.5N, 91W. HURDAT lists this as a 35 kt tropical storm at 15.0N, 91.1W. Microfilm does not analyze a closed low on this day but instead analyzes a trough over southern Mexico and northern Central America. No gales or low pressures. “Pressure had been abnormally low over Yucatan, Honduras, and Guatemala for 2 or 3 days prior to October 1” (MWR).

September 30:

HWM analyzes a low of at most 1005 mb centered near 16.7N, 90.7W. HURDAT lists this as a 40 kt tropical storm at 17.3N, 90.6W. Microfilm analyzes a broad closed low of at most 1008 mb centered in the general vicinity of 17.3N, 90.5W. Land/station highlights: 15 kt WNW and 1005 mb at 12Z at 14.9N, 92.4W (HWM).

October 1:

HWM analyzes a low of at most 1005 mb centered near 19N, 91W. HURDAT lists this as a 45 kt tropical storm at 19.1N, 91.2W. The MWR post-season track map shows a 12Z position near 18.9N, 91.3W. Microfilm analyzes a closed low of at most 1005 mb centered near 19.2N, 91.3W. Ship highlights: Land/station highlights: 20 kt S gust 30 kt and 1004 mb at 12Z at Ciudad del Carmen, Mexico (18.7N, 91.8W) (micro); 20 kt SSE and 1005 mb at 18Z at Campeche, Mexico (19.8N, 90.6W) (micro). "During the night of September 30-October 1 a low pressure center passed into the Gulf of Mexico near Carmen, Mexico" (MWR). "By October 1, the low intensified into a tropical storm just off the Yucatan Peninsula" (Wiggert et al. 1986).

October 2:

HWM analyzes a low of at most 1000 mb centered near 21.5N, 94.0W. HURDAT lists this as a 60 kt tropical storm at 21.3N, 93.8W. The MWR tracks of centers of cyclones shows a 00Z position near 20.0N, 93.3W and a 12Z position near 21.2N, 93.8W with a 1007 mb pressure. The MWR post-season track map shows a 00Z position near 19.8N, 92.8W and a 12Z position near 21.1N, 93.6W. Microfilm analyzes a low of at most 1002 mb centered near 21.1N, 93.9W. Ship highlights: 40 kt W and 1000 mb at 07Z at 20.7N, 94.0W (micro). Two other low pressures between 1002-1004 mb from same ship. Aircraft highlights: 45 kt SE (55 kt SE at flight level of 1100 feet) and 1004 mb at 1345Z at 21.3N, 93.8W (micro); center fix at 1410Z at 21.2N, 93.9W with estimated (max surface?) winds of 70 kt (micro); Navy center fix at 2338Z at 22.8N, 94.7W with highest winds encountered 50 kt and lowest pressure 990 mb (likely a peripheral pressure; treated as a peripheral pressure in the analysis) (micro). Seven other gales between 35-45 kt and four other low pressures between 992-1001 mb. "It increased to hurricane intensity by 10:45 am, October 2. This hurricane moved from Yucatan almost directly northward" (MWR). "By noon [the 2<sup>nd</sup>], it was classified as a hurricane" (Wiggert et al. 1986). "Remarks Navy: Weak squall line oriented north-south thirty miles long" (micro). "Note: Eye diameter 30 miles 21.2N, 93.9W (1410Z center fix) wind velocity estimated 70 knots [surface or flight level? Assume surface since they used the word 'estimated.'] west side. Climbing for radar pictures" (micro). "Moving NNW about 13 knots around 18Z" (micro). "Note from Navy recon: Eye indicated by radar at 2338Z at 22.8N, 94.7W. Maximum winds SW 50 kt. Min pressure 990 mbs. Eye diameter 20 miles. All quadrants appear closed" (micro). [They probably only flew to the 50 kt isotach and measured a minimum pressure of 990 mb at the 50 kt isotach.]

October 3:

HWM analyzes a low of at most 995 mb centered near 24.8N, 95.6W. HURDAT lists this as a 95 kt hurricane at 24.5N, 95.2W. The MWR tracks of centers of cyclones shows

a 00Z position near 22.7N, 94.7W and a 12Z position near 25.1N, 95.3W with a 997 mb pressure. The MWR post-season track map shows a 00Z position near 22.6N, 94.2W and a 12Z position near 24.4N, 94.9W. Microfilm analyzes a low of at most 987 mb centered near 25.2N, 95.6W. Ship highlights: 45 kt ESE and 1007 mb at 08Z at 25.9N, 93.9W (micro); 30 kt SE and 1005 mb at 10Z(?) at 26.3N, 93.2W (micro). Three other gales between 35-45 kt. Land/station highlights: 30 kt E and 1005 mb at 12Z at Port O'Connor, TX (28.4N, 96.6W) (micro); 20 kt NNW and 1003 mb at 12Z at Port Isabel, TX (26.1N, 97.2W) (micro). Three other low pressures between 1003-1005 mb. Aircraft highlights: Navy radar center fix at 0855Z at 24.2N, 95.5W (micro); 80 kt N (probably a flight level wind) and 981 mb at ~1345Z at 25.1N, 95.8W (micro); navy radar center fix at 1348Z at 25.0N, 95.6W with 100 kt max (flight level?) winds encountered and 981 mb lowest pressure encountered (micro); 90 kt W (flight level?) at ~1354Z at 24.7N, 95.7W (micro); 100 kt S (flight level?) at ~14Z at 24.8N, 95.4W (micro); navy radar center fix at 1730Z at 25.9N, 95.5W (micro); navy radar center fix at 1815Z at 26.4N, 95.2W (micro). Seven other gales between 35-45 kt. Four other low pressures between 990-1000 mb. "Navy radar 0855Z: Storm center 24.2N, 95.5W. Fix believed good; eye well defined. 0925Z present fixed continued 0855Z fix" (micro). "Navy radar 1348Z: center at 25N, 95.6W at 1348Z. 90 kt west [quadrant], 100 kt south [quadrant]. Remarks around ~1415Z: Squall line arranged N-S at 25.3N, 96.2W. It has surface gusts 65 kts. Remarks around ~1445Z: Surface gust 60 kt in squalls (~24.9N, 93.6W). Navy at 1513Z: Hurricane center located at 1348Z at 25N, 95.6W. Max winds 80 kt N 12 miles WNW of eye; 90 kt W 20 miles SSW of eye; 100 kt S 20 miles SSE of eye. Lowest pressure [encountered] 981 mb 12 miles WNW of eye. Squall line 50 miles NW of center has surface gusts of 65 kts. Hurricane winds extend 30 miles NW of center, 60 miles SW of center, and 75 miles ESE of center. 1730Z Navy radar fix: 25.9N, 95.5W. This fix believed to be accurate within 5 miles. 1815Z Navy radar fix: Storm position 26.4N, 95.2W- believed to be somewhat more accurate than the 1730Z position. Will continue reporting positions" (micro). "1750Z Freeport, TX radar (29.0N, 95.4W): 3 concentric arcs around center- 180 degrees, 180 miles (implies center at 26.4N, 95.4W). Possible circulation around center. 1830Z Freeport, TX radar: 3 concentric arcs about center- 180 degrees, 165 miles (implies center 26.6N, 95.4W). Movement arc indicates eye 30 miles in diameter. Movement toward north. 2145Z Freeport, TX radar: Heavy band points- 250 degrees, 40 miles (28.8N, 96.0W); over station (29.0N, 95.4W); 100 degrees, 40 miles (28.9N, 94.8W); 125 degrees, 20 miles (28.8N, 95.2W) (5 miles wide west to east). Moderate bands- from 225 degrees, 70 miles (28.3N, 96.2W) through 140 degrees at 170 miles (27.1N, 93.6W). Broken moderate bands (10 miles wide) from 200 degrees, 100 miles (27.6N, 95.8W) through 180 degrees, 80 miles (27.8N, 95.4W) through 150 degrees, 120 miles (27.5N, 94.5W). Heavy band 15 miles wide from 190 degrees, 110 miles (27.4N, 95.7W) through 180 degrees, 105 miles (27.5N, 95.4W) to 170 degrees, 120 miles (27.3N, 95.1W). Eye at 180 degrees, 110 miles. 2315Z Freeport, TX radar: series of sharp spiral bands are centered at 180 degrees, 95 miles (27.6N, 95.4W) moving from south at 18 to 20 mph" (micro).

October 4:

HWM analyzes a low of at most 995 mb centered near 30.0N, 95.1W. HURDAT lists this as a 60 kt tropical storm at 30.3N, 95.0W. The MWR tracks of centers of cyclones

shows a 00Z position near 27.4N, 95.3W and a 12Z position near 30.2N, 94.8W with a 992 mb pressure. The MWR post-season track map shows a 00Z position near 27.5N, 95.3W and a 12Z position near 30.2N, 94.7W. Microfilm analyzes a low of at most 993 mb centered near 30.1N, 95.2W. Ship highlights: 40 kt SSE and 1004 mb at 00Z at 28.2N, 94.3W (micro); 40 kt SE and 1012 mb at 12Z at 29.3N, 91.5W (COA). Land/station highlights: hurricane force ENE and 978 mb at 0540Z at 5 miles west of Freeport, TX (29.0N, 95.4W) (MWR); 87 kt SE (max wind; 1-minute) and 982 mb at 06Z at Freeport coast guard station (MWR, micro); 78 kt E and 993 mb at 0830Z at Houston Airport (29.7N, 95.3W) (MWR, micro); 15 kt SSW and 984 mb (barometer had already begun rising) at 1028Z at Houston Airport (micro). 29 other gales, 6 of which were hurricane force winds of 65-85 kt. About 33 other low pressures, 5 of which are less than 990 mb (between 986-988 mb). "The center moved inland near Freeport, TX during the night of October 3-4, and passed between the airport and city offices of the Weather Bureau at Houston, TX during the early morning of October 4. Winds were estimated at 135 mph 5 miles west of Freeport by the Brazos River Engineers. High tides were reported as follows: Velasco, 11.0 feet; Matagorda, 8.0 feet; Anahuac, 9.0 feet; Harrisburg (in Houston ship channel), 11.4 feet. The heaviest (rainfall) reported was at Goodrich, TX, (65 miles north of Houston) where 14.50 inches fell during the storm. Two lives were lost in this hurricane. The total damage reported amounted to \$6,700,000, of which more than four-fifths was to crops. The remainder was mainly to roads and oil rigs" (MWR). "It headed northward and made landfall between Matagorda and Freeport, Texas, about 11:30 pm on October 3<sup>rd</sup> (0530Z October 4<sup>th</sup> assuming 11:30 pm CST). Lowest reported pressure was 978 mb at Freeport, which also had maximum sustained winds of 100 mph and peak wind gusts estimated at 135 mph. Total storm damage was estimated at about \$8M. Of this, an estimated \$1M was property damage, including \$800,000 damage to oil rigs off the Texas coast. Crop damage was about \$6.7M" (Wiggert et al. 1986). US landfall RMW was 20 statute miles according to Wiggert et al. (1986). US landfall delta p (difference between central pressure and environmental pressure) was 50 mb according to Wiggert et al. (1986). From the October, 1949 Texas climatological data summary... "A Gulf hurricane entered the State near Freeport October 3-4<sup>th</sup> and traveled northeastward over Houston, causing severe damage to rice and moderate damage to cotton and other property. A tropical hurricane hit the Texas coast at Freeport on the evening of the 3<sup>rd</sup> and moved north-northeastward toward Lufkin. The inflow of humid tropical air continued all week, bringing effective rains over most of the State. The total [October] rainfall at Houston of 17.64 inches during the month was the highest ever recorded in one month in the Houston record. A hurricane moved inland near Freeport during the night of October 3-4<sup>th</sup> and passed between the City and Airport Offices at Houston during the early morning of the 4<sup>th</sup>. The highest wind reported at Houston Airport was 90 mph from the east, and from the City Office, Houston, 70 mph from the east. The low barometer reading at the Houston Airport was 29.12 (986 mb) [incorrect according to microfilm] and at the City Office 29.17 (988 mb). Crop damage in Texas was \$5,250,000 to rice and \$250,000 to cotton. Other property damage including roads and oil rigging off the Texas coast amounted to \$1,000,000. Total damage for the storm in Texas and Louisiana was \$6,700,000. Excessive rains which occurred in the lower Trinity River watershed in connection with the hurricane on the 3<sup>rd</sup> and 4<sup>th</sup> caused a rapid rise on the trinity at Liberty, where rainfall

exceeded 10 inches during this storm” (climo). “Freeport radar 0045Z: Spiral band around open area 180 degrees, 70 miles moving north. Northern edge of open area... at 180 degrees, 50 miles. Freeport radar 02Z: Center of spiral bands located at range 45 to 50 miles. Azimuth indefinite 182 degrees. Wind gusts interfering with antenna sweep. Communications difficulties at Freeport. Radar now shut down” (micro). “From Freeport at 0515Z: Wind taking southerly component; has changed direction from 80 degrees to present direction 120 degrees...” (micro). “Oct 4 – 1007 mb OCI, 90 kt equivalent 1 min max wind at US landfall” (Schwerdt et al. 1979). “Oct 4, 963 mb central pressure at landfall based upon 978 mb measured at 5 mi SW of Freeport, TX, 20 nm RMW, 11 kt translational speed, landfall point – 28.9N, 95.4W” (Ho et al. 1987). “Oct 4, landfall near Freeport, 28.70 in. (972 mb)” (Connor 1956). “Oct, TX, N2, 972 mb” (Jarrell et al. 1992). “Tropical Cyclones in Texas: 1949 Oct. 3-4, Freeport, Major, 2 killed, damage \$6,700,000 (‘Major’ – 101 to 135 mph, 949 to 982 mb)” (Dunn and Miller 1960).

#### October 5:

HWM analyzes a low of at most 1005 mb centered near 33N, 93.7W with the west-southwest end of a WSW-ENE frontal system located just a couple hundred miles north of the cyclone. HURDAT lists this as a 40 kt tropical storm at 33.0N, 93.1W. The MWR tracks of centers of cyclones shows a 00Z position near 31.8N, 93.9W and a 12Z position near 32.8N, 92.5W with a 1000 mb pressure. The MWR post-season track map shows a 00Z position near 31.5N, 94.2W and a 12Z position near 33.0N, 93.6W. Microfilm analyzes a low of at most 1002 mb centered near 32.9N, 93.8W with a frontal system located several hundred miles north of the cyclone. Land/station highlights: 10 kt SSE and 999 mb at 00Z at Lufkin (31.5N, 94.8W) (micro); 25 kt ENE and 1004 mb at 00Z at Shreveport (32.4N, 93.8W) (micro). Five other low pressures between 1002-1005 mb.

#### October 6:

HWM analyzes a low of at most 1000 mb centered near 40N, 90W with the west end of a W-E warm front located due east of the cyclone at 87W and an approaching cold front located several hundred miles west of the cyclone. HURDAT lists this as a 30 kt tropical depression at 39.6N, 89.6W. The MWR tracks of centers of cyclones shows a 00Z position near 35.6N, 90.7W, and a 12Z position near 39.8N, 89.3W with a 998 mb pressure. The MWR post-season track map shows a 00Z position near 35.2N, 91.9W and a 12Z position near 39.2N, 89.1W. Microfilm analyzes a low of at most 999 mb centered near 40.3N, 89.7W with analysis features similar to HWM’s analysis. Land/station highlights: 15 kt S and 998 mb at 12Z at Springfield, IL (39.8N, 89.7W) (micro); 25 kt S and 1006 mb at 18Z at Fort Wayne, IN (41.1N, 85.2W) (micro). Six other low pressures between 999-1005 mb.

#### October 7:

HURDAT does not list a system on this day. The MWR tracks of centers of cyclones last shows a position at 00Z near 43.6N, 87.7W. The MWR post-season track map last shows a position at 00Z near 44.4N, 87.0W. Microfilm at 00Z analyzes a closed low of at most 1005 mb centered near 44N, 87.5W with the aforementioned warm front and cold front impinging much closer on the cyclone. Land/station highlights: 10 kt S and 1003 mb at

00Z at Muskegon, MI (43.2N, 86.3W) (micro); 20 kt SSE and 1008 mb at 00Z at Fort Wayne, IN (micro).

An area of lower than normal pressure persisted over Central America and southern Mexico for several days from the 25<sup>th</sup> to the 30<sup>th</sup> of September. The tropical wave associated with 1949 Storm 9 (now Storm 10), which moved westward from the Caribbean Sea into Central America on the 25<sup>th</sup> and 26<sup>th</sup> of September, likely contributed to the low pressure in the region. Also, the remnants of 1949 Storm 8 (now Storm 9) also likely contributed to the low pressure in the region. The genesis of this cyclone, 1949 Storm 10 (now Storm 11) is somewhat obscure. HURDAT lists a tropical storm forming in the eastern Pacific on the 27 September, crossing over land from early on the 28<sup>th</sup> to early on 1 October (maintaining storm strength the entire time), and emerging into the Gulf of Mexico on 1 October. There are no observed high winds or pressure gradients to confirm the existence of a tropical storm until 1 October in the southern Bay of Campeche (all available observations over a wide area were utilized from September 26-30). However, due to a lack of data, there is not enough evidence to remove the beginning portion of the track from HURDAT. The little data available suggests a closed low (at least in a broad sense) beginning on 28 September, but no strong winds are observed between the 27<sup>th</sup> and 30<sup>th</sup>. Evidence of a closed low was much more concrete by late on the 29<sup>th</sup> and early on the 30<sup>th</sup>. Cry et al. (1959) was the first publication to include the 27<sup>th</sup> to the 30<sup>th</sup> in a track book, and this portion of the track has been included in the official Atlantic hurricane records thereafter. Tannehill (1956) does not include this portion of the track, and shows 1 October as the first day of this storm. Cry et al. does not offer an explanation as to why the track was extended back to 27 September. Although it seems unlikely for a tropical storm to maintain storm strength for 3 days over Central America and Mexico, no changes are made to the HURDAT track or intensity from genesis (27 September 06Z) through 30 September 06Z, except to make a more physically consistent initial position and first 6 hourly translational velocity. On September 30<sup>th</sup> at 12Z, a pressure of 1005 mb was observed from a station on the Pacific near the border of Guatemala and Mexico. 1005 mb yields at least 37 kt (over water exposure), but the low is over land. In addition, the low is large, broad, and slow-moving. The 40 kt in HURDAT is reduced to 35 kt from 12Z on the 30<sup>th</sup> of September until 00Z on the 1<sup>st</sup> of October. The 45 kt intensity shown in HURDAT at 06Z on the 1<sup>st</sup> of October is lowered to 35 kt as well since the low was still over land and the increase in intensity shown in HURDAT originally is likely an artifact of interpolation. The cyclone moved into the Bay of Campeche before 12Z on 1 October. A station on the Mexican coast of the Bay of Campeche recorded 20 kt S with a pressure of 1004 mb at 12Z on the 1<sup>st</sup>. This observation indicates that the HURDAT position is too far east. A peripheral pressure of 1004 mb yields a wind speed of at least 39 kt according to the Brown et al. southern pressure-wind relationship, and 40 kt is chosen for the intensity at 12Z on the 1<sup>st</sup> (45 kt originally) due to the large size and slow movement of the cyclone. The cyclone moved towards the northwest on the 1<sup>st</sup> and 2<sup>nd</sup> of October. At 06Z on the 2<sup>nd</sup>, a ship reported a pressure of 1002 mb simultaneously with 20 kt NW winds. A peripheral pressure of 1002 mb suggests at least 43 kt from the southern pressure-wind relationship. The 55 kt intensity in HURDAT is maintained at 06Z on the 2<sup>nd</sup>. A Navy reconnaissance aircraft located the center of the cyclone on radar at 2338Z of the 2<sup>nd</sup> but did not fly into

the center. The lowest pressure measured by the aircraft was 990 mb, but this value is not a central pressure. A central pressure of less than 990 mb yields an intensity of greater than 64 kt using the southern pressure-wind relationship. The HURDAT intensity of 75 kt at 00Z on the 3<sup>rd</sup> is maintained. By the 3<sup>rd</sup>, the hurricane was turning northward towards the Texas coast. On the 3<sup>rd</sup> at 1348Z, a Navy aircraft did not penetrate the center, but measured a lowest pressure of 981 mb 12 miles WNW of the eye. A central pressure of 970 mb was obtained using the Schloemer (1954) equation using values of 15 nmi for the RMW and 1009 mb for the environmental pressure. A central pressure of 970 mb equals 91 kt using the southern pressure-wind relationship for intensifying systems and 88 kt using the N of 25N relationship for intensifying systems. Due to the smaller than average RMW, 95 kt is maintained as the HURDAT intensity. A central pressure of 970 mb is added into HURDAT at 12Z on the 3<sup>rd</sup>.

The hurricane made landfall on the Texas coast just west of Freeport at 05Z on 4 October at 28.8N, 95.6W, which is slightly west-northwest of the previous interpolated HURDAT track by 2 tenths of a degree. The lowest observed pressure from a land station was 978 mb, and this observation occurred simultaneously with estimated winds of 117 kt, which were the highest measured or estimated winds during the storm. This observation of 978 mb and 117 kt estimated at 0540Z occurred on the right side of the hurricane, probably very close to or at the RMW. The highest official measured wind was 87 kt at 06Z, and this occurred simultaneously with a pressure of 982 mb, but this observation was 5 nmi east of the other observation, and thus farther outside of the RMW on the right side of the storm. The Schloemer equation was again used to obtain the central pressure assuming that the 978 mb observation was located at the RMW, and that the RMW was 15 nmi (Wiggert et al.). An environmental pressure of 1009 mb was used. This yields a central pressure of 960 mb at landfall. This central pressure is supported by Wiggert et al., which lists a delta p of 50 mb at landfall. The analyzed delta p is 49 mb, a value very close to the value published in Wiggert et al. A central pressure of 960 mb is added into HURDAT at 06Z on the 4<sup>th</sup>. This landfall central pressure, while agreeing with that derived by Wiggert et al., is substantially deeper than Connor (972 mb), Ho et al. (978 mb), and Jarrell et al. (972 mb). A central pressure of 960 mb yields an intensity of 95 kt using the Brown et al. north of 25N pressure-wind relationship and 100 kt for intensifying systems north of 25N. The climatological RMW in this case according to Vickery et al. is 20 nmi and the analyzed RMW is 15 nmi. The size and the speed of the storm are close to average. 100 kt is chosen for the landfall intensity. Although this is a reduction in the HURDAT winds from 115 kt, this is an increase in the Saffir-Simpson category from a Category 2 to a Category 3 for Texas on the U.S. landfalling hurricanes list. The category 2 impact for north Texas is changed to a category 3, and a category 1 impact is added into HURDAT for central Texas. Although no changes were made to the HURDAT intensity on the 2<sup>nd</sup> and 3<sup>rd</sup> of October, 100 kt is analyzed at 00Z and 06Z on the 4<sup>th</sup> (down from 110 kt and 115 kt respectively). Runs of the Kaplan and DeMaria (1995) Inland Decay Model yield 60 kt for 12Z on the 4<sup>th</sup>, 43 kt for 18Z, and 34 kt for 00Z on the 5<sup>th</sup>. Highest observed winds within 2 hr of the synoptic times were 40 kt around 12Z on the 4<sup>th</sup>, 30 kt around 18Z, and 25 kt around 00Z on the 5<sup>th</sup>. Revised winds in HURDAT are 60 kt at 12Z on the 4<sup>th</sup> (no change), 45 kt at 18Z (down from 55 kt originally), and 35 kt at 00Z on the 5<sup>th</sup> (down from 50 kt originally). By 12Z on the 5<sup>th</sup>, a

25 kt intensity is analyzed (down from 40 kt originally). After landfall, the cyclone turned towards the north-northeast and traveled through eastern Texas, Arkansas, southeastern Missouri, and Illinois as it weakened. From 12Z on the 4<sup>th</sup> to 18Z on the 5<sup>th</sup>, a track slightly to the left of the HURDAT track is analyzed. By 18Z on the 6<sup>th</sup>, with the cyclone centered near Chicago (and still closed), the low is analyzed to have become extratropical as it was entering an environment with colder air being advected from the north. HURDAT previously ended this system as a tropical depression at this point (18Z on the 6<sup>th</sup>). There is evidence that the low is still closed at 00Z on the 7<sup>th</sup>, and one extra point is added into HURDAT as an extratropical low before the cyclone is absorbed by a front shortly after 00Z on the 7<sup>th</sup>.

#### 1949 Storm 12 (new to HURDAT)

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34645 10/02/1949 M= 6 12 SNBR= 770 NOT NAMED XING=0
34646 10/02* 0 0 0 0* 0 0 0 0* 0 0 0 0*240 568 35 0*
34647 10/03*250 568 35 0*259 567 35 0*265 565 40 0*268 563 40 0*
34648 10/04*268 561 45 0*269 558 45 0*272 550 50 0*280 536 50 0*
34649 10/05*288 518 50 0*297 498 50 0*305 480 50 0*308 465 50 0*
34649 10/06*310 455 45 0*315 444 45 0*320 430 45 0*325 416 40 0*
34649 10/07*330 402 40 0*335 388 35 0E340 370 35 0E348 345 30 0*
34649 TS

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HWM, COADS, the MWR tracks of lows, and NHC microfilm of synoptic weather maps indicate that a tropical storm, previously undocumented in HURDAT, occurred from 2 October to 8 October in the central Atlantic.

#### September 28:

HWM analyzes a trough with a wave axis from 5N, 39W to 16N, 41W. HURDAT did not previously list this system. No gales or low pressures.

#### September 29:

HWM analyzes a trough with a wave axis from 5N, 45W to 17N, 46W. No gales or low pressures.

#### September 30:

HWM analyzes a broad, closed low of at most 1010 mb centered in the general vicinity of 18N, 45W with a trough axis extending from the low southward to 10N, 45W. No gales or low pressures.

#### October 1:

HWM analyzes a broad, closed low of at most 1010 mb centered in the general vicinity of 22N, 53W with a trough axis extending from the low southward to south of 12N, 55W. Ship highlights: 40 kt NE and 1012 mb at 26.3N, 53.4W (micro).

#### October 2:

HWM analyzes a closed low of at most 1010 mb centered near 23.2N, 55.7W with a trough axis extending from the low south-southwestward to beyond 13N, 60W. Ship

highlights: 30 kt SE and 1007 mb at 18Z at 25.7N, 56.0W (COA, micro); 30 kt S and 1008 mb at 18Z at 24.2N, 55.4W (COA).

October 3:

HWM analyzes a closed low of at most 1005 mb centered near 26.0N, 57.0W with a warm front extending from the low east-northeastward to 29N, 51W, and a trough extending from 25N, 59W to south of 13N, 64W. Microfilm analyzes a closed low of at most 1005 mb centered near 26.7N, 56.3W at 12Z. Ship highlights: 35 kt S and 1007 mb at 12Z at 26.2N, 55.7W (COA, micro, HWM).

October 4:

HWM analyzes a closed low of at most 1010 mb centered near 27.2N, 56.8W with a stationary front extending from the low eastward to 31N, 34W, and a trough extending from 25N, 60W to 16N, 70W. Ship highlights: 50 kt NE and 1014 mb at 18Z at 30.2N, 54.1W (COA, micro). From an Air Force flight... "1215 E (1715Z) Hurep Duck Four-Max winds near center of 45 knots. Center located 27.3N, 60.6W. Center estimated 60 miles diameter. Moderate turbulence and rain encountered NW quadrant and NE quadrant. Winds of 40 knots extend 100 miles from center and to 60 northwest [quadrant]" (micro). [The Air Force investigation was significantly west of the analyzed position, so the above commentary probably does not pertain to this new tropical storm.]

October 5:

HWM analyzes a closed low of at most 1010 mb centered near 30.9N, 48.2W with the intersection of a warm front and a cold front located at the low. The warm front extends from the low eastward to 30N, 36W and the cold front extends from the low southward and then westward to 29N, 51W to 29N 55W. Ship highlights: 45 kt WSW and 1008 mb at 12Z at 30.2N, 48.0W (HWM).

October 6:

HWM analyzes a closed low of at most 1015 mb centered near 30.0N, 41.0W, with a warm front extending eastward from the low to 31N, 34W, and a cold front extending southward from the low and then westward to 26N, 46W to 26N, 52W. Ship highlights: 35 kt SSW and 1012 mb at 00Z at 29.9N, 43.9W (COA); 35 kt SW and 1011 mb at 06Z at 29.7N, 44.1W (COA).

October 7:

HWM analyzes a closed low of at most 1010 mb centered near 33.9N, 37.5W with an occluded front extending from the low to a triple point at 34N, 37W. A warm front extends from this triple point east-southeastward to 31N, 26W, and a cold front extends from the triple point to 33N, 36W to 30N, 36W to 27N, 40W to 26N, 43W. No gales or low pressures.

October 8:

HWM no longer analyzes a closed low with this system, but the area of partial cyclonic turning and lowest pressure associated with the remnants of this system may have been located near 41N, 24.5W. An occluded front extends from this point southeastward to

and then southward to a triple point near 34N, 27W. A dissipating warm front extends southeastward from the triple point to 31N, 25W. A cold front extends from the triple point southwestward to 29N, 32W. A larger, deeper extratropical cyclone of at most 995 mb is analyzed by HWM to be centered near 43.5N, 37W. No gales or low pressures.

A tropical storm, new to HURDAT, is analyzed to have formed around 12Z on 2 October with an 18Z position on the 2<sup>nd</sup> at 24.0N, 56.8W and a 35 kt intensity. HWM indicates that this storm originated from an easterly wave, first plotted by HWM on 28 September along 40W. On the 28<sup>th</sup> and 29<sup>th</sup>, there are no observed gales, low pressures, or west winds south of where a center might be. On the 30<sup>th</sup>, as the wave continued towards the west, there were still no observed gales or low pressures, but a southwest wind of 15 kt and 1014 mb was observed at 19.7N, 49W. This single observation alone is not enough to indicate genesis on the 30<sup>th</sup> of September. On 1 October, a broad low started to form, and the first 40 kt gale was observed. However, there was not yet evidence of a complete or compact circulation. On 2 October, pressures as low as 1007 mb were observed with 30 kt winds. Three important ship observations at 18Z on the 2<sup>nd</sup> give enough evidence of the existence of a tropical storm by that time. A south wind of 30 kt with a 1008 mb pressure (east of the center), an east wind of 30 kt with a 1007 mb pressure (north of the center), and a north wind of 15 kt with a 1009 mb pressure (west of the center) are enough to start this tropical storm at 12Z on the 2<sup>nd</sup>. There were no observed gales or winds with a westerly component on the 2<sup>nd</sup>. However, the system is analyzed to be closed and compact enough to be considered a tropical cyclone at 18Z 2 October as a 35 kt tropical storm. The temperatures of the three aforementioned observations were all between 78-81 degrees. On 3 October, the cyclone moved northward. On the 3<sup>rd</sup> at 12Z, a 35 kt south wind with a 1007 mb pressure from a ship east of the center was an important observation for determining the position of the storm on that day. The position on the 3<sup>rd</sup> at 12Z is analyzed at 26.5N, 56.5W with a 40 kt intensity. On the 4<sup>th</sup>, the forward speed of the storm increased, and the cyclone turned to the northeast. On the 4<sup>th</sup> between 15Z to 18Z, the Air Force flew between 27-31N, 60-64W and provided observations with estimated surface winds speeds as high as 45 kt. However, the analyzed position of this tropical storm at the time of the flight is near 53W (about 7 degrees east of the furthest east position that the aircraft surveyed). Therefore, the aircraft commentary is not taken into account as being relevant to the analysis of this tropical cyclone. All of the plotted aircraft wind observations were easterly and there were no observed pressures below 1010 mb in that area. The highest observed wind during the lifetime of this storm was 50 kt from the east-northeast at 18Z on the 4<sup>th</sup> (from a ship), and this observation occurred 150 to 175 nmi north of the analyzed center at that time with a pressure of 1014 mb. At 12Z on the 5<sup>th</sup>, a different ship observed a 45 kt WSW wind with a 1008 mb pressure (18 hours after the 50 kt wind was observed). The center of the storm at 12Z on the 5<sup>th</sup> is analyzed to be about 50 nmi north of that observation. A 50 kt intensity is analyzed on the 4<sup>th</sup> and 5<sup>th</sup>, and this is the peak analyzed intensity for this tropical cyclone. The analyzed position at 12Z on the 5<sup>th</sup> is 30.5N, 48W. On the 5<sup>th</sup>, the storm moved eastward for a short while before resuming a course towards the northeast on the 6<sup>th</sup>. The last observed gale directly associated with this tropical storm occurred at 06Z on 6 October – a 35 kt wind from the southwest with a 1011 mb pressure. A 45 kt intensity is analyzed on the 6<sup>th</sup> with a 06Z position in the vicinity of

31.5N, 44.4W. It is analyzed that the cyclone became extratropical by 12Z on the 7<sup>th</sup> due to the presence of a temperature gradient across the cyclone. The analyzed position at 12Z on the 7<sup>th</sup> is 34N, 37W. The system is estimated to have weakened to 35 kt by 12Z on the 7<sup>th</sup> since observed winds on the 7<sup>th</sup> were substantially weaker (although there were no observations near the center closer than the 1011 mb isobar at 12Z). 12Z on the 7<sup>th</sup> is the last time that there is still evidence of a closed low for this system. The last point is analyzed at 18Z on 7<sup>th</sup> as a 30 kt extratropical low. The low dissipated before 00Z on the 8<sup>th</sup>.

### 1949 Storm 13 (originally Storm 11)

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34645 10/12/1949 M= 8 11 SNBR= 769 NOT NAMED XING=0
34645 10/12/1949 M=10 13 SNBR= 771 NOT NAMED XING=0
      ** **          ***

34650 10/12*  0  0  0  0*  0  0  0  0*181 786 35  0*189 769 35  0*
34650 10/12*  0  0  0  0*  0  0  0  0*183 789 25  0*191 769 30  0*
      *** **          *** **

34655 10/13*198 756 35  0*206 745 40  0*215 738 45  0*222 733 50  0*
34655 10/13*198 754 30  0*206 747 30  0*215 741 30  0*222 735 35  0*
      *** **          *** **

34660 10/14*229 728 55  0*235 723 60  0*242 719 65  0*250 714 70  0*
34660 10/14*229 729 40  0*235 724 50  0*242 719 60  0*250 714 65  995*
      *** **          *** **

34665 10/15*259 710 75  0*268 705 75  0*276 700 80  0*289 694 85  0*
34665 10/15*259 710 70  0*268 705 75  0*276 700 80  0*292 696 80  0*
      **          *** **

34670 10/16*306 688 85  0*324 683 90  0*341 677 90  0*350 665 85  0*
34670 10/16*309 692 80  0*326 687 80  0*345 680 80  981*355 669 75  0*
      *** **          *** **

34675 10/17*357 655 65  0*363 645 60  0*369 636 55  0*373 629 55  0*
34675 10/17*359 658 65  0*363 647 60  0*367 636 55  0*371 629 55  0*
      *** **          ***

34680 10/18*378 625 50  0E385 622 50  0E393 620 50  0E400 621 45  0*
34680 10/18*372 627 55  0*373 626 55  0*378 625 55  0*389 625 55  0*
      *** **          **** **

34685 10/19E407 622 45  0E415 622 45  0E421 619 45  0E436 596 45  0*
34685 10/19*400 624 50  0E412 622 50  0E421 619 50  0E430 610 50  0*
      **** **          **

(The 20th and 21st are new to HURDAT.)
34686 10/20E430 600 45  0E425 602 40  0E415 608 35  0E417 605 35  0*
34689 10/21E425 590 35  0E435 560 35  0E447 510 35  0E450 450 35  0*

34690 HR

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Minor changes to both track and intensity are analyzed for this hurricane. Major changes were made to both the timing of extratropical transition and the timing of dissipation. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, the U.S. Weather Bureau operational advisories, and Perez et al. (2000).

October 12:

HWM analyzes a spot low (not closed) near 18.3N, 78.7W. HURDAT lists this as a 35 kt tropical storm at 18.1N, 78.6W. Microfilm analyzes a broad, closed low of at most 1008 mb centered in the general vicinity of 19.0N, 79.8W. No gales or low pressures. "Disturbed conditions were observed in the western Caribbean Sea on October 11 and 12, and these moved over extreme western Cuba during the night of the 12<sup>th</sup> without any evidence of a center" (MWR).

October 13:

HWM analyzes a spot low (not closed) near 21.6N, 74.4W. HURDAT lists this as a 45 kt tropical storm at 21.5N, 73.8W. The MWR tracks of centers of cyclones first shows a position at 18Z near 22.0N, 73.6W. The MWR post-season track map shows 00Z and 12Z positions near the HURDAT positions. Microfilm analyzes a closed low of at most 1008 mb centered near 22.0N, 74.8W, another closed low of at most 1008 mb center near 23.7N, 79.3W and a third closed low of at most 1009.5 mb centered near 27.1N, 72.8W. No gales or low pressures. "But on October 13 a closed circulation began forming over the extreme southeastern Bahamas in the vicinity of Great Inagua and Mayaguana. The strongest winds at this time were only 30-35 mph" (MWR). "Sin Nombre, 1949, Octubre 13, tormentas tropicales" (Perez et al. 2000).

October 14:

HWM analyzes a closed low of at most 1005 mb centered near 24.2N, 72.2W. HURDAT lists this as a 65 kt hurricane at 24.2N, 71.9W. The MWR tracks of centers of cyclones shows a 00Z position near 22.9N, 73.2W and a 12Z position near 24.1N, 72.9W with a 1005 mb pressure. The MWR post-season track map shows a 00Z position near 22.9N, 72.6W and a 12Z position near 24.3N, 71.6W. Microfilm analyzes a low of at most 999 mb centered near 24.9N, 71.8W. Aircraft highlights: 35 kt SSE (fl 40 kt S at 1300 feet) and 1006 mb at 14Z at 25.2N, 70.7W (micro); loran center fix at 1547Z at 24.8N, 71.3W with 75 kt max winds (sfc or fl?) with gust to 80 kt and 995 mb lowest pressure (probably central pressure or close to central pressure since it appeared they flew all the way in) (micro); 50 kt ESE (60 kt ENE at fl of 600 feet) and 999 mb at 21Z at 25.1N, 71.5W (micro); center fix at 2115Z at 24.9N, 71.4W (position not as accurate as 1547Z center fix) with 70 kt (+?) max winds and lowest pressure encountered 998 mb to NE of center (micro); 65 kt ESE (sfc or fl?) and 1000 mb at 2145Z at 25.4N, 71.2W (micro). Two other gales between 35-45 kt and four other low pressures between 1003-1005 mb. "Passed through weak squall line 1435Z; wind decreased slowly and shifted to 90 degrees at 8 kts. Passed through weak squall line 1441Z; wind shifted to 350 degrees at 12 kts. Pressure rose 1 mb across squalls. Mostly clear skies ahead. No center located at recon position. Turning SE" (micro). "From Navy Recon: Passed through storm 1547Z. Loran position 24.8N, 71.3W. Lowest pressure 995 mbs. Wind shifted NW 45 kts through S to SE. Max wind 120 degrees 75 kts with gusts to 80 kts on east side. No center located on radar. Climbed to 5,000 feet for radar search. No eye formed... Complete circulation found. Wind 45 kts 60 miles from center eastern semicircle" (micro). "Approximate position of storm at 2115Z at 24.9N, 71.4W moving north. Max winds 70 (plus?) knots. Storm small in area. Lowest pressure (encountered) 998.3 mb to NE" (micro). "This center moved in a north-northeast direction and increased in

intensity, and at noon of October 14 aircraft reconnaissance indicated a very small center of hurricane force” (MWR).

#### October 15:

HWM analyzes a closed low of at most 1005 mb centered near 27.3N, 70.1W with a mid-latitude trough/frontal system approaching from the northwest. HURDAT lists this as an 80 kt hurricane at 27.6N, 70.0W. The MWR tracks of centers of cyclones shows a 00Z position near 25.4N, 71.4W and a 12Z position near 26.9N, 70.0W with a 1004 mb pressure. The MWR post-season track map shows a 00Z position near 26.1N, 70.7W and a 12Z position near 27.9N, 69.8W. Microfilm shows a low of at most 996 mb centered near 27.7N, 69.3W. Ship highlights: 30 kt NE and 999 mb at 18Z at 29.7N, 70.3W (COA, micro); 40 kt SSW and 1000 mb at 2130Z at 29.7N, 69.1W (micro). One other low pressure of 1003 mb. Aircraft highlights: Navy radar center fix at 1545Z at 27.6N, 68.4W (position uncertain) with 75 kt max flight level winds around 500 feet (micro); center fix at 22Z at 31.1N, 69.4W with 80 kt estimated winds and 997 mb lowest pressure (may be a central pressure or close to a central pressure) (micro). Four other gales of 35-45 kt and one other low pressure of 1005 mb. “Navy at 1545Z: Radar fix center of hook-shaped center 27.6N, 68.4W. South and southwest sides clear. Max wind 75 knots. Hurricane force 40 miles SE and 25 miles NE, and 35 miles NW of center of ‘hook’” (micro). “Many errors in ship reports in the Atlantic hurricane area- also recon reports in error. Coordinates given in this advisory (#9 issued at 1630Z the 15<sup>th</sup>) evidently in error by a degree or more in light of later reports from ships” (micro). “Aircraft at 1515Z: 27.1N, 67.8W (location of aircraft). Wind S 65 knots (at the surface wind S force 9), gusts to 74 knots” (micro). “SS Puerto Rico at 1530Z: force 6 east, barometer 1005.8 and falling with rain squalls (30.2N, 70.5W)” (micro). “Hurep duck 10 eight: storm area located at 2200Z to be 31.1N, 69.4W. Large dome-shaped cloud to NW with tops extending to 20,000 feet and covering over 120 degrees of horizon. CS clouds at 25,000 feet. Estimated winds 80 knots. Ceiling 500 feet or less. Lowest pressure 996.8 mb” (micro).

#### October 16:

HWM analyzes a closed low of at most 1005 mb centered near 33.9N, 68.4W with a NE-SW frontal system now very close to the low and approaching from the northwest. HURDAT lists this as a 90 kt hurricane at 34.1N, 67.7W. The MWR tracks of centers of cyclones shows a 00Z position near 30.5N, 69.1W and a 12Z position near 34.0N, 67.9W with a 1003 mb pressure. The MWR post-season track map shows a 00Z position near 30.9N, 68.9W and a 12Z position near 34.3N, 67.4W. Microfilm analyzes a hurricane of at most 996 mb centered near 34.6N, 67.6W with a NE-SW frontal system very near the low, extending from east-northeast of 41N, 60W to 39N, 68W to 38N, 70W to 34N, 73W to southwest of 30N, 75W. Ship highlights: 35-45 kt W-WNW and 999-1000 mb at 00Z at 30.5-30.6N, 69.5W (micro, COA); 55 kt SW and 994 mb at 21Z near ~35.0N, 66.2W (micro). Four other gales between 35-45 kt and four other low pressures between 998-1005 mb. Aircraft highlights: navy radar center fix at 0835Z at 33.2N, 68.5W (position uncertain) (micro); center fix at 1345Z at 34.6N, 67.8W with 84 kt measured winds, 100 kt estimated max winds, and 993 mb lowest pressure encountered 5 miles from the edge of the eye (micro). Four other gales and two other low pressures of 1005 mb. “Ship

Brazil- 0300Z: ship position latitude 31.3N, longitude 69.9W; baro 100; NW – force 8; temp 77; overcast and squalls” (micro). “Navy radar plane 0835Z: Storm penetration vague and indefinite. Possible eye 30 miles in diameter. Changing to indefinite possible location 33.2N, 68.5W. Much weather extends SE 60 to 70 miles. Believe storm weathering. What suggestions? No indications in 0600Z predicted position” (micro). “Duck 2: Penetrated to within 5 miles of eye. Highest winds 100 knots. Duck 3: Position of storm 34.6N, 67.8W. Post flight report: position at 1345Z at 34.6N, 67.8W. Strongest measured wind 84 knots 5 miles east of inside edge of eye. Lowest pressure (encountered) 992.6 mb. Diameter of eye 30 miles. Moving NNE at 15 knots” (micro). [The RMW at 1345Z is 18 to 20 miles ~ 16 to 18 nmi]. “The north-northeastward movement carried the center some 200 miles west of Bermuda by October 16” (MWR). “The strongest winds were estimated at 80 to 90 mph over most of the path [of the lifetime of this cyclone] but reached 100 mph about the time it reached latitude 35N on October 16. No damage was reported as the strong winds occurred over the ocean” (MWR).

October 17:

HWM analyzes a closed low of at most 1010 mb centered near 36.0N, 63.2W with another low of at most 1015 mb centered near 33N, 72W with a stationary front extending from the 2<sup>nd</sup> low to 36N, 70W to 38N, 66W to east of 38N, 50W. HURDAT lists this as a 55 kt tropical storm at 36.9N, 63.6W. The MWR tracks of centers of cyclones shows a 00Z position near 36.1N, 65.7W and a 12Z position near 37.1N, 63.8W with a 1007 mb pressure. The MWR post-season track map shows a 00Z position near 36.5N, 65.3W and a 12Z position near the HURDAT position. Microfilm analyzes a tropical storm of at most 1001 mb centered near 37.3N, 62.4W with the west end of a front plotted near 36N, 58W extending eastward and the northeast end of another front plotted near 39N, 66W extending southwestward to beyond 36N, 71W. Ship highlights: 45 kt NE and 1001 mb at 12Z at 36.5N, 63.7W (micro); 45 kt NE and 1004 mb at 15Z at 38.2N, 63.1W (micro). One other gale of 35 kt. Aircraft highlights: Navy radar center fix at 0325Z at 36.1N, 65.3W (micro). “From Navy radar plane: radar fix places eye at 37.0N, 64.2W. Inner edge of outer wall extends 30 miles all directions. At 36.1N, 65.3W another area presented picture similar to storm. Believe associated weather now as we closed to 40 miles and are getting southerly winds. Squalls exist between two areas. Second radar report: Radar fix near first report on eye. Eye now 36.8N, 65.3W now believed to be storm. Other indication is two separate squalls oriented NE-SW. No signs of orientation. Fix accurate within 10 miles. Departing area for base at 0235Z. Third report radar fix eye well-defined 36.1N, 65.3W. Diameter of eye 20 (or 30?) miles. Outer squall 40 miles west of eye oriented NE-SW. Mild turbulence- 0325Z” (micro). “When several hundred miles north of Bermuda, it was blocked by high pressure and moved very slowly during the following 2 days” (MWR).

October 18:

HWM analyzes a closed low of at most 1005 mb centered near 37.9N, 63.5W with a stationary front extending east-southeastward from the low to 35N, 56W. HWM analyzes another low of at most 1010 mb centered near 37N, 72W with an occluded front extending from the low to a triple point near 37N, 70W. A warm front extends from the

triple point east-southeastward to 36N, 65W and a cold front extends from the triple point to 35N, 68W to 30N, 68W to southwest of 27N, 70W. HURDAT lists this as a 50 kt extratropical storm at 39.3N, 62.0W. The MWR tracks of centers of cyclones shows a 00Z position near 37.8N, 62.6W and a 12Z position near 38.3N, 61.7W with a 990 mb pressure. The MWR post-season track map shows a 00Z position near 37.8N, 62.0W and a 12Z position near 39.0N, 61.2W. Microfilm analyzes a closed low of at most 1005 mb centered near 38.3N, 63.0. Microfilm analyzes another low of at most 1011 mb centered near 37.5N, 72.0W with an occluded front extending from 38N, 73W to a triple point near 37N, 71W. A warm front extends from this triple point to 38N, 66W and a cold front extends from this triple point southward to 31N, 70W. Ship highlights: 50 kt N and 1001 mb at 18Z at 38.8N, 63.1W (micro); 20 kt WSW and 1000 mb at 18Z at 38.6N, 62.3W (micro). Four other gales of 35 kt and two other low pressures between 1004-1005 mb.

October 19:

HWM analyzes a closed low of at most 990 mb centered near 42.5N, 61.9W. The closest front is the north end of a cold front plotted near 40N, 60W which extends southward and southwestward. A warm front is plotted from 38N, 56W extending southeastward to beyond 33N, 53W. The west end of another front is plotted near 45N, 54W extending eastward. Another low of at most 1010 mb is centered near 37.5N, 69W. HURDAT lists this as a 45 kt extratropical storm at 42.1N, 61.9W. The MWR tracks of centers of cyclones shows a 00Z position near 39.8N, 61.5W and a 12Z position near 41.3N, 60.7W with a 980 mb pressure. The MWR post-season track map shows a 00Z position near 40.0N, 61.6W and a 12Z position near 42.9N, 61.2W. Microfilm analyzes a closed low of at most 996 mb centered near 42.3N, 61.7W with another low/frontal system to the southwest of the feature of interest. Ship highlights: 50 kt SE and 988 mb at 12Z at 42.7N, 61.4W (HWM, micro); at least 35 kt NW and 993 mb at 12Z near ~42.0N, ~63.5W (HWM); 45 kt and 1005 mb at 18Z at 42.9N, 63.5W (COA). Two other gales of 40 kt and five other low pressures between 1004-1005 mb. The storm was located "a short distance south of Sable Island on October 19. During this time it took on extra-tropical character and began to spread out and dissipate" (MWR).

October 20:

HWM analyzes a closed low of at most 1005 mb centered near 41.1N, 59.0W with an occluded front extending from the low wrapping around to 42.5N, 57W to 42N, 55W to 40N, 53W to a triple point near 37N, 53W. A warm front extends from this triple point southeastward to southeast of 34N, 49W and a cold front extends from the triple point southwestward to beyond 28N, 65W. The northeast end of another NE-SW cold front is plotted near 36N, 65W extending southwestward to southwest of 31N, 74W. The west end of a west-east stationary front is plotted near 42N, 48W extending eastward to east of 42N, 37W. HURDAT no longer lists this system. The MWR tracks of centers of cyclones shows a 00Z position near 43.2N, 59.3W and a 12Z position near 42.9N, 61.2W with a 998 mb pressure. Ship highlights: 15 kt WNW and 1003 mb at 18Z at 40.0N, 63.7W. Five other low pressures between 1004-1005 mb.

October 21:

HWM analyzes a closed low of at most 1000 mb centered near 40.0N, 60.8W with an occluded front extending east-northeastward from the low to 44N, 47W and a cold front extending from the low through another low at 29N, 68W. The MWR tracks of centers of cyclones shows a 00Z position near 41.8N, 57.2W and a 12Z position near 44.3N, 49.8W with a 1007 mb pressure. Ship highlights: 35 kt NNE and 1012 mb at 12Z at 45.6N, 50.5W (COA); 15 kt SW and 1000 mb at 18Z at 37.3N, 43.3W (COA). About six other low pressures between 1001-1005 mb.

October 22:

HWM analyzes a closed low of at most 1005 mb centered near 43.2N, 47.5W with a stationary front extending from the low to 45N, 33W, a cold front extending from the low to southwest of 32N, 60W, and a dissipating occluded front extending from the low southwestward to 40N, 58W. The stationary front that extends east of the low turns into a cold front which connects to another closed low of at most 1010 mb near 48N, 25W. This low also contains a warm front that extends from this low east-southeastward to beyond 47N, 16W. The MWR tracks of centers of cyclones shows a 00Z position near 46.0N, 37.8W and a 12Z position near 45.0N, 30.3W with a 1006 mb pressure. Highlights: Not applicable.

October 23:

HWM analyzes a closed low of at most 995 mb centered near 43.6N, 35.6W with a dissipating occluded front extending from the low southwestward to 43N, 40W, a warm front extending eastward from the low to 43, 24W, and a cold front extending from the low to 40N, 35W to 36N, 40W to west of 35N, 48W. The MWR tracks of centers of cyclones last shows a position at 00Z at 46.6N, 21.1W. Highlights: Not applicable.

An area of low pressure in the northwestern Caribbean Sea attained a closed circulation around 12Z on 12 October near 18N, 79W. HURDAT started this as a 35 kt tropical storm at that time. No change is made to the timing of genesis, but the intensity at 12Z on the 12<sup>th</sup> is revised down to 25 kt. The cyclone traveled northeastward and made landfall in eastern Cuba around 00Z on the 13<sup>th</sup>. The center was over land for nearly the next 6 hours. HURDAT shows an intensity increase during the time when the cyclone was over Cuba. It is analyzed that the intensity at landfall in Cuba was 30 kt (35 kt originally at 00Z on the 13<sup>th</sup>) and at 06Z on the 13<sup>th</sup>, when the cyclone had just reemerged over water, the analyzed intensity is still 30 kt (40 kt originally). Perez et al. (2000) calls this cyclone a tropical storm for Cuba. Sufficient spatial coverage of observations late on the 12<sup>th</sup> and early on the 13<sup>th</sup> indicate that the depression was not of tropical storm intensity. An intensity of 30 kt is held at 12Z on the 13<sup>th</sup> (revised down from 45 kt) as the winds surrounding the circulation (between 21-23N, 78-81W) were all 10-15 kt. At 18Z on the 13<sup>th</sup>, a 30 kt wind was observed as well as two pressure readings below 1007 mb so the intensity is raised to 35 kt at 18Z on the 13<sup>th</sup> (down from 50 kt). The reanalysis therefore shows this cyclone becoming a tropical storm 30 hours later than originally shown. At this time, the tropical cyclone was passing through the Bahamas on a continued northeast course. Aircraft on the 14<sup>th</sup> fixed the center twice (at 1547Z and 2115Z). At 1547Z, the aircraft recorded a central pressure of 995 mb. This value is added into HURDAT for 18Z on the 14<sup>th</sup>. A central pressure of 995 mb yields an

intensity of 56 kt using the Brown et al. southern pressure-wind relationship for intensifying systems and 54 kt using the north of 25N relationship. On the same day, aircraft reported that the storm was small in area. The aircraft at 1547Z reported max winds of 75 kt and the flight at 2115Z reported max winds of 70 kt and no central pressure. 60 kt is chosen for 12Z on the 14<sup>th</sup> and 65 kt is chosen for 18Z (a decrease of 5 kt from HURDAT at both times). Therefore, it is analyzed that this cyclone became a hurricane 6 hours later than originally. Of note is that the first time a ship reported a gale with this cyclone was the 15<sup>th</sup> at 2130Z. Track changes on the 14<sup>th</sup> through the 17<sup>th</sup> were mostly less than half of a degree. On the 15<sup>th</sup> and 16<sup>th</sup> the hurricane passed well to the west of Bermuda moving north-northeastward. There were two flights on the 15<sup>th</sup>, and center fixes were obtained at 1545Z and at 2200Z. Maximum winds on each flight were estimated at 75 kt and 80 kt respectively. The later flight encountered a lowest pressure of 997 mb, but neither flight reported central pressures. It is analyzed that the hurricane strengthened to 80 kt by 12Z on the 15<sup>th</sup> (no change to HURDAT). On the 16<sup>th</sup> at 1345Z, an aircraft located the center at 34.6N, 67.8W. The center was not penetrated; the lowest pressure encountered was 993 mb. It is known that the aircraft penetrated to within five miles of either the RMW or the eye's edge, so it is assumed that the 993 mb was measured at the time of closest penetration to the center since it is clear the 993 mb was the minimum pressure encountered by the aircraft. From the aircraft information, it is estimated that the RMW was about 16 to 18 nautical miles. The Schloemer equation (Schloemer 1954) was used to calculate the central pressure. In this case, there were two different scenarios since the aircraft message was unclear about whether the aircraft was 5 miles outside the RMW or whether it was at the RMW and 5 miles outside the eye. The equation yields central pressure values of 985 mb if the plane was at the RMW and 981 mb if the plane was 5 miles outside the RMW at 1345Z on the 16<sup>th</sup>. Using the lower central pressure value of 981 mb to attain a wind speed from the pressure-wind relationship yields a wind speed of 71 kt using the Brown et al. north of 25N relationship. This is well below the 90 kt listed in HURDAT at 12Z on the 16<sup>th</sup>. Another factor to consider is that the aircraft reported highest measured (flight level) winds of 84 kt, and estimated maximum surface winds of 100 kt. 80 kt is chosen for 12Z and 18Z on the 16<sup>th</sup> as a compromise of the data, but leaning more heavily towards the central pressure value of 981 mb. The analyzed central pressure value of 981 mb is added into HURDAT for 12Z on the 16<sup>th</sup>. Therefore, the peak intensity of this hurricane is analyzed as 80 kt from 12Z on the 15<sup>th</sup> to 18Z on the 16<sup>th</sup> (originally 90 kt from 06Z on the 16<sup>th</sup> to 12Z on the 16<sup>th</sup>). The hurricane weakened to a tropical storm on the 17<sup>th</sup> as it moved northeastward between Bermuda and Nova Scotia. On the 17<sup>th</sup> at 12Z, a 1001 mb peripheral pressure was observed simultaneously with 45 kt winds. A peripheral pressure of 1001 mb yields an intensity of greater than 47 kt using the north of 35N pressure-wind relationship. The HURDAT intensity of 55 kt for 12Z the 17<sup>th</sup> is unchanged. Later on the 17<sup>th</sup>, the cyclone slowed down and turned towards the north, and it continued moving slowly towards the north on the 18<sup>th</sup> and early on the 19<sup>th</sup> to a location near 42N, 62W on the 19<sup>th</sup>. It is analyzed that the cyclone slowed down even more than shown in HURDAT, and the position at 12Z on the 18<sup>th</sup> is analyzed to be about 1.6 degrees to the SSW of the previous HURDAT position. HURDAT has this cyclone becoming extratropical at 06Z on the 18<sup>th</sup>. Available observations indicate that the cyclone maintained a small core of high winds near the center and warm temperatures surrounding the cyclone for one more day.

It is analyzed that the cyclone did not become extratropical until 06Z on the 19<sup>th</sup> (24 hours later than originally). The HURDAT intensities are increased slightly on the 18<sup>th</sup> and 19<sup>th</sup> due to ship observations of higher winds. At 12Z on the 19<sup>th</sup>, no changes are made to the HURDAT position, and HURDAT lists this cyclone at 18Z on the 19<sup>th</sup>, with a northeast motion in the final six hours. On the 20<sup>th</sup>, the cyclone combined with a separate, but much weaker cyclone [see #13 in additional notes section]. According to Eric Blake at the National Hurricane Center (personal communication), if an intense, extratropical cyclone (which was formerly a tropical cyclone) absorbs a separate, but much weaker low, the former tropical cyclone will often not be considered absorbed yet and the best track will not terminate at that time. That is what is analyzed to have occurred in this case, and HURDAT is extended for two more days through the 21<sup>st</sup>. By the 20<sup>th</sup> at 12Z, it had moved slightly southeast from its position on the 19<sup>th</sup> at 12Z. By 12Z on the 21<sup>st</sup>, it accelerated towards the east-northeast to near 44.7N, 51W with 35 kt winds. The new final point is at 18Z on the 21<sup>st</sup>.

### 1949 Storm 14 (originally Storm 12)

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34695 10/13/1949 M= 5 12 SNBR= 770 NOT NAMED XING=0
34695 10/13/1949 M= 5 14 SNBR= 772 NOT NAMED XING=0
      **          ***

34700 10/13*  0  0  0  0*218 492 35  0*221 501 35  0*225 509 35  0*
34705 10/14*229 516 35  0*233 522 40  0*240 527 40  0*251 533 45  0*
34705 10/14*229 516 35  0*233 521 40  0*240 523 40  0*252 525 45  0*
      ***          ***          *** ***

34710 10/15*263 539 50  0*275 546 50  0*288 553 50  0*304 562 50  0*
34710 10/15*268 530 50  0*281 540 50  0*291 550 50  0*302 562 50  0*
      *** ***          *** ***          *** ***          ***

34715 10/16*321 571 50  0*336 572 45  0*350 566 40  0*361 558 35  0*
34715 10/16*321 569 50  0*336 567 45  0*350 557 40  0*361 546 35  0*
      ***          ***          ***          ***

34720 10/17*371 536 30  0*378 515 25  0*  0  0  0  0*  0  0  0  0*
34720 10/17*372 531 35  0*380 512 35  0*  0  0  0  0*  0  0  0  0*
      *** *** **          *** *** **

34725 TS

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Minor track changes and minor intensity changes are analyzed for this tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, and NHC microfilm of synoptic weather maps.

#### October 12:

HWM analyzes a dissipating W-E warm front and an associated area of troughiness which extends from 27N, 52W to east of 27N, 37W. HURDAT does not yet list a system on this day. No gales or low pressures.

#### October 13:

HWM analyzes a spot low (not closed) located within an area of troughiness near 21N, 51.5W. HURDAT lists this as a 35 kt tropical storm at 22.1N, 50.1W. No gales or low pressures.

October 14:

HWM analyzes a spot low (not closed) located within an area of troughiness near 23N, 52W. HURDAT lists this as a 40 kt tropical storm at 24.0N, 52.7W. Ship highlights: 35 kt E at 23Z at 32.3N, 49.9W (COA).

October 15:

HWM analyzes a closed low of at most 1010 mb centered near 28.3N, 57.2W. HURDAT lists this as a 50 kt tropical storm at 28.8N, 55.3W. The MWR tracks of centers of cyclones shows a 00Z position near 28.3N, 53.8W and a 12Z position near 29.2N, 55.0W with a 1007 mb pressure. Microfilm analyzes a closed low of at most 1014 mb centered in the general vicinity of 28.8N, 55.3W. No gales or low pressures.

October 16:

HWM analyzes a closed low of at most 1010 mb centered near 35.0N, 56.0W. HWM analyzes storm 11 as a closed low of at most 1005 located near 33.9N, 68.4W. A NE-SW frontal system extends from 36N, 71W to 40N, 61W to 42N, 56W to northeast of 44N, 53W. HURDAT lists this as a 40 kt tropical storm at 35.0N, 56.6W. The MWR tracks of centers of cyclones shows a 00Z position near 33.1N, 57.8W and a 12Z position near 35.2N, 57.0W with a 1008 mb pressure. Microfilm analyzes a closed low of at most 1011 mb centered near 34.0N, 54.4W with a trough or frontal feature extending southward from the low to 32N, 54W to 29N, 56W. Ship highlights: 35 kt SSE and 1009 mb at 06Z at 32.5N, 53.7W (COA).

October 17:

HWM analyzes a closed low of at most 1010 mb centered near 38.9N, 47.0W now completely embedded within the frontal system which extends from just north of storm 11 near 38N, 62W eastward through the feature of interest (remnants of storm 12) northeastward to beyond 45N, 32W. HURDAT last lists this system at 06Z as a 25 kt tropical depression at 37.8N, 51.5W. The MWR tracks of centers of cyclones shows a 00Z position near 37.7N, 53.6W and a 12Z position near 38.0N, 48.5W with a 1011 mb pressure. Ship highlights: 15 kt NW and 1005 mb at 06Z at 46.1N, 38.2W (COA); 15 kt SW and 1004 mb at 06Z at 46.0N, 37.8W (COA); 35 kt S and 1019 mb at 06Z at 36.0N, 44.9W (COA); 35 kt SW and 1015 mb at 12Z at 36.1N, 46.5W (COA).

October 18:

HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 00Z position near 38.0N, 41.0W.

HURDAT shows genesis of this tropical cyclone occurring on 13 October at 06Z in the central Atlantic near 22N, 49W with an intensity of 35 kt. There were only a few available observations for much of the cyclone's lifetime, so few significant changes were made. Available observations indicate that the cyclone was slightly east of the previous HURDAT track from the 14<sup>th</sup> to dissipation on the 17<sup>th</sup>. The cyclone moved north-northwestward on the 14<sup>th</sup> and 15<sup>th</sup>, and it recurved early on the 16<sup>th</sup> near 33N, 56W. The peak intensity of 50 kt in HURDAT is maintained. The 17<sup>th</sup> is the only day

for which intensity changes are analyzed. The intensity of 35 kt at 18Z on the 16<sup>th</sup> is held at both 00Z and 06Z on the 17<sup>th</sup> due to two observations of 35 kt winds. No changes are made to the timing of dissipation (06Z on the 17<sup>th</sup>). The cyclone was absorbed by a front and was no longer closed before 12Z on the 17<sup>th</sup>. The tropical cyclone did not become extratropical before dissipation.

#### 1949 Storm 15 (new to HURDAT)

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34645 11/01/1949 M= 6 15 SNBR= 773 NOT NAMED XING=0
34646 11/01* 0 0 0 0* 0 0 0 0*260 455 35 0*250 465 40 0*
34647 11/02*241 477 40 0*233 490 40 0*225 510 45 0*218 536 45 0*
34648 11/03*212 560 45 0*208 580 45 0*205 600 45 0*208 620 45 0*
34649 11/04*215 640 40 0*224 653 35 0*235 660 35 0*250 662 30 0*
34649 11/05*267 660 30 0E290 650 30 0E318 635 30 0E360 630 30 0*
34649 10/06E415 630 30 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*
34649 TS

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HWM, COADS, the MWR tracks of lows, and NHC microfilm of synoptic weather maps indicate that a tropical storm, previously undocumented in HURDAT, occurred from 1 November to 7 November in the Atlantic Ocean. This new storm was also noted in Jack Beven's list of suspects.

#### November 1:

HWM analyzes a broad, closed low of at most 1015 mb centered in the general vicinity of 26N, 43W with a trough/wave axis extending south-southwestward from the low to 15N, 47W. An east-west stationary front is plotted along 28N, just north of the low. HURDAT did not previously list this system. Ship highlights: 30 kt NNW and 993 mb [ship pressure biased 8 to 10 mb too high] at 18Z at 24.9N, 48.5W (COA); 30 kt N and 1004 mb at 18Z at 26.2N, 48.0W (COA).

#### November 2:

HWM analyzes a closed low of at most 1010 mb centered near 23N, 52W with a trough/wave axis extending from the low southwestward to at least 16N, 56W. Microfilm analyzes a low just off the east edge of the map at 12Z. Ship highlights: 30 kt NNE and 1004 mb at 06Z at 22.5N, 53.9W (COA); 35 kt NE and 1012 mb at 12Z at 27.0N, 53.2W (COA); 15 kt N and 1002 mb at 12Z at 22.4N, 52.9W (COA); 20 kt SE and 1003 mb at 18Z at 22.0N, 51.9W (COA). Aircraft highlights: 40 kt E (50 kt E at fl of 10,900 ft) at 2030Z at 27.2N, 54.7W (micro). 35 kt E and 1008 mb at 2315Z at 23.5N, 55.2W (micro). At least 3 other aircraft gales well north of the center.

#### November 3:

HWM analyzes a closed low of at most 1000 mb centered near 23.2N, 60.0W with a trough/wave axis extending from the low south-southwestward to south of 12N, 67W. The MWR tracks of centers of cyclones shows a 12Z position near 21.9N, 60.6W with a 1000 mb pressure. Microfilm analyzes a large, broad closed low of at most 1005 mb centered in the general vicinity of 21N, 60W at 12Z. Ship highlights: 15 kt SE and 1001 mb at 03Z at 21.8N, 55.9W (micro); 30 kt ESE and 1004 mb at 15Z at 22.5N, 58.3W (micro); 35 kt SE and 1004 mb [pressure biased 3 to 4 mb too low] at 18Z at 18.9N,

57.5W (micro); 40 kt SE at 1830Z at 25.2N, 58.8W (micro). Two other gales of 35 kt and two other low pressures of 1005 mb.

November 4:

HWM analyzes a closed low of at most 1000 mb centered near 24.2N, 66.2W with a trough/wave axis extending from 22N, 66W to south-southwest of 14N, 71W. HWM also analyzes a cold front approaching the low from the west from north of 38N, 69W to 30N, 71W to 27N, 73W to 25N, 76W. The MWR tracks of centers of cyclones shows a 00Z position near 22.1N, 63.9W and a 12Z position near 23.6N, 66.1W with a 997 mb pressure. Microfilm analyzes a broad closed low of at most 1008 mb centered in the general vicinity of (but perhaps 1 degree west of) the HWM position at 12Z. Microfilm analyzes a front approaching the low extending from north-northeast of 31N, 70W to 28N, 72W to southwest of 26N, 74W. Ship highlights: 10 kt NE and 1005 mb at 12Z at 25.7N, 68.4W (COA). Aircraft highlights: 35 kt NE [may be a flight level wind] at 1252Z at 25.2N, 63.6W (micro); 30 kt SW (55 kt at flight level) and 1011 mb at 13Z at 24.9N, 64.0W (micro). From aircraft reconnaissance flight... "Lowest pressure 1008.5 millibars at 1243Z at 25.0N, 64.1W. Surface winds calm [at that location?]. Heavy squalls circle area. Max wind 050 degrees 35 knots at 1252Z at 25.2N, 63.6W. Winds backed west through south from 1225Z. Avg 12 knots" (micro).

November 5:

HWM analyzes a closed low of at most 1005 mb centered near 35.3N, 63.4W with a warm front extending from the low northeastward to 39N, 60W and a cold front extending from the low southward and then southwestward to 30N, 64W to 24N, 69W. The MWR tracks of centers of cyclones shows a 00Z position near 28.0N, 65.9W and a 12Z position near 34.2N, 63.3W with a 1005 mb pressure. Microfilm at 00Z analyzes a closed low of at most 1008 mb centered near 31.5N, 65.1W with an approaching front located only about 100 nmi west of the low. Ship highlights: 15 kt SE and 1006 mb at 06Z at 31.3N, 63.7W (COA).

A broad, area of low pressure was first noted in the central Atlantic on 1 November near 26N, 45W. It moved west-southwestward on the 1<sup>st</sup> and 2<sup>nd</sup>, westward on the 3<sup>rd</sup> (20.5N, 60W), and turned northward on the 4<sup>th</sup> (23.5N, 66W). On the 1<sup>st</sup>, the wind structure was slightly asymmetric on the northeast side of the cyclone, but from the 2<sup>nd</sup> to the 4<sup>th</sup>, the cyclone was clearly symmetric and non-frontal. It is important to note that this cyclone never contained a significant temperature gradient across the low from 1 November to 4 November. This cyclone is analyzed to be a tropical cyclone from 12Z on 1 November to 00Z on 5 November, and it is therefore added into HURDAT. On the 1<sup>st</sup>, there were only three relevant observations of winds with a westerly component south of the center. However, a time series of a ship from 06Z on 1 November to 12Z on 2 November reveals that the ship experienced a pressure drop of 12 mb during a 12 hour period followed by a pressure rise of 14 mb over the next 18 hours. This ship is analyzed to contain a low pressure bias of 8 to 10 mb. The minimum pressure recorded by the ship was 993 mb (likely to actually be 1001-1003 mb) at 18Z on the 1<sup>st</sup> with a 30 kt NNW wind. By 00Z on the 2<sup>nd</sup>, the wind shifted to 30 kt ENE and the pressure rose 4 mb. Unfortunately, the 6 hour time resolution of the observations from this ship may have prevented an



34745 11/05\*145 836 25 0\* 0 0 0 0\* 0 0 0 0\* 0 0 0 0\*  
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 34750 TS

Minor changes to both track and intensity are analyzed for this tropical storm that made landfall in Honduras. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, and the U.S. Weather Bureau Operational Advisories.

#### November 2:

HWM analyzes a closed low along a dissipating front of at most 1010 mb centered near 17.2N, 80.9W. HURDAT does not yet list a system on this day. Microfilm does not yet analyze a closed low, but it analyzes a sharp trough in the western Caribbean. No gales or low pressures. “The pressure began falling in the northwestern Caribbean Sea on November 2...” (MWR).

#### November 3:

HWM analyzes a closed low of at most 1005 mb centered near 18N, 83.5W. HURDAT lists this as a 50 kt tropical storm at 17.8N, 83.2W. The MWR tracks of centers of cyclones shows a 12Z position near 18.0N, 83.1W with a 1005 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 18.4N, 83.8W. Ship highlights: Three obs of 35-40 kt N-NW and 1012 mb between 17-18Z between 19-20N, 85.9-86.5W (micro). [Those gales may be related to a frontal passage.] Land/station highlights: 15 kt WSW and 1005 mb at 12Z at Swan Island (17.3N, 83.9W) (micro). Aircraft highlights: At least 40 kt S and 1002 mb at 19Z at 17.6N, 83.3W (micro); Navy center fix sometime between 1930Z-2055Z at 17.3N, 83.4-83.6W with a 993 mb central pressure and 55 kt maximum winds (micro). One other gale of 35 kt. “Note from Navy at 2055Z (fix occurred sometime between 1930Z-2055Z): Small circular storm centered 20 miles east of Swan Island (17.3N, 83.6W). Closed circulation. Average winds 40 knots. NE sector 50 knots. Central pressure 993 mb. Accurate pressure check over Swan Island. Definite eye visual and radar. Criss-crossed high and low levels. Departing area” (micro). “Navy postflight summary: Sully just came in off the hop. Anybody got any hot questions they would like to ask? While you are thinking up some 64 dollar questions here is some of the dope he passed on to us. The center is very well-defined and is small in area. But here is the hot one. It is a very shallow storm with vertical extent to only 3000 feet. The pressure in the center is 993 mbs and is accurate as they checked in with the Swan Island bunch by radio while orbiting the island and set their barometer while there. They then flew east from there and the pressure dropped off very rapidly. The maximum wind was 55 knots on the northeast side. The southeast side it was 50 knots and on the southwest side it was 35 knots. On the northwest side it was 40 knots. On the north side it was 45 knots. The storm is almost concentric in appearance. The center is 25 miles from Swan due east with the diameter 30 miles in both north/south and east/west directions. That is about all I can get from him unless you want to ask something I have not thought of” (micro). “By the morning of November 3 low pressure had become concentrated in the vicinity of Swan Island. A reconnaissance plane located a small center about 50 miles in diameter, perfectly formed with a well defined eye, about 30 miles east of Swan Island. The highest wind was estimated at 50

knots, and the lowest pressure 992.9 mb. It was described as very shallow in its organization. Earlier on November 3 a TACA airliner en route from San Jose to Havana had flown over the storm at 9,000 feet and described it very much as the reconnaissance plane had done. From this elevation, the entire system could be seen; the active part extended only 4,000 feet” (MWR).

November 4:

HWM analyzes a closed low of at most 1005 mb centered near 16.0N, 83.9W with a front along 20N approaching the TC. HURDAT lists this as a 35 kt tropical storm at 15.8N, 84.2W. The MWR tracks of centers of cyclones shows a 00Z position near 18.4N, 84.5W and a 12Z position near 18.3N, 85.6W with a 1000 mb pressure. The MWR post-season track map shows a 00Z position near 17.2N, 83.2W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 15.7N, 83.8W. Ship highlights: 20 kt ENE and 1005 mb at 00Z at 18.8N, 82.6W (micro). Land/station highlights: 15 kt ENE and 1004 mb at 00Z at Swan Island. “Navy: recrossed front at 18.6N, 83.9W – wind shift. 070 degrees 8 knots to 030 degrees 20 knots – ENE SW” (micro). “1335Z: Pirep arrived 1218 direct route overhead Swan clear up to Cape Gracias. High overcast low overcast tops 7000 (ft) with thunder-heads protruding tops 20 to 25,000 (ft) avoidable. Little turbulence around CBs extending on a line NE/SW. Rain area to 120 miles north of Swan not bad then hi overcast, low broken, ocnl overcast tops 6 to 8,000 (ft) to south Cuba then clearing. Winds practically calm all the way” (micro). “During the night of November 3 it drifted south-southwestward into the northeastern tip of Honduras and dissipated. No damage was reported” (MWR).

November 5:

HWM analyzes a closed low of at most 1010 mb centered near 15.7N, 81.8W with a WSW-ENE stationary front just northwest of the low extending from 16N, 89W to 17N, 85W to 19N, 81W to 20N, 76W to beyond 22N, 72W. HURDAT last lists this at 00Z as a 25 kt tropical depression at 14.5N, 82.6W. Microfilm at 00Z shows a closed low of at most 1008 mb centered near 14.9N, 83.2W. No gales or low pressures.

A tropical storm developed in the western Caribbean Sea on 3 November from a trough/area of low pressure, which was evident on 2 November. This area of low pressure may have originated from the tail end of a cold front on 1 November. No changes were made to the timing of genesis, which was at 06Z on 3 November. At the genesis time, the position was shifted half a degree to the west-northwest (18N, 82.5W). The storm traveled slowly in a westward direction before making a southwestward turn later on the 3<sup>rd</sup>. Swan Island recorded a pressure of 1005 mb at 12Z on the 3<sup>rd</sup>, and several gales from ships and aircraft were recorded later on the 3<sup>rd</sup>. Around 20Z on the 3<sup>rd</sup>, a Navy aircraft performed a center fix, locating the center about 20 to 25 miles east of Swan Island. A central pressure of 993 mb was measured by the aircraft at that location, and that value is added into HURDAT. A central pressure of 993 mb yields a wind speed of 59 kt using the Brown et al. southern pressure-wind relationship. Although the cyclone was described as “small” in the Weather Bureau operational advisories, the forward speed of the storm was slow. The aircraft observer estimated maximum surface winds in the tropical cyclone of 55 kt. The HURDAT intensity of 50 kt at 18Z on the 3<sup>rd</sup>

is raised to 55 kt, which is the new peak intensity for the lifetime of this cyclone. Going back to the intensity at genesis, sufficient observational coverage in the area on the 2<sup>nd</sup> and early on the 3<sup>rd</sup> shows that a 50 kt intensity at 06Z on the 3<sup>rd</sup> is probably too high. An intensity of 35 kt is chosen for 06Z on the 3<sup>rd</sup> and 45 kt is chosen for 12Z. The HURDAT positions around the time of the center fix on the afternoon of the 3<sup>rd</sup> are only adjusted a few tenths of a degree. On the 4<sup>th</sup>, the storm turned towards the south and made landfall at or just after 12Z on the 4<sup>th</sup> on the north coast of eastern Honduras (no change to the 12Z position on the 4<sup>th</sup>). The HURDAT intensities at 00Z, 06Z, and 12Z on the 4<sup>th</sup> are raised by 5 kt, showing an identical rate of weakening to the previous HURDAT prior to landfall. There were no peak intensity observations on the 4<sup>th</sup> and the landfall likely occurred in a sparsely populated area, and 40 kt is analyzed as the intensity at landfall. The tropical storm weakened to a depression by 18Z on the 4<sup>th</sup> and no changes were made to the timing of dissipation, which was after 00Z on the 5<sup>th</sup>. Available observations warranted a few track changes, which were made at the end of the track. The changes keep the TC inland in Central America until dissipation rather than moving erratically back over water.

#### 1949 additional notes

Note: Initially, 49 potential suspects were identified for the year 1949. Only 24 of these made the first cut, and the COADS ship data was obtained for 22 of these 24 suspects. 19 of these 24 made the next cut, all of which either appear in this list or were added into HURDAT. 3 of these 19 were found to be new tropical storms and were added into HURDAT, and the other 16 are mentioned here. Additional notes #1, 3, 11, 13, and 16 were the 5 suspects that were closest to being added in, but were not added in to HURDAT

#### 1)

HWM, the MWR tracks of lows, and COADS indicate that a low, which originated from a frontal system, developed just off the southeast coast of the U.S. on 2 June. Numerous low pressure observations of 1004-1005 mb and numerous gales of 35-45 kt were observed between 08Z on 2 June and 09Z on 3 June. The gale that contained the lowest pressure was 35 kt N and 1007 mb at 18Z on 2 June at 32.5N, 77.8W (COA). Two low pressures of 1004 and 1005 mb contained wind speeds of 30 kt on the 2<sup>nd</sup>. On the 2<sup>nd</sup>, there was a moderate temperature gradient and a large moisture gradient across the low, and the wind structure looks frontal. On the 3<sup>rd</sup>, there was no longer a temperature gradient across the low, and there was a moderate moisture gradient across the low, but some of this may have been a natural moisture gradient. On the 3<sup>rd</sup>, although the wind structure appears less frontal than on the 2<sup>nd</sup>, the strongest winds were located well north of the center. From the 1<sup>st</sup> to the 6<sup>th</sup>, the low meandered around between 30-33N, 75-79W. There were no observed gales or low pressures from 10Z on the 3<sup>rd</sup> through 23Z on the 5<sup>th</sup>. On the 4<sup>th</sup> and the 5<sup>th</sup>, the low remained closed and continued to lose its frontal characteristics, but sufficient observational coverage indicates that the low was very weak on these days. The only highlight from the 3<sup>rd</sup> at 10Z through the 6<sup>th</sup> occurred at 00Z on

the 6<sup>th</sup>. The observation was a 30 kt SW wind with 1004 mb at 32.7N, 75.5W, and this was the closest available observation to the center of the low around that time. On the 5<sup>th</sup> and 6<sup>th</sup>, available observations indicate that the low was closed, and there were minimal temperature and moisture gradients across the low. However, this one piece of evidence is not enough justification to add this system into HURDAT.

DAY	LAT	LON	STATUS
Jun 1			Open trough/front/too elongated
Jun 2	33N	75W	Extratropical
Jun 3	30N	76W	Extratropical
Jun 4	32N	78W	Extratropical
Jun 5	33N	79W	Weak low
Jun 6	33N	76W	Weak low- extratropical?

2)

HWM shows a low near the Texas coast on 9 June. Available data shows no west winds south of the center. Also, the lowest pressure was not below 1010 mb and the highest wind was only 20 kt. This may have been a tropical depression, but that is not confirmed by available data.

DAY	LAT	LON	STATUS
Jun 9	27N	96W	Spot low
Jun 10			Dissipated

3)

HWM, the MWR tracks of lows, COADS, and Jack Beven's list of suspects indicate that a low, possibly of tropical origin, became defined on 13 June near Florida. This low was closed from 13 June to 20 June and traveled from 28N, 81W to 37N, 73W during that time. From the 13<sup>th</sup> to the 20<sup>th</sup> of June, there were no temperature or moisture gradients across the low, and temperatures were warm the whole time. Also from the 13<sup>th</sup> to the 20<sup>th</sup>, there were a total of three observed gales of 35 kt and one low pressure of 1004 mb, all of which occurred on 16 June when the low was centered near 31N, 78W. However, none of the gales were within 200 nmi of the center. The gale with the lowest simultaneously observed pressure occurred at 00Z on the 16<sup>th</sup>, and the pressure value was 1014 mb. This observation occurred about 250 nmi (but perhaps as close as 200 nmi) northeast of the center. The low moved inland into North Carolina on the 17<sup>th</sup>, and it moved eastward back over water on the 19<sup>th</sup>. There are no observations of gales from any U.S. coastal station; however, the only sources utilized to look for land/station gales were HWM and MWR. The local and state climatological dataset from NCDC was unavailable at the time the 1949 reanalysis was conducted. It is recommended that additional data be obtained from coastal stations from Florida through Virginia (but especially the Carolinas) from the 15<sup>th</sup> through the 17<sup>th</sup> of June. A subsequent analysis

should then be performed to determine whether this system should be added into HURDAT as a tropical storm. Of all 16 items listed in the additional notes section for 1949, this suspect was probably the closest to being added in to HURDAT.

DAY	LAT	LON	STATUS
Jun 13	28N	81W	Spot low
Jun 14	28N	80W	Low
Jun 15	28N	80W	Subtropical Depression???
Jun 16	31N	78W	Subtropical Storm???
Jun 17	34N	77W	Subtropical/tropical depression/storm???
Jun 18	36N	77W	Low
Jun 19	36N	74W	Weak low
Jun 20	37N	73W	Weak low

4)

HWM and the MWR tracks of lows indicate that a surface trough over the northeastern Gulf of Mexico was located at the southwest end of a SW-NE frontal system on 1 July. This trough broke off from the front and may have become a closed low by 2 July. The low moved westward in the northern Gulf of Mexico on the 2<sup>nd</sup> and 3<sup>rd</sup>, and it may have moved inland in Texas or Louisiana as a weak low. The highest observed wind after the low may have become closed (from the 2<sup>nd</sup> onward) is 25 kt and the lowest observed pressure is 1011 mb. Although temperatures were warm surrounding the low on the 2<sup>nd</sup> and 3<sup>rd</sup>, since there is no definitive evidence that it was closed, and since there are no gales or low pressures, this system cannot be added to HURDAT.

DAY	LAT	LON	STATUS
Jul 1	28N	87W	Trough
Jul 2	27N	91W	Spot low
Jul 3	28N	94W	Spot low
Jul 4			Dissipated

5)

A westward moving tropical wave was first analyzed by HWM on 4 August from 7N, 53W to 16N, 50W. It entered the Caribbean Sea on 7 August and reached the western Caribbean on 9 August. The wave spawned a broad area of low pressure in the northeastern Gulf of Mexico on 11 August (also indicated in the MWR tracks of lows beginning on 11 August) that was essentially stationary through 14 August. By the 14<sup>th</sup>, there is definitive evidence of a closed, more compact circulation located on the coastline of the western Florida panhandle. The low is dissipated by the 15<sup>th</sup>. Although this may have been a tropical depression, the highest observed wind was 32 mph from the NNW at New Orleans on the 14<sup>th</sup>, and the lowest observed pressure was 1010 mb associated with this system. Thus, it cannot be added into HURDAT.

DAY	LAT	LON	STATUS
Aug 11	29N	85W	Trough
Aug 12	28N	84W	Trough
Aug 13	29N	84W	Trough
Aug 14	31N	86W	Tropical depression
Aug 15			Dissipated

6)

HWM and the MWR tracks of lows indicate that low began to develop along a front on 16 August just off the southeast coast of the U.S. On the 16<sup>th</sup> and 17<sup>th</sup>, the wind structure was still elongated and frontal in nature. On the 18<sup>th</sup>, the low started to become better organized while located off the North Carolina coast. On the 19<sup>th</sup>, the low rapidly deepened and accelerated northeastward. Once the low started to obtain a structure slightly more similar to a tropical cyclone (18<sup>th</sup> around 18Z) there were no more observed gales until 12Z on the 19<sup>th</sup>, when a 50 kt SW wind with a pressure of 985 mb and a temperature of 75 degrees was observed just southeast of the center. Since temperatures in the low 60s were observed just a couple of degrees north of the center, it is analyzed that this system was extratropical by 12Z on the 19<sup>th</sup>. It is possible that this could have been a tropical storm sometime between 18Z on the 18<sup>th</sup> and 06Z on the 19<sup>th</sup>, but there were no observed gales during that time. However, there were several low pressures below 1000 mb and several 30 kt winds at 00Z and 06Z on the 19<sup>th</sup>. Although the structure looked more tropical late on the 18<sup>th</sup> and early on the 19<sup>th</sup>, it is analyzed that the system never attained both the wind structure and temperature structure simultaneously to be considered a tropical cyclone. Therefore, this system is not added into HURDAT.

DAY	LAT	LON	STATUS
Aug 16	33N	77W	Broad low/trough (35 kt/1014 mb)
Aug 17	34N	76W	Broad low/trough (35 kt/1010 mb)
Aug 18	35N	71W	Broad low (35 kt/1001 mb)
Aug 19	41N	64W	Extratropical Storm (55 kt/980 mb)
Aug 20	51N	63W	Extratropical Storm (971 mb)
Aug 21	51N	58W	Extratropical low
Aug 22			Merged with another extratropical low

7)

HWM, the MWR tracks of lows, NHC microfilm of synoptic weather maps and Jack Beven's list of suspects indicate that a tropical wave, which had been moving westward in the tropical Atlantic since the 22<sup>nd</sup>, may have formed a complete circulation by the 26<sup>th</sup>, although there are no north, northwest, or west winds near the low then. There are no observed low pressures during the lifetime of this system, and there were two gales. The first gale was a east wind of 35 kt on the 22<sup>nd</sup>, but there is not nearly enough

evidence to consider closing off a low until 26 September. The second gale was a 45 kt E wind with a 1018 mb pressure on the 26<sup>th</sup> only 2 degrees northeast of the center, but this wind could have been influenced by a front that was analyzed by HWM to be located near the low. On the 27<sup>th</sup>, a combination of observations from HWM and COADS confirm that the low is closed (with a somewhat asymmetric/elongated structure), but there were no more observed gales or low pressures for the remainder of the lifetime of this system. By 12Z on the 28<sup>th</sup>, there is no longer evidence the low is closed and it likely dissipated around that time. This system is not added into HURDAT.

DAY	LAT	LON	STATUS
Sep 22			Open wave along 44W between 9N – 19N
Sep 23			Open wave along 47W between 10N – 22N
Sep 24			Open wave along 50W between 11N – 22N
Sep 25			Open wave along 53W between 13N – 24N
Sep 26	30N	59W	Spot low
Sep 27	29N	62W	Spot low
Sep 28	34N	64W	Spot low
Sep 29			Dissipated

8)

On 25 September, microfilm analyzes a small low with a closed 1008 mb isobar near 19N, 82W. Aircraft investigated the system during the afternoon of the 25<sup>th</sup>, and reported that they found “no evidence of a closed circulation near 18.2N, 85.9W.” Although it appears that the aircraft was searching too far west, there are no observed west winds near the feature of interest near 19N, 82W. The highest wind was 20 knots from the east on the north side and the lowest pressure was 1008 mb. This area was also located in an area of low environmental pressure, and it was likely part of a tropical wave. This was likely the same tropical wave that spawned storm 9 (now storm 10).

DAY	LAT	LON	STATUS
Sep 25	19N	82W	Open wave

9)

Microfilm indicates the presence of a low in the northeastern Gulf of Mexico from 28 September at 18Z to 29 September at 00Z. The highest observed wind with this system was 30 kt and the lowest observed pressure was 1004 mb. There were at least five separate reliable observations of 1004-1005 mb. The wind structure of this system appears to be frontal. Although there appears to be some slightly cooler air to the northeast of the low, the temperature gradient across the low is not large. Apparently, a plane enroute from Havana, Cuba to New Orleans, LA reported flight level winds with this system as high as 35 kt and surface winds of about 30 kt near 25N, 85W. This report

came after a report of heavy rain from the aircraft between 23-25N, 83-85W. Due to the extremely disorganized wind structure, this system is not added in to HURDAT.

DAY	LAT	LON	STATUS
Sep 28 18Z	27N	87W	Extratropical
Sep 29 00Z	27N	87W	Extratropical

10)

HWM and COADS indicate that a low with gale force winds existed in the northeastern Atlantic during 29-30 September. On the 29<sup>th</sup>, there were signs that the fronts analyzed by HWM were somewhat accurate. The gales on the 29<sup>th</sup> as high as 45 kt were observed west of the low (and maybe also west of a front). However, the wind structure showed compact cyclonic turning, which is typical of tropical cyclones on the 29<sup>th</sup> and 30<sup>th</sup>. The frontal structure on the 29<sup>th</sup> was much less evident on the 30<sup>th</sup>, and the fronts may have partially dissipated. There is only a slight temperature gradient across the low on the 30<sup>th</sup>. Furthermore, absolute temperatures increased from the lower 60s on the 29<sup>th</sup> to the upper 60s on the 30<sup>th</sup>. However, on the 30<sup>th</sup>, there are no west winds observed south of the center. The last observed gale associated with this system on the 30<sup>th</sup> was at 06Z, but it was observed simultaneously with a pressure of 1022 mb. Due to the cold temperatures, lack of observed gales near the center, and partial frontal structure, this system is not added into HURDAT.

DAY	LAT	LON	STATUS
Sep 29	38N	34W	Extratropical
Sep 30	37N	33E	Extratropical

11)

Top 5 not included in HURDAT

A broad low appeared in the north-central Atlantic on 2 October. A front was approaching from the west and the low was absorbed by 00Z on 3 October. On the 2<sup>nd</sup>, there were no observed gales and only one low pressure of 1005 mb observed with this system. The low was probably too broad to be considered a tropical depression. This system is not added into HURDAT.

DAY	LAT	LON	STATUS
Oct 2	35N	41W	Broad low
Oct 3			Absorbed

12)

HWM, microfilm, and COADS indicate that a weak low was located in the area north of Puerto Rico and Hispaniola from 9-12 October. There were no observed gales or low pressures with this system. Although it never attained the compact wind structure of a tropical cyclone, the time when it is closest to perhaps being classified as a tropical depression is around 00Z on the 10<sup>th</sup>. The system is not added into HURDAT.

DAY	LAT	LON	STATUS
Oct 9	20N	67W	Broad low/trough
Oct 10	22N	67W	Broad low/trough
Oct 11	25N	69W	Broad low/trough
Oct 12			Dissipated

13)

Top 5 not included in HURDAT

HWM, the MWR tracks of lows, microfilm, and COADS indicate that an elongated low developed along a frontal boundary on 16 October off the southeast coast of the U.S. The low only moved northward to offshore of the mid-Atlantic coast by the 18<sup>th</sup>. This low maintained frontal features for much of its lifetime. From the 16<sup>th</sup> through the 18<sup>th</sup> at 12Z, the strongest winds were too far from the center and the organization was not good enough for the low to be a tropical cyclone. From 18Z on the 18<sup>th</sup> through some of the 19<sup>th</sup>, the organization improved with more gales closer to the center. However, during this time, a 10 degree temperature gradient existed across the low. This low is analyzed to have been extratropical for the duration of its lifetime and thus it is not added into HURDAT. However, if the structure would have been slightly less frontal on the 18<sup>th</sup> or slightly less of a temperature gradient on the 19<sup>th</sup>, this system could have been added into HURDAT.

DAY	LAT	LON	STATUS
Oct 16	30N	76W	Extratropical
Oct 17	33N	73W	Extratropical
Oct 18	36N	71W	Extratropical
Oct 19	37N	70W	Extratropical
Oct 20			Absorbed by Storm 11 (now Storm 13)

14)

HWM and COADS indicates that a weak low formed off the east coast of northern Florida on 10 November. This low moved eastward through 13 November. On the 14<sup>th</sup> through the 16<sup>th</sup>, HWM still analyzes a trough to the east of the position on the 13<sup>th</sup>, but available observations indicate that the low/trough became less organized/pronounced by the 14<sup>th</sup>, and it was gone totally by the 17<sup>th</sup>. There was one 35-kt gale observed with this system at 05Z on the 10<sup>th</sup>, but there were no low pressures. Since there is only one piece

of evidence, and the gale occurred on a day when the low looked elongated and trough-like, this system is not added into HURDAT.

DAY	LAT	LON	STATUS
Nov 10	30N	79W	Broad low/trough
Nov 11	32N	69W	Broad low/trough
Nov 12	28N	62W	Broad low/trough
Nov 13	25N	57W	Broad low/trough
Nov 14			Dissipated

15)

HWM, the MWR tracks of lows, COADS, and Jack Beven's list of suspects indicate an area of interest in the central to western Atlantic from 12-19 December. HWM and COADS indicate that two enhanced areas of cyclonic turning associated with a front were present on 12 December in the central Atlantic. The area of cyclonic turning located further north was near 32N, 50W on the 12<sup>th</sup>. HWM analyzes a warm front extending east-northeastward from this low and a dissipating quasi-stationary front extending from this low southward to the other area of cyclonic turning near 22N, 53W. On the 13<sup>th</sup> and 14<sup>th</sup>, the frontal features dissipate and the two areas of cyclonic turning seem to merge into one very large, broad area of low pressure. From the 14<sup>th</sup> through the 16<sup>th</sup>, this non-frontal, broad, closed low moved slowly westward. The tail end of the next approaching frontal system appears to have interacted with the broad low from the 17<sup>th</sup> through the 19<sup>th</sup>. Although the low does not appear to be completely absorbed by the front, the interaction with the front may have caused the low to begin dissipating on the 17<sup>th</sup>. By the 20<sup>th</sup>, HWM no longer analyzed a closed low, and the low is completely dissipated by that date.

There were several observed gales and low pressures associated with this system. Most of the gales occurred outside the 1015 mb isobar and were well removed from the center. Most of the low pressures had very weak winds over an area of several hundred miles; however, there were a few instances of low pressures observed with winds above 20 kt. There was one observation at 06Z on the 14<sup>th</sup> of a 35 kt south wind with a 1003 mb pressure. This was the only observation of a gale with a low pressure. This system was very large, and inspection of the 500 mb analysis in HWM reveals that this was likely an occluded low. This system is not added into HURDAT.

DAY	LAT	LON	STATUS
Dec 12	32N	50W	Extratropical
Dec 13	26N	55W	Broad low, occluded
Dec 14	27N	60W	Broad low, occluded
Dec 15	25N	59W	Broad low/trough
Dec 16	23N	63W	Broad low/trough
Dec 17	23N	62W	Broad low/trough
Dec 18	22N	61W	Broad low/trough

Dec 19	22N	64W	Dissipating
Dec 20			Dissipated

16)

Top 5 not included in HURDAT

HWM indicates a low broke off from the tail end of a front in the northeastern Atlantic on 23 December. The low began moving southward, and from the 14<sup>th</sup> through the 17<sup>th</sup>, there was no temperature gradient across the low. Gales were observed a few hundred miles from the center and were directly associated with this low on the 24<sup>th</sup> and 25<sup>th</sup>. During this time, absolute temperatures were in the upper 60s. By the 26<sup>th</sup>, the low became even broader and the strong winds weakened and spread out. However, HWM shows that on the 27<sup>th</sup>, an east gale was observed about 200 to 300 nmi north of the center. On the 28<sup>th</sup>, the low is picked up and moved northward, expanding and becoming extratropical again as it does so. The low merges with another extratropical low on the 29<sup>th</sup>.

In summary, on the 23<sup>rd</sup>, there were several gales and low pressures observed with this system, but it was extratropical and absolute temperatures were cold. The time when available observations indicate that this system was closest to being a tropical cyclone was from about 12Z on the 24<sup>th</sup> to 12Z on the 25<sup>th</sup>. Before 12Z on the 24<sup>th</sup>, the system was extratropical. After 12Z on the 25<sup>th</sup>, there were no more observed gales within 300 nmi of the center. But late on the 24<sup>th</sup> and early on the 25<sup>th</sup> there were a few observed gales within 300 nmi of the center. The observation of 35 kt NW with 998 mb and 67 degrees at 00Z on the 25<sup>th</sup> at 30.9N, 35.9W (COA) suggests that there is chance that this may have been a subtropical cyclone. However, there is not enough evidence for this to be added into HURDAT.

DAY	LAT	LON	STATUS
Dec 23	37N	28W	Extratropical
Dec 24	32N	28W	Occluded low
Dec 25	28N	35W	Broad low
Dec 26	25N	33W	Broad low
Dec 27	28N	28N	Broad low
Dec 28	36N	20W	Extratropical
Dec 29	44N	17W	Absorbed

## 1950

## 1950 Storm 1 (Able)

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34755 08/12/1950 M=11 1 SNBR= 772 ABLE          XING=0
34755 08/12/1950 M=13 1 SNBR= 772 ABLE          XING=0
      **

34760 08/12*165 545 35  0*171 555 40  0*177 570 45  0*184 583 50  0*
34760 08/12*171 555 35  0*177 563 40  0*182 574 45  0*190 586 50  0*
      *** ***          *** ***          *** ***          *** ***

34765 08/13*191 595 50  0*201 611 55  0*210 625 65  0*216 632 70  0*
34765 08/13*200 600 50  0*207 611 50  0*213 622 55  0*220 632 60  995*
      *** ***          *** **          *** *** **          *** ** ***

34770 08/14*222 637 70  0*230 646 70  0*236 653 70  0*240 658 75  0*
34770 08/14*227 638 60  995*231 646 60  0*234 654 60  995*239 660 65  989*
      *** *** ** *** **          *** *** ** *** *** *** ** ***

34775 08/15*244 662 75  0*248 667 75  0*252 672 80  0*255 677 80  0*
34775 08/15*244 662 65  0*248 665 65  0*252 668 70  987*255 675 75  0*
      **          *** **          *** ** *** ** *** *** **

34780 08/16*257 683 85  0*258 688 90  0*257 692 90  0*256 697 95  0*
34780 08/16*257 681 80  0*257 687 80  0*255 693 80  980*254 698 85  0*
      *** **          *** *** **          *** *** ** *** *** *** **

34785 08/17*254 704 100 0*253 714 105 0*253 724 110 0*255 732 115 0*
34785 08/17*254 706 90 0*254 715 95 0*255 726 100 962*259 733 100 0*
      *** ***          *** *** ***          *** *** *** *** *** ***

34790 08/18*261 738 120 0*268 744 120 0*275 749 120 0*282 754 120 0*
34790 08/18*267 739 100 0*273 744 100 0*279 749 100 958*284 753 105 0*
      *** *** ***          *** ***          *** ***          *** *** ***

34795 08/19*289 758 120 0*299 761 120 0*310 762 120 0*319 760 120 0*
34795 08/19*291 755 105 0*299 755 105 0*307 755 105 953*317 755 110 0*
      *** *** ***          *** ***          *** *** *** *** *** ***

34800 08/20*328 757 120 0*345 748 115 0*365 729 110 0*379 714 105 0*
34800 08/20*328 752 110 0*344 743 105 0*360 727 100 0*376 710 95 0*
      *** ***          *** *** ***          *** *** ***          *** *** ***

34805 08/21*394 695 90  0*418 670 65  0*442 643 35  0*460 620 30  0*
34805 08/21*393 694 90  0*412 673 75  0*433 650 65  0*455 626 45  0*
      *** ***          *** *** **          *** *** **          *** *** **

34810 08/22*479 596 30  0*498 568 25  0*518 540 25  0*536 507 25  0*
34810 08/22E479 598 35  0E500 568 30  0E520 538 30  0E536 507 30  0*
      * *** **          **** **          ***** **          * **

(The 23rd and 24th are new to HURDAT.)
34810 08/23E547 477 35  0E553 448 35  0E553 418 35  0E545 377 30  0*
34810 08/24E535 337 30  0E525 303 30  0* 0 0 0 0* 0 0 0 0*

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34815 HR

Minor track changes and major intensity changes are analyzed for this hurricane. Major alterations are also made to the tropical nature of the cyclone as well as the timing of dissipation. Evidence for these changes comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, Local and National Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps,

U.S. Air Weather Service (post-season report), U.S. Navy (1950) (flight log book), and U.S. Weather Bureau public advisories.

August 7:

HURDAT does not yet list this system. No gales or low pressures. “On 9 August, the following message was received from Martinique: ‘Meteo Dakar advised no cyclonic center located Monday the 7<sup>th</sup> at 0200Z by 14N, 25W’” (AWS).

August 8:

HURDAT does not yet list this system. No gales or low pressures. “‘AINMP’s EIN confirm existence of this center on the 8<sup>th</sup> at about 0300Z toward 15N, 30W.’ The EIN AINMP’s were expanded and clearly indicated the existence at the 11,000 foot level of a cyclonic vortex centered near 15N, 30W at 080300Z. The two positions given in the Dakar message indicated a WNW movement of approximately 11 knots” (AWS).

August 9:

HURDAT does not yet list this system. No gales or low pressures.

August 10:

HURDAT does not yet list this system. No gales or low pressures.

August 11:

HWM does not analyze any features of interest on this day except for hinting at the possibility that a trough/wave might exist along/near 55W due to the kink in the 1015 mb isobar. HURDAT does not yet list a system on this day. No gales or low pressures. “Reconnaissance flights were sent out on the 11<sup>th</sup> and 12<sup>th</sup> but found no indication of a storm. The flight on the 11<sup>th</sup> reported easterly winds with some indication of cyclonic curvature around 50W” (AWS).

August 12:

HWM does not analyze any features of interest on this day. HURDAT lists a 45 kt tropical storm at 17.7N, 57.0W. The MWR post-season track map shows a 00Z position near 17N, 54W, and a 12Z position near the HURDAT position. No gales or low pressures. “The first hurricane of the season was suspected on the afternoon of August 12 from general conditions several hundred miles northeast of the Leeward Islands” (MWR). “Duck special observations: Passed through mass CBs 16N, 59W at 1300Z. Sea calm with slight swell. Radar report... CB in area” (micro). “The flight on the 12<sup>th</sup> reported wind shifts which indicated a vortex to the north of the flight track” (AWS).

August 13:

HWM analyzes a tropical storm of at most 1005 mb centered near 21.1N, 62.3W. HURDAT lists this as a 65 kt hurricane at 21.0N, 62.5W. The AWS best track lists a 0030Z position at 20.5N, 59.2W with max winds of 30 kt and central pressure 1000 mb. The AWS best track lists a 1230Z position at 21.8N, 62.1W with max winds of 40 kt and central pressure 998 mb. The MWR tracks of centers of cyclones shows a 12Z position near 20.2N, 62.2W with a 1002 mb pressure. The MWR post-season track map shows a

12Z position near the HWM and HURDAT positions. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 21.1N, 61.8W. Ship highlights: 35 kt SE and 1012 mb at 06Z at 22.0N, 59.9W (COA); 40 kt ENE and 1000 mb at 18Z at 23.2N, 63.6W (micro); 20 kt NE and 994 mb at 2030Z at 22.3N, 63.4W (micro); 50 kt NE and 998 mb at 2045Z at 23.0N, 62.8W [ob suspicious] (micro); center fix at 22Z at 22.8N, 63.2W with winds variable at 10 kt, pressure 996 mb, and blue sky overhead (micro). One other gale of 35 kt and one other low pressure of 1003 mb. Aircraft highlights: 35 kt S (40 kt SSW at flight-level of 700 ft) and 1008 mb at 21.2N, 61.5W (micro, ATS); Air Force center fix (low-level penetration) at 2045Z at 22.2N, 63.5W with 997 mb central pressure and max observed winds of 45 kt (micro, AWS). One other gale and one other low pressure. "A reconnaissance plane located the developing hurricane on the morning of the 13<sup>th</sup> near 21N, 62W. It soon increased to hurricane force..." (MWR). "Computing from the 08/0300Z position to the position at which Storm Able was located on 13 August, a movement of WNW at slightly less than 15 knots is obtained. This [along with other information] indicates fairly conclusively that Storm Able developed from the cyclonic vortex reported by Dakar 150 miles south of the Cape Verde Islands on 7 August" (AWS). "The Navy flight on the morning of the 13<sup>th</sup> reported a cyclonic wind shift from 190 degrees at 40 kt to 20 degrees at 12 kt over an 85 miles track but did not investigate the area. The Air Force flight approximately six hours later reported an eye with a central pressure of 997 mbs and a maximum winds of 45 kt" (AWS). A description of the eye from the Air Force flight... "13/2045Z: diameter of eye 10 nautical miles. Calm area with circular clouds around us as reported by radar" (AWS). From microfilm... "Duck #8 2045Z: 22.2N, 63.5W. Eye at this position. Just after crossing center of eye wind SE 45 kt" (micro). From the ATS report... "This flight was dispatched from Ramey AFB, Puerto Rico to investigate an easterly wave lying just to the east of the Lesser Antilles. The area of squally weather was encountered at 1141Z near 18N, 61W. Penetration on an easterly heading was made and the wind backed across the squall zone. Plain language was appended to 'Navy three: Passed through moderate squall line at 1144Z- position 18.1N, 60.6W. Wind backed 200 degrees at 20 kts to 170 degrees at 20 kts. Turned north at 1150Z.' Squall line was about 25 miles wide. At 1217Z, and squall line was again penetrated. Penetration was made to about the center of squall at 1234Z. At 1305Z position 20.4N, 60.1W, radar showed off to the east of track a severe squall, banana shaped with good curvature to the NW, and with a series of light squalls to the W. At 1315Z, course was set to WNW but no significant weather was encountered so departure was set for Ramey AFB" (ATS). From microfilm... "S.S. P. Lincoln passed center at 2200Z at 22.8N, 63.2W. Wind variable 10 kt. Blue sky overhead. Lowest barometer 995.8 mb" (micro).

#### August 14:

HWM analyzes a tropical storm of at most 1005 mb centered near 23.6N, 66.0W. HURDAT lists this as a 70 kt hurricane at 23.6N, 65.3W. The AWS best track has a 0030Z position at 22.5N, 64.0W with max winds of 50 kt and central pressure of 997 mb and a 12Z position of 23.3N, 65.5W with max winds of 65 kt and central pressure 995 mb. The MWR tracks of centers of cyclones shows a 12Z position near 24.0N, 66.0W with a 995 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyses a low of at most 996 mb centered near 23.2N,

65.4W. Ship highlights: 35 kt SW and 1002 mb at 00Z at 22.5N, 63.4W (COA, micro). At least three other low pressures. Aircraft highlights: center fix (low-level penetration; DR confirmed by loran) at 1208Z at 23.3N, 65.5W with central pressure 995 mb and max flight-level winds encountered of 65 kt at 500 ft (micro, ATS); Air Force center fix (low-level penetration) at 1935Z at 24.0N, 66.2W with 989 mb central pressure (AWS, micro). Four other surface gales and seven other low pressures reported. “During the [14<sup>th</sup> and 15<sup>th</sup>] it decelerated, turned to a more northerly direction and intensified” (AWS). A description of the eye from the Navy flight... “14/1245Z: N-5: Eye diameter 20 nmi. Symmetrical but ragged. The eye was well defined in all respects except for relative dryness on the west side” (AWS). Regarding the Air Force flight... “Center of storm by penetrating 24N, 66.2W at 1935Z. Low pressure 989.1 mb... SE corner of eye and SE sector winds not over 50 kt. Sea rough. NE sector winds over 75 kt. Gale force to 80 miles from center in NE direction. Sea very high. Heavy rain with continuous lightning. Storm moving NW at about 15 kt. Winds north sector 75 degrees 80 kts, west sector 310 degrees 55 kt, south sector 260 degrees 45 kts” (micro). From the ATS report... “This flight was destined to find the first hurricane of 1950. The tropical disturbance had been classified as a storm on 13 August with winds near 45 knots. The storm was approached from the southwest side until a position west of the center was attained. Penetration to the eye was then effected in the standard Navy ‘low-level – wind on the port beam’ manner. Highest wind encountered on entry was 65 knots. Central pressure of 995 mb was established and the center DR position confirmed by Loran. Departure was taken through the southwest quadrant and the storm was then circumnavigated to show its extent” (ATS). From microfilm (Navy flight)... “N-4: In eye. DR fix 1208Z 23.4N, 65.5W. Climbing for loran. N-9: Wind backing to west” (micro). “Note: PAA flight San Juan-LaGuardia reported wind 348 degrees 22 kt at about 24.5N, 68.1W at 8500 feet. Hurricane position (estimated?) 24.8N, 67.5W at 2315Z” (micro).

August 15:

HWM analyzes a hurricane of at most 1000 mb centered near 24.4N, 67.1W. HURDAT lists this as an 80 kt hurricane at 25.2N, 67.2W. The AWS best track lists a 0030Z position at 24.4N, 66.4W with max winds of 85 kt and central pressure 987 mb and a 1230Z position at 25.2N, 66.9W with 90 kt max winds and 987 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 25.8N, 67.3W with a 987 mb pressure. The MWR post-season track map shows a 12Z position near 25.4N, 67.0W. Microfilm analyses a low of at most 987 mb centered near 25.3N, 67.0W. Ship highlights: 35 kt N and 1005 mb at 12Z at 24.9N, 68.4W (HWM); 45 kt SE and 1012 mb at 18Z at 26.1N, 66.1W (COA, micro); 80 kt N (estimated) [not necessarily max w] and 996 mb [probably not min p] [both obs not necessarily simultaneous] around 16 to 22Z at 26.2N, 67.0W (micro). Aircraft highlights: Navy center fix (low-level penetration, DR) at 1304Z at 25.3N, 66.8W with 987 mb central pressure (AWS, ATS, micro); Air Force center fix at 1955Z [?] at 26.7N, 67.7W with 100 kt max winds reported. At least seven other surface gales reported, at least two other flight-level hurricane force winds reported, and at least three other low pressures below 1000 mb reported. “By the afternoon of the 15<sup>th</sup>, it reached a minimum speed estimated at 4 kt. At this point, it made an abrupt turn to the left and accelerated along a track slightly south of west” (AWS). A description of the eye from the Navy flight... “Eye diameter 20 nmi. Eye well defined. West and south

side defined poorly on radar due to relative dryness” (AWS). From the ATS report... “This was the second Navy flight into Hurricane Able, as the flight on the previous day had definitely established the storm as a hurricane with a fairly well-defined eye. It was decided [today] to go directly to the storm and establish a fix on the eye by going up to the west side, since the west side had been reported relatively dry and weak. Departure was taken from Ramey AFB, Puerto Rico on a northwesterly heading. The wind was kept on the port bow until 70 knots from the ENE was reached, then put on the beam and the eye was entered on the western side at 1304Z. Plain language appended to ‘Navy seven: Highest winds encountered at 1253Z at aircraft position of 25.6N, 66.9W. NNE 80 knots. 45 kt winds extend 55 miles to west of eye. Entered eye on west side. Navy eight: Entered eye at 1304Z- 20 mile radius. Well defined. Position [of eye] 25.3N, 66.8W. Circling in eye at 5,000 feet.’ After having spent one hour and seventeen minutes inside the eye trying to obtain a Loran fix, it was decided to return to base as circumnavigation was impractical due to fuel limitations” (ATS, micro). Regarding an afternoon Air Force flight... “Air Force: Eye located 25.7N, 67.7W at 1955Z. Winds 100 kt in NE quadrant” (micro). From a ship report... “Rebecca Boone Ship: estimated position 26.2N, 67.0W. Hurricane definitely changed course northerly. Was hoveed to on fast rising barometer 1600Z. Started to fall at 2200Z 29.40 [inches] (996 mb). Wind north force estimated 90 mph (80 kt). Visibility ½ mile. Sea very high and confused” (micro).

August 16:

HWM analyzes a hurricane of at most 1000 mb centered near 25.4N, 69.1W. HURDAT lists this as a 90 kt hurricane at 25.7N, 69.2W. The AWS best track lists a 0030Z position at 25.7N, 67.9W with max winds of 105 kt and central pressure 984 mb and a 1230Z position at 25.5N, 69.3W with max winds 120 kt and central pressure 980 mb. The MWR tracks of centers of cyclones shows a 12Z position near 26.0N, 69.2W with a 980 mb pressure. The MWR post-season track map shows a 12Z position near 25.8N, 69.0W. Microfilm analyses a closed low of at most 996 mb centered near 25.7N, 69.4W. Ship highlights: 60 kt SE and 990-999 mb at 04Z at 25.7N, 66.9W (micro); 40 kt W and 1001 mb around 18Z at 24.3N, 70.4W. Six other gales between 35-45 kt and two other low pressures of 1005 mb. Aircraft highlights: Hurricane force S (80 kt S at flight-level of 500 ft) and 997 mb at 1145Z at 25.3N, 68.5W (ATS); hurricane force NNE (100 kt NNE at flight-level of 700 ft) and 985 mb at 1230Z at 26.1N, 69.8W (ATS); Navy center fix (low-level penetration, but with loran) at 1305Z at 25.4N, 69.4W with 980 mb central pressure and 850 mb height of 4250 feet (AWS, ATS, micro); Air Force center fix (boxing method) at 2003Z at 25.2N, 70.1W with 80 kt max winds encountered [they may not have been anywhere near the RMW when they hit 80 kt since this center fix was not obtained by penetration]. Two other hurricane force surface winds reported, three other hurricane force flight-level winds reported, and two other low pressures below 1000 mb reported. “Twenty-four hours after discovery of the storm, the AF flight reported winds to 80 kt [on the 16<sup>th</sup>]” (AWS). A description of the eye from the Navy flight... “Eye diameter 20 nmi. Eye well defined at 5,000 [feet] by precip pattern, not well defined at low level between 230 and 280 degrees” (AWS). From the ATS report... “Flight departed Ramey AFB, Puerto Rico at 16/0924Z to reconnoiter the two day old hurricane, first of the 1950 season, expected to be located near 26N, 68W. At 1256Z, the eye was

entered with maximum winds from the north at 75 knots on this new approach for penetration. After circling in the eye for 34 minutes, the following was observed: (a) Loran fix of eye at 16/1305Z was 25.4N, 69.4W; (b) Lowest pressure 980 mb; (c) Diameter of eye 20 miles; (d) Eye well defined at 5,000 feet by precipitation pattern; and (e) Eye not well defined at low levels between true bearings of 230 and 280 degrees. Departure of eye was taken at 1329Z in a west southwest direction and course was altered ay 1345Z to return to Ramey AFB” (ATS). “Note: PAA 525 at 1005Z- Flying at 7500 [feet] in south edge of hurricane at 24.0N, 68.3W” (micro). “Hurep Duck 16 Aug located eye at 2003Z at 25.2N, 70.1W by boxing procedure” (micro). “Gull special eleven 2330Z: At 24.5N, 71.7W reports they are first out of eye of storm” (micro).

#### August 17:

HWM analyzes a hurricane of most 1000 mb centered near 25.6N, 72.4W. HURDAT lists this as a 110 kt hurricane at 25.3N, 72.4W. The AWS best track lists a 0030Z position at 25.3N, 70.8W with a 130 kt max winds and 971 mb central pressure and a 1230Z position at 25.5N, 72.7W with 130 kt max winds and 962 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 25.9N, 73.0W with a 962 mb pressure. The MWR post-season track map shows a 12Z position near 26.0N, 72.5W. Microfilm analyzes a hurricane of at most 987 mb centered near 25.5N, 72.8W. Ship highlights: 70 kt SE at 00Z at 25.9N, 70.7W (micro); 40 kt S and 996 mb at 00Z at 24.3N, 69.8W (micro); 45 kt E and 1006 mb at 18Z at 27.4N, 73.8W (micro). At least four other gales and one other low pressure. Aircraft highlights: Air Force center fix (700 mb penetration) at 00Z at 25.3N, 70.7W with max 10,000 ft winds encountered 72 kt in NE quadrant, 977 mb pressure from dropsonde, and 700 mb height in eye of 9,380 feet (AWS, micro); 90 kt W at flight-level of 1000 ft and 983 mb at 1330Z at 25.4N, 72.7W (AWS); Navy center fix (low level penetration/DR) at 1335Z at 25.6N, 72.8W with 962 mb central pressure and max flight-level (~1000 ft) winds of 120 kt encountered upon departure of the eye around 1405Z (AWS, micro); Air Force center fixes (by low-level boxing method) at 1955Z and at 2000Z at 26.0N, 73.2W and at 26.2N, 73.8W (micro); Air Force center fix (700 mb penetration) at 2245Z at 27.1N, 73.8W with estimated max intensity of storm 130 kt, 969 mb pressure measured from dropsonde, and 700 mb height of 9,450 feet (AWS). Six other surface gales, two other flight-level hurricane force winds, and three other low pressures. “Corrected location of eye at 0000Z by two loran fixes at 10,000 feet. Maximum measured wind in NE quadrant 72 kt” (micro). “Gull special 17 Aug located eye at 0000Z at 25.3N, 70.7W. This center was found by penetrating eye at 10,000 feet and obtaining two 3 station loran fixes in the eye of the storm. Storm position excellent reliability” (micro). “Post flight summary Aug 17: DR position of eye 25.6N, 72.8W at 1335Z considered excellent. Lowest pressure observed 962 mb. Departed eye to northwest with maximum winds encountered 120 kt extending 12 mi from edge of eye. Observed at least two spiral bands of heavier weather on western side of storm” (micro). “Hurep Duck Special: Center of hurricane located 26.0N, 73.2W at 1955Z. Hurep Duck Special: Second position of storm located by low-level boxing method 26.2N, 73.8W at 2000Z. Storm moving WNW at 11 kt. AF Gull flight: center 27.1N, 73.8W at 2245Z” (micro). “The wind was estimated [by aircraft] to have reached 130 kt. This was the highest estimate reported and was reported on the 17<sup>th</sup>. It is believed that winds of this intensity persisted at least until the 18<sup>th</sup>” (AWS). A

description of the eye from the first Air Force flight... "Eye diameter 25 nmi by radar" (AWS). A description of the eye from the Navy flight... "Eye diameter 25 nmi. Edge of eye not well defined, considerable blue sky observed while circling in eye. Departed eye on NW heading, winds increased gradually rather than with the usual abrupt jolt" (AWS). A description of the eye from the last Air Force flight on this day... "Eye diameter 30 nmi" (AWS). "By 17/1530Z, a major trough formed in the Mississippi valley in the midst of the ridge which had been there. This indicated the beginning of a new turn to the north which was confirmed by aircraft fixes" (AWS). From the ATS report... "This was the first hurricane reconnaissance in this storm flown from Miami, and showed the storm to be still deepening with central pressure down to 962 mbs. Low level penetration was made until 70-knot winds were encountered west of the center, then commenced circumnavigation. Wind increased steadily to 90 kt SSE of center, so decision was made to enter the eye rather than get into the extreme conditions of the east and northeast sectors. Highest winds immediately prior to entry were 110 knots. Eye was rather poorly defined but about 25 miles in diameter. Stayed in eye from 1335Z until 1400Z, then departed on a NW heading. Wind increased gradually rather than with the usual abrupt jolt, and 120 knots was found in this sector with severe turbulence and heavy rain. Hurricane winds extend 40 miles from center, and 45 kt winds [extend] 90 miles [from center]" (ATS).

August 18:

HWM analyzes a hurricane of at most 1005 mb centered near 27.7N, 75.4W. HURDAT lists this as a 120 kt hurricane at 27.5N, 74.9W. The AWS best track lists a 0030Z position at 26.6N, 73.9W with max winds of 130 kt and central pressure 960 mb and a 12Z position at 27.9N, 75.0W with max winds of 130 kt and central pressure 958 mb. The MWR tracks of centers of cyclones shows a 12Z position near 28.1N, 75.7W with a 958 mb pressure. The MWR post-season track map shows a 12Z position near 27.6N, 74.8W. Microfilm analyzes a hurricane of at most 990 mb centered near 28.0N, 75.1W. Ship highlights: 35 kt SE and 1001 mb at 12Z at 29.5N, 70.7W (COA); 35 kt SE and 1011 mb at 18Z at 29.5N, 72.7W (COA). Aircraft highlights: Navy radar center fixes at 0200, 0230, 0700, 0800, and 0920Z between 27.0-27.7N, 73.7-74.9W (micro); Navy center fix (low-level penetration with loran) at 1315Z at 28.0N, 75.0W with central pressure 958 mb and max flight-level gusts of 110 kt [max flight-level wind was at least 95 kt at 400 ft] (AWS, ATS, micro); Air Force center fix (700 mb penetration) at 2039Z at 28.7N, 75.4W with a 967 mb pressure from dropsonde and 700 mb height of 9125 ft (AWS, micro); Navy radar center fixes at 2040Z, 2159Z, and 2358Z between 29.0-29.2N, 74.8-75.5W [loran aided on at least the first two of these three fixes] (micro). Seven other surface gales, three other flight-level hurricane force winds, and four other low pressures between 968-995 mb. "Navy aircraft penetrating the south and west sides of the storm on the 18<sup>th</sup> and 19<sup>th</sup> estimated maximum winds of 110 kt in these sectors. This would indicate winds of at least 125 kt on the east side" (AWS). A description of the eye from the Navy radar flight... "18/0700Z: center poorly defined (on radar)" (AWS). A description of the eye from Navy flight... "18/1315Z: Eye well defined; extremely hazy" (AWS). A description of the eye from the Air Force flight... "18/2039Z: Diameter of center of storm as observed by radar 50 miles; eye almost complete circle. Surface winds [in eye] estimated as variable at 17-20 kt with moderate to rough sea" (AWS). From the

ATS report... “Direct penetration of the eye was agreed to by pilot and aerologist. Consequently, approach was made from Miami to a point WNW of the center. Winds gradually increased from 50 knots to 95 knots 3 miles outside the eye boundary with severe, continuous turbulence lasting for approximately 20 minutes. Heavy rain was encountered as squall lines were crossed. Gusts were estimated to 110 knots. Eye was well defined with central pressure of 958 mb located at 28.0N, 75.0W at 1315Z, loran fix. Remained in eye for 58 minutes. Departed eye south, spiraling out on SE side. Previous intention to circumnavigate was abandoned and flight returned to Miami” (ATS).

August 19:

HWM analyzes a hurricane of at most 1005 centered near 30.3N, 75.8W. HURDAT lists this as a 120 kt hurricane at 31.0N, 76.2W. The AWS best track lists a 0030Z position at 29.0N, 75.6W with 125 kt max winds and 955 mb central pressure and a 1230Z position at 30.7N, 75.5W with max winds 125 kt and central pressure 953 mb. The MWR tracks of centers of cyclones shows a 12Z position near 30.8N, 75.9W with a 953 mb pressure. The MWR post-season track map shows a 12Z position near 31.2N, 75.9W. Microfilm analyzes a hurricane of at most 993 mb centered near 31.0N, 75.5W. Ship highlights: 35 kt S and 1008 mb at 06Z at 27.6N, 73.7W (COA). One other gale of 35 kt. Aircraft highlights: Navy radar center fixes at 0059, 0200, 0300, 0400, 0500, 0600, 0700, 0755, 0844, 1005Z between 29.2-30.4N, 75.1-75.7W (micro); Navy center fix (low-level penetration- DR and loran) at 1307Z at 30.8N, 75.4W with 953 mb central pressure, maximum flight-level winds encountered 110 kt on the west side, and 5000 ft pressure of 810 mb (AWS, micro, ATS); radar center fix at 18Z at 31.7N, 76.1W (estimated position) (micro); Air Force center fix (700 mb penetration) at 2015Z with 972 mb pressure by dropsonde and a 700 mb height in the eye of 9040 feet (AWS, micro); center fix (penetration, radar, and loran) at 2058Z at 32.2N, 75.2W with max flight-level winds encountered 120 kt from the south (micro). Three other surface gales, one other flight-level hurricane force wind, and three other low pressures reported. “It moved slowly on a variable northwesterly course which brought the center a short distance east of Cape Hatteras during the night of the 19<sup>th</sup>” (MWR). “Navy 4- entered eye position 30.7N, 75.5W at 1252Z. Navy 5- In eye. Loran position excellent at 1307Z 30.8N, 75.4W. Diameter well-defined 35 miles- open in SW quadrant. Max wind 110 kt west side 12 miles [from center]; 90 kt 30 miles [from center]. 6000 ft pressure 810 mb. Surface pressure 953 mb. N-6: 29.9N, 76.5W (aircraft position) surface winds NW 45 kt” (micro). “1800Z: Hurricane estimated 31.7N, 76.1W. Center completely dissipated from scope during last hour. Correct previous hurricane course and speed to 351 degrees at 4 kt” (micro). “Post flight summary: Departed Miami and encountered long low swell from the NE about 100 miles ENE of Miami. Swells increased rapidly to heavy with increasing northwesterly winds, causing a cross state of sea and sharper crests. Entered eye of hurricane at 1252Z and obtained an excellent loran fix at 1307Z position 30.8N, 75.4W. Diameter of eye measured 35 miles and open at the top vertically. Radar indicated lack of precipitation in southwest quadrant. Surface pressure 953 mbs. Pressure at 5,000 feet 810 mbs. Strongest winds encountered west side estimated 110 knots at a distance of 12 miles from the center wall [from edge of eye. This implies an RMW of approximately 30 miles]. Winds of 90 knots extend west and southwest to 30 miles” (micro). “Hurep Duck: In eye 10,600 feet. Eye 30 by 30 miles moving NE 11 kts.

Dropsonde at 2045Z- surface pressure 972.5 mbs, wind across eye S to N 140/80 kts” (micro). “2058Z: Radar plus loran fix 32.2N, 75.2W. Wind last leg into eye 190 degrees 140 mph” (micro). “During the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> the storm made a gradual recurve to the northeast passing 100 miles off Hatteras...” (AWS). “This was the last direct observation of the central pressure (the 953 mb ob); however, it is considered to be near the minimum developed by the storm since it had completed recurvature by this time and had begun to accelerate toward the NE” (AWS). A description of the eye from the Navy flight... “19/1252Z: Eye diameter 35 nmi. Eye well defined, radar shows lack of precipitation in SW quadrant, open at top vertically” (AWS). A description of the eye from the Navy radar flight... “19/1500Z: Broken center poorly defined. 19/1700Z: Center determination becoming difficult with apparent increasing clouds in center and fading side definition” (AWS). A description of the eye from the Air Force flight... “19/2015Z: Eye diameter 30 nmi. Wind across eye at flight level 10,000 feet 140 degrees 80 kt, eye clear above 5,000 feet to well above 25,000 feet, topped by cirrus type overcast. Temperature at 25,000 feet -10C, dropped to -27C on way out of storm. Air very moist (over 90% [RH?]) up to 25,000 feet on dropsonde from this level” (AWS). From the ATS report... “The flight departed Miami at first light and proceeded to an area approximately 350 miles northeast of Miami with plans to penetrate the center of the storm from the west quadrant. This was accomplished very satisfactorily and excellent loran fixes in the center verified the DR track within 3 miles accuracy. ‘Entered eye 1252Z. Diameter well defined 35 miles. Open SW quadrant. Max winds 110 knots west side 12 miles, 90 knots 30 miles. 5000 ft pressure 810 mbs, surface pressure 953 mbs” (ATS).

#### August 20:

HWM analyzes a hurricane of at most 1000 mb centered near 36.2N, 73.0W with a dissipating cold front extending from 34N, 76W to 32N, 80W to 31N, 84W, a warm front extending from 40N, 76W to 43N, 73W, and a cold front extending from 46N, 75W to 42N, 78W to 38N, 82W to 37N, 84W. HURDAT lists this as a 110 kt hurricane at 36.5N, 72.9W. The AWS best track lists a 0030Z position at 33.1N, 74.8W with 120 kt max winds and 961 mb central pressure and a 1230Z position at 36.0N, 72.6W with 110 kt max winds and 969 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 36.5N, 73.5W with a 955 mb pressure. The MWR post-season track map shows a 12Z position close to the HWM and HURDAT positions. Microfilm analyzes a tropical storm of at most 981 mb centered near 36.2N, 72.7W with a front located from 40N, 75W extending northeastward to beyond 43N, 72W. Ship highlights: 45 kt SE and 1002 mb at 06Z at 34.3N, 72.3W (micro); 60 kt S and 1000 mb at 12Z at 34.8N, 71.4W (micro); 55 kt S and 1003 mb at 15Z at 36.0N, 70.0W (COA); 65 kt ESE and 986 mb at 17Z at 37.5N, 70.2W (micro). Nine other gales between 35-55 kt and four other low pressures between 996-1005 mb. Land/station/land radar highlights: 50 kt NE and 998 mb at 06Z at Diamond Shoals Lightship (35.0N, 75.2W) (micro); 30-35 kt NNW and 1000 mb at 06Z at Cape Hatteras (micro); center fixes from Norfolk, VA land-based radar at 0805, 0829, and 0900Z around between 35.2-35.4N, 74.0-74.3W [may not be as accurate as aircraft fixes] (micro); 40 kt NW and 1003 mb at 12Z at Diamond Shoals Lightship (micro); 15 kt WNW and 1004 mb at 12Z at Cape Hatteras (micro); max 1-minute winds from Able at Cape Hatteras, Cape Henry, and Nantucket were all 32 kt and

occurred sometime during the day of the 20<sup>th</sup> (between 20/05Z - 21/05Z) (climo). Aircraft highlights: Navy radar center fixes at 0125 (“excellent”), 0200 (“excellent”), two fixes at 0300 (one “good” and the other with loran), 0400, 0500 (“good”), 0700, 0800, 0900, 1000, and 1400Z between 33.2-37.0N, 72.4-75.2W (micro); Air Force center fix (loran) at 1939Z at 36.8N, 71.0W with estimated max winds of 100 kt (micro, AWS); Air Force center fix (700 mb penetration, loran) at 2030Z at 38.1N, 70.0W with 100 kt max winds and 700 mb height in eye of 9095 feet (AWS, micro). “On the afternoon of the 20<sup>th</sup>, the Air Force flight estimated maximum winds at 100 kt” (AWS). A description of the eye from the Navy radar flights... “20/0200Z: Eye open SW quadrant. 20/0400Z: Eye diameter 45 nmi. Eye open S quadrant. 20/1000Z: Eye breaking up. Storm assuming extratropical characteristics. 20/1100Z: Impossible to determine center of storm. 20/1420Z: Storm circular formation 80 miles diameter. No defined eye. 20/1443Z: Storm diameter increasing” (AWS). A description of the eye from the Air Force flight on the afternoon of the 20<sup>th</sup>... “Eye large and indefinite” (AWS). “20/1420Z: Navy hurricane position 37.0N, 72.4W. Course [of storm] 035 [degrees], speed [of storm] 20. Radar fix 1400Z: Plane position 35.7N, 74.9W” (micro). “D-4: Surface winds estimated at 60 kt” (micro). “At 2030Z, storm was at 38.1N, 70.0W based on loran fix in eye at ten thousand ft and loran aided box at low level. Eye is large and indefinite. The eye is elliptical in shape 65 by 55 miles. Maximum estimate winds 100 kt. Radius of hurricane winds NE quadrant 120 nmi, SE quad 100 nmi, NW quad 100 nmi, SW quad 80 nmi” (micro). Riverdale in Prince George’s County measured a 24-hour rainfall of 5.65 inches in the 20<sup>th</sup> (Delaware-Maryland-D.C. climatological data). The southern coastline of New Jersey suffered \$1,000 in property damage. “Damage was caused by high tides and accompanying towering waves which destroyed cottage porches. Heavy rains caused flood conditions at some coastal towns and cities, but little permanent damage resulted” (climo). In Massachusetts, “heavy surf, induced by the hurricane swell, cost two bather’s lives at Duxbury and Plymouth” (climo).

#### August 21:

HWM analyzes a hurricane of at most 995 mb centered near 43.3N, 64.8W. An occluded front extends from 59N, 66W to 58N, 60W to 56N, 58W to a triple point near 55N, 57W. A warm front extends from this triple point south-southeastward to 50N, 54W to 47N, 52W to 45N, 50W. A dissipating stationary front extends from the triple point to 50N, 63W to 46N, 68W to 41N, 69W becoming a cold front there and continuing to 38N, 71W to 35N, 74W to 34N, 80W. HURDAT lists this as a 35 kt tropical storm at 44.2N, 64.3W. The AWS best track lists a 0030Z position at 39.6N, 68.9W with 95 kt max winds and 977 mb central pressure and a 1230Z position at 43.3N, 64.8W with 80 kt max winds and 983 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 43.6N, 65.4W with a 967 mb pressure. The MWR post-season track map shows a 12Z position near 43.9N, 64.3W. Microfilm analyzes a low of at most 987 mb centered near 42.6N, 64.4W. Ship highlights: 100 kt NW 990-999 mb at 00Z at 39.8N, 71.0W (micro); 50 kt W and 999 mb at 12Z at 40.0N, 66.2W. 12 other gales between 35-45 kt and seven other low pressures between 996-1005 mb. Land/station highlights: 55 kt NE and 995 mb at 06Z at 40.5N, 69.9W (micro); 978 mb (min p) around ~16Z at Halifax (44.6N, 63.6W) (AWS); 40 kt sustained winds with gusts to 65 kt reported over Nova Scotia (AWS). One other gale of 35 kt and four other low pressures between 988-

998 mb. “It moved northeastward into Nova Scotia on the 21<sup>st</sup>. It caused strong winds on Cape Hatteras and Cape Cod, but hurricane force was not experienced on land, except in parts of Nova Scotia” (MWR). The storm accelerated “along a straight track passing over Halifax, Nova Scotia on the 21<sup>st</sup>...” (AWS). “The storm center passed over Halifax, Nova Scotia, which reported a minimum [pressure] near 978 mbs” (AWS). “As the storm passed over Nova Scotia on the 21<sup>st</sup>, winds of 40 kt with gusts to 65 kt were reported” (AWS).

August 22:

HWM analyzes a closed low of at most 1000 mb centered near 51.8N, 54.0W. A cold front extends from 48N, 50W to 45N, 52W to 42N, 56W to 39N, 62W. Another weak low is centered near 65N, 58W, and a dissipating occluded front extends from this low southward to 59N, 56W to 56N, 54W, becoming a warm front at 54N, 51W continuing southeastward to 52N, 48W to 46N, 43W. Another occluded front is approaching the feature of interest from the west, and this feature is plotted from 58N, 70W to 54N, 69W to 51N, 70W to 48N, 72W to 46N, 76W. HURDAT lists this as a 25 kt tropical depression at 51.8N, 54.0W. The AWS best track lists a 0030Z position at 47.3N, 60.2W with 60 kt max winds and 987 mb central pressure and a 1230Z position at 51.7N, 54.0W with 55 kt max winds and 991 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 52.3N, 54.4W with a 996 mb pressure. Ship highlights: 25 kt NE and 1005 mb at 11Z at 53.5N, 56.5W (COA); 30 kt S and 1003 mb at 18Z at 53.5N, 48.5W (COA). Three other low pressures of 1005 mb. Land/station highlights: 15 kt WNW and 1000 mb at 12Z at 51.7N, 55.3W (HWM). The storm moved “off Newfoundland into the North Atlantic on the 22<sup>nd</sup>” (AWS).

August 23:

HWM analyzes a closed low of at most 1010 mb centered near 55.8N, 37.5W with an occluded front extending from the low southward to a triple point near 50N, 36W. A warm front extends southeastward from the triple point to 45N, 33W, and a cold front extends southwestward from the triple point to 43N, 45W. HURDAT no longer lists the system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 56.0N, 37.7W with a 1007 mb pressure. Ship highlights: 25 kt W and 1004 mb at 00Z at 53.5N, 47.5W (COA); 35 kt E and 1010 mb at 06Z at 57.5N, 48.5W (COA).

August 24:

HWM analyzes a closed low of at most 1005 mb centered near 52.2N, 26.1W with an occluded front extending from 53N, 25W to 49N, 24W to 45N, 27W. The MWR tracks of centers of cyclones shows a 12Z position near 52.3N, 26.5W with a 1003 mb pressure. No gales or low pressures.

The first tropical cyclone of 1950 (Able) formed from an African easterly wave which emerged off of Africa around 5 August. It is possible that Able existed as a tropical depression or even a weak tropical storm a few days prior to the genesis time shown in HURDAT, but there is not enough evidence to change the timing of genesis in HURDAT (00Z on 12 August). The 35 kt HURDAT intensity for the genesis point is also retained, but the position is shifted to 17.1N, 55.5W (over one degree to the west-northwest of the

previous HURDAT position). By 06Z on the 13<sup>th</sup>, the position was adjusted slightly northward of the previous HURDAT position. The track changes on the 12<sup>th</sup> and early on the 13<sup>th</sup> are based on ship observations. The first observed gale also occurred at 06Z on the 13<sup>th</sup>, and many more highlight observations would follow for the rest of Able's lifetime. Later on the 13<sup>th</sup>, there were several ship observations of less than 1000 mb as well as an aircraft central pressure report of 997 mb at 2045Z obtained via low-level penetration. Since ship reports at the same time indicate that the central pressure may have been as low as 992 mb, a 995 mb central pressure was added into HURDAT at 18Z on the 13<sup>th</sup> as a compromise among the data. A 995 mb central pressure was also added into HURDAT at 00Z on the 14<sup>th</sup> due to a 22Z ship report of 10 kt with 996 mb inside the RMW. A 995 mb central pressure yields 56 kt according to the Brown et al. southern pressure-wind relationship. The eye radius at the time was reported to be 5 nmi. The highest wind from a ship on the 13<sup>th</sup> was 50 kt at 2045Z. 60 kt is chosen for the intensity at 18Z on the 13<sup>th</sup> (down from 70 kt originally). On the 14<sup>th</sup> and 15<sup>th</sup>, Able, which had been moving northwestward well north of the Greater Antilles and well east of the Bahamas, slowed down and turned towards the west. On the 16<sup>th</sup>, Able continued at a crawling pace and turned towards the west-southwest near 25.7N, 68.7W. Finally, on the 17<sup>th</sup>, Able started to slowly accelerate again as it turned back towards the west and west-northwest with a 17/12Z position near 25.5N, 72.6W. All track changes made from the 14<sup>th</sup> through the 17<sup>th</sup> are less than half a degree and are based on several aircraft fixes as well as ship observations. Aircraft measured a central pressure of 995 mb at 1208Z on the 14<sup>th</sup> via low-level penetration. This indicates that no deepening had taken place during the previous 18 hours. The intensity is analyzed to have remained steady at 60 kt through 12Z on the 14<sup>th</sup> (down from 70 kt originally at 00, 06, and 12Z on the 14<sup>th</sup>). A 995 mb central pressure is added into HURDAT at 12Z on the 14<sup>th</sup>. At 1935Z on the 14<sup>th</sup>, a central pressure of 989 mb was measured by aircraft via low-level penetration, and this value is added into HURDAT at 18Z on the 14<sup>th</sup>. A central pressure of 989 mb yields 65 and 63 kt respectively for south and north of 25N making use of the intensifying subset of the Brown et al. pressure-wind relationship. 65 kt is chosen for 18Z on the 14<sup>th</sup> (down from 75 kt originally). Able is analyzed to have attained hurricane intensity at 18Z on the 14<sup>th</sup> (30 hours later than originally- a major change to HURDAT). The next peak intensity information available is a 987 mb central pressure obtained by Navy Aircraft via low-level penetration at 1304Z on the 15<sup>th</sup>. A 987 mb central pressure is added into HURDAT at 12Z on the 15<sup>th</sup>. A ship estimated winds of 80 kt during the afternoon of the 15<sup>th</sup>. An aircraft central pressure of 980 mb was measured at 1305Z on the 16<sup>th</sup> via low-level penetration, and this value is added into HURDAT at 12Z on the 16<sup>th</sup>. On the 17<sup>th</sup> at 1335Z, an aircraft measured a central pressure of 962 mb via low-level penetration, indicating significant intensification had taken place. A 962 mb central pressure is added into HURDAT at 12Z on the 17<sup>th</sup>. A 987 mb central pressure yields wind speeds of 68 and 64 kt respectively for south and north of 25N. A central pressure of 980 mb yields 78 and 76 kt respectively for south and north of 25N using the intensifying subset of the pressure-wind relationship. A central pressure of 962 mb yields wind speeds of 100 and 97 kt respectively for south and north of 25N using the intensifying subset. The revised intensities at 12Z each day from the 15<sup>th</sup> through the 17<sup>th</sup> are 70, 80, and 100 kt (down from 80, 90, and 110 kt originally). On the 18<sup>th</sup> and 19<sup>th</sup>, Able began to slowly accelerate, and it recurved, passing 85 miles east-southeast of Cape

Hatteras, NC around 06Z on the 20<sup>th</sup>. Although all track changes to HURDAT from the 18<sup>th</sup> through 06Z on the 20<sup>th</sup> were less than seven-tenths of a degree, and the revised track is consistently to the right of the previous HURDAT track. These track changes were based primarily on the numerous aircraft fixes because no ships ventured near the center. The Navy radar aircraft was used on the 18<sup>th</sup> through the 20<sup>th</sup> to provide hourly center fixes at times, but this aircraft was rarely used for intensity estimates. On the 18<sup>th</sup> at 1315Z, the other Navy Aircraft (PB4Y-2) measured a central pressure of 958 mb, and on the 19<sup>th</sup> at 1307Z it recorded a central pressure of 953 mb, both by low-level penetration. In addition, observations of 700 mb heights from Air Force penetrations at 700 mb on the 18<sup>th</sup> and 19<sup>th</sup> are consistent with the central pressures obtained by low-level penetration. The Air Force released dropsondes from 700 mb and these dropsondes reported surface pressure at splash. However, the dropsondes did not contain wind information so it cannot be assumed that these dropsondes landed in the eye. Therefore, when considering intensity adjustments to HURDAT, the dropsonde pressure is only used as an upper bound for what the central pressure might be, and these values are not added into HURDAT as central pressure values. The central pressure values of 958 and 953 mb obtained by the Navy aircraft are added into HURDAT at 12Z on the 18<sup>th</sup> and 19<sup>th</sup> respectively. A central pressure of 958 mb yields a wind speed of 97 kt using the north of 25N pressure-wind relationship and a central pressure of 953 mb yields a wind speed of 102 kt using the north of 25N pressure-wind relationship. The RMW (obtained by multiplying the aircraft reported eye radius by 1.5) increased from 22 nmi at 2245Z on the 17<sup>th</sup> to 37 nmi by 2040Z on the 18<sup>th</sup>. But then it decreased again to 27 nmi by 1307Z on the 19<sup>th</sup>. The climatological RMW on the 18<sup>th</sup> is 20 nmi and 22 nmi on the 19<sup>th</sup>. The speed of the storm increased from 8 kt on the 18<sup>th</sup> to 11 kt on the 19<sup>th</sup>. Intensities of 100 and 105 kt are chosen for 12Z on the 18<sup>th</sup> and 19<sup>th</sup> (down from 120 kt originally on both days). The 20 kt intensity change on the 18<sup>th</sup> is a major downward adjustment to HURDAT. As Able passed the outer banks of North Carolina, tropical storm force winds occurred on the barrier islands, but no hurricane force winds were observed on land. On the 20<sup>th</sup>, Able accelerated as it moved north-northeastward off the mid-Atlantic coast. The final aircraft intensity information received was at 2030Z on the 20<sup>th</sup>. An Air Force aircraft reported a 700 mb height of 9095 ft implying a central pressure somewhere between 947-965 mb, although it is highly likely that the central pressure was near the very high end of that range because the eye was described as becoming much less organized and larger on the 20<sup>th</sup>. The RMW was about 45 nmi at 2030Z on the 20<sup>th</sup> (the climatological value is 30 nmi). The speed of the storm had increased substantially and was now in excess of 25 kt. The peak analyzed intensity of 110 kt is analyzed to have occurred from 18Z on the 19<sup>th</sup> to 00Z on the 20<sup>th</sup> (down from 120 kt at those times) because the eye was contracting from 18/2040Z to 19/2015Z and the lowest 700 mb height was recorded at 2015Z on the 19<sup>th</sup>. HURDAT previously listed a peak intensity of 120 kt from 00Z on the 18<sup>th</sup> to 00Z on the 20<sup>th</sup>. By 18Z on the 20<sup>th</sup>, 95 kt is chosen for the intensity (down from 105 kt originally). Early on the 21<sup>st</sup>, tropical storm force winds barely brushed the easternmost portions of the Massachusetts capes. Later on the 21<sup>st</sup>, Able made landfall in Nova Scotia at 16Z as a 65 kt hurricane. The center passed directly over Halifax around 16Z. A nice continuous (or hourly) temperature record at Halifax is available, and it indicates that the temperature did not drop after the passage of the cyclone. In fact, the temperature after the cyclone passage was a few degrees warmer

than before the cyclone passage (likely due to solar radiation in the afternoon). This temperature record along with all other available observations indicate that Able was still tropical at landfall in Nova Scotia. Although only winds of tropical storm force were observed, a 978 mb minimum pressure was observed at Halifax. It may have been a central pressure but there is no information as to whether a calm was observed at the location of the barometer. A central pressure of less than or equal to 978 mb yields a wind speed of at least 75 kt according to the pressure-wind relationship for north of 35N. Since no hurricane force winds were observed in Nova Scotia, 65 kt is chosen for 12Z on the 21<sup>st</sup> (up from 35 kt originally- a major intensity adjustment) and landfall as a compromise of the wind and pressure data. Slight southwestward track adjustments are analyzed for the 21<sup>st</sup>. Able quickly weakened to a tropical storm by 18Z on the 21<sup>st</sup> and became extratropical by 00Z on the 22<sup>nd</sup> with a 35 kt intensity at 47.9N, 59.8W. HURDAT does not list Able as ever becoming extratropical and lists dissipation after 18Z on 22 August. The extratropical addition is a major change to HURDAT. It is analyzed that the extratropical low remained closed until after 06Z on the 24<sup>th</sup>, so 36 hours are added to HURDAT (another major change). After 06Z on the 24<sup>th</sup>, the low became very weak and dissipated with a final point of 52.5N, 30.3W with a 30 kt intensity at 06Z on the 24<sup>th</sup>.

There were several interesting/noteworthy quotes from AWS and MWR regarding Able, and they are included below:

“The strongest winds reported in this hurricane were about 140 mph and lowest pressure 953.3 mb recorded by aircraft at sea” (MWR).

“Reconnaissance aircraft penetrated Storm Able 14 times, six of which were at the 10,000 ft level. These penetrations and night radar flights revealed a fairly consistent increase in the size of the eye from a diameter of 10 miles of the 13<sup>th</sup> to an indefinite ellipse 55 by 65 miles on the 20<sup>th</sup>” (AWS).

“It is interesting to note that the central surface pressures as obtained by dropsonde from 10,000 feet and above are consistently 10 or more mbs higher than central pressures as obtained by low level penetration” (AWS).

“As usual, the maximum wind in the storm area did not follow a linear relationship with the minimum pressure” (AWS).

### 1950 Storm 2 (Baker)

34820	08/20/1950	M=13	2	SNBR=	773	BAKER		XING=1	SSS=1					
34825	08/20*	0	0	0	0*163	550	60	0*165	565	60	0*165	574	65	0*
34825	08/20*	0	0	0	0*160	560	50	0*162	570	55	0*164	579	60	0*
					***	**		***	***	**	***	***	**	
34830	08/21*166	583	80		0*166	592	95	0*167	600	105	0*166	607	100	0*
34830	08/21*166	588	65		0*167	598	70	0*169	606	70	990*170	610	75	987*
		***	**		***	***	**	***	***	***	***	***	***	***
34835	08/22*165	613	90		0*166	618	80	0*167	624	70	0*168	631	60	0*

34835	08/22*170	614	90	0*169	618	80	0*168	622	60	0*168	629	45	1003*
	***	***		***			***	***	**		***	**	****
34840	08/23*170	640	50	0*173	650	40	0*176	660	35	0*180	670	30	0*
34840	08/23*170	640	45	0*174	651	40	0*178	662	35	0*182	673	30	0*
			**	***	***		***	***		***	***		
34845	08/24*186	683	30	0*194	700	25	0*203	717	25	0*209	734	25	0*
34845	08/24*186	686	30	0*194	700	25	0*203	717	30	0*209	734	40	0*
		***							**			**	
34850	08/25*213	751	25	0*216	770	25	0*218	784	30	0*218	793	30	0*
34850	08/25*213	748	45	0*216	766	45	0*217	781	35	0*217	791	30	0*
		***	**		***	**	***	***	**	***	***		
34855	08/26*217	801	35	0*218	810	35	0*218	818	40	0*219	826	40	0*
34855	08/26*217	801	35	0*217	812	45	0*218	819	45	0*219	825	50	0*
				***	***	**		***	**	***	**		
34860	08/27*220	833	45	0*221	841	50	0*222	848	50	0*223	856	55	0*
34860	08/27*220	832	50	0*222	840	45	0*223	846	50	0*224	853	55	996*
		***	**	***	***	**	***	***		***	***		***
34865	08/28*226	864	55	0*229	872	60	0*232	877	65	0*234	880	65	0*
34865	08/28*226	861	55	0*228	868	55	0*230	872	55	998*232	875	55	996*
		***		***	***	**	***	***	**	***	***	**	***
34870	08/29*236	883	70	0*239	886	75	0*244	889	80	0*250	891	85	0*
34870	08/29*235	877	65	0*237	880	75	0*239	883	80	0*241	884	85	0*
		***	***	**	***	***	***	***		***	***		
34875	08/30*256	892	90	0*263	893	90	979*272	892	95	0*282	887	95	0*
34875	08/30*247	886	90	0*257	888	90	0*270	890	90	0*282	887	85	0*
		***	***	***	***		***	***	***	**		**	
34880	08/31*294	881	75	0*308	878	65	0*322	879	50	0*332	881	35	0*
34880	08/31*294	882	75	979*311	879	60	0*334	882	40	0*348	887	35	0*
		***		***	***	***	***	***	**	***	***		
34885	09/01*343	885	25	0*352	889	20	0*360	893	15	0*370	899	15	0*
34885	09/01*360	890	25	0*367	890	20	0*367	892	15	0*370	897	15	0*
		***	***	***	***		***	***		***			
34890	HR	AL1											
34890	HE	AL1	AFL1										
				****									

### U.S. Landfalls:

8/31/1950 – 03Z - 30.2N, 88.0W – 75 kt – 979 mb – 1003 mb OCI – 250 nmi ROCI – 21 nmi RMW – 16 kt speed

8/31/1950 – 04Z - 30.7N, 87.9W – 75 kt – 979 mb – 1003 mb OCI – 250 nmi ROCI – 21 nmi RMW – 16 kt speed

Minor track changes and major intensity changes are analyzed for this hurricane that made landfall on the U.S. Gulf Coast. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, National Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps, Caribbean station observations, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, Ho et al. (1987), Dunn and Miller (1960), Connor (1956), Perez et al. (2000), Schwerdt et al. (1979), and Jarrell et al. (1992).

August 20:

HWM does not analyze any features of interest on this day. HURDAT lists a 60 kt tropical storm near 16.5N, 56.5W. The MWR post-season track map shows a 12Z position near the HURDAT position. No gales or low pressures. "The vortex formed east of Antigua on the 20<sup>th</sup>" (AWS). "This hurricane appeared east of the Leeward Islands on August 20" (MWR).

August 21:

HWM analyzes a broad, closed low of at most 1010 mb centered in the general vicinity of 17.2N, 60.1W with a trough/wave extending from 18N, 59W northeastward to 26N, 53W. HURDAT lists this as a 105 kt hurricane at 16.7N, 60.0W. The AWS best track lists a 1230Z position at 17.0N, 61.0W with 70 kt max winds and 990 mb central pressure. The MWR post-season track map shows a 12Z position near 17.0N, 60.4W. Microfilm analyzes a low of at most 996 mb centered near 16.9N, 60.8W. Ship highlights: 60 kt SE and 1006 mb at 10Z at 16.9N, 60.3W (micro). Land/station highlights: 45 kt NNE and 1004 mb at 18Z at Antigua. One other 35 kt gale at 12Z at Antigua. Aircraft highlights: center fix (low-level penetration, DR) at 1247Z at 17.2N, 62.0W with 990 mb central pressure and maximum flight-level winds encountered of 90 kt at ~700 feet (ATS, micro, AWS); center fix at (low-level penetration) at 2040Z at 17.0N, 61.1W with 987 mb central pressure and 90 kt max winds (AWS, micro). At least one surface hurricane force wind, two other flight-level hurricane force winds, and five other peripheral pressures between 996-999 mb. "Navy hurep eight 21/1247: DR position excellent. Hurricane center 17.2N, 61.0W. Max winds 90 kt in the west and north quadrants. 40 kt winds extend outward 25 miles in the SE quadrant, 25 miles in the west quadrant, 30 miles in the northeast quadrant. Eye open SSE to SW. Hook extends from SW to east. Width 10 to 15 miles with heavy rain. Min pressure 990 mb" (micro). "Post flight report 21/1625Z: Eye forming. No area of relative calm or apparent cloud breaks. Minimum winds area 12 miles diameter. Hurricane carries torrential rain all quadrants except SSW. DR positions excellent" (micro). "N-10: Gust 75 kts in squall line" (micro). "AF 2040Z: Recon 17.0N, 61.1W [center fix]. Climbing to 10,000 ft in eye (received at 2105Z)" (micro). From Air Force flight... "Hurricane winds extend 40 miles to NE of center and 15 miles to SW. Storm winds extend 60 miles NE and 35 miles SW of center. Gale winds extend 80 miles NE and 35 miles SW of center. Storm center located by simultaneous radar fix on island and eye of storm" (micro). "A reconnaissance mission was dispatched early on the 21<sup>st</sup> to search the area east of Antigua. This flight found a storm with winds to 70 knots and a central pressure of 990 mbs. The center had not developed a well defined eye but did contain an area of relative calm. The afternoon flight found Storm Baker better organized with a central pressure of 987 mbs and winds to 90 kt" (AWS). From the ATS report... "This flight departed Ramey AFB, Puerto Rico at 21/0952Z to investigate an area of suspicion existing to the east of the Lesser Antilles. After having cleared the islands by 1240Z the wind was placed on the port beam and penetration of the hurricane commenced. The wind increased to over 90 knots and radar indicated our position to be in the northwestern edge of the eye at 1247Z. However, the wind did not diminish in the next minute so heading was immediately altered to circumnavigate the hurricane. At 1252Z, the aircraft emerged

into an area of very confused seas and winds from all direction ranging in velocities from 25 to 50 knots. This area was 12 miles in diameter and centered near 17.2N, 61.0W at 21/1247Z with no apparent breaks in the lower clouds present. Departure was immediately taken from this area in a southwesterly direction after having observed a pressure low of 990 mb. Circumnavigation was again commenced at 1300Z with the flight returning to Ramey AFB, Puerto Rico” (ATS).

August 22:

HWM analyzes a closed low of at most 1010 mb centered near 15.8N, 62.8W with a trough/wave extending from the low northeastward to 24N, 58W. HURDAT lists this as a 70 kt hurricane at 16.7N, 62.4W. The AWS best track lists a 0030Z position at 17.0N, 61.2W with 90 kt max winds and 987 mb central pressure and a 1230Z position at 17.0N, 61.6W with 50 kt max winds and 1003 mb central pressure. The MWR post-season track map shows a 12Z position near 16.9N, 62.7W. Microfilm analyzes a closed low of at most 1005 mb centered near 16.5N, 62.4W. Land/station highlights: 80-105 kt N (estimated, max w) around ~04Z at Antigua (AWS); 990 mb [min p?] around ~04Z at Antigua (AWS); 40 kt ENE G 50 kt and 1008 mb at 06Z at St. Kitts. Aircraft highlights: 35 kt NE (flight-level of 900 ft 45 kt ENE) and 1006 mb at 1415Z at 16.8N, 62.9W (ATS); center fix (low-level) at 15Z at 16.7N, 62.2W with 1003 mb central pressure and maximum flight-level gusts of 50 kt (ATS, micro, AWS). Two other low pressures of 1005 mb. “It passed about over the island of Antigua during the night of the 21<sup>st</sup> with winds reported at 90 to 120 mph” (MWR). “Navy-6: Area of relative calm and confused seas was centered at 16.7N, 62.2W at 22/1500Z. Land radar fix [by radar on Navy aircraft]. Central pressure 1003.1 mb. All quadrants except NE open at 10,000 ft. 850 mb height 4890, temperature 19.6C, wind 160 degrees 18 kts [in center]. 700 mb data [in center] height 10,300 ft, temperature 13.7C, wind 220 degrees 38 kt. Max winds- gust to 50 kt 15 miles NW of the center [at ~700 mb or 10,000 ft]” (micro). “A verbal report from Antigua indicated that the wind had reached 90 to 120 mph N and the pressure had dropped to 990 mbs approximately 22/0400Z. A few hours later, Antigua reported NE winds force 3 to 5 [10 to 20 kt] and pressures above 1005 mb. Since the wind direction had not changed, it was quite apparent that Storm Baker had either reversed its direction and moved off to the east or northeast or had weakened considerably. The morning reconnaissance flight on the 22<sup>nd</sup> reported a weak cyclonic circulation centered 60 miles SW of Antigua at 22/1500Z. This added to the confusion since Antigua still reported NE winds. However, at 22/1930Z, Antigua reported a SE wind [had shifted from NE] making it fairly conclusive that Storm Baker had dissipated immediately after formation” (AWS). “After crossing Antigua, Baker moved in a west-northwesterly direction and accelerated to about 18 knots; at this point it existed as a small unstable vortex with maximum winds of 50 knots and minimum pressure of 1003 mbs” (AWS). From the ATS report... “Shortly after departure from Ramey AFB, Puerto Rico at 22/1200Z, course was taken from Montserrat Island in the Lesser Antilles to investigate the hurricane which in the previous 24 hours had moved from a position 40 miles east of Antigua Island into the Montserrat- St. Kitts Island area. A thorough investigation of this area was made maintaining a margin of safety around the mountainous islands with the following in-flight plain language and post flight summary bring reported: ‘In-flight plain language- Area of relative calm and confused seas centered near 16.7N, 62.2W at

22/1500Z by land radar fix. Central pressure 1003.1 mb. All quadrants except northeast open at 10,000 feet. Maximum winds gust 50 knots 15 miles northwest of center. Post flight summary- intertropical front extends west southwest from south of Antigua into closed circulation thence southwest. Swells and weather indicate this to be remains of severe hurricane located yesterday. Observations in eye indicate rapid filling of this low although severe squalls accompany it to the northwest, north and northeast. Flight was routine throughout returning to Ramey AFB, Puerto Rico at 22/1804Z" (ATS). Regarding the storm in Antigua... "Roofs blown off several sugar warehouses, trees uprooted, some power and telephone lines broken, and 40 or more homes flattened" (climo). Regarding the storm in Barbados... "Heavy rains and some flooding caused minor damages due to the effects of the southern part of easterly wave with which hurricane was associated" (climo).

August 23:

HWM analyzes a closed low of at most 1010 mb centered near 18.0N, 66.2W with a trough/wave extending from 19N, 66W northeastward to 26N, 61W. HURDAT lists this as a 35 kt tropical storm at 17.6N, 66.0W. The AWS best track lists a 0030Z position at 17.1N, 63.0W with 45 kt max winds and 1006 mb central pressure and a 1230Z position at 18.2N, 66.5W with 45 kt max winds and 1006 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 18.3N, 66.1W with a 1002 mb pressure. The MWR post-season track map shows a 12Z position near the HWM position. Microfilm continues to analyze a closed low of at most 1005 mb centered near 17.7N, 65.9W. Aircraft highlights: 20 kt SW (at both the surface and flight-level of 1000 ft) and 1003 mb at 1145Z at 17.6N, 65.7W (ATS); 40 kt E (45 kt E at flight-level of 700 ft) and 1006 mb at 15Z at 19.5N, 66.8W (ATS). One other surface gale of 35 kt and one other low pressure of 1005 mb. "It progressed slowly west-northwestward losing force, and was only a minor disturbance on the 23<sup>rd</sup> when it reached Puerto Rico, where strongest winds were 35 to 40 mph" (MWR). "As the vortex passed just south of St. Croix on 23 August, the station at Eingshill reported a wind shift from north to south and force 6 winds [25 kt] with gusts to 35 mph. Navy recon found the storm on the 23<sup>rd</sup> just as it entered the Puerto Rican coast and passed NE of Ponce at about 1300Z. Ponce indicated a pressure of 1006 as the center passed. Moving through the Mona Passage and skirting the north coast of Hispaniola, the storm, still in the unstable vortex stage, continued at a steady 15 knot movement" (AWS). "Strong squall line passed north of Puerto Rico at 23/1130Z oriented SW to ENE which marked boundary between ENE and SE flow [aloft?]. Moderate squall line passed north of Puerto Rico at 23/1627Z oriented SW to ENE which marked boundary between ESE and S flow aloft. Pressure and winds indicate existence of weak cyclonic circulation to south southwest of Ramey. Morning flight encountered squalls mentioned which appear to cease at 20N. Situation looks identical to yesterday's flight results" (micro). From the ATS report... "Flight was to scout the area in vicinity and southwest of Puerto Rico. Showers and light southerly winds were found south of the island, but upon investigating this area northeast and north of Puerto Rico, increasing heavy squalls were experienced and winds of east 40 knots were observed, gusting to 50 in squall centers. These squalls were heaviest in a 60 square mile area north of Puerto Rico" (ATS). Regarding the storm in the Virgin Islands and Puerto Rico... "Virgin Islands and Puerto Rico experienced very minor damages from the

wind and rain which occurred in connection with tropical disturbance which degenerated into an area of squally weather. Damages consisted of a few broken electric and telephone lines, torn awnings, and broken neon signs. Heavy rains in some sections of Puerto Rico delayed farm work and construction projects. Some small streams reached flood stage” (climo).

August 24:

HWM analyzes a closed low of at most 1010 mb centered near 20.2N, 71.7W with a trough/wave axis extending from the low northeastward to 27N, 68W. HURDAT lists this as a 25 kt tropical depression at 20.3N, 71.7W. The AWS best track lists a 0030Z position at 19.6N, 69.1W with 45 kt max winds and 1006 mb central pressure and a 1230Z position at 20.7N, 72.2W with 50 kt max winds and 1003 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 20.4N, 71.3W with a 1009 mb pressure. The MWR post-season tracks map shows a 12Z position near 20.4N, 72.0W. Microfilm analyzes an open wave containing a spot low near 20.6N, 71.8W. Land/station highlights: 20 kt SW and 1003 mb (min p) at 18Z at Great Inagua Island (21.1N, 73.3W) (micro, AWS). Aircraft highlights: 35 kt E (micro). “This track brought the storm across Great Inagua at about 1800Z on the 24<sup>th</sup>, at which time the island had a 1003 mb pressure. A slow deceleration and deepening of the central pressure occurred from this point on” (AWS). “D-10: Weak squall line oriented NW by SE 30 miles N of position appears to extend 100 miles E and 75 mi W then across to the south approximately 2.5 [degrees?] proceeding to 20N, 74W” (micro).

August 25:

HWM analyzes a closed low of at most 1005 mb centered near 21.8N, 77.9W. HURDAT lists this as a 30 kt tropical depression at 21.8N, 78.4W. The AWS best track lists a 0030Z position at 21.2N, 75.1W with 50 kt max winds and 1003 mb central pressure and a 1230Z position at 21.6N, 78.1W with 46 kt max winds and 1003 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 21.6N, 78.7W with a 1002 mb pressure. The MWR post-season track map shows a 12Z position between the HURDAT and HWM positions. Microfilm analyzes a closed low of at most 1002 mb centered near 21.7N, 78.2W. Land/station highlights: 25 kt W and 1002 mb (min p) at 1230Z at Camaguey, Cuba (21.4N, 78.0W) (AWS, HWM); 20 kt NNW and 1004 mb at 18Z at 21.9N, 79.4W (micro). “Thereafter, it was in the nature of a squally wave until the evening of the 25<sup>th</sup> when signs of another developing center were noted off the south Cuban coast. This center developed slowly, moved westward across the western tip of Cuba into the Gulf, made a curve to northward, and increased to hurricane force” (MWR). “After passing Great Inagua, the vortex moved due west and entered the Cuban coast just east of Camaguey. This station later reported a minimum pressure of 1002 mbs with force 6 winds [25 kt] as the storm passed just to the north of the city at about 1230Z on the 25<sup>th</sup>” (AWS). “Baker – Aug. 25-28 – TS in Cuba” (Perez et al. 2000).

August 26:

HWM analyzes a closed low of at most 1005 mb centered near 20.9N, 83.0W. HURDAT lists this as a 40 kt tropical storm at 21.8N, 81.8W. The AWS best track lists a 0030Z position at 21.5N, 80.3W with 46 kt max winds and 1001 mb central pressure and a

1230Z position at 21.9N, 82.1W with 46 kt max winds 1001 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 21.9N, 82.3W with a 1001 mb pressure. The MWR post-season track map shows a 12Z position near 22.0N, 82.3W. Microfilm analyzes a closed low of at most 1002 mb centered near 21.6N, 82.0W. Ship highlights: 20 kt W and 1005 mb at 18Z at 20.6N, 82.8W (COA, micro). Land/station highlights: 35 kt N and 1001 mb at 06Z at Cayo Guano de Este (21.7N, 81.5W) (micro); 45 kt ESE and 1005 mb at 18Z at Cayo Guano de Este (micro). 11 other low pressures between 1003-1005 mb. Aircraft highlights: 46 kt maximum flight-level wind encountered by Air Force during afternoon flight (AWS); 25 kt SW (25 kt WSW at flight-level of 1500 ft) and 1003 mb at 2045Z at 20.9N, 82.9W (micro). “The disturbance emerged from the south Cuban coast in the vicinity of Palo Alto and passed just north of the Isle of Pines with a westerly movement of 7 knots at 2000Z on the 26<sup>th</sup>. Air Force reconnaissance in the area found evidence of a closed circulation at the 700 mb level. Descending to the low level, the flight encountered maximum winds of 46 knots” (AWS).

#### August 27:

HWM analyzes a closed low of at most 1005 mb centered near 22.3N, 85.5W. HURDAT lists this as a 50 kt tropical storm at 22.8N, 84.8W. The AWS best track lists a 0030Z position at 22.1N, 83.4W with 46 kt max winds and 1001 mb central pressure and a 1230Z position at 22.4N, 84.6W with 55 kt max winds and 1000 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 22.9N, 84.5W with a 1000 mb pressure. The MWR post-season track map shows a 12Z position near 22.5N, 84.8W. Microfilm analyzes a closed low of at most 1002 mb centered near 22.4N, 84.8W. Ship highlights: 20 kt SW and 1005 mb at 12Z at 21.2N, 83.8W (COA, micro); 35 kt ESE and 1012 mb at 18Z at 24.3N, 82.5W (COA). One other low pressure of 1005 mb. Land/station highlights: 20 kt NW and 1005 mb at 00Z at Caletade (21.5N, 82.8W) (micro); 20 kt W and 1003 mb at 12Z at Cayo de San Antonio (21.8N, 84.8W) (HWM); 50 kt SE and 1012 mb at 18Z at Dry Tortugas (micro). Nine other low pressures and two other gales, both at Dry Tortugas. Aircraft highlights: Navy center fix at 15Z at 22.5N, 84.9W with 996 mb central pressure, 40 kt maximum surface winds and 50 kt measured flight-level winds with a report of “eye forming” (AWS, ATS); Air Force center fix (low-level penetration) at 2204Z with 997 central pressure and 58 kt winds with report of “eye not definite” (AWS). Three other surface gales of 35-40 kt, two other flight-level gales of 40-44 kt, and five other low pressures of 1001-1005 mb. “The vortex again crossed western Cuba in the vicinity of Pinar del Rio at about 0700Z on the 27<sup>th</sup>. The press reported a crop loss in this area of \$2,000,000 and 20 deaths caused by devastating winds and rain. Upon entering the Gulf, the storm again took up a WNW movement and at 2200Z on the 27<sup>th</sup>, Aircraft Recon penetrated the storm at low level to find a minimum pressure of 997 mbs and maximum winds of 58 knots. No definite eye had yet formed” (AWS). After entering the Gulf of Mexico, Baker intensified in terms of wind speed on the 27<sup>th</sup> through the 29<sup>th</sup>, “but the surface pressure remained between 995-998 mbs. Also, the degree of organization of the storm remained unchanged” (AWS). “Post flight summary 27 August: Lowest pressure located at 1500Z at 22.5N, 84.9W with characteristics of eye in formative stage. West and south sides very weak with max winds 20 kt. Noticeable lack of middle and high clouds west and south sides. Entire

storm relatively dry all quadrants. North and northeast quadrants max winds 50 kt at a distance of 100 miles from center 40 kt to 150 miles. Lowest pressure in center 996 mb. Would indicate moderate deepening and intensification expected” (micro). From the ATS report... “This was the fifth recco flight into a squally area which had previously been a well-developed hurricane before being broken up moving through the Lesser and Greater Antilles island group. During the 24 hours preceding this flight, the weak low pressure center had moved over western Cuba, and now out over open water in the Gulf it would bear investigating for possible redevelopment. The flight departed Miami and a weak closed circulation was found, but winds of tropical force were found in the northeast quadrant. Further reconnaissance would be necessary to determine extent of future intensification. Surface pressure 996 mb believed to be weak center. 5000 ft pressure (834 or 854 mb?)” (ATS).

August 28:

HWM analyzes a hurricane of at most 1000 mb centered near 22.8N, 87.6W. HURDAT lists this as a 65 kt hurricane at 23.2N, 87.7W. The AWS best track lists a 0030Z position at 22.9N, 85.5W with 58 kt max winds and 996 mb central pressure and a 1230Z position at 23.2N, 86.6W with 60 kt max winds and 995 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position 23.6N, 87.4W with a 1000 mb pressure. The MWR post-season track map shows a 12Z position near 23.3N, 87.3W. Microfilm analyzes a low of at most 996 mb centered near 22.8N, 87.3W. Ship highlights: 40 kt NNE and 1000 mb at 00Z at 23.5N, 86.9W (micro); 45 kt SE and 1008 mb at 12Z at 24.6N, 84.3W (COA); 995 mb (min p) and 50 kt (max w), both around 2130Z (but not necessarily simultaneous observations) (AWS). Six other gales and eight other low pressures. Land/station highlights: 20 kt S and 1003 mb at 00Z at 22.1N, 84.1W. Aircraft highlights: Navy radar attempted center fix at 05Z with report of “no center discernable, scattered squalls” (AWS); Navy center fix (low-level penetration) at 1315Z at 22.9N, 87.4W with 998 mb central pressure and maximum flight-level winds encountered of 65-75 kt (AWS, ATS); Air Force center fix (low-level penetration) at 18Z at 23.3N, 87.0W with 996 mb pressure and 60 kt winds (AWS, micro); Air Force center fix (at 10,000 feet) at 2039Z at 23.3N, 87.2W with 993 mb pressure from dropsonde (micro). Seven other surface gales, five other flight level winds of between 60-70 kt, ten other low pressures of 1000-1005 mb. “On the 28<sup>th</sup>, the storm continued to decelerate and to intensify in so far as wind speed is concerned. The minimum central pressure remained nearly constant. The forward speed reached about 4 kt, the minimum speed since leaving Antigua” (AWS). “Navy 2: 0500Z 23.2N, 84.1W. 10,000 ft wind estimated 161 degrees 38 kt. No center discernable. Scattered squalls. Will proceed to 23N, 85W then to 24N, 85W. Navy: 25N, 85.2W. Proceeded as indicated in previous report. Only light squalls on scope” (micro). “1345Z: Navy 7- departed eye NE side. Max winds 65 to 70 kt 23.5N, 86.8W. Navy 8 (1430Z): 23.8N, 85.7W. Winds extend 70 miles from center on NE side” (micro). “PM duck flight on Gulf hurricane: Post flight remarks- Storm center at 1800Z was 23.3N, 87.0W located by low-level flight. SLP = 995.9 mb. At 2039Z at 10,000 feet altitude the center was located at 23.3N, 87.2W. A dropsonde reported SLP 993 mb. Max winds north sector 60 kt. Gale winds extend 150 miles in the NE quadrant. South sector open with light winds” (micro). “SS Rincon Hills at 2130Z reported SW 5 kt 999 mb pressure at 23.8N, 87.7W. Remarks- passing through

center of storm. Wind SW 10 kt. Increasing. Greatest wind experienced 50 kt” (micro). From the ATS report... “Winds gradually increased from 20 knots to 60 knots from the SE to ESE over a distance of nearly 200 miles. As the low pressure center was approached, heavy squall lines were encountered. Course was held to the north of the storm center until the winds backed through the east and then very rapidly backed through northeast and north and subsided down to 35 knots down to 15 knots and then to near calm as the flight entered from the northwest into a calm and clear area. Departed through northeast side encountering extremely heavy rain as squall lines were crossed. Returned to Miami” (ATS).

#### August 29:

HWM analyzes a tropical storm of at most 1000 mb centered near 23.3N, 89.9W. HURDAT lists this as an 80 kt hurricane at 24.4N, 88.9W. The AWS best track lists a 0030Z position at 23.4N, 87.5W with 75 kt max winds and 993 mb central pressure and a 1230Z position at 23.6N, 88.4W with 85 kt max winds and 992 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 24.4N, 88.3W with a 988 mb pressure. The MWR post-season track map shows a 12Z position near 24.4N, 88.5W. Microfilm analyzes a low of at most 993 mb centered near 23.8N, 88.0W. Ship highlights: 45 kt SE and 1008 mb at 06Z at 25.8N, 86.8W (micro); 30 kt E and 1001 mb at 12Z at 25.7N, 88.0W (micro); 55 kt [?] SE and 1008 mb [?] at 18Z at 26.1N, 86.2W (micro). Eight other gales and ten other low pressures. Aircraft highlights: Navy radar center fixes at 0415, 0500, and 0600Z between 23.1-23.2N, 86.4-86.5W (micro, AWS); at least 40 kt (80 kt SE at flight-level of 600 ft) and 997 mb at 13Z at 24.1N, 87.1W (ATS); Navy center fix (low-level) at 1307Z with 85 kt max flight-level winds with a report of “passed through clear area 25 miles wide, 60 miles long; wind dropped to 20 knots” (AWS); Air Force center fix at 1930Z at 23.7N, 88.9W [or 88.5W?] with 997 mb pressure [probably not central pressure] with report of “center elliptical, clear to SW” (AWS, micro). Five other surface gales, two other flight-level hurricane force winds, and five other low pressures. “Late on the 29<sup>th</sup>, the storm turned abruptly to the north. The afternoon flight on the 29<sup>th</sup> indicated no change in movement [though]...” (AWS). “Navy six storm position 22.7N, 86.6W at 0345Z. Radar, land, loran fix. Poorly defined eye open to northwest. Checked area to north and west with negative results. Time of first position 0230Z. Navy seven correct storm position at 0415Z determined by radar fix on land to 23.1N, 86.4W. 0500Z: Radar fix on land 23.1N, 86.4W. Eye lies on bearing 35 to 170 degrees – 20 miles wide, 65 miles in length. Open to NW. 0600Z: Center of widely diffused storm area at 23.2N, 86.5W. No eye apparent” (micro). “D-5: Position of center 23.7N, 88.9W. Not completely closed. Clear to west-southwest quadrant. Diameter of center 40 miles long and 30 miles wide” (micro). From the ATS report... “Previous reconnaissance of this storm had shown hurricane force winds in severe squalls in the eastern sector, with a weak circulation, but no definite eye. This flight verified the fact that there were still winds in excess of 65 knots in the squalls, but no circulation was established. A post flight analysis that the center of the weak circulation was further north than the track flown. The heavy rain area was determined to have been 120 miles wide. Severe thunderstorms with a greenish cast to the sky were observed near 23.5N, 87.7W to the south of the flight path” (ATS).

August 30:

HWM analyzes a tropical storm of at most 995 mb centered near 27.3N, 88.1W. HURDAT lists this as a 95 kt hurricane at 27.2N, 89.2W. The AWS best track lists a 0030Z position at 24.7N, 89.0W with 85 kt max winds and 992 mb central pressure and a 1230Z position 27.0N, 88.6W with 85 kt max winds and 992 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 28.1N, 88.8W with a 985 mb pressure. The MWR post-season track map shows a 12Z position near 27.3N, 88.8W. Microfilm analyzes a low of at most 990 mb centered near 26.9N, 88.8W. Ship highlights: 80 kt SE and 996 mb [around ~06Z is a guess for the time, but it definitely occurred sometime between 00Z-12Z] at 26.2N, 87.0W (micro); 55 kt SW and 993 mb at 12Z at 26.8N, 88.1W (micro); 60 kt ESE and 1004 mb at 18Z at 29.8N< 87.8W (COA); 978 mb (min p encountered by ship "Mather") at 20Z (AWS); hurricane force at or around 20Z by ship "Mather" (AWS). Nine other gales and one other low pressure of less than 1000 mb. Land/station highlights: 25 kt NE and 999 mb at 18Z at 29.0N, 89.4W (micro). Aircraft highlights: At least 40 kt S (80 kt S at flight-level of 900 ft) and 992 mb at 13Z at 27.4N, 88.8W (ATS); Approximate Navy center fix at 1307Z at 27.5N, 89.0W with lowest peripheral pressure encountered of 992 mb (ATS); attempted Navy center fix at 1540Z with lowest peripheral pressure encountered 992 mb and 90 kt winds with report of "no eye, only NE-SW trough" (AWS); at least 65 kt NW (60 kt NNW at flight-level of 600 ft) and 986[?] mb at 19Z at 28.1N, 88.6W (micro); 100 kt ESE at flight-level of ~600 feet and 980 mb at 1930Z at 28.2N, 88.1W (micro); Air Force center fix at 1930Z at 28.0N, 88.5W with 980 pressure [not sure if central pressure- 50/50 chance] and 100 kt flight-level winds with flight-level gusts to 125 kt with report of "storm intensified" (AWS, micro). Eight other surface gales, six other flight-level hurricane force winds, and eight other low pressures of less than 1000 mb. "Ship reports during the night [of the 29<sup>th</sup>-30<sup>th</sup>] indicated the possibility that the storm center was turning northward and the morning reconnaissance flight found the storm center at latitude 27.8N, indicating not only a turn to the north but rapid acceleration. Hurricane Warning was advised from Mobile to Cross City at 30/0930Z on the basis of the ship reports in the Gulf. During the afternoon of the 30<sup>th</sup>, the SS Mather reported a minimum pressure of 978 mbs and reconnaissance reported gusts to 125 kt. At this time, the center was moving north at 12-15 kt" (AWS). "Aircraft and ship reports on the afternoon of the 30<sup>th</sup> estimated strongest winds at about 115 mph some distance south of the Alabama coast. This was the strongest reported in connection with this storm" (MWR). "On the 30<sup>th</sup>, wind speeds continued to rise to 125 kt in gusts and the surface pressure fell rapidly to at least 978 mbs. Approximately 8 hours after those observations were reported, the center moved inland" (AWS). "Hurep Duck: Very rough sea. Gusts to 125 kt. Center of storm at 1930Z 28.0N, 88.5W. Storm has intensified very much. Winds are 100 kt in NE quadrant. Sea is very rough with very high swells. Severe turbulence encountered" (micro). From the ATS report... "It is now apparently moving northward toward the U.S. Gulf Coast. The flight departed Miami for a position almost due west of Miami, but found after a short distance that the hurricane was further north than anticipated and plans were changed enroute. The storm area was circumnavigated twice and the rather indistinct center of low pressure was passed through twice and investigated thoroughly. Then the area to the northeast was searched so that knowledge of the weather and wind field preceding the storm toward the coastline, particularly the Pensacola area, could be

related to the people who needed to know. Several extra hours in flight were spent to gather the fullest amount of data possible. 1540Z plain language message: No eye encountered. Elongated trough oriented NE-SW. Easterly wave type wind shear across trough. Min pressure 993 mbs extends along trough” (ATS). “Tropical cyclones in Florida, Aug. 30, Pensacola, Minor, Damage \$550,000. Tropical cyclones in Louisiana, Mississippi, and Alabama, Minimal, 1 killed, damage \$2,550,000” (“Minor” is equivalent to winds of less than 74 mph and pressure above 996 mb; “minimal” is equivalent to winds of 74-100 mph and pressure 983 to 996 mb- Dunn and Miller). “Aug 30 – Center crossed coast near Mobile – Estimated lowest 28.90” (Connor 1956).

August 31:

HWM analyzes a closed low of at most 995 mb centered over west-central Alabama near 33.7N, 87.9W. HURDAT lists this as a 50 kt tropical storm at 32.2N, 87.9W. The AWS best track lists a 0030Z position at 29.2N, 88.0W with 100 kt max winds and 978 mb central pressure and a 1230Z position at 34.0N, 88.7W with 55 kt max winds and 992 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 34.3N, 88.1W with a 987 mb pressure. The MWR post-season track map shows a 12Z position near 33.7N, 87.6W. Microfilm analyzes a closed low of at most 993 mb centered near 34.2N 88.2W with a front plotted extending from 37N, 91W northeastward to beyond 41N, 84W. Ship highlights: 60 kt E and 996 mb at 00Z at 29.8N, 87.8W (micro). One other gale of 35 kt and 34 other low pressures between 1001-1005 mb. Land/station highlights: 85 kt at Santa Rosa Island (max w) [gust or sustained? Measured or estimated?] (climo); 40 kt SE (max w/1-min) at Pensacola, Apalachicola, and Birmingham (climo); 979 mb (central pressure) around ~03Z at Fort Morgan, AL (30.2N, 88.0W) (Connor, Ho et al.); 63 kt NW around ~03Z at Fort Morgan (Connor); 991 mb (min p) at 03Z at Pensacola (climo); 987 mb (min p) around 03Z or 04Z at Mobile, AL (Connor); 40 kt WSW and 995 mb at 06Z at Pensacola (micro); 20 kt WSW and 993 mb at 06Z at Mobile (micro); 30 kt N and 993 mb at 12Z at Tupelo, MS (34.3N, 88.8W) (micro); 30 kt NNW and 998 mb at 18Z at Memphis, TN. Three other gales and six other low pressures of less than 1000 mb. “It lost some force before moving inland during the night of the 30<sup>th</sup> between Mobile and Pensacola. Winds on the coast were 75 to 85 mph; a total of about \$2,550,000 damage to property and crops resulted from winds and tides in a zone from near Mobile to St. Marks, FL. There were two tornadoes reported in connection with this hurricane, one of which demolished four dwellings and a store building, and damaged 11 other buildings at Apalachicola. The other tornado occurred in Jackson County, FL, but only one home was destroyed. Heavy rain and winds results in heavy crop damage in southern Alabama and northwest Florida. Gusts of 50 mph were recorded as far inland as Birmingham Airport, and were estimated as high as 75 mph atop adjacent mountains. One person was killed and two injured in Birmingham by fallen live wires” (MWR). “This movement brought the center inland just east of Mobile at about 0400Z on the 31<sup>st</sup>. Coastal stations reported maximum winds of only 75 to 80 knots as compared to the 90 to 120 knots expected on the basis of winds reported by ships and aircraft recon. The storm continued inland along the Mississippi-Alabama state line into western Tennessee at an accelerated rate. In this area, the disturbance became associated with a frontal system and lost its identity as a tropical storm as the winds dropped below gale force. Although the storm did not live up to its advance notices in strength,

Northwest Florida and Alabama along the Mississippi state line received damages in excess of \$1,000,000. Two people were killed and six hurt. Florida suffered \$600,000 worth of property damage along the Gulf Coast between Apalachicola and Pensacola. Alabama had property damage of at least \$500,000” (AWS). “No land station reported even gusts above 80 kt” (AWS). “After the center moved inland it accelerated to 24 kt for 12 hours and then dropped back to about 15 kt. Regarding the storm in Alabama (where \$1,500,000 damage was done to crops and \$500,000 damage was done to property, 1 killed, and 2 injured)... “Center of storm moved northward from Gulf through Alabama, near Mississippi border. Considerable roof and miscellaneous damage to houses and other buildings in Monroe County. Damage progressively lighter eastward and northward [in the state of Alabama]; no damage in eastern border counties and extreme north. Some slight damage to most houses in Frisco City, Monroe County, but farther south where building designers are wind-conscious, little general damage to buildings. Limit of area in which roof damage occurred included southwestern one-fourth of State. Some uprooted trees over an area including about one-half of remainder of State and extended to within 50 or 60 miles of Georgia line and about 100 miles of Tennessee line. Damage heavy in Birmingham area, however, due to topographic effect on air flow” (climo). Regarding the storm in Florida (northwestern portion- Franklin County, and all of Florida west of Apalachicola river, where \$100,000 damage was done to crops and \$409,000 was done to property)... “Center passed inland between Mobile and Pensacola moving north-northeastward. Wind reached 100 mph night of 30<sup>th</sup> at Santa Rosa Island south of Pensacola. At Pensacola, lowest sea-level pressure was 29.27 inches at 10 pm, 30<sup>th</sup> (991 mb at 03Z on the 31<sup>st</sup>), and maximum wind speed 42 mph from the southeast at 8:48 to 8:53 pm 30<sup>th</sup> (37 kt SE- 5 min max wind at 0150Z on the 31<sup>st</sup>)” (climo). Regarding two tornadoes associated with Baker... “Apalachicola- 22Z- 2210Z- 30<sup>th</sup>- 50 yards wide- damage to property \$35,000- Tornado moved northeastward in northeastern quadrant of hurricane damaging 23 homes. Reported as a waterspout that came ashore. It was on the ground for a length of 900 yards. Another tornado was reported in Jackson County, FL- early am- 31<sup>st</sup>- property damage \$6,000- Tornado occurred in northeastern quadrant of hurricane. One home and one other building destroyed; one home and two other buildings damaged” (climo). “Aug 31, 1950 – 979 mb landfall pressure based upon 979 mb observed at Ft. Morgan, AL – RMW 21 nm – speed 23 kt – landfall point 30.2N, 88.1W” (Ho et al. 1987). “Baker – 1004 mb environmental pressure at landfall – 70 kt estimated max 1-min wind at landfall” (Schwerdt et al. 1979). “Baker – AL, 1 – 980 mb” (Jarrell et al. 1992).

#### September 1:

HWM analyzes a closed low of at most 1005 mb centered over the northern part of extreme western Tennessee near 36.3N, 89.0W. HURDAT lists this as a 15 kt tropical depression at 36.0N, 89.3W. Microfilm analyzes a closed low of at most 1005 mb centered near 36.6N, 89.0W. Land/station highlights: 25 kt NNW and 999 mb at 00Z at 36.4N, 90.0W (micro); 20 kt N and 1004 mb at 06Z at 39.2N, 88.5W (micro).

#### September 2:

HWM no longer analyzes a closed low on this day but instead analyzes a trough over the south-central states around the Arkansas area. A warm front extends southeastward from

a mid-latitude low pressure area over South Dakota to the Nebraska/Missouri border. The warm front becomes a cold front there and it extends eastward all the way through to near southeastern Pennsylvania. HURDAT no longer lists a system on this day.

Baker formed from an easterly wave that emerged off the African coast on 13 August. HURDAT starts this system at 06Z on 20 August at 16.3N, 55.0W with a 60 kt intensity. Although there is a chance that Baker was a tropical depression or tropical storm by the 19<sup>th</sup>, there are not sufficient observations to close off a circulation, so no change is made to the timing of genesis. The intensity at 06Z on the 20<sup>th</sup> is lowered by 10 kt and the position is moved one degree west-southwest of the previous HURDAT starting position. By 06Z on the 21<sup>st</sup>, observations from the Leeward Islands indicated the approaching cyclone with slowly falling pressures and cyclonic curvature of the winds. The first highlight observation was a ship report of 60 kt and 1006 mb at 10Z on the 21<sup>st</sup>, and the first aircraft center fix was made at 1247Z (the aircraft found a 990 mb central pressure and reported an eye radius of 6 nmi). Later, at 2040Z, aircraft measured a 987 mb central pressure with the cyclone centered at 17N, 61.1W. Central pressures of 990 and 987 mb are added into HURDAT at 12Z and 18Z on the 21<sup>st</sup> respectively. At 04Z on the 22<sup>nd</sup>, the hurricane is analyzed to have passed just south of Antigua. Antigua verbally reported winds of between 80-105 kt, but it is unknown whether these winds were estimated or measured. The minimum pressure reported at Antigua was 990 mb, but there were no reports of calm on the island. The HURDAT track is moved northward to show a track closer to Antigua. For intensity on the 21<sup>st</sup>, a 990 central pressure yields 64 kt according to the Brown et al. southern pressure-wind relationship, but 70 kt is chosen for 12Z (down from 105 kt originally) due to the small RMW size reported by the aircraft. A 987 mb central pressure yields 68 kt, and 75 kt is chosen for 18Z (down from 100 kt originally). The 90 kt intensity in HURDAT at 00Z on the 22<sup>nd</sup> is unchanged since there is no intensity information between the last aircraft fix on the 21<sup>st</sup> and the Antigua impact. All available information indicates that Baker rapidly weakened as it moved westward after its impact on Antigua. Aircraft fixes at 15Z on the 22<sup>nd</sup> reported central pressure values of 1003 mb, but the circulation was definitely still closed. A central pressure of 1003 mb is added into HURDAT at 18Z on the 22<sup>nd</sup>. A central pressure of 1003 mb yields 43 kt using the southern pressure-wind relationship for weakening systems, and 45 kt is chosen for 18Z on the 22<sup>nd</sup> (down from 60 kt originally). Baker is analyzed to have made landfall on the southern coast of Puerto Rico just east of Ponce around 13Z on the 23<sup>rd</sup> as a 35 kt tropical storm. Some Puerto Rican land stations reported 30 kt winds and pressures as low as 1006 mb, and aircraft estimated surface winds as high as 40 kt and measured pressures as low as 1003 mb around the time of Puerto Rican landfall. Baker is analyzed to have weakened to a tropical depression at 18Z on the 23<sup>rd</sup>, about the same time it exited the west coast of Puerto Rico. Baker made landfall on Hispaniola at 18.6N, 68.3W at 00Z the 24<sup>th</sup> as a 30 kt tropical depression (no change to HURDAT). The center of circulation stayed over the island or hugged the coastline until 10Z the 24<sup>th</sup> when it moved north of the island. While over Hispaniola, Baker is analyzed to have weakened to a 25 kt tropical depression. At 18Z on the 24<sup>th</sup>, Baker passed over Great Inagua Island in the Bahamas, where a minimum pressure of 1003 mb was recorded. A 30 kt wind was also reported from a ship, and observations indicated the circulation was definitely closed. It is analyzed that Baker re-strengthened

to a 40 kt tropical storm by that time (up from 35 kt originally). Baker continued moving westward and is analyzed to have made its first Cuban landfall around 08Z on the 25<sup>th</sup> at 21.7N, 77.1W as a 45 kt tropical storm. The previous HURDAT track was a few tenths of a degree too far west at each point on the 25<sup>th</sup> as indicated by Cuban observations, and slight eastward adjustments are analyzed. Even though the highest observed wind on the 25<sup>th</sup> was only 30 kt, a minimum pressure of 1002 mb was recorded at Camaguey simultaneously with 25 kt winds around 1230Z on the 25<sup>th</sup>. It is possible that the central pressure was lower prior to landfall. The revised intensities on the 25<sup>th</sup> are as follows: 45, 45, 35, and 30 kt (originally 25, 25, 30, and 30 kt). The center of Baker emerged over water south of Cuba around 20Z on the 25<sup>th</sup>, and it is analyzed that Baker strengthened again to a 35 kt tropical storm by 00Z on the 26<sup>th</sup> (no change to HURDAT). On the 26<sup>th</sup>, no track changes of more than two-tenths of a degree are analyzed. At 06Z on the 26<sup>th</sup>, the island of Cayo Guano de Este recorded 35 kt N and 1001 mb, and a 45 kt intensity is analyzed for HURDAT at that time (up from 35 kt originally). Baker is analyzed to have passed near or over the north coast of the Isle of Youth from 12Z on the 26<sup>th</sup> to 00Z on the 27<sup>th</sup>. Observations indicate that Baker was likely strengthening during this time. HURDAT intensities are increased by 5 to 10 kt from 06Z to 18Z on the 26<sup>th</sup> in accordance with observations. It is analyzed that Baker made another landfall on Cuba around 05Z on the 27<sup>th</sup> near 22.2N, 83.8W as a 50 kt tropical storm. Baker emerged over the Gulf of Mexico by 11Z on the 27<sup>th</sup>. It is analyzed that Baker weakened by 5 kt during its short time over western Cuba. From the 27<sup>th</sup> through the 29<sup>th</sup>, Baker moved slowly and erratically towards the west-northwest, reaching a position of 24.1N, 88.4W by 18Z on the 29<sup>th</sup> (original position 25.0N, 89.1W). Numerous aircraft fixes from the 27<sup>th</sup> through the 29<sup>th</sup> do not resemble anything remotely similar to a smooth curve. Available ship observations aided somewhat in the track reanalysis during this period. It is noteworthy that the Dry Tortugas anemometer appeared consistently too high with wind speed observations, and this may be due in part to the elevation of the anemometer. Navy aircraft reported central pressures between 996-998 mb between 15Z on the 27<sup>th</sup> and 18Z on 28<sup>th</sup>. Central pressures of 996, 998, and 996 mb are added into HURDAT at 18Z on the 27<sup>th</sup>, and 12 and 18Z on the 28<sup>th</sup> respectively. The 996 mb central pressures yields 54 kt according to the southern pressure-wind relationship. A steady intensity of 55 kt is chosen at all times from 18Z on the 27<sup>th</sup> through 18Z on the 28<sup>th</sup> (down from 65 kt originally by 18Z on the 28<sup>th</sup>). At 2039Z on the 28<sup>th</sup> a dropsonde from an Air Force plane recorded a 993 mb pressure, and a ship around the same time recorded a minimum pressure of 995 and a maximum wind of 50 kt. On the 29<sup>th</sup>, Baker likely underwent intensification, but the aircraft did not attempt to penetrate the center on that day and no reliable observations of the peak intensity were made on the 29<sup>th</sup>. On the 30<sup>th</sup>, Baker suddenly accelerated towards the north. The analyzed position, which is a degree south of the previous HURDAT position at 00Z on the 30<sup>th</sup>, "caught up" with the HURDAT position by 12Z. Aircraft approximately fixed the center at 1307Z, and located the center more precisely with the final aircraft fix at 1930Z on the 30<sup>th</sup> at 28.0N, 88.5W. A ship reported winds of 80 kt along with a pressure of 996 mb sometime between 06Z – 10Z on the 30<sup>th</sup>. A 980 mb pressure was the lowest pressure reported by the aircraft on the afternoon flight, but it is uncertain whether this is a central pressure value. At 20Z on the 30<sup>th</sup> a ship involved with Baker recorded a minimum pressure of 978 mb, and it is unknown whether this value is a central pressure. This ship also recorded maximum

winds of 70 kt around the same time, but not necessarily simultaneously. A 978 mb peripheral pressure suggests wind speeds of greater than 75 kt according to the north of 25N pressure-wind relationship.

Baker made landfall at Fort Morgan, AL (30.2N, 88.0W) at 03Z on 31 August where a 979 mb central pressure was recorded at landfall (Ho et al. 1987, Connor 1956). The 979 mb central pressure at 06Z on the 30<sup>th</sup> is removed from HURDAT and a central pressure of 979 mb is added into HURDAT at 00Z on the 31<sup>st</sup>. The center of Baker then traveled into Mobile Bay and made its final landfall at 04Z on the 31<sup>st</sup> at 30.7N, 87.9W. The highest wind information available from land is an 85 kt max wind report from Santa Rosa Island, FL (30.3N, 87.1W), but it is unknown whether these winds were observed or estimated and it is unknown whether this was a sustained wind or a gust. An official wind of 63 kt was recorded at Fort Morgan (Connor). The RMW at landfall was 21 nmi (Ho et al.) (climo RMW is 23 nmi), the 12 hour forward speed of Baker was 16 kt, the OCI is analyzed to be 1003 mb and the ROCI was 250 nmi. Baker was either steady state or weakening at landfall. A 979 mb central pressure corresponds to 74 or 71 kt according to the north of 25N pressure-wind relationship for steady state and weakening systems respectively. The HURDAT intensity at 00Z on the 31<sup>st</sup> of 75 kt is unchanged, and 75 kt is chosen for 00Z and landfall despite the very low environmental pressure. Although the environmental pressure of the southwest side of the cyclone was very low, it was higher on the northeast side where a much tighter pressure gradient is evident. Intensities of 75 kt are chosen for both landfalls because of the uncertainty in the Santa Rosa Island observation (described above). A run of the Schwerdt Model indicates a Category 1 impact for northwest Florida, and this is added into HURDAT. Baker is also analyzed as a Category 1 impact for Alabama. The Schwerdt model suggests that Mississippi did not receive hurricane force winds. For the 30<sup>th</sup>, intensities of 90, 90, 90, and 85 kt are analyzed for 00, 06, 12, and 18Z respectively (originally 90, 90, 95, and 95 kt). Although there are not available intensity observations that show that the hurricane was that strong, there were no definite central pressure observations on the 30<sup>th</sup>. Baker is analyzed to have reached its peak intensity of 90 kt for the 2<sup>nd</sup> time between 00Z and 12Z on the 30<sup>th</sup>. Baker is analyzed to have weakened from 90 kt to 75 kt during the final 12 hours or so before reaching the Gulf Coast. After landfall, Baker moved northward near the Alabama/Mississippi border and into western Tennessee. The largest track changes for the lifetime of Baker are analyzed after landfall from 12Z on 31 August through 06Z on 1 September with changes up to 1.8 degrees to the north-northwest of the previous HURDAT positions. Runs of the Kaplan and DeMaria Inland Decay Model yield 58, 39, and 29 kt for 06, 12, and 18Z on 31 August respectively. The highest observed wind within 2 hr of the synoptic times are 40, 30, and 30 kt respectively. Intensities of 60, 40, and 35 kt are chosen (down from 65 kt at 06Z and 50 kt at 12Z originally). Baker weakened to a tropical depression by 00Z on 1 September and dissipated after 18Z on the 1<sup>st</sup>. No intensity changes are made on the 1<sup>st</sup>, and no changes are made to the timing of dissipation. The final point at 18Z on 1 September is over extreme southeastern Missouri.

1950 Storm 3 (Charlie)

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34895 08/21/1950 M=16 3 SNBR= 774 CHARLIE XING=0
34900 08/21* 0 0 0 0* 0 0 0 0*131 240 35 0*124 254 35 0
34900 08/21* 0 0 0 0* 0 0 0 0*131 264 35 0*124 276 35 0*
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34905 08/22*118 270 35 0*112 288 35 0*107 306 35 0*104 320 35 0*
34905 08/22*118 289 35 0*112 301 35 0*107 314 35 0*106 327 35 0*
*** ***

34910 08/23*103 332 35 0*102 344 35 0*102 356 35 0*103 369 35 0*
34910 08/23*106 340 35 0*106 352 35 0*107 364 35 0*108 375 35 0*
*** ***

34915 08/24*103 382 35 0*104 391 35 0*105 400 35 0*106 410 40 0*
34915 08/24*110 386 35 0*112 397 35 0*115 407 35 0*119 417 40 0*
*** ***

34920 08/25*108 420 40 0*110 427 40 0*114 434 40 0*122 441 40 0*
34920 08/25*124 427 40 0*129 436 40 0*135 445 40 0*142 454 40 0*
*** ***

34925 08/26*132 449 45 0*144 458 45 0*155 467 45 0*164 474 45 0*
34925 08/26*149 462 45 0*157 471 45 0*165 480 45 0*173 490 45 0*
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34930 08/27*172 480 50 0*181 487 55 0*190 495 55 0*204 510 60 0*
34930 08/27*181 500 50 0*189 510 55 0*198 520 55 0*209 529 60 0*
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34935 08/28*220 528 70 0*234 543 80 0*247 555 85 0*255 564 90 0*
34935 08/28*223 537 65 0*238 546 70 0*250 555 70 985*261 564 75 0*
*** *** **

34940 08/29*262 571 95 0*277 577 95 0*292 580 100 0*303 578 100 0*
34940 08/29*271 571 80 0*283 573 80 0*295 575 85 974*304 575 90 0*
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34945 08/30*313 573 100 0*323 566 95 0*332 558 90 0*328 546 90 0*
34945 08/30*312 571 90 0*319 566 90 0*325 561 90 0*328 560 90 0*
*** *** **

34950 08/31*322 554 85 0*324 562 85 0*326 571 85 0*327 577 85 0*
34950 08/31*329 562 90 0*328 564 90 0*328 567 95 0*328 573 95 0*
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34955 09/01*327 582 75 0*328 586 75 0*329 590 70 0*330 595 75 0*
34955 09/01*328 579 95 0*327 584 90 0*326 589 85 0*327 595 85 0*
*** *** **

34960 09/02*330 601 75 0*331 607 80 0*333 612 85 0*341 617 85 0*
34960 09/02*330 601 80 0*333 607 80 0*337 612 75 0*343 614 75 980*
** *** **

34965 09/03*350 617 85 0*357 613 85 0*363 608 85 0*366 605 80 0*
34965 09/03*349 615 75 0*354 613 75 0*360 610 75 0*363 607 70 0*
*** *** **

34970 09/04*369 601 75 0*373 595 70 0*378 588 70 0*384 581 65 0*
34970 09/04*366 601 65 0*371 593 65 0*378 582 60 0E386 571 55 0*
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34975 09/05E397 568 55 0E417 547 45 0E437 525 40 0* 0 0 0 0*
34975 09/05E400 558 55 0E422 530 50 0E448 474 50 0* 0 0 0 0*
*** ***

34980 HR

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Major changes to both track and intensity are analyzed for this hurricane. Evidence for these alterations arises from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), and U.S. Weather Bureau public advisories.

August 20:

HWM analyzes a broad closed low of at most 1010 mb centered near 15N, 31W and trough of low pressure over northwest Africa. HURDAT does not yet list a system on this day. No gales or low pressures.

August 21:

HWM analyzes an elongated but closed low of at most 1010 mb centered in the general vicinity of 14.5N, 24.0W. HURDAT lists this as a 35 kt tropical storm at 13.1N, 24.0W. No gales or low pressures.

August 22:

HWM analyzes an elongated but closed low of at most 1010 mb centered in the general vicinity of 11.5N, 31.0W. HURDAT lists this as a 35 kt tropical storm at 10.7N, 30.6W. No gales or low pressures.

August 23:

HWM analyzes a closed low of at most 1010 mb centered near 11.5N, 35.5W. HURDAT lists this as a 35 kt tropical storm at 10.2N, 35.6W. No gales or low pressures. "Charlie, the third storm of the 1950 Hurricane Season, entered the sphere of our maps as a closed circulation. The first manifestation of a disturbance was a ship at 10N, 40W at 1830Z on 23 August reporting a west wind of 10 kt, pressure 1010.5 mbs, pressure tendency -2.0 mbs and rain within the last hour. Post analysis placed the center of a closed disturbance at 13N, 39.4W at 23/1830Z. To say how or where the storm developed would be pure conjecture since we have neither map nor data for earlier analysis. For nearly four days subsequent to its initial detection, the disturbance was carried alternatively as a closed low and open wave because of the lack of positive data" (AWS).

August 24:

HWM analyzes 2 spot lows- the feature of interest near 11N, 39.5W and another spot low near 14N, 27W, both enclosed by a single 1010 mb isobar, which covers a distance from 9-19N, 24-45W. HURDAT lists this as a 35 kt tropical storm at 10.5N, 40.0W. No gales or low pressures.

August 25:

HWM analyzes two spot lows- the feature of interest near 13N, 43W and another spot low near 14N, 32W, both enclosed by a single 1010 mb isobar, which covers a very large area similar to the previous day. HURDAT lists this as a 40 kt tropical storm at 11.4N, 43.4W. No gales or low pressures. "Charlie [was analyzed in the post-season analysis to have] moved on a west-northwest course [from the 23<sup>rd</sup>] until the 25<sup>th</sup> in conformance with the conception that a storm in its initial stages of development moves about 15 to 20 degrees to the right of the flow in which it is imbedded" (AWS). "The track to the

northwest on the 25<sup>th</sup> was short lived... [and then synoptic conditions] forced the storm to resume its WNW movement” (AWS).

August 26:

HWM analyzes a closed low of at most 1010 mb centered near 15.5N, 46.0W. HURDAT lists this as a 45 kt tropical storm at 15.5N, 46.7W. No gales or low pressures.

August 27:

HWM analyzes a spot low within a open trough (the 1015 mb isobar is not completely closed) located near 19.5N, 49.5W. HURDAT lists this as a 55 kt tropical storm at 19.0N, 49.5W. The AWS best track lists a 0030Z position at 20.3N, 49.3W with 80 kt max winds and 984 mb central pressure and a 1230Z position at 21.4N, 51.6W with 80 kt max winds and 984 mb central pressure. Ship highlights: 40-50 kt E G 70 kt and 1015 mb at 13Z at 21.9N, 52.0W (AWS). “It was noted on August 27 near 23N, 53W whence it moved northwestward to about 29N, 58W and recurved to the northeast” (MWR). “On the 27<sup>th</sup>, we received the following report from the ship Liparus: ‘Liparus 1300 GMT, 21.9N, 52.0W, very rough sea, very heavy SSE swell, overcast, wind east by north force 9, force 10 to 12 in squalls, visibility poor, barometer 1015 mb rising slowly.’ This report showed rather conclusively the presence of a full fledged hurricane. AFBUL (advisory) number one on Hurricane Charlie was issued at 27/2000Z placing the center at 21.0N, 52.5W. In post analysis, it was learned that this position was approximately 90 miles too far south” (AWS).

August 28:

HWM analyzes a spot low within a trough located near 23.5N, 52.5W. HURDAT lists this as an 85 kt hurricane at 24.7N, 55.5W. The AWS best track lists a 0030Z position at 23.3N, 53.8W with 85 kt max winds and 983 mb central pressure and a 1230Z position at 25.4N, 55.8W with 85 kt max winds and 981 mb central pressure. The MWR post-season track map shows a 12Z position near 24.6N, 55.2W. Microfilm analyzes a tropical storm of at most 999 mb centered near 25.1N, 55.2W. Ship highlights: 35 kt ENE and 998 mb at 12Z at 26.0N, 55.3W (micro); less than or equal to 981 mb at 21Z near 26.6N, 56.5W (micro); 50 kt SSW and 996 mb at 22Z at 26.5N, 56.5W (micro). One other gale. Aircraft highlights: Air Force center fix at 10Z at 25.2N, 55.2W with 85 kt max winds (micro); Air Force center fix (by boxing) at 20Z at 26.8N, 57.2W (micro). From the 27<sup>th</sup> through the 29<sup>th</sup> the storm moved around the outer periphery of the subtropical high in a “smooth parabolic curve” (AWS). “Duck 10: Circling in eye of hurricane. Center located at 25.2N, 55.2W moving NW 15 kt at 10Z. Duck 11: Eye of hurricane 35 miles diameter. Max winds 85 kt. Hurricane force winds extend [40?] miles in all quadrants” (micro). “Post flight AF plane: Entered eye 0955Z at 25.2N, 55.1W. Eye 35 miles in diameter. Max winds 85 kt in all quadrants. Hurricane force winds extend 40 miles in all quadrants. Gales extend 80 miles in all quadrants” (micro). “Estimated position of center from boxing is 26.8N, 57.2W at 2000Z by AF plane” (micro).

August 29:

HWM analyzes a tropical storm of at most 1010 mb centered near 29.0N, 57.0W. HURDAT lists this as a 100 kt hurricane at 29.2N, 58.0W. The AWS best track lists a 0030Z position at 27.6N, 57.2W with 95 kt max winds and 978 mb central pressure and a 1230Z position at 29.5N, 57.7W with 100 kt max winds and 974 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 29.8N, 58.4W with a 996 mb pressure. The MWR post-season track map shows a 12Z position near 29.5N, 58.1W. Microfilm analyzes a tropical storm of at most 999 mb centered near 29.2N, 58.7W. Ship highlights: 35 kt SW and 1010 mb at 18Z at 28.7N, 57.0W (COA). Aircraft highlights: Air Force center fix at 1023Z at 29.3N, 57.4W with 974 mb central pressure, 90 + kt max measured (at flight-level) wind on southwest side, and 100 kt estimated max surface winds (micro, AWS); Air Force center fix at 1850Z at 30.5N, 57.5W with 100 kt max winds [at 700 mb?] (micro); Air Force center fix at 21Z at 30.9N, 57.3W (micro). "Duck 4: Position of eye 29.3N, 57.4W at 1023Z" (micro). "975 mb surface pressure in eye. Wind SW edge 90 kt plus" (micro). Duck 9: Hurricane center 30.5N, 57.5W at 1850Z. Circling in eye. Second position by boxing. Eye of hurricane 20 miles wide by 30 miles long. Elongated E-W. Winds edge of eye 100 kt in NE quadrant and 90 kt in remaining quadrants. Leaving eye to box low levels" (micro). "Post flight summary: Hurricane approached from southwest at 10,000 ft by surface winds and radar. Hurricane winds on surface observed 60 miles from edge of eye. Eye entered from west at 1840Z. Center located 30.5N, 57.5W at 1840Z. Departed eye to the west at 1900Z and started boxing procedure [at 1500 feet?] at 1927Z. Completed box at 2104Z. Eye elongated east-west 20 by 35 miles in diameter. Hurricane winds extend 80 miles in all quadrants. Gale winds extend 90 miles in all quadrants. Second position of center located 30.9N, 57.3W at 2100Z" (micro). "Theoretically, a storm should attain its highest wind velocity at the time of minimum central pressure and vice versa. This may or may not have been true in the case of the storm in question. A minimum pressure of 974.4 mbs and a maximum wind of 100 knots was reported at 29/1049Z" (AWS).

August 30:

HWM analyzes a low of at most 1005 mb centered near 31.2N, 55.8W. HURDAT lists this as a 90 kt hurricane at 33.2N, 55.8W. The AWS best track lists a 0030Z position at 31.3N, 57.1W with 100 kt max winds and 972 mb central pressure and a 1230Z position at 32.3N, 56.3W with 105 kt max winds and 968 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 33.8N, 55.6W with a 983 mb pressure. The MWR post-season track map shows a 12Z position near 33N, 56W. Microfilm analyzes a hurricane of at most 999 mb centered near 33.7N, 56.2W. Ship highlights: 50 kt SSW and 1006 mb at 06Z at 30.7N, 55.2W (COA). Five other gales between 35-45 kt. Aircraft highlights: Air Force center fix (by boxing) at 2145Z at 32.9N, 56.1W with 105-110 [estimated?] max winds (micro, AWS); 994 mb 50 mi SW of center and 996 mb 50 mi NE of center around time of 2145Z fix (micro, AWS). "On the 30<sup>th</sup> when it had reached the vicinity of 34N, 56W, its progress was blocked by high pressure to the north" (MWR). "The movement of the storm to the northeast on the 30<sup>th</sup> and the abrupt change of direction to the west on the 31<sup>st</sup> were the result of a series of [synoptic] changes that took place at upper levels" (AWS). "By 30/2145Z, the wind had increased to 110 knots. While boxing the storm on the 30<sup>th</sup> the reconnaissance flight reported a pressure of 994.4 mbs 50 miles SW of the center and a pressure of 996.1 mbs 50 miles NE of the center"

(AWS). “Storm boxed. Position of center 32.9N, 56.1W. Definite oval shape SE to NW. Maximum winds 105 to 110 kt. Hurricane [winds extend outward] to 80 miles, gale winds to 150 miles [radius from center]. Minimum pressure 32.1N, 56.8W 994.4 mb and 33.7 N and 55.8W 996.1 mb” (micro).

August 31:

HWM analyzes a low of at most 1005 mb centered near 33.2N, 55.6W with a SW-NE stationary front located north of the cyclone from 40N, 62W to 44N, 52W. HURDAT lists this as an 85 kt hurricane at 32.6N, 57.1W. The AWS best track lists a 0030Z position at 33.0N, 56.2W with 115 kt max winds and 964 mb central pressure and a 1230Z position at 33.0N, 56.6W with 125 kt max winds and 960 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 33.9N, 56.5W with a 969 mb pressure. The MWR post-season track map shows a 12Z position near 33N, 56W. Microfilm analyzes a hurricane of at most 1005 mb centered near 32.7N, 55.8W. Aircraft highlights: center fix (by boxing) around 21Z at 33.0N, 57.0W with estimated max winds of 125 kt (micro, AWS). “On the 31<sup>st</sup>, Charlie was effectively blocked to the north. Its only recourse was to move westward around the southern periphery of the high” (AWS). “On the 31<sup>st</sup>, the storm had slowed to 2 knots with a maximum intensity of 125 knots” (AWS). “Since no penetration was attempted on the 31<sup>st</sup>, it is impossible to say what the central pressure was at the time the winds had reached their maximum of 125 knots. It is safe to assume, however, that the central pressure on the 31<sup>st</sup> was in the neighborhood of 960 mbs since the storm was in the process of filling on the 1<sup>st</sup> and 2<sup>nd</sup> and still had a pressure of 980.2 mbs at 02/1847Z” (AWS). “Extent of hurricane winds NW quadrant 110 miles SW quadrant 65 miles, SE quadrant 80 miles, NE quadrant 90 miles. Extent of storm winds NW quadrant 125 miles, SW quadrant 80 miles, SE quadrant 105 miles, NE quadrant 110 miles. Extent of gale winds NW 135 mi, SW 90 mi, SE 120 mi, NE 120 mi. Generally light, continuous turbulence over track covered while boxing storm. Generally light, continuous rain. Storm center by navigator and weather observer in very close agreement. Degree of confidence of DR fixes is high. Storm seems to be moving SW at 16 kt. Winds at center estimated 125 kt” (micro). “Duck 08 special: Hurricane calculation- storm center at 33N, 57W- weather observer’s data show southwesterly movement at 16 kt” (micro).

September 1:

HWM analyzes a low of at most 1005 mb centered near 33.2N, 58.9W. HURDAT lists this as a 70 kt hurricane at 32.9N, 59.0W. The AWS best track lists a 0030Z position at 32.9N, 57.5W with 125 kt max winds and 970 mb central pressure and a 1230Z position at 32.8N, 58.7W with 100 kt max winds and 984 mb central pressure. The MWR post-season track map shows a position near 33N, 59W. Microfilm analyzes a hurricane of at most 1002 mb centered near 32.5N, 59.5W. Ship highlights: 30 kt NW and 1005 mb at 18Z at 32.4N, 62.2W (COA); 30 kt SSW and 1005 mb at 18Z at 29.4N, 61.3W (COA). Aircraft highlights: Air Force center fix (loran-aided) at 1610Z at 32.5N, 59.4W (micro). There were hurricane force winds in all quadrants on the 1<sup>st</sup> and into most of the 2<sup>nd</sup> (AWS). “AF 1727Z: In eye at 1610Z at 32.5N, 59.4W by loran. Eye filled by clouds” (micro).

#### September 2:

HWM analyzes a low of at most 1005 mb centered near 32.4N, 61.3W. HURDAT lists this as an 85 kt hurricane at 33.3N, 61.2W. The AWS best track lists a 0030Z position at 33.2N, 59.9W with 80 kt max winds and 984 mb central pressure and a 1230Z position at 33.9N, 60.9W with 95 kt max winds and 979 mb central pressure. The MWR post-season track map shows a 12Z position near 33.6N, 61.1W. Microfilm analyzes a hurricane of at most 984 mb centered near 34.3N, 61.2W. Ship highlights: 45 kt NW and 998 mb at 00Z at 32.7N, 61.4W (COA). Three other gales and one other low pressure. Aircraft highlights: center fix at 1847Z with 980 mb central pressure (AWS). "After becoming quasistationary, or perhaps making a loop in this area, it drifted very slowly westward to 34N, 62W on September 2 when it resumed northward and northeastward movement and rapidly became extratropical several hundred miles southeast of Nova Scotia. Strongest winds reported in this hurricane were about 115 mph recorded by aircraft" (MWR). "By 2 September, the storm had reached the western edge of the main body of the high and began to move slowly northward being retarded by a persistent ridge of high pressure that lay to the north" (AWS). "By 02/0630Z its speed had increased to 5.8 kt and the maximum wind had decreased to 80 kt. At this point it again slowed down and recurved to the north with winds increasing to 95 kt by 02/1230Z. On the afternoon of the 2<sup>nd</sup>, the 373<sup>rd</sup> Reconnaissance plane flew into the storm through the weak quadrant (the west side) and reported the maximum winds to be 58 kt. This report on the maximum wind is very misleading first because it is a measured wind and not an estimate of the maximum over the area of the storm traversed and secondly because the gradient to the east of the storm at that time was very tight. It is believed that the maximum wind in the east quadrant was near or in excess of 100 knots" (AWS).

#### September 3:

HWM analyzes a tropical storm of at most 1005 mb centered near 34.0N, 61.3W with a WSW-ENE cold front analyzed from 39N, 68W to 42N, 58W. HURDAT lists this as an 85 kt hurricane at 36.3N, 60.8W. The AWS best track lists a 0030Z position at 34.4N, 61.3W with 100 kt max winds and 978 mb central pressure and a 1230Z position at 34.9N, 61.3W with 75 kt max winds and 982 mb central pressure. The MWR post-season track map shows a 12Z position near 36.1N, 61.3W. Microfilm analyzes a low of at most 999 mb centered near 36.3N, 61.2W with a east end of an apparent E-W frontal boundary located near 38N, 67W. Ship highlights: 35 kt S and 1013 mb at 00Z at 31.4N, 57.9W (COA); 35 kt SW and 1017 mb at 12Z at 31.4N, 59.4W (COA). "On the 3<sup>rd</sup> of September, the ridge to the north began to decay in the face of a cold front and upper trough moving in from the northwest. At the same time, the center of the high to the east of the storm shifted more to the south and the storm moved off to the NNE" (AWS).

#### September 4:

HWM analyzes a closed low of at most 1000 mb centered near 36.3N, 58.5W embedded within an elongated region of below 1005 mb pressure elongated N-S along 56-59W from 35-43N. A warm front extends from 42N, 56W to 44N, 52W to 44.5N, 46W, and a cold front extends from 37N, 62W to 38N, 63W, and then it becomes a warm front extending northwestward to another, separate low. HURDAT lists this as a 70 kt hurricane at 37.8N, 58.8W. The AWS best track lists a 0030Z position at 35.6N, 60.7W

with 50 kt max winds and 983 mb central pressure and a 1230Z position at 37.6N, 59.2W with 35 kt max winds and 985 mb central pressure. The MWR post-season track map shows a 12Z position near 37.6N, 59.1W. Microfilm analyzes a hurricane of at most 999 mb centered near 40.5N, 57.0W. Ship highlights: 35 kt NNE and 1008 mb at 06Z at 39.6N, 61.1W (COA); 20 kt S and 1004 mb at 12Z at 41.5N, 55.5W (COA); 35 kt S and 1004 mb at 18Z at 41.5N, 53.5W (COA); 20 kt NNW and 999 mb at 18Z at 38.7N, 57.7W (COA, micro). Three other gales and two other low pressures. "Charlie joined forces with a small frontal wave [on this day]. The final bulletin was issued at 04/2130Z" (AWS).

#### September 5:

HWM analyzes a closed low of at most 1000 mb centered near 44.5N, 47.3W with a warm front extending from the low northeastward for 2 degrees, becoming a cold front, and connecting to another closed low of at most 995 mb centered near 49.5N, 41.5W. A cold front extends from the first low (feature of interest) southward and then west-southwestward, becoming a warm front near 39N, 50W. HURDAT lists this as a 40 kt extratropical storm at 43.7N, 52.5W. At 12Z, the low is just off the edge of the microfilm map; however, microfilm analyzes a low (closed in all likelihood) of at most 999 mb centered in the general vicinity of 45N, 47W. Ship highlights: 35 kt S and 1008 mb at 00Z at 41.8N, 51.1W (COA); 30 kt S and 999 mb at 06Z at 42.2N, 52.0W (micro); 45 kt S and 1006 mb at 06Z at 41.6N, 48.3W (COA, micro); 45 kt SW and 1005 mb at 18Z at 44.0N, 41.0W (COA). A few more gales and a few to several more low pressures.

Charlie formed from an easterly wave that emerged off the African coast on 20 August. HURDAT starts this system as a 35 kt tropical storm at 12Z on 21 August at 13.1N, 24.0W. At 12Z on the 21<sup>st</sup>, there is a ship observation of 20 kt westerly winds just over 1 degree northeast of the HURDAT position. Therefore, the position would have to either be moved further away from this observation, or the intensity would have to be lowered. Due to some later evidence on 23 August that the position was likely well west of the previous HURDAT position, the positions from the 21<sup>st</sup> to the 23<sup>rd</sup> are moved west of the previous HURDAT positions with major westward track adjustments introduced on the 21<sup>st</sup>. Also, although there is not definite evidence of a closed circulation on the 21<sup>st</sup>, there is not enough evidence to remove this portion of the track from HURDAT. On the 23<sup>rd</sup> at 18Z, a ship reported 10 kt W with 1010 mb. This observation was important for the previously mentioned track adjustments. The next time there were any observations pertaining to this system was not until the 27<sup>th</sup> when a ship recorded easterly gales north of the center. At the same time, another ship located 4.5 degrees to the south recorded light southwest winds. These observations allowed for an approximate location of the storm to be analyzed and a position of 19.8N, 52.0W is chosen for 12Z on the 27<sup>th</sup> (a major track adjustment of more than 2.5 degrees west-northwest of the previous HURDAT position). The revised track from the 24<sup>th</sup> through the 27<sup>th</sup> is consistently well northwest of the previous HURDAT track. No changes are made to the intensity from the 20<sup>th</sup> through the 27<sup>th</sup>, by which time HURDAT lists Charlie as a 55 kt tropical storm. On the 28<sup>th</sup>, Charlie moved north-northwestward, and on the 29<sup>th</sup>, it turned towards the north and slowed down near 29.5N, 57.5W. The largest track change made on the 28<sup>th</sup> through the 29<sup>th</sup> is about 1 degree. The track changes are based mainly on aircraft fixes,

but some important ship data late on the 28<sup>th</sup> influenced the analyzed track as well. The first aircraft reconnaissance flight into Charlie on the early morning of the 28<sup>th</sup> apparently measured a central pressure of 985 mb, and this value is added into HURDAT at 12Z on the 28<sup>th</sup>. A central pressure of 985 mb yields wind speeds of 71 and 66 kt according to the Brown et al. southern and north of 25N pressure-wind relationships respectively, and 70 kt is chosen for 12Z (down from 85 kt originally). During the afternoon of the 28<sup>th</sup>, a ship reported that the pressure fell from 1007 mb to 981 mb between 18Z and 21Z and then rose from 981 mb to 1008 mb between 21Z and 00Z on the 29<sup>th</sup>. Although there are no available wind observations higher than 50 kt from this ship, its time series provides extremely consistent observations that indicate that an Air Force center fix by boxing at 20Z on the 28<sup>th</sup> was likely off by a few tenths of a degree. A pressure of less than or equal to 981 mb yields wind speeds of at least 76 and 71 kt according to the southern and north of 25N pressure-wind relationships respectively. It may be appropriate to make use of the intensifying subset of the pressure-wind relationship since Charlie was in the midst of a 24-hour period during which the central pressure deepened by 11 mb and that would yield wind speeds of greater than 77 and 74 kt respectively for south and north of 25N. On the 29<sup>th</sup> at 1023Z, an Air Force aircraft penetrated the center and measured a central pressure of 974 mb, and this value is added into HURDAT at 12Z on the 29<sup>th</sup>. A central pressure of 974 mb yields 80 kt according to the north of 25N pressure-wind relationship and 83 kt if the cyclone was intensifying. 85 kt is chosen for 12Z on the 29<sup>th</sup> (down from 100 kt originally). On the 30<sup>th</sup>, the previous HURDAT track shows Charlie making a small, clockwise loop in the vicinity of 33N, 55W; however, observations and center fixes do not show any evidence that this loop occurred, and the loop is removed. On the 30<sup>th</sup>, the reanalyzed track shows Charlie moving towards the north-northeast, slowing down, and making a westward turn late on the 30<sup>th</sup> near 33N, 56W. On the 31<sup>st</sup> of August and the 1<sup>st</sup> of September, Charlie continued to move slowly in a westward direction, reaching 32.7N, 59.5W by 18Z on 1 September. Including the removal of the loop, all track changes made from 30 August through 1 September were less than 1 degree. The changes were mainly based on aircraft fixes with some weight applied to any ship observations that conflicted with aircraft data. Although there were no subsequent central pressure observations after the 974 mb observation on the 29<sup>th</sup>, there is evidence that intensification continued to take place. During the flight on the 29<sup>th</sup>, aircraft had estimated maximum winds only as high as 100 kt. During subsequent flights, maximum winds were estimated as high as 110 and 125 kt on the 30<sup>th</sup> and 31<sup>st</sup> respectively indicating that the cyclone was more intense on the 31<sup>st</sup> than on the 29<sup>th</sup>. Additionally, on the 30<sup>th</sup>, the aircraft reported that the average pressure at a radius of 50 nmi from the center was 995 mb. Since the RMW and the environmental pressure are not known with a high enough degree of accuracy, the Schloemer equation should not be used to deduce a precise central pressure value; however, upon choosing the conservative (small- i.e. producing a more intense cyclone) value of 20 nmi for the RMW and using 1016 mb for the environmental pressure (best analysis estimate), a central pressure value of 958 mb is obtained. This yields 97 and 102 kt respectively for north of 25N and north of 25N and intensifying. After subtracting 5 kt for the very slow speed of the cyclone, 95 kt would likely be chosen. The 90 kt intensity in HURDAT at 18Z on the 30<sup>th</sup> is unchanged due to large uncertainty. The flight on the 31<sup>st</sup> did not reveal any additional intensity information besides the max wind estimate of 125 kt. The flight on 1 September does not

reveal any intensity information, and the flight on the 2<sup>nd</sup> (the final flight into Charlie) reported a central pressure of 980 mb, indicating Charlie had weakened. The peak intensity for Charlie is analyzed to be 95 kt from 12Z on the 31<sup>st</sup> to 00Z on the 1<sup>st</sup> of September (previously 100 kt from 29/12Z – 30/00Z). Therefore, downward adjustments to the HURDAT intensity were implemented on the 28<sup>th</sup> – 30<sup>th</sup>, and the intensity was increased on the 31<sup>st</sup> – 1<sup>st</sup>. Charlie continued moving very slow through 4 September, during which time it recurved northeast of Bermuda. The largest track change analyzed between the 2<sup>nd</sup> – 4<sup>th</sup> of September is only six-tenths of a degree. The 980 mb central pressure (mentioned above) is added into HURDAT at 18Z on the 2<sup>nd</sup>. A central pressure of 980 mb equals 73 kt according to the pressure-wind relationships for north of 25N as well as north of 35N and 75 kt is chosen for 18Z on the 2<sup>nd</sup> (down from 85 kt originally). Although the highest observed winds on the 3<sup>rd</sup> and 4<sup>th</sup> were only 35 kt, the ship density was not quite high enough to justify a significant downward adjustment of the HURDAT intensities. Analyzed intensities are 10 kt lower than the previous HURDAT intensities at most times on the 3<sup>rd</sup> and 4<sup>th</sup>. Charlie is analyzed to have become extratropical by 18Z on the 4<sup>th</sup> (6 hours earlier than originally). By 00Z on the 5<sup>th</sup>, a 22 degree F / 140 nmi temperature gradient existed across the cyclone. On the 5<sup>th</sup>, Charlie accelerated northeastward, and a major track change was made for the final point at 12Z on the 5<sup>th</sup> before Charlie was absorbed by a large extratropical wave train. The final HURDAT position was moved to 44.8N, 47.4W (originally 43.7N, 52.5W), and the intensity at that time is raised from 40 to 50 kt due to ship observations of higher winds.

A couple of additional quotes of interest from AWS are included below:

“During the course of Hurricane Charlie, the 373<sup>rd</sup> Reconnaissance Squadron flew 11 missions and established 16 separate fixes. All fixes were on or within 30 miles of the post analysis track in both time and position. It seems that with ‘fixes’ that close to the true track, forecasting by means of pure extrapolation should be fairly accurate. This however is not true. The practice of issuing forecasts based purely on the extrapolation of reconnaissance fixes can be very disastrous. In most cases, the immediate forecast position is placed in an extended line joining the last two fixes. If on the other hand there are more than two fixes, an attempt is made to place the forecast position on an extended curved line joining all the fixes that in some cases result in a snake-like track. Experience in both the Pacific and Atlantic has indicated that the best procedure to follow is that once you have established a straight or curved track on the basis of the synoptic pattern and verified it by two or more fixes do not change that track merely on the basis of one additional reconnaissance fix. Wait for a second fix to verify the change unless it can be verified by other means. Since the ‘eye’ or ‘fix’ on a storm can vary from 0 to 75 miles in diameter and the navigational error can often exceed 30 miles, any track derived by using the coordinates given in each ‘fix’ is exceedingly questionable. Unless, of course, the fixes themselves describe a smooth curve.

All in all, the reconnaissance on this storm was exceedingly good. The one thing that greatly decreases the immediate value of reconnaissance is inadequate communications facilities. In this case, the most valuable part of reconnaissance was received so late that its value was in the past tense. A good example of this is the two fixes that we received

at 29/1032Z and 29/1049Z, both from the same plane but at different times. At the time the fixes were received no mention was made of the fact that both fixes were a part of the same eye. When the Form 5D and the narrative history of the flight were received by mail, we learned that both fixes were the opposite extremities of an eye 40 miles long and 30 miles wide. This would have been an invaluable piece of information had it been transmitted with the 'fix' positions. As it happened, the 29/1049Z fix was used which gave the storm a NNW movement. Had the truth been known, a NNE course would have been forecast. On the 2<sup>nd</sup> of September, a similar situation occurred but with less drastic results" (AWS).

"Most people think that the first problem that confronts a forecaster after a storm has been detected is, where is it going? That is a misconception. His first problem is to determine from whence it came. Once the storm's track to its present position is determined, the next step is to try and formulate with, in most cases, a very limited amount of data, a synoptic pattern into which the storm will fit. Once this has been done, the forecaster is ready to forecast its direction of movement. The first 24 hour forecast made is usually the most uncertain. Once the synoptic pattern and track have been established and verified by two or more reconnaissance fixes, the direction of movement can be fairly accurately forecast. This situation will continue to exist in the vast reaches of the Atlantic where there is an absence of data. The hurricane forecaster is holding his own and making great strides toward better forecasts with the limited supply of resources at his command" (AWS).

#### 1950 Storm 4 (Dog)

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34985 08/30/1950 M=19 4 SNBR= 775 DOG          XING=0
34985 08/30/1950 M=20 4 SNBR= 775 DOG          XING=0
      **

34990 08/30*  0  0  0  0*  0  0  0  0*  0  0  0  0*  0*152 553 60 0*
34990 08/30*  0  0  0  0*  0  0  0  0*  0  0  0  0*  0*152 556 80 0*
      *** **

34995 08/31*157 565 65 0*159 576 70 0*160 587 75 0*162 596 80 0*
34995 08/31*155 569 90 0*159 581 100 0*162 592 110 953*165 601 115 0*
      *** *** **      *** ***      *** *** *** *** *** ***

35000 09/01*164 603 85 0*169 611 90 0*175 618 95 0*179 623 105 0*
35000 09/01*168 609 120 0*172 617 125 0*177 624 115 0*182 631 105 0*
      *** *** ***      *** *** ***      *** *** ***      *** ***

35005 09/02*184 628 110 0*191 636 110 0*198 643 115 0*203 647 115 0*
35005 09/02*186 635 105 0*191 639 100 0*195 643 100 962*201 647 105 0*
      *** *** ***      *** ***      *** ***      *** *** ***

35010 09/03*207 650 120 0*210 652 125 0*213 655 125 0*216 658 125 0*
35010 09/03*206 649 105 0*211 650 105 0*216 651 105 0*221 652 105 0*
      *** *** ***      *** *** ***      *** *** ***      *** *** ***

35015 09/04*219 661 130 0*222 664 130 0*226 668 135 0*229 672 135 0*
35015 09/04*224 654 105 0*227 657 105 0*231 660 105 0*234 664 110 0*
      *** *** ***      *** *** ***      *** *** ***      *** *** ***

35020 09/05*234 677 140 0*241 681 140 0*248 684 145 0*255 685 145 0*
35020 09/05*237 668 115 0*241 673 120 0*246 677 125 0*253 682 125 0*
      *** *** ***      *** ***      *** *** ***      *** *** ***

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35025	09/06*262	685	155	0*267	684	160	0*272	683	160	0*279	681	160	0*	
35025	09/06*261	684	125	0*268	684	120	0*275	682	120	0*282	681	120	0*	
	***	***	***	***	***	***	***	***	***	***	***	***		
35030	09/07*286	679	150	0*293	677	140	0*300	675	130	0*304	674	125	0*	
35030	09/07*289	680	115	0*296	679	105	0*302	676	100	0*304	674	85	972*	
	***	***	***	***	***	***	***	***	***	***	***	***	***	
35035	09/08*307	673	115	0*309	674	105	0*312	677	95	0*311	682	90	0*	
35035	09/08*306	673	80	0*308	674	75	0*309	676	75	0*310	679	75	0*	
	***	***	***	***	***	***	***	***	**	***	***	**		
35040	09/09*310	686	85	0*309	690	85	0*307	695	80	0*306	699	80	0*	
35040	09/09*310	682	70	0*309	685	70	0*306	689	70	0*305	693	65	987*	
	***	**		***	**		***	***	**	***	***	**	***	
35045	09/10*305	702	80	0*305	706	80	0*310	710	85	0*323	717	85	0*	
35045	09/10*304	700	65	0*305	706	65	0*310	710	65	986*320	715	65	986*	
	***	***	**		**		**	**	***	***	***	**	***	
35050	09/11*337	721	85	0*351	723	85	0*365	721	80	0*379	717	75	0*	
35050	09/11*333	721	75	982*349	722	80	978*364	719	85	974*379	714	85	972*	
	***	**	***	***	***	**	***	***	***	**	***	***	**	***
35055	09/12*393	706	65	0E405	688	65	0E413	669	60	0E419	651	60	0*	
35055	09/12E390	700	80	0E397	684	75	0E404	669	70	979E411	657	70	0*	
	****	***	**	***	***	**	***	**	***	***	***	**		
35060	09/13E422	634	60	0E424	618	55	0E426	603	55	0E428	583	50	0*	
35060	09/13E415	644	70	0E419	627	65	0E422	607	60	0E423	583	55	0*	
	***	***	**	***	***	**	***	***	**	***	**	**		
35065	09/14E429	559	50	0E430	532	50	0E431	500	50	0E432	462	50	0*	
35065	09/14E423	559	55	0E425	532	50	0E428	500	50	0E430	455	50	0*	
	***	**	***	***	***	***	***	***	***	***	***	***	***	
35070	09/15E434	421	50	0E440	379	50	0E453	336	50	0E471	285	50	0*	
35070	09/15E434	415	55	0E445	375	60	0E460	332	60	0E475	285	60	0*	
	***	**	***	***	***	**	***	***	**	***	**	**		
35075	09/16E490	232	50	0E509	186	50	0E528	147	50	0E543	116	50	0*	
35075	09/16E492	232	65	0E509	186	65	0E528	147	65	0E543	116	65	0*	
	***	**	***	***	***	**	***	***	**	***	***	**	***	
35080	09/17E552	91	50	0*	0	0	0*	0	0	0*	0	0	0*	
35080	09/17E556	91	65	0E568	66	65	0E578	45	60	0E588	38	55	0*	
	***	**	***	***	**	**	***	**	**	***	**	**	***	

(The 18th is new to HURDAT.)

35080	09/18E598	38	55	0*	0	0	0*	0	0	0*	0	0	0*
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35085 HR

### U.S. close approaches: TS impacts in NC, VA, NJ

Minor track changes and major intensity changes are analyzed for this powerful, long-lived Atlantic hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, National Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps, Caribbean station observations, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, Dunn and Miller (1960), and Boose et al. (2004).

August 24:

HWM analyzes an elongated east-west trough with a spot low analyzed near 14N, 27.5W. HURDAT does not yet list a system on this day. No gales or low pressures.

August 25:

HWM analyzes an elongated area of troughiness in the central tropical Atlantic with a spot low analyzed near 14.5N, 32W. HURDAT does not yet list a system on this day. No gales or low pressures.

August 26:

HWM does not show any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures. "Closed surface circulation is evident as far back as 26/0030Z August in the area just north of Cayenne, French Guiana" (AWS).

August 27:

HWM does not show any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures.

August 28:

HWM does not show any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures.

August 29:

HWM does not show any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures. "Note- Received from San Juan: 'Received from Trinidad report from SS Sibrodin 29/2000Z. Position is in vicinity of disturbance tracked in this office from Cape Verde since 8/24 with speed, 13 kt...' (micro).

August 30:

HWM does not show any features of interest on this day. HURDAT first lists this system at 18Z as a 60 kt tropical storm at 15.2N, 55.3W. Ship highlights: 40 kt at 18Z (AWS); 45 kt NE at 20Z at 16.6N, 57.2W (micro). "This hurricane was located August 30 when the SS Sibrodin reported gale winds and falling pressure near 16.5N, 57W. It might have been the same storm whose beginnings were reported near the Cape Verde Islands on August 24, but there were no reports of it after it left the Cape Verde area until the Sibrodin reported on the 30<sup>th</sup>. It proved to be the most severe hurricane of the 1950 season, with winds estimated by aircraft at over 160 kt and waves 100 feet high" (MWR). "At 30/1830Z, the ship Sibrodin reported a force 9 [40 kt] wind on the west side of the disturbance" (AWS). "The closed low north of Cayenne drifted slowly to the northwest and developed winds of hurricane speed on or shortly prior to 31/0000Z August" (AWS).

August 31:

HWM analyzes a tropical storm of at most 1005 mb centered near 16.1N, 59.4W. HURDAT lists this as a 75 kt hurricane at 16.0N, 58.7W. The AWS best track lists a 0030Z position at 15.0N, 58.3W with 70 kt max winds and a 1230Z position at 16.2N,

59.5W with 125 kt max winds and 953 mb central pressure. The MWR post-season track map shows a 12Z position at 16.1N, 58.6W. Microfilm analyzes a hurricane of at most 1000 mb centered near 16.2N, 59.2W. Ship highlights: 75 kt N and 1000 mb at 00Z at 15.0N, 57.9W (micro); 35 kt ENE and 1008 mb at 18Z at 18.0N, 60.9W (COA, micro). Aircraft highlights: Air Force center fix (DR plus four radar bearings) at 1050Z at 16.3N, 59.0W with 953 mb central pressure and estimated maximum winds of 125 kt (AWS, micro); Air Force center fix (boxing, 700 mb penetration) at 13Z at 16.5N, 59.5W with 953 mb surface pressure by dropsonde and the 700 mb height in the eye of 8780 feet (AWS, micro); 105 kt W at flight level of 800 ft and 990 mb at 1915Z at 16.2N, 60.2W (ATS); Navy radar center fix (PB4Y-2) (radar, DR, no penetration) at [1715Z or 1915Z?] at 16.4N, 60.3W with lowest pressure encountered 988 mb 3 miles west of the edge of the eye and maximum flight-level winds encountered of 120 kt (AWS, ATS). At least four other surface gales (including one other surface hurricane force wind), three flight-level hurricane force winds, and six other low pressures. “[At 31/0030Z], the Sibrodin reported hurricane winds. Recon aircraft on 31 August reported the hurricane centered at 16.3N, 59.0W at 1050Z with maximum winds estimated at 125 kt, a minimum central pressure of 953 mbs and ‘phenomenally heavy seas.’ This placed the storm center 160 nautical miles southeast of Antigua, BWI. In view of the size and intensity of the storm, the low latitude and the high seas reported, it is safe to say that this storm has been developing for several days and had not developed suddenly” (AWS). “When first investigated by aircraft on 31 August, the weather observer reported a central pressure 953 mbs, estimated the maximum winds at over 125 kt with hurricane winds covering an area 90 to 100 miles in diameter and gales covering 180 miles [in diameter]” (AWS). “31/1130Z: In eye proper. Eye diameter 22 miles” (AWS). “31/1915Z: Eye appeared well defined by radar” (AWS). “The storm recurved toward the west somewhat so that by 31/1200Z it was moving in a west by north direction” (AWS). From microfilm’s version of the Air Force flight... “D-11: In eye of storm. Eye located at 1050Z. Definite circular cloud around eye. Winds estimated to be over 100 kt at edge of eye. Diameter 22 miles wide of 30 kt from several direction observed in eye” (micro). “Duck 11: in eye of storm at 16.3N, 59.0W at 1050Z. Definite circular cloud around eye. Position by dead reckoning. Position of 16.3N, 59.1W was given 15 minutes later based on four radio bearings” (micro). “Center located by box at 16.5N, 59.5W at 1300Z. Position reliable” (micro). “1715Z- N-6: Eye by radar and dead reckoning 16.4N, 60.3W. Lowest pressure [encountered] 3 miles west 988 mb. Highest wind estimated 120 kt- circumnavigation” (micro). From the ATS report... “This was the first Navy flight into this very severe hurricane, departing Ramey AFB, Puerto Rico about noon. Direct entry was made from the west-northwest until due west of the center. The wind was then placed on the port beam and entry into the eye through violent turbulence with winds up to 120 knots was made. Although the eye appeared well defined by radar, it was poorly defined to the eye and winds decreased only slightly, so that pilot was forced immediately into south sector where again 120 knots winds were encountered. Lowest pressure at the edge of the eye was 988 mbs and center position was 16.4N, 60.3W. Course was taken to get out to somewhat lower velocities and then circumnavigate. Two very rough spirals were crossed where winds again increased briefly to 100 knots and then backed. Remainder of flight was routine as winds gradually backed and decreased, and precipitation became intermittent and ended” (ATS).

## September 1:

HWM analyzes a tropical storm of at most 1005 mb centered near 17.5N, 63.0W. HURDAT lists this as a 95 kt hurricane at 17.5N, 61.8W. The AWS best track lists a 0030Z position at 16.8N, 60.9W with 125 kt max winds and 960 mb central pressure and a 1230Z position at 17.6N, 62.4W with 130 kt max winds and 964 mb central pressure. The MWR post-season track map shows a 12Z position at 17.4N, 61.8W. Microfilm analyzes a low of at most 996 mb centered near 17.7N, 62.3W. Land/station highlights: 60 kt NE and 1003 mb at 0115Z at Antigua (17.1N, 61.7W) (micro); 125 kt at Antigua (“anemometer disintegrated before maximum could be recorded”) (AWS); 973 mb (min p) at Antigua (AWS). One other gale at Antigua and four other low pressures. Aircraft highlights: 65 kt E and 997 mb at 18Z at 19.0N, 63.4W (micro); Air Force center fix at 1832Z at 18.3N, 63.2W with 110 kt estimated maximum surface winds, 964 mb surface pressure by dropsonde and the 700 mb height in the eye of 9140 feet (AWS, micro). One other gale and two other low pressures. “It moved on a northwesterly course and passed close to Antigua, Barbuda, and other islands of the northeastern Leeward group on September 1. Residents of Antigua, where highest winds were estimated at over 130 mph and hurricane force lasted for 6 hours, reported it to be the most severe hurricane in the history of that island. Many homes and businesses were destroyed or damaged, crops destroyed, roads blocked by washouts and fallen trees, communications and power lines down, and many small craft wrecked. Two persons were drowned when their small boat capsized. The island of Barbuda also estimated winds of 130 mph or greater, with equal or worse devastation than experienced at Antigua. Damage has been placed at over \$1,000,000 on these small islands” (MWR). From “Antigua 01/0115Z: Present condition worsening and now 30/60 barometer 1002.8 mb falling rapidly. Forced to close now” (micro). “D-3 in the eye 1832Z position 18.3N, 63.2W. Radar position on island shows movement 201 degrees at 18 kt. Surface wind in NE quadrant estimated 110 kt” (micro). “From the point at which detected, Dog moved WNW passing just north of Antigua, turned slowly toward the northwest passing just NE of St. Martin, BWI at 1830Z on the 1<sup>st</sup> of September. Speed had been 8 kt but at this point decreased to 5 kt.” (AWS). “According to newspaper reports and a report from the San Juan Weather Bureau Office the islands of St. Martin and Antigua were badly battered by the storm. Three fatalities, thousands homeless and \$1,000,000 worth of property damage were reported on Antigua. Coastal craft were swept ashore and the streets of St. Johns on Antigua were flooded by high tides. The PAA weather station on Antigua reported a maximum wind of 144 mph (125 kt) before the anemometer disintegrated. Sea level pressure dropped to a minimum of 28.73 inches (972.6 mbs); although the eye did not pass directly over the station” (AWS). “01/1832Z: Eye located by radar” (AWS). “Late on 1 September Dog resumed its nearly northward track. This continued through the 2<sup>nd</sup> and 3<sup>rd</sup> of September” (AWS).

## September 2:

HWM analyzes a tropical storm of at most 1005 mb centered near 18.7N, 64.6W. HURDAT lists this as a 115 kt hurricane at 19.8N, 64.3W. The AWS best track lists a 0030Z position at 18.6N, 63.5W with 130 kt max winds and 964 mb central pressure and a 1230Z position at 19.6N, 63.9W with 135 kt max winds and 964 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 19.2N, 64.5W with a

980 mb pressure. The MWR post-season track map shows a 12Z position near 19.8N, 64.3W. Microfilm analyzes a hurricane of at most 990 mb centered near 19.9N, 64.5W. Ship highlights: 60 kt E and 985 mb at 21Z at 21.7N, 65.0W (micro). Two other gales. Aircraft highlights: Navy center fix at 1405Z at 19.6N, 64.4W (low-level penetration, DR) with 962 mb central pressure, maximum estimated surface winds 120 + kt on west side and 140 kt on north side (AWS, micro, ATS); Air Force 700 mb penetration at 1945Z with 964 mb surface pressure by dropsonde, 140 kt estimated [maximum surface winds estimated after descending in the eye], and 700 mb height in the eye of 9050 feet (AWS). Ten other surface gales, two other flight-level hurricane force winds, and five other pressures below 1000 mb. "N-14: Entered eye 1405Z. DR fix 19.3N, 64.3W. Max winds 340 degrees 120 kt. Severe turbulence. Further entry not recommended. Eye on radar well defined. Central pressure 962 mb" (micro). "Hurep Duck 18: In eye. Loran inoperative. Will drop dropsonde and head for San Juan for back DR position. 65 kt surface winds at 100 mi west of center. Max surface winds west side eye 120 plus kt. 140 kt north side. Do not plan to box" (micro). "On the morning of 2 September the Navy flight into the storm reported 'severe turbulence. Further entry into eye not recommended.' It also reported winds 120 kt on the west side and minimum pressure 962 mbs. The direct observation of the central pressure makes the 953 mbs obtained by dropsonde on the 31<sup>st</sup> seem questionable. However, in those cases in which the sea level pressures were obtained by dropsonde, the 700 mb height was obtained by direct observation and the variations in the 700 mb heights and sea levels are in perfect agreement and both follow a logical sequence. Therefore, all sea level pressure in this storm obtained by dropsonde have been assumed to be approximately accurate. [Since the dropsondes contained no winds, they could not have known whether the dropsonde splashed in the eye]" (AWS). "On the afternoon of September 2<sup>nd</sup>, the AF flight at 10,000 feet reported 140 kt on the north side of the storm center and 120 kt on the west" (AWS). "02/1405Z: Eye on radar well defined south half only. Diameter estimated 20 miles. Eye not well defined and winds in eye not less than 30 kt" (AWS). "02/1945Z: Eye approximately 30 miles in diameter with 10 miles area calm (no whitecaps). The surface winds were visible on all sides of the eye and estimated to be in excess of 120 kt" (AWS). From the ATS report... "This hurricane had passed over and caused considerable damage to the island of Antigua in the Lesser Antilles on the preceding day. It was decided to circumnavigate the storm at approximately the 45 kt wind circle, then penetrate to the eye. This would not only locate the center, but would determine all other characteristics of the storm. Only on the south side did the flight have to deviate from this plan. This was to avoid getting too close to nearby islands. This storm was exceedingly turbulent entering the eye from the west side and winds in excess of 120 knots were encountered for nearly 20 miles. Flight message: Entered eye at 1405Z. Max winds 340 degrees 120 kts. Severe turbulence. Further entry eye not recommended. Eye on radar defined south half only. Diameter [of eye] 20 miles. Central pressure 962 mb" (ATS).

September 3:

HWM analyzes a tropical storm of at most 1000 mb centered near 21.0N, 65.1W. HURDAT lists this as a 125 kt hurricane at 21.3N, 65.5W. The AWS best track lists a 0030Z position at 20.6N, 64.2W with 135 kt max winds and 964 mb central pressure and

a 1230Z position at 21.1N, 64.5W with 140 kt max winds and 964 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 22.1N, 65.8W with a 972 mb central pressure. The MWR post-season track map shows a 12Z position near 21.5N, 65.5W. Microfilm analyzes a low of at most 996 mb centered near 21.7N, 65.3W. Ship highlights: 80[?] kt E and 985 mb at 00Z at 21.6N, 64.8W (micro); 75 kt ENE at 18Z at 23.2N, 65.5W (micro). 11 other gales between 35-55 kt and one other low pressure of 999 mb. Aircraft highlights: Navy center fix (no penetration, radar) at 1252Z at 21.7N, 65.0W with lowest pressure encountered 979 mb 10 miles west of [the edge of the] eye, maximum flight-level winds encountered of 125 kt, and estimated maximum surface winds of 125 kt (micro, AWS, ATS); 125 kt at flight-level of around 600 feet and 979 mb at 1252Z at 21.7N, 65.3W (micro, AWS, ATS); Air Force center fix (700 mb penetration, loran) at 21Z at 22.5N, 65.1W with maximum observed flight-level winds [at approximately 700 mb or 10,000 ft] of 120 kt and 700 mb height in eye of 9100 ft (micro). At least eight other surface gales, four other flight-level hurricane force winds, and three other low pressures below 1000 mb. "Estimate small but intense storm. Diameter of hurricane winds 120 miles. DR checked- good. Max error 5 miles. Penetrated west side to the 125 kt isotach. In extreme turbulence. Radar reports possible eye eight miles to east but believe to be farther east about ten miles. Lowest pressure [encountered] 979 mb at 1252Z" (micro). "Radar eye 8 miles east of 21.7N, 65.3W" (micro). "Hurep Duck 9: Loran radio fix in eye at 9500 feet at 2100Z at 22.5N, 65.1W. Storm is still very intense. Winds of 120 kt observed on the outskirts of eye" (micro). "The storm continued its slow turn to the right until 03/1230Z when it slowly turned back to a NW course" (AWS). "As previously mentioned the Navy flight on the 3<sup>rd</sup> penetrated the west side at low level to within 10 miles of the eye. At this point, the winds were estimated 125 kt, pressure 979 mbs" (AWS). "03/2100Z: Very little turbulence was encountered during passage into the eye. It was cloudy and not as distinct at 10,000 feet as previously. At the surface the winds were generally 25 kt from various directions with a small calm region in the inner portion" (AWS). From the ATS report... "Flight departed Ramey AFB, PR at dawn, and in little more than an hour, were in hurricane winds and commenced circumnavigation, keeping at an average distance of about 70 miles from the center. On reaching the northwest quadrant, commenced gradual penetration until due west of the center, then put the wind on the port wing and probed until the winds reached 125 knots and plane became almost uncontrollable. At this point, radar showed the edge of the core to be 8 miles east. Unable to continue further, were forced to slide southward, eventually leaving the storm. Lowest pressure observed- 979 mb" (ATS)

#### September 4:

HWM analyzes a tropical storm of at most 1000 mb centered near 23.2N, 65.6W. HURDAT lists this as a 135 kt hurricane at 22.6N, 66.8W. The AWS best track lists a 0030Z position at 22.6N, 65.2W with 140 kt max winds and 964 mb central pressure and a 1230Z position at 23.3N, 65.9W with 145 kt max winds and 964 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 23.7N, 66.3W with a 965 mb pressure. The MWR post-season track map shows a 12Z position near 23.2N, 66.6W. Microfilm analyzes a hurricane of at most 987 mb centered near 23.3N, 66.3W. Ship highlights: 60 kt SE and 1000 mb at 18Z at 23.0N, 63.0W (COA). Six other gales

between 35-60 kt and two other low pressures between 1001-1003 mb. Aircraft highlights: 70 kt SSW at flight-level of 700 feet and 991 mb at 1130Z at 22.5N, 65.3W (ATS); center fix (estimated position) at 13Z at 23.2N, 66.2W (micro); center fix (boxing) at 1930Z at 24.0N, 66.0W (micro); Air Force center fix (loran) at 22Z at 23.7N, 66.6W with 120 kt estimated maximum surface winds, 963 mb surface pressure by dropsonde, and 700 mb height in the eye of 9013 feet (AWS, micro). At least nine other surface gales, three other hurricane force flight-level winds, and six other low pressures between 987-999 mb. "Post flight summary: Center estimated near 23.2N, 66.2W at 1300Z. Hurricane force winds extend outward [90 to 110 miles from the center]" (micro). "Estimated position of center from boxing 24.0N, 66.0W at 1930Z. Proceeding into eye. Loran fix while flying in eye at 2200Z 23.7N, 66.6W. Diameter of eye 22 miles. Shape of eye almost perfect" (micro). "The AF flight on the afternoon of the 4<sup>th</sup> circumnavigated the storm center at low level and later penetrated the center at 700 mbs. Of the low-level portion of the mission the weather observer wrote as follows: 'When closest to the eye, we estimated winds of 120 kt which confused the swell and appeared to scoop off great quantities of seething white sea surface at times. The waves were so great that they gave the sensation of a slow motion movie'" (AWS). "04/2200Z: Eye penetrated by radar. It was almost perfectly round, about 22 miles in diameter as measured on the radar scope. [Cloud] tops were apparently above 30,000 feet. Hurricane Dog was very round at this stage and fit the classical pattern better than usual. On departing from the eye our radar operator informed us that a north heading would be as good as any since the cloud returns on his radar scope were so symmetrical" (AWS). Dog recurved slightly to the northwest of the 4<sup>th</sup> and "this northwesterly course continued into the day on 5 September" (AWS). From the ATS report... "This flight was planned for circumnavigation only, with the circumnavigation in close enough to determine the extent of hurricane force winds and to afford a close approximation of the center. The flight was made in about an average 70 kt wind circle with moderate to heavy rainfall and moderate to severe turbulence characterizing the entire flight in the storm area" (ATS).

#### September 5:

HWM analyzes a tropical storm of at most 1000 mb centered near 24.7N, 66.9W. HURDAT lists this as a 145 kt hurricane at 24.8N, 68.4W. The AWS best track lists a 0030Z position at 24.1N, 66.8W with 145 kt max winds and 961 mb central pressure and a 1230Z position at 24.8N, 67.8W with 150 kt max winds and 950 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 25.0N, 67.7W with a 958 mb pressure. The MWR post-season track map shows a position near 24.6N, 67.6W. Microfilm analyzes a hurricane of at most 996 mb centered near 24.7N, 67.7W. Ship highlights: 70 kt SE and 1001 mb at 00Z and at 06Z at 23.0N, 64.0W (COA). Two other hurricane force winds and three other low pressures between 1002-1005 mb. Aircraft highlights: center fix at 13Z at 24.5N, 67.8W (micro); Air Force center fix (low-level box, and then 10,000 ft loran and radar) at 21Z at 25.8N, 68.3W with 943 mb surface pressure from dropsonde and 700 mb height in the eye of 8540 feet (AWS, micro). At least ten other surface gales, six other flight-level hurricane force winds, and seven other low pressures below 1000 mb. "Summary Atl flight: 13Z center 24.5N, 67.8W. 65 kt wind 80 mi radius north and east; 45 kt wind 180 mi radius. 65 kt wind 60 mi radius west and 95 mi radius south of center" (micro). "Hurep Duck 19 five position of storm

by low level box and 10000 ft loran radar fix 25.8N, 68.3 at 2100Z. Pressure at 26.2N, 67.5W 995.4 mb; 24.9N, 69.1W 986.1 mb; 24.3N, 68.3W 992.2 mb. Winds 26.2N, 69.0W 036 degrees at 51 kt; 25.3N, 69.0W 350 degrees at 68 kt; 24.5N, 69.0W 290 degrees at 69 kt; 24.4N, 68.4W 265 degrees at 72 kt. Height of 700 mb in eye 8540 ft. Eye well defined at 10000 ft. At low level, west quadrant very heavy rain. 600 ft ceilings in north quadrant and south quadrant ceilings 1200 ft. Light rain. Penetration at high level..." (micro). "At 05/1830Z, Dog again turned right, accelerated slightly and moved almost due north at 7 kt" (AWS). "On the 5<sup>th</sup> and 6<sup>th</sup> the diameter of hurricane force winds was approximately 175 miles and the gales covered twice this distance" (AWS). "05/2100Z: Eye well defined at 10,000 feet" (AWS). "Late on 5 September, Dog again curved toward the north moving almost directly due north during the 6<sup>th</sup> and 7<sup>th</sup> of September" (AWS). From the ATS report... "Flight departed Ramey AFB at dawn for another flight to this almost impenetrable hurricane centered about 400 miles north of the station. Simple circumnavigation with no attempt made to penetrate the core of the storm made this flight relatively easy and uneventful. Principle features of interest noted were: that the northwest sector was quite dry, that the center was about 30 miles SSE of the assigned coordinates, and that the hurricane winds covered an area 150 miles in diameter" (ATS).

#### September 6:

HWM analyzes a tropical storm of at most 1000 mb centered near 27.4N, 68.0W with a frontal boundary located north of the cyclone extending from 32N, 77W to 33N, 69W to 35N, 62W to 36N, 60W. HURDAT lists this as a 160 kt hurricane at 27.2N, 68.3W. The AWS best track lists a 0030Z position at 25.9N, 68.4W with 150 kt max winds and 941 mb central pressure and a 1230Z position at 27.4N, 68.3W with 150 kt max winds and 940 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 28.1N, 68.3W with a 953 mb pressure. The MWR post-season track map shows a 12Z position near 27.3N, 68.3W. Microfilm analyzes a low of at most 993 mb centered near 27.7N, 68.3W. Ship highlights: 70 kt SSE and 1001 mb at 18Z at 27.9N, 66.5W (COA). Five other gales between 50-70 kt and three other low pressures. Aircraft highlights: 85 kt NW at flight level of 800 ft and 984 mb at 1415Z at 27.9N, 69.0W (ATS); Air Force center fix at 19Z at 28.4N, 67.9W (micro); Air Force 700 mb penetration at 2115Z with 944 mb surface pressure by dropsonde and 700 mb height in the eye of 8560 feet (AWS). At least 13 other surface gales, nine other flight-level hurricane force winds (600-1000 feet), and nine other low pressures below 1000 mb. "N-10: Tremendous SE swell estimated 100 feet high" (micro). "Duck 3- fix 28.4N, 67.9W at 1900Z" (micro). "At noon on the 6<sup>th</sup> the Navy flight circumnavigated the storm center and on the north side reported 'tremendous SE swell estimated 100 feet high.' On the basis of these the weather observer wrote, 'It is believed that highest winds near the center were probably in excess of 150 kt'" (AWS). "06/2122Z: Eye is 35 miles in diameter, circular and well defined. Located by radar" (AWS). From the ATS report... "As in previous flights into this storm, no penetration was planned because of the severity of the turbulence...it was considered desirable and adequate to circumnavigate at approximately the 70 kt wind circle. Features of this flight include the observation of the extremely large swells ahead of the hurricane, and the extent of hurricane winds over a

very large area. It is believed that highest winds near the center were probably in excess of 150 kt” (ATS).

#### September 7:

HWM analyzes a tropical storm of at most 1000 mb centered near 30.1N, 67.5W with a dissipating WSW-ENE stationary front located north of the cyclone from 32N, 77W to 32N, 73W to 35N, 66W becoming a (non-dissipating) stationary front at 35N, 66W extending eastward to 36N, 57W. HURDAT lists this as a 130 kt hurricane at 30.0N, 67.5W. The AWS best track lists a 0030Z position at 28.8N, 68.2W with 140 kt max winds and 947 mb central pressure and a 1230Z position at 30.2N, 67.9W with 125 kt max winds and 961 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 31.1N, 67.3W with a 948 mb pressure. The MWR post-season track map shows a 12Z position near 29.7N, 67.8W. Microfilm analyzes a low of at most 990 mb centered near 30.3N, 67.5W. Ship highlights: 35 kt SE and 1005 mb at 00Z at 29.7N, 66.2W (COA); 45 kt SSW and 1008 mb at 12Z at 26.0N, 66.7W (COA, HWM). Four other gales. Aircraft highlights: Air Force center fix (loran) at 0420Z at 29.4N, 68.1W with 962 mb surface pressure by dropsonde and 700 mb height in the eye of 9010 feet (AWS, micro); center fix at 1215Z just south of 30.5N, 67.6W with 700 mb height in the eye of 8800 feet (AWS, micro); Air Force center fix at 1945Z with 105 kt estimated maximum surface winds, 972 mb central pressure by low-level penetration, and 700 mb height in the eye of 9295 feet (AWS). “Hurep: In eye at 0420Z at 29.4N, 68.1W. Determined by loran in eye. Eye very good. 0510Z- 29.5N, 68.0W- loran fix. 0800Z- 29.0? or 30.0? N, 68.8W” (micro). “Duck 4: In eye now, surface wind 120 kt, position by DR and degree of confidence medium. Leaving storm” (micro). “It reached a point approximately 200 miles SW of Bermuda at 07/1230Z. At this time, it turned NNE toward Bermuda and decelerated” (AWS). “Dog appears to have lost intensity rapidly during the last few hours of the 6<sup>th</sup> and early 7<sup>th</sup>. A night flight into the eye of 07/0420Z indicated an 18 mb rise in the central surface pressure during the 8 hours since the last flight. This was the first night mission into a hurricane by an aircraft equipped with APQ-13 radar. The radar was used only to guide the flight into the eye of the storm at 700 mbs. Here the aircraft stayed for over an hour obtaining loran fixes, taking a dropsonde and computing movement of the storm center. Two more missions were flown during the daylight on the 7<sup>th</sup>. The second indicated another 10 mb rise in the central surface pressure and estimated the maximum surface wind in the NE quadrant as 105 kt” (AWS). “07/0510Z: Eye of storm well defined circle on radar scope and 30 miles in diameter” (AWS). “07/1215Z: In center wind never observed less than 30 to 35 kt, direction following usual storm pattern. Eye not extremely well defined. No definite rim cloud at edge of eye, which appears nearly circular at about 40 miles in diameter” (AWS). “07/1945Z: The eye was poorly defined and gave poor returns on the radar scope” (AWS). A “ridge prevented the northward movement of Dog and also slowed it to an almost complete halt 150 to 200 miles southwest of Bermuda” (AWS).

#### September 8:

HWM analyzes a tropical storm of at most 1000 mb centered near 30.7N, 67.8W with the west end of a dissipating W-E stationary front located north of the cyclone extending from 35N, 65W to 35N, 54W. HURDAT lists this as a 95 kt hurricane at 31.2N, 67.7W.

The AWS best track lists a 0030Z position at 30.6N, 67.7W with 115 kt max winds and 969 mb central pressure and a 1230Z position at 30.9N, 67.4W with 110 kt max winds and 975 mb central pressure. The MWR tracks of center of cyclones shows a 12Z position near 31.1N, 67.3W with a 954 mb pressure. The MWR post-season track map shows a 12Z position near 31.2N, 67.7W. Microfilm analyzes a low of at most 996 mb centered near 30.4N, 67.5W. Ship highlights: 35 kt NNW and 1003 mb at 21Z at 30.6N, 70.3W (micro). One other gale and one other low pressure. “The hurricane continued to move slowly on a northwesterly course after leaving the Leeward Islands and curved northward toward Bermuda, but its progress was blocked about 200 miles southwest of Bermuda near 31N, 67.5W on September 8” (MWR). “During 8 September, Dog remained nearly stationary with disorganization indicated” (AWS).

#### September 9:

HWM analyzes a tropical storm of at most 1000 mb centered near 30.4N, 69.3W. HURDAT lists this as an 80 kt hurricane at 30.7N, 69.5W. The AWS best track lists a 0030Z position at 31.3N, 67.4W with 105 kt max winds and 981 mb central pressure and a 1230Z position at 31.0N, 68.3W with 100 kt max winds and 984 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 30.9N, 68.9W with a 955 mb pressure. The MWR post-season track map shows a 12Z position near 31.0N, 69.3W. Microfilm analyzes a low of at most 1002 mb centered in the general vicinity of 30N, 69.5W. Ship highlights: 45 kt WSW and 997 mb at 15Z at 29.1N, 70.5W (micro); 50 kt E and 1004 mb at 18Z at 32.3N, 69.7W (micro). Three other gales and 13 other low pressures. Aircraft highlights: Air Force center fix (loran) at 0534Z at 31.0N, 67.5W (micro); center fix (loran) at 2029Z at 30.5N, 69.3W with 987 mb central pressure by low-level penetration, 100 kt estimated maximum winds, and 700 mb height in the eye of 9670 feet (AWS, micro). At least one other flight-level gale. “It reached a virtual standstill 160 miles SW of Bermuda at 09/0030Z. It then accelerated toward the WSW through the 9<sup>th</sup>” (AWS). “Duck 6- at 0534Z: Eye at 31.2N, 67.5W- Loran fix in eye. Radar returns poor. Pressure patterns indicate eye elongated north-south. Remarks on Duck summary: Low center at 700 mb level is elongated and oriented N-S. Gradient near the center is not tight. Estimate eye to be 60 mi long on N-S line and 30 miles wide... center of eye is 15 to 20 mi south of 31.2N, 67.5W” (micro). “Navy 5: Our point 0800Z 32.2N, 68.4W. 09/0753 have thoroughly investigated and flown over area. Area marked with heavy line squalls. Definitely no eye indication” (micro). “Hurep Duck 17 six: Winds 120/64 at 32.2N, 68.2W. Center of storm 30.5N, 69.3W at 2029Z by loran. Eye covers large area. Not well-defined. Making decent sounding in eye” (micro). “Three flights were made on the 9<sup>th</sup>, two early morning radar flights were unable to obtain radar echoes indicating that the storm had lost organization. The afternoon flight entered at 10,000 feet and descended in the eye. The central pressure was 987 mbs, but winds on the east side were still estimated at 100 kt” (AWS). “During the 8<sup>th</sup> and 9<sup>th</sup> as Dog came to a standstill and reversed its course 360 miles SW of Bermuda, Kindley AFB reported force 7 winds at the surface for 24 hours. Winds at 4000 feet during this period rose to 50 kt at 09/0300Z” (AWS). “09/0534Z: The radar operator was unable to pick up any returns from the stratiform cloud layers” (AWS). “09/0800Z: (Navy radar plane searching storm area reported:) Area marked by heavy line squalls. Definitely no eye indication” (AWS). “09/2029Z: Center of storm very indefinite, covers very broad area

70 miles in diameter. Center not discernible on radar scope” (AWS). Dog “recurved toward the west so that we find it moving south of west during 9 September” (AWS).

#### September 10:

HWM analyzes a tropical storm of at most 1000 mb centered near 30.5N, 70.9W. HURDAT lists this as an 85 kt hurricane at 31.0N, 71.0W. The AWS best track lists a 0030Z position at 30.6N, 69.8W with 95 kt max winds and 987 mb central pressure and a 1230Z position at 31.5N, 71.4W with 90 kt max winds and 987 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 31.0N, 70.5W with a 964 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 996 mb centered near 31.0N, 70.3W. Ship highlights: 45 kt S and 1005 mb at 00Z at 28.6N, 67.2W (COA); 30 kt WNW and 996 mb at 15Z 30.8N, 72.6W (micro); 35 kt NNW and 1002 mb at 18Z at 31.5N, 73.4W (micro); 65 kt SW and 1014 mb at 18Z at 32.0N, 69.3W (micro). Four other gales and four other low pressures of less than 1000 mb. Land/station highlights [had to have occurred between 10/05Z and 11/05Z]: 35 kt W (max w/1-min) at Cape Hatteras (climo); 34 kt NW (max w/1-min) at Baltimore (climo). Aircraft highlights: center fix at 1240Z at 31.2N, 71.2W with 986 mb central pressure by low-level penetration, 90 kt max flight-level winds encountered on the west-northwest side of the storm, and 700 mb height in the eye of 9677 feet (AWS, micro); center fix at 2005Z at 32.4N, 71.8W with 986 mb central pressure by low-level penetration, 75 kt maximum flight-level winds encountered on the east side and 700 mb height in the eye of 9760 feet (AWS, micro). At least one other surface and flight-level hurricane force wind. “Post flight summary Hurricane Dog: Position of hurricane was located by penetration at low level at 31.2N, 71.2W at 1240Z. Pressure in center was 986 mb. Eye is approximately 90 miles long and 60 miles wide. The sea is relatively calm and the wind variable at 12 kt. Aircraft sounding was made in center of hurricane. 700 mb height 9677 feet. Hurricane winds extend to 75 miles from center in NE, E, SE, NW quadrants and storm winds exist to 120 miles in all quadrants but the WSW. Gale winds extend 150 miles in NE and SE quadrant and 135 miles in NW. The WNW through SW sector is relatively weak. Winds of 90 kt or better prevail in a small area near the center edges except in WNW sector. Sea in area of center is extremely high” (micro). “Center of storm at 10000 by radar indicates considerably spread out center approximately 90 miles long and 75 miles wide with an opening to the WNW [message transmitted at 1522Z]” (micro). “Duck 18- The eye of the storm is 32.4N, 71.8W at 2005Z” (micro). “It turned right and accelerated during the 10<sup>th</sup>” (AWS). “The two flights on the 10<sup>th</sup> both reported surface pressures of 986 mbs but the first reported winds of 90 kt near the center on the WNW side while the second only a few hours later reported maximum winds of 75 kt on the east side” (AWS). “10/1315Z: The eye as determined by visual and radar observation was approximately 90 miles long and 60 wide, oriented WNW-ESE and open to the WNW. The sea was relatively calm and the wind variable at 12 kt” (AWS). “10/2000Z: Eye circular about 65 miles across, not well defined” (AWS). “It recurved [again] to move north during 10 and 11 September” (AWS). The following quote from the Monthly National Climatological Data Summary is definitely not directly related to Hurricane Dog... “Location: Maryland, entire state. Date: 10<sup>th</sup> of September during the pm hours. Number of people killed: 3. Character of storm: Flooding. Remarks: State police reported that stretches of highways

flooded in almost every county. Washington Boulevard near Bladensburg, Md. Covered with over a foot of water, making it necessary for thousands of motorists to detour. In some instances water on roads was as high as 6 feet in low places. A driver lost control of his car and went over side of bridge as another car splashed water on windshield; three men drowned. At Whitemarsh a small 4-room house was swept from its foundation and into a nearby field. At Whitehall there were 6 feet of water in basement of a house, a general store, and a food shed. About a dozen people forced to flee” (climo). The following quote is probably not directly related to Dog, but may be somewhat related to Dog... “Location: The following counties in Virginia- Rockbridge, Beteourt, Floyd, Bedford, Henry, Franklin, Roanoke, Patrick, Montgomery, Prince George, Curry, Greenville, Spotsylvania, and Caroline. Date: 10<sup>th</sup> of September. People killed: 3. Property damage (exclusive of crops): \$750,000. Crop damage: \$250,000. Character of storm: Rain. Remarks: Flash flood caused drowning of two persons in Rockbridge County; and severe erosion of land, damage to crops, and destruction of roads, bridges, culverts, farm houses and contents, business establishments, telephone and power lines, tractors, trailers and cargo, and railroad roadbeds in Rockbridge and portions of Rotetourt Counties and to comparatively small areas in other counties named” (climo).

September 11:

HWM analyzes a tropical storm of at most 1000 mb centered near 36.5N, 71.8W with a W-E stationary front located north of the cyclone extending from 41N, 83W to 40N, 71W to 42N, 54W. HURDAT lists this as an 80 kt hurricane at 36.5N, 72.1W. The AWS best track lists a 0030Z position at 33.7N, 72.0W with 95 kt max winds and 983 mb central pressure and a 1230Z position at 36.4N, 71.6W with 110 kt max winds and 974 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 36.7N, 72.0W with a 970 mb pressure. The MWR post-season track map shows a 12Z position near 36.7N, 72.3W. Microfilm analyzes a hurricane of at most 993 mb centered near 36.5N, 72.3W with a frontal boundary located north of the cyclone extending from 42N, 83W to 41N, 72W to 44N, 64W. Ship highlights: 45 kt E and 985 mb at 03Z at 34.4N, 72.4W (COA, micro). Nine other gales between 35-45 kt and 15 other low pressures between 988-1005 mb. Land/station highlights [had to have occurred between 11/05Z and 12/05Z]: 35 kt N (max w/1-min at Atlantic City, NJ (climo). Aircraft highlights: Navy center fix (low-level penetration) at 1240Z at 36.5N, 71.5W with 974 mb central pressure and winds of 90-100 kt reported (AWS, ATS); Air Force center fix at 19Z near 38.1N, 71.2W with 972 mb central pressure (by low-level penetration), 120 kt estimated maximum winds, and 700 mb height in the eye of 9340 feet (AWS). At least eight other surface gales, three other flight-level hurricane force winds, and nine other low pressures below 1000 mb. “Here is the answer to the dispatch I sent to the plane which landed at Norfolk after this morning’s flight quote. Negative- this applies to my query as to whether the eye was defined well enough to justify night radar flights- then the message continues, entered eye located at 36.5N, 71.5W. Fix reliably established twice by bearings, by out flight, by back track navigation and plane radio compass bearing on NGU. Eye characterized by broken lower cloudiness and encircling cumulus to 6000 feet. Signs of dissipation. 75 kt extend to 130 miles in western semicircle. Lowest pressure 974 mb” (micro). “N-6: Circling in eye. Strongest sustained winds west side 85 kt. Center fixed at 36.5N, 71.5W. Lowest pressure 976 mb” (micro). “It passed

approximately 200 miles east of Hatteras at 11/0630Z moving north at 14 kt” (AWS). “On September 11<sup>th</sup>, Dog appears to have intensified again. Central pressures reported were 974 and 972 mbs. The Navy flight reported winds 90-100 kt extended outward 100 miles from the center to the WSW. The AF flight entered only the south side and estimated highest winds there at 120 kt” (AWS). “By the 11<sup>th</sup>, hurricane winds extended 150 miles to the ESE and 80 miles to the west, gales swept an area 500 miles across from Diamond Shoals to 65W” (AWS). “11/1145Z: Eye diameter 25 miles, showed little phenomena on radar scope” (AWS). “11/1915Z: Eye not well defined. Eye 70 miles wide NE-SW and appears to be circular. Unable to find eye aloft” (AWS). “It accelerated to 14 kt by 11 September when it began a recurvature toward the east” (AWS). From the ATS report... “Flight was made to investigate eye and determine fix on position of well developed storm off Virginia coast. Penetration was made into southwest quadrant and fixes determined directional bearings from several RDO stations and by backtracking navigation of outflight from eye. The eye was fixed at 36.5N, 71.5W, but showed little phenomena on radar scope. This indicated that although the storm was still well-defined and sustained winds of 90-100 knots outward 100 miles from the center, it was in its first stage of filling and dissipation” (ATS). [Maybe there was radar attenuation.] From the Monthly National Climate Data Summary... “Location: New Jersey (southern coastline). Date: 11<sup>th</sup>-12<sup>th</sup> of September. Property damage (exclusive of crops): \$1,000. Character of storm: Hurricane. Remarks: Passed 200 miles east of New Jersey shoreline. High tides and heavy seas caused considerable beach erosion and some damage to dwellings located near beach. Heavy rain caused mild flood conditions at some coastal towns and cities, but no permanent damage resulted from water” (climo). From the Monthly National Climatic Data Summary... “Location: Massachusetts (eastern portion), and Rhode Island. Date/time: Noon 11<sup>th</sup> to noon 12<sup>th</sup>. Deaths: 12. Injuries: 1. Property damage (exclusive of crops): \$2,000,000. Character of storm: Hurricane. Remarks: By the morning of the 12<sup>th</sup>, center of the storm had reached a point 85 miles ESE of Nantucket. Still a very severe extratropical storm, but had lost some of its true hurricane character. Shortly before midnight of the 11<sup>th</sup>, winds attained velocity in peak gusts of over 75 mph at Nantucket and off elbow of Cape Cod, but precautionary measures held damage to a minimum. However, several fishing vessels were caught in worst sector of storm, where winds of hurricane velocity and tremendous seas overwhelmed 105-foot scalloper ‘Theresa A,’ lost with 11 persons on board. Another, the ‘Muriel and Russell,’ managed to make North Chatam Beach, where Coast Guard aided the 10-man crew to get ashore. At Provincetown, an automobile that was blown off road, overturned, killing driver. In combination with naturally high Spring tides, hurricane swell and gale-driven surf pounded sea-walls and coastal highways, undermining buildings in some places. Pleasure boats and small craft suffered largest monetary loss in New England’s history, although numerically not as great as the 1938 hurricane. At Marblehead, Mass., alone, wide open to a northeaster, yacht replacement damage set at \$1,125,000; at Winthrop a 50-foot section of sea-wall smashed, damage of \$300,000; on Cape Cod damage to traps alone \$150,000. The overall estimate of \$2,000,000 is probably too conservative. Along south New England coast, west of Bussard’s Bay, winds less violent and off-shore, no damage confined to wired and trees. Twenty-five communities without light or power all night and 20,000 homes without telephone service” (climo).

September 12:

HWM analyzes a tropical storm of at most 1000 mb centered near 40.5N, 66.3W with the west end of a W-E warm front located just east of the cyclone extending from 41N, 64W to 41N, 56W becoming a stationary front there continuing eastward to 40N, 46W. The east end of a cold front is located west of the cyclone and it extends from 38N, 72W to 38N, 76W, becoming a warm front there and extending northwestward to 42N, 83W. HURDAT lists this as a 60 kt extratropical storm at 41.3N, 66.9W. The AWS best track lists a 0030Z position at 38.9N, 70.2W with 120 kt max winds and 972 mb central pressure and a 1230Z position at 40.8N, 67.3W with 100 kt max winds and 979 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 41.3N, 67.3W with a 975 mb pressure. The MWR post-season track map shows a 12Z position near 41.5N, 67.6W. Microfilm analyzes a low of at most 990 mb centered near 40.6N, 66.7W with the west end of a frontal boundary located east of the cyclone extending from 41N, 62W to 41N, 52W. Ship highlights: 50 kt SSW and 995 mb at 06Z at 38.7N, 67.1W (micro); 45 kt WSW and 985 mb at 16Z at 40.5N, 66.4W (micro); 60 kt E and 1001 mb at 18Z at 42.7N, 64.8W (COA, micro). At least 31 other gales between 35-60 kt and nine other low pressures. Land/station highlights: 63 kt NE (max w/1-min) at Nantucket sometime between 00Z-05Z (climo); 55 kt ENE and 998 mb at 06Z at Nantucket (micro); 42 kt NE (max w/1-min) at Boston (climo); 35 kt NE (max w/1-min) at Eastport, ME (climo). At least one other gale and one other low pressure at Nantucket. Aircraft highlights: center fix (low-level penetration) at 1303Z at 39.9N, 66.9W with 979 mb central pressure and 75 kt max winds on the west side of the storm (AWS, micro); Air Force center fix at 1745Z at 41.4N, 65.9W [accuracy in doubt due to description of degree of certainty in estimated position] (micro). "It drifted slowly westward for two days before resuming a north to northeast course, and finally turned eastward south of Nova Scotia on the 13-14<sup>th</sup>. It gave strong winds to Cape Cod when it was passing some distance offshore on the 12<sup>th</sup>, and the station at Nantucket reported gusts of near hurricane force. Although winds along the New England coast were less than full hurricane force, damage amounted to \$2,000,000 and 12 lives were lost, 11 in capsized boats" (MWR). "On September and 12 an Atlantic hurricane passed near the New England coast, causing 13 casualties and over \$2,000,000 damage, mostly in Massachusetts" (climo). "Hurep Duck summary: Center of storm located by penetration at low level 39.9N, 66.9W at 1303Z. Eye was completely overcast. Light to calm winds in small area approximately 90 miles wide E to W. Winds on east side 50 kt or less, west side maximum 75 kt. Ceiling in all quadrants 500 ft or less. Very rough seas. 60 kt winds extend 110 miles S of center. 35 kt winds extend 215 mi south. Low pressure in eye 979 mb" (micro). "D-7: Center of storm at 1745Z- 41.4N, 65.9W by pressure drop and wind shift at 700 mb" (micro). "On the 12<sup>th</sup>, weaker values were reported again, 979 mbs and 75 kt. Dog seems to have maintained extremes near or even exceeding these all across the Atlantic" (AWS). "From this time on the areas of strong winds continued to expand except for a shrinking in the area of hurricane winds on the 12<sup>th</sup> and 13<sup>th</sup>. On the 12<sup>th</sup>, as the center passed 120 miles SE of Marthas Vineyard, hurricane winds grazed the island with gales lashing the coast from New York City to Portland, Maine and extending inland as far as Westover AFB" (AWS). "12/1303Z: Eye completely overcast, light to calm winds in area approximately 90 miles wide east to west" (AWS). "By late on 12 September, Dog

was moving almost directly east with constantly increasing speed and continued this course until it passed north of the Azores” (AWS).

#### September 13:

HWM analyzes a low of at most 995 mb centered near 42.3N, 60.4W with a WNW-ESE warm front extending from the low to 39N, 45W and the northeast end of a cold front located near 38N, 60W extending to 36N, 63W to 35N, 68W. HURDAT lists this as a 55 kt extratropical storm at 42.6N, 60.3W. The AWS best track lists a 0030Z position at 42.0N, 63.4W with 80 kt max winds and 981 mb central pressure and a 1230Z position at 42.2N, 59.2W with 75 kt max winds and 982 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 42.2N, 60.8W with a 980 mb pressure. The MWR post-season track map shows a 12Z position near 42.6N, 60.0W. Microfilm analyzes a low of at most 996 mb centered near 42.3N, 60.0W. Ship highlights: 65 kt SW and 993 mb at 00Z at 40.5N, 64.6W (micro); 60 kt W and 1003 mb at 06Z at 40.5N, 64.9W (COA); 50 kt W and 1006 mb at 18Z at 39.2N, 60.4W (COA). At least 18 other gales between 35-50 kt and three other low pressures between 1002-1004 mb. “During the 11<sup>th</sup> and 12<sup>th</sup> and 13<sup>th</sup> Dog made a broad turn to the east, bringing gale winds to the storm area from New York City to Portland, Maine and to southern Nova Scotia” (AWS). “Three ships reported pressures below 979 mbs after the [final] aircraft flight” (AWS). “As the storm moved eastward across the Atlantic, gales swept a latitude band 10-11 degrees wide including all but the southern Azores and hurricane winds swept a latitude band 2-4 degrees wide” (AWS).

#### September 14:

HWM analyzes a low of at most 990 mb centered near 43.3N, 51.2W with a warm front extending from 44N, 51W southeastward to 38N, 35W and a cold front extending from 41N, 51W to 38N, 55W to 37N, 60W. HURDAT lists this as a 50 kt extratropical storm at 43.1N, 50.0W. The AWS best track lists a 0030Z position at 42.3N, 54.8W with 75 kt max winds and 982 mb central pressure and a 1230Z position at 42.5N, 50.4W with 70 kt max winds and 982 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 43.0N, 49.5W with a 985 mb pressure. The MWR post-season track map shows a 12Z position near 43.5N, 48.4W. By 12Z, the low is moving off of the microfilm map. Ship highlights: 50 kt SW and 998 mb at 00Z at 40.9N, 55.2W (COA); 45 kt WNW and 998 mb at 12Z at 41.3N, 53.0W (HWM, micro). At least 14 other gales between 35-45 kt and seven other low pressures between 998-1005 mb. “By 14 September, it had reached a speed of 17 knots moving due east. The storm later moved into Ireland [on or after 16 September]” (AWS).

#### September 15:

HWM analyzes a low of at most 980 mb centered near 46.2N, 33.7W with a warm front extending from 46N, 29W to 36N, 21W and a cold front extending from 44N, 32W to 39N, 35W to 35N, 42W to 35N, 45W. HURDAT lists this as a 50 kt extratropical storm at 45.3N, 33.6W. The AWS best track lists a 0030Z position at 42.6N, 43.6W with 70 kt max winds and 982 mb central pressure and a 1230Z position at 43.0N, 35.0W with 75 kt max winds and 982 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 45.0N, 33.7W with a 985 mb pressure. Ship highlights: 50 kt NW

and 1005 mb at 00Z at 41.6N, 48.5W (COA); 55 kt NW and 1008 mb at 06Z at 42.6N, 46.0W (COA); 60 kt N and 982 mb at 18Z at 48.2N, 30.8W (COA). Numerous other gales and low pressures.

#### September 16:

HWM analyzes a low of at most 965 mb centered near 52.8N, 15.0W with an occluded front extending from just east of the low near 53N, 12W southward to a triple point at 44N, 13W. From this triple point, a warm front extends southward to 37N, 15W and a cold front extends from the triple point southwestward to 37N, 22W. HWM also analyzes a much weaker extratropical cyclone of at most 990 mb centered near 58N, 26W and a third extratropical cyclone of at most 985 mb centered near 68N, 0W. All three cyclones are located inside the same 995 mb closed isobar which extends over a huge distance. HURDAT lists this as a 50 kt extratropical storm at 52.8N, 14.7W. Ship highlights: 50 kt SSE and 994 mb at 06Z at 49.1N, 11.9W (COA); 30 kt S and 966 mb at 12Z at 52.2N, 13.4W (COA). Numerous other gales and low pressures. "It then moved almost due east passing 300 miles north of the Azores on the 16<sup>th</sup>" (AWS). "From the WBAN analysis, this storm still had a low pressure of 963 mbs just off the coast of Ireland at 1830Z on 16 September" (AWS).

#### September 17:

HWM analyzes a low of at most 970 mb centered near 57.5N, 4.5W with an occluded front wrapping around the low extending from 60N, 7W to 61N, 2W to 60N, 3E to 58N, 6E to 55N, 7E to 50N, 4E to 44N, 3W and a dissipating occluded front extending from 53N, 3E to 51N, 0W to 50N, 5W becoming a dissipating cold front there extending westward to 51N, 20W. Another weak extratropical low of at most 995 mb is centered near 69N, 3W. Both cyclones are located inside the same 1000 mb isobar extending over a large distance. HURDAT last lists this system at 00Z as a 50 kt extratropical cyclone at 55.2N, 9.1W. Ship highlights: 50 kt W and 992 mb at 00Z at 52.5N, 15.0W (COA); 55 kt SSE at 00Z at 55.5N, 4.9W; 50 kt NW and 987 mb at 12Z at 56.0N, 11.0W (COA); 35 kt SE and 976 mb at 12Z at 59.0N, 1.0W (COA); 45 kt ESE and 974 mb at 18Z at 60.7N, 1.7W (COA); 10 kt SE and 971 mb at 18Z at 59.0N, 3.0W (COA); 45 kt N and 996 mb at 23Z at 62.5N, 13.5W (COA). Several other gales and low pressures. "It brought 80 kt winds to the British Isles on the 17<sup>th</sup>" (AWS). "The British Isles experienced winds of 80 kt as Dog arrived on September 17<sup>th</sup>" (AWS).

#### September 18:

HWM suggests that Dog completely merged with another strong extratropical low by 12Z. HWM analyzes the center of the combined low near 61.0N, 0.1W. HURDAT no longer lists Dog on this day. Ship highlights (through 06Z only): 45 kt SW and 988 mb at 06Z at 56.0N, 1.0E (COA); 20 kt SE and 979 mb at 06Z at 62.0N, 1.0E (COA). Several other gales and low pressures.

The origin of what became Hurricane Dog is somewhat unclear. The Air Weather Service post-season report stated that the surface circulation that formed into Dog originated near the northeastern coast of South America around the 26<sup>th</sup> of August just north of Cayenne, French Guiana. The Monthly Weather Review article and messages

from NHC microfilm maps indicate that Dog originated from an easterly wave noted near the Cape Verde Islands on 24 August. Regardless of which scenario is correct, there are no observations available to draw a track before the first 6-hourly point in HURDAT for this cyclone, so no changes are made to the timing of genesis (18Z on 30 August) about 300 miles east of the Leeward Islands. The first observed gales occurred during the afternoon of the 30<sup>th</sup> from a ship, confirming the existence of Dog. On the 31<sup>st</sup> at 00Z, a ship reported 75 kt with 1000 mb, and at 1050Z on the 31<sup>st</sup>, aircraft measured a central pressure of 953 mb and estimated the center at 16.3N, 59.0W. This central pressure value is added into HURDAT at 12Z on 31 August. A central pressure of 953 mb yields 110 kt according to the Brown et al. southern pressure-wind relationship for intensifying systems, and 110 kt is chosen for the 12Z intensity on the 31<sup>st</sup> (up from 75 kt originally). There is little to no information available to indicate the pace at which the organization and intensification of Dog occurred during the previous hours and days. Backtracking the intensity obtained at 12Z the 31<sup>st</sup> to the first HURDAT point (18Z the 30<sup>th</sup>) an intensification of 10 kt per 6 hours is shown. Therefore, the first point in HURDAT at 18Z on the 30<sup>th</sup> is shown as a hurricane with an 80 kt intensity (up from 60 kt originally). No track changes of larger than 1 degree are analyzed for the entire tropical portion of the lifetime of Dog (30 August – 11 September). On the 31<sup>st</sup>, this powerful hurricane was moving towards the west-northwest and was approaching the northern Leeward and Virgin Islands. Early on 1 September, Hurricane Dog inflicted a major blow to the islands of Antigua and Barbuda (described as the worst hurricane in the history of those islands). The anemometer at Antigua recorded a maximum wind of 144 mph (125 kt) before the anemometer “disintegrated,” so the highest may not have been recorded. The minimum pressure recorded at Antigua was 973 mb, but this was not a central pressure. Dog passed to the north of Antigua, so the island was on the left (typically weaker) side of the cyclone. The revised track shows Dog to have moved two-tenths of a degree closer to the island. An intensity of 125 kt is chosen for 06Z on 1 September (up from 90 kt originally), but it is possible that Dog could have been stronger at that time. At 01/1832Z, an Air Force plane reported a 700 mb height in the eye of 9140 feet, implying a central pressure in the range of 948 to 966 mb, but a 964 mb pressure was reported from a dropsonde at the same time, so the central pressure is assumed to be some value between 948-964 mb. This range indicates an intensity in the range of 97-113 kt according to the southern pressure-wind relationship. 105 kt is chosen for 18Z (no change to HURDAT) since the forward speed of Dog had slowed to 7 kt. A central pressure of 962 mb was obtained by aircraft low-level penetration on 2 September at 1405Z about 80 miles north of the Virgin Islands indicating that some filling had taken place since the 953 mb central pressure was reported on the 31 August. A 962 mb central pressure is added into HURDAT at 12Z on the 2<sup>nd</sup>. A 962 mb central pressure yields 99 kt according to the southern pressure-wind relationship but since the storm was moving at only 6 kt, 95 kt should be chosen. However, surface winds were estimated visually at 120 kt and were believed to be as high as 140 kt on the strong side, so 100 kt is chosen for HURDAT for 12Z on the 2<sup>nd</sup> (down from 115 kt originally) placing a slight weighting on the surface wind estimates. After the central pressure of 962 mb was recorded on 2 September, Dog was not penetrated at low-levels again until 7 September when it was located near 30N, 67W. However, 700-mb penetrations were performed each day in between by the Air Force. The 700 mb heights obtained in the eye on the 3<sup>rd</sup> and 4<sup>th</sup> were

similar to the 2<sup>nd</sup> of September, but those obtained on the 5<sup>th</sup> and 6<sup>th</sup> indicated a stronger hurricane than was observed during the previous three days. The peak aircraft observations for this storm occurred on 5 September. A 700 mb height of 8540 ft was measured, which implies a central pressure in the range of 930 to 946 mb. A dropsonde at the same time measured a surface pressure of 943 mb, so the central pressure was probably in the range of 930-943 mb at the time. Making use of the intensifying subset of the pressure-wind relationship on the 5<sup>th</sup>, wind speed values in the range of 120-132 kt and 114-129 kt are yielded for south and north of 25N respectively. 125 kt is chosen for the peak intensity (for the second time) from 12Z on the 5<sup>th</sup> through 00Z on the 6<sup>th</sup>. Previously, HURDAT listed a peak intensity of 160 kt from 06 to 18Z on the 6<sup>th</sup>. On the 6<sup>th</sup>, it is analyzed that Dog weakened from 125 to 120 kt because the storm slowed down, moved north of 25N, and the reported 700 mb height that day was slightly higher. Also, the RMW was larger on the 6<sup>th</sup>. After having moved in a general northerly direction from the 4<sup>th</sup> to the 6<sup>th</sup>, Dog slowed down and turned westward by the time it reached a position only a couple hundred miles southwest of Bermuda. The slow westward motion continued until 10 September, when an acceleration towards the north-northwest commenced. On the 11<sup>th</sup>, Dog reached a longitude as far west as 72W before beginning a recurvature to the north-northeast. At 1945Z on 7 September, a central pressure of 972 mb was obtained by aircraft, and this value is added into HURDAT at 18Z on the 7<sup>th</sup>. A central pressure of 972 mb yields 82 and 78 kt utilizing the north of 25N relationships for steady state and weakening systems respectively. The forward speed of the cyclone was 3 kt. Maximum surface winds were visually estimated to be 105 kt from aircraft reconnaissance. 85 kt is chosen for 18Z on the 7<sup>th</sup> (down from 125 kt originally). A central pressure of 987 mb was obtained by aircraft low-level penetration on the 9<sup>th</sup> at 2029Z, and this value is added into HURDAT at 18Z on the 9<sup>th</sup>. A central pressure of 987 mb yields 64 and 61 kt utilizing the north of 25N relationships for steady state and weakening systems respectively; however, the 700 mb height in the eye around the same time corresponds to a central pressure in the range of 965 to 984 mb, which is somewhat contradictory. At this time, the RMW was much larger than climatology and the speed was still slow, so 5 to 10 kt should be subtracted from the pressure-wind relationship. 65 kt is chosen for the intensity at 18Z on the 9<sup>th</sup> (down from 80 kt originally). Several more central pressures were obtained on the 10<sup>th</sup> and 11<sup>th</sup>. The following central pressure values are added into HURDAT on those days: 986 mb at both 12 and 18Z on the 10<sup>th</sup>, 982, 978, 974, and 972 mb at 00, 06, 12, and 18Z on the 11<sup>th</sup>. By 18Z on the 11<sup>th</sup>, although Dog is analyzed to have been located at 37.9N, 71.4W, it is still analyzed to be tropical. It is analyzed that Dog reintensified from 65 kt on the 10<sup>th</sup> to 85 kt on the 11<sup>th</sup>. Dog is analyzed to have become extratropical by 00Z on 12 September (6 hours earlier than originally). Around the same time, it made a turn toward the east-northeast. Dog is analyzed to have made its closest approach to Nantucket, MA around 03Z on 12 September. Nantucket recorded a 1-min maximum wind of 63 kt. It is analyzed that Dog passed 125 nmi south-southeast of Nantucket at closest approach. HURDAT originally indicated roughly 75 nmi for the closest approach to Nantucket. This track adjustment weights the aircraft center fixes obtained at 11/1900Z and 12/1303Z as well as several important ship observations early on the 12<sup>th</sup>. Since Dog is analyzed as extratropical before its closest approach to Nantucket, a hurricane impact is not analyzed for any portion of the United States coastline. After the 12<sup>th</sup>, Dog moved rapidly eastward across

the north Atlantic as an extratropical system without being absorbed by any other low pressure systems through the 17<sup>th</sup> of September. The largest track changes made to HURDAT occur early on the 13<sup>th</sup> when the positions are analyzed to be just over 1 degree southwest of the previous HURDAT positions. By the 15<sup>th</sup> at 12Z, Dog was located near 46N, 33W, and by the 16<sup>th</sup>, it was located near 53N, 15W. A 60 kt wind was observed late on the 15<sup>th</sup>, and a 966 mb pressure was observed on the 16<sup>th</sup>. The final position listed in HURDAT is at 00Z on the 17<sup>th</sup> at 55.2N, 9.1W (revised to 55.6N, 9.1W). The analysis indicates that Dog still existed as a powerful extratropical cyclone even though it began occluding on the 16<sup>th</sup>, and Dog was not absorbed until the 18<sup>th</sup> after 00Z when it merged with a large low to its northeast. Dog passed through the British Isles on the 17<sup>th</sup>, and the Air Weather Service report stated that 80 kt winds were reported in the British Isles that day. The analyzed position at 12Z on the 17<sup>th</sup> is 57.8N, 4.1W, which is over Scotland. An intensity of 65 kt is analyzed from 00Z on 16 September to 06Z on 17 September (up from 50 kt originally at all times), and the intensity is brought down to 55 kt by 18Z on the 17<sup>th</sup>. The 55 kt intensity is maintained for the final position of 59.8N, 3.8W at 00Z on 18 September.

Some interesting quotes from the Air Weather Service post-season report...

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“Storm Dog definitely reached its maximum intensity between the 2<sup>nd</sup> and 7<sup>th</sup> with the extreme apparently on the 6<sup>th</sup>. Despite the report sent back by the Navy plane on the 2<sup>nd</sup>, another attempted to penetrate the eye on the 3<sup>rd</sup> and had to give up a few miles outside the eye due to severe turbulence. After this, Navy flights circumnavigated the storm center until the 11<sup>th</sup>. Meanwhile, Air Force aircraft penetrated the storm center at the 700 mb level and by means of dropsondes obtained sea level pressures in the eye. Values of 943 and 944 mbs were obtained in this way on the 5<sup>th</sup> and 6<sup>th</sup> respectively. Estimates of maximum wind during this period are of course questionable but indicate extreme intensity. Values of 120 kt and above were reported consistently from the first flights on August 31<sup>st</sup> until the afternoon of September 7<sup>th</sup>. Most of the Navy estimates were from the west and south sides which were presumably the weaker quadrants. The Air Force flights into the center of the storm were at 10,000 feet which made estimation of the surface wind difficult” (AWS).

Regarding the size, “Dog was a ‘great hurricane’ in both size and intensity” (AWS).

### 1950 Storm 5 (Easy)

35090	09/01/1950	M=	9	5	SNBR=	776	EASY		XING=1	SSS=3				
35095	09/01*	0	0	0	0*191	841	40	0*202	835	45	0*204	834	50	0*
35095	09/01*	0	0	0	0*197	832	40	0*199	832	45	0*201	832	50	0*
					***	***		***	***		***	***		
35100	09/02*206	832	55		0*208	830	60	0*210	828	65	0*214	825	65	0*
35100	09/02*203	832	50		0*205	833	55	0*207	833	55	996*209	832	55	995*
	***		**		***	***	**	***	***	**	***	***	**	***
35105	09/03*220	822	70		0*228	820	70	0*237	820	70	0*249	824	75	0*
35105	09/03*214	827	70		0*224	824	80	0*238	823	75	980*249	826	75	980*
	***	***			***	***	**	***	***	**	***	***		***

35110	09/04*260	828	90	0*269	832	105	0*274	832	110	0*280	838	110	0*
35110	09/04*262	828	80	0*271	833	85	0*277	835	85	973*280	838	85	973*
	***		**	***	***	***	***	***	***	***	***	***	***
35115	09/05*279	831	110	0*283	829	105	958*287	826	105	0*290	830	100	0*
35115	09/05*281	837	95	0*285	833	105	0*288	830	110	0*291	828	105	958*
	***	***	***	***	***		***	***	***	***	***	***	***
35120	09/06*283	826	85	0*282	822	65	0*283	818	60	0*286	815	50	0*
35120	09/06*287	828	90	0*284	826	75	0*282	821	60	0*286	817	40	0*
	***	***	**	***	***	**	***	***		***	***	**	
35125	09/07*293	812	45	0*300	817	40	0*312	830	35	0*324	845	30	0*
35125	09/07*293	816	40	0*302	819	35	0*312	830	30	0*320	848	25	0*
	***	**		***	***	**		**		***	***	**	
35130	09/08*334	859	30	0*341	870	25	0*346	877	25	0*348	881	25	0*
35130	09/08*331	859	25	0*339	870	20	0*352	883	20	0*352	885	20	0*
	***	**		***	**		***	***	**	***	***	**	
35135	09/09*350	886	25	0*353	892	25	0*356	897	25	0*359	902	25	0*
35135	09/09*353	893	20	0*350	898	20	0*356	899	20	0*359	902	20	0*
	***	***	**	***	***	**	***	**		***	**	**	
35140	HRAFL3												
35140	HRAFL3BFL1												
	****												

#### U.S. Landfalls:

09/05/1950 - 17Z - 29.1N 82.8W - 105 kt - 958 mb – 1009 mb OCI – 325 nm ROCI – 15 nmi RMW

09/06/1950 – 04Z – 28.5N, 82.7W – 90 kt – 965 mb – 1008 mb OCI – 300 nmi ROCI

Minor track changes and major intensity changes are analyzed for this cyclone that made landfall near Cedar Key, FL as a major hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, National and Local Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, Gentry (1951), Ho et al. (1987), Dunn and Miller (1960), Connor (1956), Perez et al. (2000), Schwerdt et al. (1979), and Jarrell et al. (1992).

#### August 31:

HWM does not analyze any features of particular interest except it appears as though a trough of low pressure extends southward from Tropical Storm Baker into the extreme western Caribbean Sea. HURDAT does not yet list a system on this day. Microfilm analyzes a closed low of at most 1008 mb centered near 15.6N, 83.7W. No gales or low pressures. “Storm Baker had passed inland over the Gulf Coast near Mobile early on the morning of the 31<sup>st</sup> of August moving northward across the Gulf States and leaving in its wake a large area of cyclonically curving winds covering the entire western Caribbean, and a deep trough extending from the center of the low [Baker] down across the Gulf of Mexico between the Yucatan Peninsula and western Cuba. This trough was recognizable at the surface level and at all upper levels up to and including at least the 300 mb level. Winds aloft at Swan Island remained westerly and ship reports indicated that low ceilings, precipitation and squally weather persisted in the area, factors indicating possible development of a tropical cyclone. Consequently, a close watch was kept over

this area and a Navy flight was sent out [on 1 September] to check conditions in this area” (AWS).

#### September 1:

HWM analyzes a hurricane of at most 1000 mb centered near 20.2N, 83.4W. HURDAT lists this as a 45 kt tropical storm at 20.2N, 83.5W. Microfilm analyzes a closed low of at most 1005 mb centered near 21.2N, 84.7W. Ship highlights: At least 15 kt NW and 999 mb at 17Z at 19.5N, 84.8W (micro); 30 kt W and 1008 mb at 18Z at 18.5N, 82.9W (COA, micro). One other low pressure of 1005 mb. Land/station highlights: 30 kt SE and 1005 mb at 18Z at Isle of Pines 1 (21.5N, 82.8W) (micro). Aircraft highlights: 75 kt SW at flight-level of 500 ft and 999 mb at 2058Z at 20.4N, 82.8W (ATS). Five other low-level flight-level winds of between 50-75 kt, and two other pressures of 999 mb. “[Easy] developed in the northwestern Caribbean Sea south of the Isle of Pines on September 1” (MWR). “At 2100Z, position 19.9N, 82.8W- passed into relatively clear area. Wind 290 degrees 35 kt. Max wind 80 kt in gusts. Penetrated above with wind placed on port beam. Circling in clear area. Wall penetrating squall again. N-2: Passed through moderate squall at 1725Z at 23.8N, 83.0W. Wind shifted 130 degrees 20 kt to 160 degrees 28 kt. Squall oriented NW-SE at 01/1800Z. N-3: Passed through scattered squall at 23.2N, 83.9W at 1823Z. Wind dropped off to 6 kt- scattered squalls all quads” (micro). “On the morning of 1 September 1950 a Navy reconnaissance aircraft was dispatched from Miami to investigate a suspicious area southwest of the Isle of Pines in the western Caribbean. At 1725Z at position 23.8N, 83.0W a squall line oriented NW-SE was crossed with a wind shift from 130 degrees at 20 kt to 160 degrees at 20 kt. Heavy rain was encountered at 2027Z and [flight-level] winds were observed from 230 degrees at 60 kt with gusts to 80 kt in heavy squalls. No definite center could be found but a relatively clear area was reported at 19.9N, 82.2W. Minimum pressure reported in the area was 999 mbs” (AWS). From the weather observers’ summaries- “01/2100Z: Passed through several squalls and calm areas. Passed into one relatively clear area, wind 290 degrees 35 kt, with maximum winds in squall line to SE 80 kt in gusts. Pressure 999 mb” (AWS). From the ATS report... “On the morning of 1 September, this flight departed Miami to investigate a suspicious area north of Isle of Pines south of Cuba. The coordinates were to 21.5N, 85.0W thence southeastward to 17.2N, 81.0W. At 1752Z position 23.8N, 83.0W passed through moderate squall line oriented NW-SE. Wind shifted 130 degrees 20 kt to 150 degrees 28 kts across squall line. The radar became inoperative about 1840Z due to excessive moisture in radar range unit, and without radar the orientation of squalls covering western tip of Cuba was extremely difficult to determine. At 1949Z position 20.6N, 84.3W moderate rain commenced and by 2000Z had become heavy. Winds southeasterly north of Cuba, backed to northwesterly 25 kt south of Cuba and by 2027Z were 230 degrees 60 kt, with gusts to 80 kt in heavy squalls. At 2100Z position 19.9N, 82.8W passed into relatively clear area. A commercial ship [plane?] was observed at 2112Z heading directly for area of high winds so information about high winds was transmitted to ship. At 2130Z departed clear area of southeasterly heading and a gradual turn to the north was made. At 2200Z, passed from under heavy squall line oriented WNW-ESE. Winds dropped rapidly off to calm so departure was taken for Miami” (ATS).

September 2:

HWM analyzes a tropical storm of at most 1000 mb centered near 20.4N, 84.0W. HURDAT lists this as a 65 kt hurricane at 21.0N, 82.8W. The AWS best track lists a 0030Z position at 20.8N, 83.5W with 80 kt max winds and 999 mb central pressure and a 1230Z position at 20.8N, 83.5W with 80 kt max winds and 997 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 21.1N, 83.0W with a 988 mb pressure. The MWR post-season track map shows a 12Z position near 21.1N, 82.8W. Microfilm analyzes a hurricane of at most 996 mb centered near 20.7N, 83.6W. Ship highlights: 35 kt SE and 1000 mb at 03Z at 20.3N, 82.3W (micro); 40 kt W and 1000 mb at 16Z at 20.4N, 83.6W (micro); 50 kt WSW and 1001 mb at 18Z at 19.3N, 83.6W (micro); 30 kt S and 996 mb at 21Z at 20.4N, 82.4W (micro). Two other gales and 26 other low pressures. Land/station highlights: 50 kt E and 994 mb at 20Z at Isle of Pines 2 (21.8N, 82.8W) (micro); 40 kt E and 993 mb at 21Z at Isle of Pines 1 (21.5N, 82.8W) (micro). Five other gales and 11 other low pressures. Aircraft highlights: Navy center fix at 1335Z at 20.8N, 83.4W with 996 mb central pressure and max flight-level winds encountered of 65 kt (AWS, ATS); 20 kt NE (25 kt ENE at flight-level of 1000 feet) and 994 mb at 1415Z at 21.0N, 82.2W (micro); Navy center fix at 1830Z at 20.8N, 83.5W with 995 mb central pressure (max flight-level winds encountered 75 kt ESE at 19Z at 800 ft at 20.9N, 82.0W (AWS, ATS). At least three other surface gales, two other flight-level winds of 55 kt, and seven other low pressures below 1000 mb. "N-13 (1545Z): Position [of aircraft?] 21.9N, 83.8W. Hook center by land radar fix at 20.7N, 82.9W [position of aircraft?]. Circular center 20.8N, 83.7W [position of aircraft?]. Lowest pressure 996 mb. Eye appears to be forming with center at 1335Z at 20.8N, 83.4W. Well defined hook from center..." (micro). "Navy special: Entered storm on west side. Storm center 20.8N, 83.5W. Lowest barometer 995 mb at 1825Z. Wind located on the NE and E side 80 kts. Heavy squall lines forming on east side of storm" (micro). "On September 2<sup>nd</sup>, two reconnaissance flights were made into the area. Each found a center with a partially formed eye, minimum pressure of 996 and 995 mbs and gusts to 80 kt in the squall line forming the eastern wall of the eye. The center positions, reported five hours apart, were separated by less than 7 miles. After the second of these fixes at 1830Z, the storm center began to move to the NE and had crossed Cuba almost before the movement could be detected. Exactly the same thing happened in October 1947 when an even more intense hurricane passed near the Isle of Pines and crossed Cuba. Its movement not being detected until rising winds and falling pressure at Havana and Rancho Bayeros revealed the storm's location. In both cases the storm center seemed to be located in the Isle of Pines area and then suddenly jumped across Cuba and appeared over water north of Havana. However, careful checking indicates that storm Easy moved at nearly a constant speed of between 10 and 12 kt from 02/1830Z and located by reconnaissance north of Cuba at 03/1215Z" (AWS). From the weather observers' summaries- "02/1335Z: Found cyclonic circulation with minimum pressure 996 mbs. Maximum winds of 65 kt with gusts to 80 kt. 02/1830Z: Found widespread calm area approximately 30 miles in diameter, lowest pressure 995 mbs. Strongest winds around center were WNW side 40 kt, S side 45 kt, NW side gusts to 80 kt with torrential rain in squall line" (AWS). From the ATS report... "This flight was ordered out on the morning of 2 September 1950 to further investigate a suspicious area south of the Isle of Pines which had been reconnoitered the previous afternoon. The standard Navy low-level

procedure was commenced shortly after reaching a position five miles west of the Isle of Pines. After one hour and 45 minutes of search, a cyclonic circulation with minimum pressure of 996 mb was centered at 02/1335Z near 20.8N, 83.4W. Maximum winds of 65 kt with gusts to 80 kt and torrential rains were encountered in the heavy weather which existed between true bearings of 040 and 170 degrees at a distance of 25 to 30 miles from the circulation center. A climb to 10,000 feet was commenced at 1500Z in order to view the storm structure from that altitude. The flight returned to Miami, landing at 02/1800Z” (ATS). From another ATS report... “Crossed Cuba and entered storm on the northwest side. Highest winds encountered west-northwest of the center 40 knots. A widespread calm area approximately 30 miles in diameter was centered at 20.8N, 83.5W. Lowest central pressure was 995 mb. The strongest west winds encountered near the south side of the calm area were 260 degrees 45 kt. Departed through east side spiraling out through the northeast quadrant and encountering torrential rain and gusts to 75 kt in squall lines” (ATS).

### September 3:

HWM analyzes a hurricane of at most 1000 mb centered near 23.7N, 82.4W. HURDAT lists this as a 70 kt hurricane at 23.7N, 82.0W. The AWS best track lists a 0030Z position at 21.5N, 82.8W with 80 kt max winds and 990 mb central pressure and a 1230Z position at 23.9N, 82.3W with 80 kt max winds and 980 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 23.8N, 82.0W with a 975 mb pressure. The MWR post-season track map shows a 12Z position near 23.7N, 82.1. Microfilm analyzes a low of at most 993 mb centered near 24.2N, 82.3W. Ship highlights: 75 kt NE and 987 mb at 03Z at 22.3N, 82.8W (micro); 75 kt ENE and 998 mb at 12Z at 24.3N, 81.5W (micro); 65 kt SE and 998 mb at 15Z at 24.3N, 81.6W (micro); 75 kt ENE at 19Z at 25.7N, 82.9W (micro). Eight other gales and 27 other low pressures. Land/station highlights: 58 kt G 63 kt (max w) at Havana, Cuba around ~10Z (micro, AWS); 10 kt (min w inside RMW) and 989 mb (min p) at Havana around ~10Z (micro, Gentry); 60 kt E (wind maybe biased too high) and 1000 mb at 12Z at Key West (micro); 40 kt SSE and 995 mb at 15Z at Key West (micro); 991 mb around 17 or 18Z at Dry Tortugas (Connor); 63 kt NE at Dry Tortugas (Connor); 55 kt SE at Miami (Connor). Eleven other gales and 17 other low pressures. Aircraft highlights: Navy center fix at 1310Z at approximately 24.1N, 82.4W with 980 mb central pressure (AWS, ATS, micro); Navy center fix at 20Z at 25.6N, 82.7W with 980 mb central pressure and max flight-level winds encountered 75 kt ENE at 600 ft at 1938Z at 25.7N, 82.9W (AWS, ATS). At least ten other surface gales, four other flight-level hurricane force winds, and 16 other low pressures below 1000 mb. Several other center fixes by Navy radar plane. “[Easy] remained nearly stationary for two days before moving northward across Cuba near Havana. The center moved north-northwestward thereafter as a storm of just the lower limit of hurricane force and passed between Key West and Dry Tortugas around noon of September 3” (MWR). “The storm passed over the Isle of Pines and just east of Havana where the wind dropped off to 10 or 15 mph” (Gentry). “Navy 2: 24.1N, 81.8W [position of aircraft]. Possible weak eye 30 mi diameter at 23.9N, 82.5W. Squalls 60 miles to NNE from eye. Navy 3: Eye located by radar fix at 1330Z at 24.2N, 83.6W moving northeast. Open to south. Navy 6: Position 24.1N, 82.5W [plane position or storm position?]. Wind NW 65 kt. Entered weak, poorly defined eye at 1310Z. Squalls

in the north to southeast quadrants. Eye radar fix 24.7N, 82.7W..." (micro). "Hurricane passed just east of Havana at 1000Z. Max winds 67 mph. Lowest pressure 989 mb [at Havana]" (micro). "Navy 9 (1730Z): Plane position 23.9N, 81.4W. Hurricane radar position 24.7N, 82.6W. 15 mi wide. Navy 10: position of plane 24.5N, 81.9W. Radar fix eye 25.1N, 82.6W (1830Z). Navy 11- 1900Z: Radar fix eye located 25.2N, 82.6W. 2120Z hurricane position 25.5N, 82.6W. Eye poorly defined but considered good fix" (micro). "03/2315Z: Hurricane position 26.0N, 82.7W. Excellent radar fix" (micro). "Although winds of 65 kt with gusts to 80 kt were reported by reconnaissance south of Cuba, the highest winds reported at Havana were gusts to 63 kt. Damage was apparently slight. A gradual turn to the NW occurred as Easy moved over Cuba and into the Florida Straits and this course continued until approximately 03/1400Z when another turn was made to the north. The storm was not particularly intense during this period although winds up to hurricane force covered a wide area. Key West reported gusts to 75 knots at 03/1230Z while the center of the circulation was still 50 miles to the southwest. Beginning at 1215Z on the 3<sup>rd</sup> of September Navy radar aircraft kept almost constant vigil on Storm Easy until its eventual entry into the Florida Gulf Coast southeast of Cedar Keys on the 5<sup>th</sup>. The reports were received with such regularity that it was possible to nearly pinpoint the position of the center at any time. Aircraft radar reports ended only when the storm entered the land area" (AWS). From the weather observers' summaries-03/1310Z: "A weak, poorly defined eye, with lowest pressure 980 mbs and semicircular squalls along N to SE sides was encountered but the majority of the heavy weather with NE to E winds of 65-80 kt and heavy squalls was 60 miles to the north of the eye" (AWS). "1<sup>st</sup> Navy radar flight- 03/1215Z: Possible weak eye 30 miles in diameter. Well defined squall line extending 60 miles to NNE from eye. 03/1330Z: Eye complete with spiral bands open to south. No weather on scope south of Cuba. 03/1430Z: Gradually becoming better defined. 03/1530Z: Eye 30 miles diameter, increasing. 03/1630Z: Eye open to south becoming confused. 03/1730Z: 15 mile wide weather band bears 330 to 90 degrees, 50 mile wide weather band bears 330 to 090 degrees 50 miles from center. 03/2000Z: After passing through one strong and one moderate squall line (approaching from east) aircraft emerged into a large area of confused seas with a noted absence of low and middle clouds. Minimum pressure 980 mb" (AWS). "2<sup>nd</sup> Navy radar flight-03/2210Z: Eye poorly defined. Unable to obtain reliable fix at present. 03/2345Z: Very distinct pinwheel for eye" (AWS). From the ATS report... "South of Key West on a morning flight from Miami, winds averaged 35-50 kt from the east to northeast at 24N, 83W, but diminished east of this position. A weak, poorly defined eye, with lowest pressure 980 mb was encountered, but the majority of the heavy weather and winds were encountered in the area between 24.5N to 25.5N, and 83.3W to 82.0W on the return leg. Northeast to east winds of 65-80 kt and heavy squalls characterized this area" (ATS). From the next ATS report... "The second Navy flight of 3 September into the developing hurricane off the west coast of Florida departed NAS Miami at 03/1827Z. After passing through a strong squall line at 1900Z and a moderate squall line shortly after 1915Z, the aircraft emerged into a large area of confused seas with a noted absence of low and middle clouds. However, it required 45 minutes of search after this time before the position of the hurricane center was definitely located at 2000Z near 25.6N, 82.7W. Maximum winds from the east-northeast of 75 kt were encountered near 25.7N, 82.9W. In order to check the dead reckoning position of the hurricane center, course was taken

from the center for Dry Tortugas Island” (ATS). “Easy – Sep. 2-3 – Cat 1 in Cuba” (Perez et al. 2000).

#### September 4:

HWM analyzes a tropical storm of at most 1000 mb centered near 27.4N, 83.1W. HURDAT lists this as a 110 kt hurricane at 27.4N, 83.2W. The AWS best track lists a 0030Z position at 26.3N, 82.8W with 90 kt max winds and 977 mb central pressure and a 1230Z position at 28.0N, 83.6W with 105 kt max winds and 974 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 28.3N, 83.3W with a 980 mb pressure. The MWR post-season track map shows a 12Z position near 27.7N, 83.4W. Microfilm analyzes a hurricane of at most 993 mb centered near 27.9N, 83.6W. Ship highlights: 65 kt SW and 982 mb at 05Z at 26.5N, 83.3W (micro). A few other gales and low pressures. Land/station highlights: 45 kt E and 997 mb at 10Z at St. Petersburg, FL (micro); 70 kt SSE G 90 (station may be elevated) at 16Z at 27.8N, 82.8W (micro). At least 24 other gales and 40 other low pressures. Aircraft highlights: Navy center fix at 1454Z with 973 mb central pressure and max flight-level winds encountered 100 kt NNW at 600 feet 27.8N, 83.9W (ATS, micro); Navy center fix at 1915Z at 28.1N, 83.8W with 973 mb central pressure and 110 kt max flight-level winds encountered [100 kt max surface estimate?] (AWS, ATS, micro). At least four other surface gales, five other flight-level hurricane force winds, and nine other low pressures below 1000 mb. Several other center fixes throughout the day by Navy radar plane. “It continued about parallel to the west Florida coast 30 to 50 miles offshore until it reached a point some 70 miles northwest of Tampa on the 4<sup>th</sup>. Here it described the first of two loops and started moving northeastward” (MWR). “04/0045Z hurricane position 26.4N, 82.8W. Good radar fix. 04/0145Z hurricane position 26.5N, 83.0W. Poorly defined eye. Questionable accuracy. 04/0200Z: 26.7N, 82.7W. 04/0215Z hurricane position 26.6N, 83.2W. Eye poorly defined. Accurate within eight miles. 04/0345Z: 26.7N, 83.2W. 0415Z: 26.8N, 83.3W. 0445Z: 26.9N, 83.4W. 0515Z: 27.0N, 83.3W. Two Navy 0900Z radar position-eye centered 27.5N, 83.3W. Plane position 26.5N, 81.8W [115 statute miles distance from plane to center]. Eye semi-circular and closed from SW to NW and 40 miles in diameter. Open SE sector. Three Navy 1000Z radar position eye centered 27.6N, 83.4W. Eye diameter increased to 45 miles. Plane position 26.6N, 81.6W [130 statute miles from plane to center]. Five Navy 1100Z radar position of eye- 27.8N, 83.4W. Plane 26.3N, 82.1W. Eye retains definition. Radar fix at 12Z at 27.9N, 83.6W. Position doubtful due to poor definition. Navy radar fix 1317Z 28.0N, 83.7W. Radar position Navy nine: 28.2N, 83.7W at 14Z. Radar position 15Z: 28.2N, 83.8W. Hurep Navy five: Eye at 1452Z well defined 26 by 25 miles diameter. Position 27.8N, 83.7W. Max winds 5 mi east of eye 350 degrees 100 kt sustained for 5 miles. Min pressure 975 mb. DR and radio fix accurate within 8 miles. N-7: Left eye south side. Encountered wind 270 degrees 90 kt. Wind backed around to 190 degrees to 130 degrees- sustained 85 kt gusts to 100 kt. Entered eye at 1715Z. Eye well-defined 20 miles on diameter. Blue sky. Highest wind 110 [kt?]. Center 28.1N, 83.8W” (micro). “Storm Easy continued its northerly course, making a 45 degree turn to the left at 04/0030Z but resuming course three hours later. Very little change occurred either in size or intensity during this travel. Edgemont Key reported storm winds from the northeast when the storm was positioned 50 miles due southwest of the station. At 04/1230Z, the forward speed reduced to 4 knots

and the storm began a movement to the west. By 1830Z, it had become nearly stationary 50 miles due west of Anclote Key and reconnaissance by two Navy aircraft gave evidence that it was at this point that intensification progressed to a high degree. Penetration by one aircraft revealed the center position at 04/1915Z as 28.1N, 83.8W with the added information that the eye was well defined 20 miles in diameter with winds of over 100 kt extending 15 miles from the center and hurricane winds extending 35 miles from the center” (AWS). From 2<sup>nd</sup> Navy radar flight (continued), “04/0145Z: Poorly defined eye. 04/0345Z: Eye appears 35 to 40 miles in diameter” (AWS). “3<sup>rd</sup> Navy radar flight: 04/0900Z: Eye semicircular closed from SW to ENE with 40 miles inside diameter open SE sector. 04/1000Z: Eye diameter increased to 45 miles. 04/1100Z: Eye retains definition. 04/1200Z: Eye position doubtful due to poor definition. 04/1320Z: Fair radar eye. Considerable weather return in center” (AWS). From aircraft, “04/1915Z: Eye well defined with partly cloudy blue skies inside, 25 by 26 miles. Minimum pressure 973 mbs. Maximum wind 5 miles W of eye 350 degrees 110 kt. Rain heavy to torrential W, S, and SE sides. 04/1915Z: Eye well defined, 20 miles in diameter, blue sky above. Highest wind 100 kt accompanied by torrential rain” (AWS). From the ATS report... “Radar planes of VX-4 had been covering this storm all night and reported the eye seemed well-defined just offshore from Tampa. At 1349Z the eye appeared on radar to be 28 mi to the SW, surface winds at this time were east-northeasterly 75 kts. The storm was circumnavigated and the eye penetrated on the west side at 1454Z. The eye was well-defined with partly cloudy skies inside the eye. It was 26 miles long N-S, and 35 miles wide E-W. Lowest pressure was 973 mb. Max sustained winds from 350 degrees 110 kts for 5 mi west of the eye, and on south side 270 degrees 100 kt for 8 miles from eye. 75 kt winds extended 35 mi north and west of eye and 22 mi east of eye” (ATS). From the next ATS report... “Flight was made to determine fix on the center of [the storm]. Approach was made from the southeast quadrant and penetration was made at 1915Z. The eye was found to be well defined; calm and clear to have a diameter of 20 miles, and fixed at 28.1N, 83.8W. Circumnavigation was made out the west side and around to the east, leaving the 75 kt perimeter about 35 miles from the center. This storm had developed considerably during the morning of 4 September. It proved to be relatively small in area, but severe in intensity, with max winds near the center to 110 kt” (ATS).

#### September 5:

HWM analyzes a hurricane of at most 995 mb centered near 28.7N, 82.9W with the west end of a dissipating cold front located north of the cyclone near 32N, 85W extending eastward and becoming a cold front near 32N, 81W extending eastward to 34N, 71W. HURDAT lists this as a 105 kt hurricane at 28.7N, 82.6W. The AWS best track lists a 0030Z position at 28.2N, 83.0W? or 83.8? with 120 kt max winds and 958 mb central pressure and a 1230Z position at 28.9N, 82.9W with 120 kt max winds and 950 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 29.3N, 82.6W with a 982 mb pressure. The MWR post-season track map shows a 12Z position near 28.7N, 82.7W. Microfilm analyzes a hurricane of at most 993 mb centered near 28.9N, 82.9W. Land/station highlights: 65-75 kt NE and 985 mb at Cedar Key, FL at 1050Z at 29.1N, 83.0W (micro); 110 kt (max w before instrument was blown away) and 960 mb [probably simultaneous observations] at Cedar Key (micro, advisories); 958

mb (min p) at either 1530Z or 1630Z at Cedar Key (MWR, micro, Connor); calm from 1600Z – 1830Z at Cedar Key (MWR, micro); 60 kt NNE and 993 mb at 21Z at Cross City, FL (29.6N, 83.1W) (micro); 85 kt [estimated?] at Cedar Key at 22Z (micro). Numerous other gales and low pressures. At least five center fixes from land-based radar in Gainesville at University of Florida between 12Z-18Z. Aircraft highlights: About 20 center fixes from Navy radar plane between 0245Z-1300Z. “The center reached the coast a short distance south of Cedar Keys the morning of the 5<sup>th</sup>, where it made another loop; in making this loop, the calm center moved over the town of Cedar Keys from the southeast and then away toward the south. This gave the town the unusual experience of exposure to the same side of a hurricane twice, with 2.5 hours of calm center between. About the time of the first loop, the intensity increased to 125 mph, the strongest wind reported at Cedar Keys, but the loop described over that place resulted in hurricane force or higher from 11Z to 23Z on the 5<sup>th</sup>, except for 2.5 hours of calm from 16Z to 1830Z. Long time residents reported it was the worst hurricane experienced at that place in more than 70 years. This fishing village of about 1,000 people was badly wrecked. Half of the houses were destroyed or rendered unfit for habitation, and 90 percent of the remainder were damaged. The fleet of fishing boats which was the principal source of livelihood for the community was completely destroyed. Extremely heavy rainfall occurred in connection with the storm over central and northeast Florida. Cedar Keys had 24.50 inches in 3 days while many other stations had from 10 to 20 inches of rainfall. These rains caused much flooding and some crop damage which, when added to the damage by high tide and wind of the west Florida coast, amounted to about \$3,300,000. Two persons were killed by fallen live wires and 27 others were injured in various ways. The small damage figure is due to the sparsely settled area where the worst part of the hurricane occurred. The lowest pressure reported was 958.3 mb at Cedar Keys” (MWR). The extremely erratic movements of this storm as well as forecasting problems are discussed by Gentry (1951). “Radar position at 0310Z 28.2N, 83.5W. Navy four storm position at 0350Z 28.3N, 83.4W. Excellent land and hurricane radar bearings. Eye three-quarters closed. Southern quadrant open” (micro). From Anclote island... “3-5 ft of water over entire island at 1015Z” (micro). “N-13 Hurricane position 28.9N, 83.0W. Good radar fix. N-14: Hurricane position 28.9N, 82.9W 1230Z. Leading edge of eye on beach. N-15: Hurricane position 1300Z 29.0N, 82.8W. Land fix- eye or band nearing” (micro). “Radar fixes from Gainesville- 12Z: 28.8N, 83.0W. 1230Z: 28.9N, 82.9W. West 70 miles 216 degrees. 1430Z: 29.0N, 82.9W. Pressure at Gainesville 1001 mb. Gainesville radar fix 1530Z 29.0N, 83.9W. Gainesville radar 18Z: 29.1N, 82.8W. Barometer at Gainesville 1000 mb. Wind at Gainesville ENE 20 kt” (micro). “After an almost stationary period of about six hours Storm Easy took up an erratic course to the northeast and north until at 05/0930Z when it began a turn to the east-northeast and continued at a rate of 5 to 6 kt, merging with the Gulf Coast shoreline 20 miles SE of Cedar Keys at 1400Z. The storm began a turn to the left at 1530Z which continued until the storm center was again over the Gulf of Mexico whereupon it began a twisting course southward along the coast finally re-entering the land mass at a point about 30 miles SE of Cedar Keys. Reports from Cedar Keys indicate that the winds blew steadily and heavily there for a period of 18 hours wreaking widespread damage to all part of the town. Almost all of the total damage due to the storm, estimated at \$3,500,000 and two deaths, occurred in and around Cedar Keys” (AWS). “On the 5<sup>th</sup>, northwestern Florida

experienced one of its worst hurricanes on record. Wind gusts reached a speed of 125 mph and over 20 inches of rain fell in the Cedar Key area. The path of this hurricane was unusual in that it described a loop near Cedar Key and this city was in the calm center for 2 ½ hours. There were 29 casualties, and over \$3,000,000 damage” (climo). From the Monthly National Climatic Data summary... “Place: Florida Counties of Dixie, Levy, Alachua, Marion, Citrus, Lake, Hernando, Pasco, Pinellas, Hillsborough, Manatee, and Polk. Date/time: 5<sup>th</sup> 6 am to 6 pm. Path of area affected 60 by 150 miles in size. Number of persons killed: 2. Number of persons injured 27. Property damage (exclusive of crops): \$3,100,000. Property damage to crops: \$300,000. Character of storm: Hurricane. Remarks: Storm center passed between Key West and Dry Tortugas between 10 and 11 am of the 3<sup>rd</sup>, and moved north-northwestward, parallel to west Florida coast 30 to 50 miles offshore, about 10 or 12 mph to a point about 70 miles northwest of Tampa at 8 pm of the 4<sup>th</sup>. Here it began to show increased intensity and aircraft estimated highest winds about 125 mph. During the night of the 4<sup>th</sup> and 5<sup>th</sup>, storm made a sharp turn to the northeast and reached the coast a little south of Cedar Keys about 8 am of the 5<sup>th</sup>. Here it made a small loop that brought the lull over Cedar Keys at 11 am from the east. Center lingered over Cedar Keys until 1:30 pm when the southward bend of the loop carried the center away to the south. Strongest winds were 125 mph in gusts, and hurricane force or higher prevailed from about 6 am to 6 pm on the 5<sup>th</sup>, except for the calm period. Lowest pressure was 28.30 inches (958.3 mb). The whole coastal area from Sarasota to Cedar Keys suffered extensively from wind and high water. Beach erosion severe, especially in St. Petersburg-Clearwater area. Tide in Tampa Bay rose 6.5 feet, the highest since 1921” (climo). “4<sup>th</sup> Navy radar flight- 05/0245Z: Eye well defined. Open south quadrant. Diameter 25 miles. 05/0515Z: Diameter of eye fluctuating from 18 to 26 miles. 05/0545Z: Eye complete, diameter 19 miles” (AWS). “5<sup>th</sup> Navy radar flight- 05/0630Z: eye well defined, completely closed. 05/0930Z: Eye 12 to 15 miles in diameter, outer wall touching beach from Cedar Keys 25 miles down the coast. 05/1030Z: Pinwheel eye now almost anchored at this position. 05/1300Z: Land and eye merging” (AWS). “Easy – Sept. 5, 1950 – 958 mb landfall pressure based 958 mb observed at Cedar Key, FL – RMW 15 nm – Speed 3 kt – Landfall point 28.6N, 82.7W” (Ho et al. 1987). “Tropical Cyclones in Florida – Sept. 3-7 – Peninsula – Major – Cedar Keys bar. 28.30 in. (958 mb), wind 125 mph” (“Major” is equivalent to Saffir-Simpson Hurricane Scale 2 or 3; Dunn and Miller 1960). “Sept. 5 – Center crossed coast near Cedar Key – Estimated lowest pressure 28.30 (958 mb)” (Connor 1956). “Easy – 1009 mb environmental pressure at landfall – 88 kt estimated max 1-min wind at landfall” (Schwerdt et al. 1979). “Easy – FL, NW – 958 mb” (Jarrell et al. 1992).

#### September 6:

HWM analyzes a hurricane of at most 995 mb centered near 28.5N, 82.3W with the west end of a W-E stationary front located north of the cyclone near 32N, 83W extending eastward to 33N, 71W. HURDAT lists this as a 60 kt tropical storm at 28.3N, 81.8W. The AWS best track lists a 0030Z position at 28.8N, 82.7W with 100 kt max winds and 966 mb central pressure and a 1230Z position at 28.3N, 82.4W with 80 kt max winds and 982 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 28.6N, 82.1W with a 984 mb pressure. The MWR post-season track map shows a 12Z position near 28.2N, 82.2W. Microfilm analyzes a low of at most 990 mb centered

near 28.3N, 82.3W with the west-southwest end of a WSW-ENE frontal boundary located near 30N, 82W extending east-northeastward to 32N, 75W. Ship highlights: Two gales of 35 kt at 12Z and numerous low pressures of 1001-1005 mb throughout the day. Land/station highlights: 70 kt SW (elevated) and 986 mb at 07Z at Anclote Light (28.2N, 82.8W) (micro); 40 kt SW and 988 mb at Tampa at 08Z and 09Z (micro); center fix at 0905Z at Lutz, FL (28.2N, 82.5W) with variable winds of 5 kt reported with scattered clouds (micro); 60 kt W (elevated) and 994 mb at 12Z at Anclote Light (micro); 35 kt SSW and 996 mb at 21Z at Orlando (micro). Ten radar center fixes by land-based radar in Gainesville at University of Florida. Several other gales and low pressures. "The hurricane was not through with its gymnastics. It moved southward about 70 miles to a point about 30 miles north of Tampa where it turned eastward and made a rather sharp curve back to northward over Florida on the 6<sup>th</sup>. This made four abrupt changes in course in 3 days! It had lost hurricane force by this time, however" (MWR). "Gainesville radar report: 0000Z: 28.8N, 82.8W. 0030Z: 28.8N, 82.8W. 0330Z: 28.6N, 82.6W. 0430Z: 28.5N, 82.6W. Barometer [at Gainesville] 1000 mb. 0530Z: 28.5N, 82.6W. 0630Z: 28.5N, 82.6W. 0730Z: 28.4N, 82.5W. 0830Z: 28.3N, 82.4W. Fix indefinite, pattern spotty. Not known if due to distance or poorly organized storm. Distance 94 miles, azimuth 185 degrees. Barometer at Gainesville 999 mb. Light to moderate rain" (micro). "A report from Lutz, which is about 20 mi north of Tampa, indicates light variable winds and scattered clouds at 0905Z" (micro). "Gainesville radar- estimated position at 0910Z- 28.3N, 82.4W. 1030Z: 28.2N, 82.3W. [Previous 2] Gainesville radar position are estimates. Image badly broken up and spotty. Gainesville radar reports: 1130Z: Series of squalls between Dade City and Zephyrhills. No well defined center. 1230Z: Squall area drifting eastward and now over Withlacoochee swamp. No further reports unless reported" (micro). "A slow movement to the southeast followed the storm's second entry into the coastline with rapid reduction in wind force around the center. Gainesville radar gave its last definite position report at 06/1530Z and stated that the storm pattern was becoming indefinite and diffuse. Its path carried it around in a wide curve to the northwest, passing just west of Orlando at 06/1830Z, with steadily diminishing intensity" (AWS). "The greatest monthly amount [of precipitation during September, 1950 recorded for any station in the entire United States] was 26.40 inches which fell at Cedar Key, FL. Twenty-four hour amounts exceeding 10 inches were measured in Florida" (climo).

#### September 7:

HWM analyzes a low of at most 1000 mb centered near 31.2N, 83.0W with a dissipating stationary front located from 33N, 81W to 32N, 75W to 34N, 68W to 36N, 64W. HWM analyzes Hurricane Dog to be centered near 30.1N, 67.5W. HURDAT lists Easy as a 35 kt tropical storm at 31.2N, 83.0W. The AWS best track lists a 0030Z position at 29.5N, 81.9W with 40 kt max winds and 992 mb central pressure and a 1230Z position at 31.2N, 83.1W with 20 kt max winds and 996 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 31.7N, 83.0W with a 998 mb pressure. The MWR post-season track map shows a 12Z position near 31.5N, 82.8W. Microfilm analyzes a low of at most 999 mb centered near 31.6N, 83.3W with a frontal boundary located from 33N, 81W to 33N, 76W. Ship highlights: 40 kt NE and 1006 mb at 00Z at 32.1N, 79.6W (micro); 35 kt E and 1011 mb at 00Z at 32.9N, 77.1W (COA); 30 kt S and 1003 mb at

00Z at 28.3N, 78.6W (COA, micro). Two other low pressures. Land/station highlights: 25 kt S and 997 mb at 00Z at Daytona Beach (micro); 10 kt WNW and 993 mb at 00Z at Ocala (micro); 20 kt S and 998 mb at 06Z at Jacksonville (micro); 20 kt SSE and 1001 mb at 12Z at Alma, GA (micro); 42 kt NE [not representative of storm intensity due to topography] (max w/1-min) at Spartanburg, SC (climo). One other gale and five other low pressures. “[Easy] dissipated as it moved into southern Georgia on the 7<sup>th</sup>” (MWR). “Increasing speed of movement took the dying storm into South Georgia just north of Valdosta by 1230Z on the 7<sup>th</sup> and gale winds continued in Georgia and South Carolina for some time” (AWS).

#### September 8:

HWM analyzes a closed low of at most 1005 mb centered near 34.6N, 87.6W. HURDAT lists this as a 25 kt tropical depression at 34.6N, 87.7W. The MWR tracks of centers of cyclones shows a 12Z position near 35.1N, 89.3W with a 1007 mb pressure. Microfilm analyzes a closed low of at most 1008 mb centered near 35.5N, 89.0W. Land/station highlights: 5 kt WSW and 1005 mb at 00Z at 32.3N, 86.2W (micro); 10 kt WNW and 1008 mb at 18Z at Memphis, TN (micro).

#### September 9:

HWM analyzes a closed low of at most 1010 mb centered in the general vicinity of 34.6N, 90.6W with a warm front extending from 44N, 105W to 40N, 101W becoming a cold front at 39N, 97W continuing to 40N, 91W to 45N, 78W. HURDAT lists this as a 25 kt tropical depression at 35.6N, 89.7W. The MWR tracks of centers of cyclones shows a 12Z position near 35.1N, 89.3W with a 1009 mb pressure. Microfilm analyzes an extremely broad, closed low of at most 1011 mb with the 1011 mb enclosing an area extending from 30-39N, 86-93W. Land/station highlights: 5 kt SSW and 1008 mb at 00Z at Memphis, TN (micro).

#### September 10:

HWM analyzes a spot low near 38N, 88W with a complex W-E frontal system located about 3 degrees north of the spot low. HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 38.5N, 92.0W with a 1008 mb pressure. Microfilm analyzes a closed low of at most 1008 mb centered in the general vicinity of 37.7N, 92.0W. No gales or low pressures.

#### September 11:

HWM no longer analyzes the feature of interest on this day, and it only analyzes a complex frontal system with a weak extratropical cyclone center unrelated to the remnant of Easy. HURDAT no longer lists this system. The MWR tracks of centers of cyclones shows a 12Z position near 41.1N, 88.8W with a 1010 mb pressure.

#### September 12:

The MWR tracks of centers of cyclones shows a 12Z position near 41.4N, 84.0W with a 1012 mb pressure.

#### September 13:

The MWR tracks of centers of cyclones shows a 12Z position near 43.0N, 81.3W with a 1011 mb pressure.

September 14:

The MWR tracks of centers of cyclones shows a 12Z position near 45.9N, 80.2W with a 1009 mb pressure.

Easy formed in the western Caribbean Sea on 1 September from a trough of low pressure that existed which extended from Tropical Storm Baker along the U.S. North Gulf Coast southward to the western Caribbean and Central America. There are no changes to the timing of genesis or the 40 kt intensity at genesis, but the genesis point is moved about one degree northeast of the previous HURDAT position to 19.7N, 83.2W at 06Z on 1 September. By 17Z on 1 September, ship and station observations were beginning to indicate that a cyclone of tropical storm intensity likely existed in the western Caribbean. Aircraft investigated the system during the afternoon of the 1<sup>st</sup> but could not locate a definite center. The lowest pressure observed by both aircraft and ships on the 1<sup>st</sup> was 999 mb. On the 1<sup>st</sup> and the 2<sup>nd</sup>, Easy moved very slowly towards the north, but on the night of the 2<sup>nd</sup> – 3<sup>rd</sup>, it slowly accelerated and curved a little to the northeast before turning back northward and north-northwestward later on the 3<sup>rd</sup>. On 2 September, Easy was slowly approaching the Isle of Pines from the south. Early on the 2<sup>nd</sup>, the first ship gales were reported, and at 1335Z on the 2<sup>nd</sup>, aircraft fixed the center and measured a central pressure of 996 mb. A 995 mb central pressure was measured by aircraft at 1830Z; however, by 20Z, observations from the Isle of Pines indicate that the central pressure may have been lower than 989 mb. Central pressures of 996 and 995 mb are added into HURDAT at 12 and 18Z respectively on 2 September. Central pressures of 996 and 995 mb yield 54 and 56 kt respectively according to the Brown et al. southern pressure-wind relationship, and 55 kt is chosen for both 12 and 18Z on the 2<sup>nd</sup> (down from 65 kt originally at both times). Easy made landfall on the eastern tip of the Isle of Pines (21.5N, 81.6W) at 01Z on 3 September. Winds as high as 50 kt and pressures as low as 993 mb were observed on the Isle of Pines, but more intense values may have occurred. As Easy continued northward between the Isle of Pines and mainland Cuba, a ship reported 75 kt simultaneously with 987 mb at 03Z on 3 September. This ship was located 25 to 30 nmi from the interpolated analyzed center position for 03Z. The approximate RMW reported 9 hours earlier as well as 12 hours later was 22 to 23 nmi. Easy made landfall on mainland Cuba around 07Z on 3 September at 22.7N, 82.3W. The center of Easy passed just a few nmi east of Havana around 10Z. Havana recorded a maximum wind of 58 kt and a minimum pressure of 989 mb. The 989 mb minimum pressure observation was reported simultaneously with minimum winds of 10 kt inside the RMW as the center passed just to the east of the city (Gentry). By 1310Z on the 3<sup>rd</sup>, aircraft fixed the center between Havana, Key West and Dry Tortugas with a central pressure value of 980 mb, and this value is added into HURDAT at 12Z on the 3<sup>rd</sup>. An intensity of 80 kt is chosen for 06Z on the 3<sup>rd</sup> (up from 70 kt originally) and for the Cuban landfall at 07Z. There is a chance that Easy could have been a Category 2 hurricane at Cuban landfall, but there is not enough evidence to change Perez et al.'s assessment of a Category 1 for Cuba. A central pressure of 980 mb at 1310Z on the 3<sup>rd</sup> yields 78 kt according to the southern pressure-wind relationship. A ship reported a 75 kt

wind at 12Z. 75 kt is chosen for the 12Z intensity (up from 70 kt originally). Another ship reported a 75 kt wind at 19Z and aircraft reported another 980 mb central pressure at 20Z. A central pressure of 980 mb is added into HURDAT at 18Z on 3 September, and 75 kt is also chosen for the 18Z intensity (no change to HURDAT) because although the RMW contracted, Easy was moving north of 25N, which changes the pressure-wind relationship. Easy passed between Key West and Dry Tortugas between 15-18Z on the 3<sup>rd</sup>. Dozens of aircraft center fixes on the 4<sup>th</sup> and 5<sup>th</sup> by the Navy radar aircraft enabled for accurate hourly tracking of the center. Late on the 3<sup>rd</sup> through 12Z on the 4<sup>th</sup>, Easy moved north-northwestward paralleling the west coast of Florida. By 12Z on the 4<sup>th</sup>, Easy reached a position of 27.7N, 83.5W, or about 55 nmi west-southwest of Tampa, FL. At this point, Easy became nearly stationary for the next 12 hours and moved slowly and erratically to the northwest with a 00Z position on the 5<sup>th</sup> of 28.1N, 83.7W. Thereafter, a northeastward motion commenced so that by 12Z on the 5<sup>th</sup>, the center of Easy was very nearly approaching the coast of the big bend of Florida with a position of 28.8N, 83.0W. All available data indicate that the HURDAT positions at 00 and 06Z on the 5<sup>th</sup> are too close to the coast and the positions are shifted about half a degree westward. Observations indicate that the 980 mb hurricane observed from 13Z to 20Z on the 3<sup>rd</sup> began to intensify again early on the 4<sup>th</sup>. At 05Z on 4 September, a ship observed 65 kt with a 982 mb pressure, which indicates a central pressure well below 980 mb. At 1454Z on the 4<sup>th</sup> and again at 1915Z, aircraft measured central pressures of 973 mb, and this value is added into HURDAT at both 12 and 18Z. A central pressure of 973 mb yields 81 kt north of 25N and 85 kt for intensifying systems, and 85 kt is chosen for both 12 and 18Z on the 4<sup>th</sup> (down from 110 kt originally at both times).

On the 5<sup>th</sup> from 00Z to 13Z, Easy moved generally northeastward towards the coastline. Center fixes from the Navy radar aircraft and the land-based radar located in Gainesville, FL, as well as comments from the aircraft aerologists indicate that the edge of the eye of Hurricane Easy came onshore around 13Z on the 5<sup>th</sup> near 29.0, 82.7W. However, the 13Z center fix (29.0N, 82.8W) indicates that the center of the eye was located 1 to 4 nmi offshore at the time. The next available center fix, at 1430Z, is 28.0N, 82.9W, indicating a westward motion of one-tenth of a degree in 1 and a half hours, which takes the center of Easy farther out over the water. Due to the time resolution of the center fixes combined with the fact that the accuracy of these center fixes is one or two tenths of a degree, it is possible that Hurricane Easy made a brief landfall just after 13Z and then moved back over the Gulf of Mexico again by 14Z. However, no landfall is analyzed for that time. Although no landfall is analyzed at 13 - 14Z, the RMW and the calm eye of Easy are analyzed to have touched the coastline at that time at 29.0N, 82.7W, but not the center of the eye. All fixes between 1430Z and 1530Z were at a position of 29.0N, 82.9W. The next radar fix, which did not come until 18Z, is at 29.1N, 82.8W, which is inland on the coastline. Between 1530Z and 1800Z, the center of Easy is analyzed to have curved to the northwest, north, northeast, and then east with this entire arc occurring in the tiny area between 29.0-29.1N, 82.8-82.9W. Landfall is analyzed to have occurred at 17Z at 29.1N, 82.8W, and this is also the 18Z position. Cedar Keys (29.1N, 83.0W) experienced a huge blow from this hurricane while providing crucial observations of wind and pressure. Hurricane force winds commenced at Cedar Key at 1050Z, when 70 kt with 985 mb was recorded. At 1430Z, Cedar Keys recorded a 5-minute average wind

of 89 kt N. A peak gust of 110 kt N was recorded at Cedar Keys before the anemometer blew away. Some conflicting sources suggest that the 110 kt observation was a 1-minute wind rather than a gust. Information does however indicate that these values were measured by an anemometer (not estimated). A microfilm message implies that the 110 kt observation may have occurred simultaneously with a 960 mb pressure observation, but it is not certain whether these observations are simultaneous. At 1530Z, Cedar Keys recorded its minimum pressure of 958 mb. Calm was experienced at Cedar Keys from 1600Z – 1830Z. Therefore, the best available information indicates that the minimum pressure at Cedar Key occurred before the calm arrived. This indicates that the central pressure of Easy at 16 and 17Z was higher than at 1530Z. If the 960 mb and 110 kt was a simultaneous observation, then the central pressure of Hurricane Easy could have risen from less than or equal to 949 mb (using the 10 kt per mb rule) to greater than or equal to 958 mb within the span of just 1 to 2 hours. Nevertheless, the 958 mb observation is treated as a central pressure. A 949 mb central pressure cannot be added into HURDAT due to the numerous uncertainties. However, if the central pressure was 949 mb around 1430-1500Z, that equals 106 kt north of 25N, and 111 kt north of 25N and intensifying. The storm was moving very slow, but the aircraft reported a “pinwheel eye” at 12Z. If the hurricane was weakening the whole time between 12Z-18Z, then it is possible that the intensity at 12Z was 115 kt and that the coastline ten miles southeast of Cedar Key felt Category 4 winds, especially between 13Z – 14Z. If the 110 kt observation was a sustained wind, and not a gust, then an intensity of 115 kt should be chosen using the rule to go 5 kt above the highest wind speed observation, and higher winds may have occurred after the wind instrument was blown away. An additional important note is that the peak intensity and central pressure observation shown in the original HURDAT appear to be placed in the incorrect 6-hourly time slots. The 958 mb central pressure in HURDAT at 06Z on the 5<sup>th</sup> is removed, and it is added at 18Z instead. HURDAT previously showed a peak intensity of 110 kt from 12Z on the 4<sup>th</sup> to 00Z on the 5<sup>th</sup>. Due to the numerous uncertainties involved with the observations, 110 kt is chosen for 12Z on the 5<sup>th</sup> (up from 105 kt originally). The central pressure of Easy at the time of the analyzed landfall (17Z) is analyzed to have been 958 mb. A central pressure of 958 mb at landfall yields a wind speed of 97 kt according to the north of 25N pressure-wind relationship. Although 110 kt is chosen for 12Z, 105 kt is chosen for the 17Z landfall and for the 18Z intensity. A Category 3 impact is maintained. Although 105 kt is the analyzed landfall intensity for the 17Z landfall, it is analyzed that winds of 110 kt occurred on the coast around 13Z ten miles SE of Cedar Keys (and Cedar Keys may have experienced 110 kt winds also around 1430Z). Also, since the lowest pressure recorded at Cedar Keys was 958 mb at 1530Z, and the pressure there may have been higher than that at the time of landfall (17Z), perhaps a landfall central pressure higher than 958 mb should be analyzed, but no additional changes are necessary due to uncertainty. The landfall RMW is analyzed to be 15 nmi, OCI 1009 mb, and ROCI 325 nmi. We do not know the exact strength of the winds at Cedar Keys after the eye was experienced since the anemometer had blown away (these were estimated to be 85 kt or higher for several hours after the calm). After 18Z on the 5<sup>th</sup>, after traveling inland perhaps a couple of miles, Easy turned towards the south and emerged back over water by 21Z at nearly the same spot where the hurricane was located at 13Z. After 21Z, the severe hurricane conditions at Cedar Key likely began to slowly abate, but hurricane force winds lasted from 1050 to 2300Z at Cedar Keys

except when the calm center was observed from 1600 to 1830Z. From 21Z on 5 September to 00Z on 6 September, Easy traveled southward off the coast, but at 00Z, it made a turn to the southeast. Easy made its 2<sup>nd</sup> and final Florida landfall at 04Z on 6 September at 28.5N, 82.7W as a 90 kt hurricane. The 90 kt intensity chosen at 00Z on the 6<sup>th</sup> is a 5 kt increase over the original HURDAT intensity. After this final landfall, which occurred several dozen miles north of Tampa, Easy moved slowly southeastward reaching 28.2N, 82.1W by 12Z on the 6<sup>th</sup>. Then it made a rather sharp turn to the east, northeast, and north by 18Z, staying over the Florida peninsula the entire time. It moved northward over the eastern half of the northern Florida peninsula, passing west of Jacksonville around 06Z on the 7<sup>th</sup>, and it then moved northwestward over the southeastern United States as it continued to weaken. Runs of the Kaplan and DeMaria (1995) Inland Decay Model yield 73 kt for 06Z on the 6<sup>th</sup>, 57 kt for 12Z, 41 kt for 18Z, 40 kt for 00Z on the 7<sup>th</sup>, and 35 kt for 06Z. Highest observed winds within 2 hr of the synoptic times were: 70 kt (elevated, which reduces to 64 kt at 10 m) at 06Z on the 6<sup>th</sup>, 60 kt (elevated, which reduces to 55 kt at 10 m) at 12Z, 35 kt at 18Z, 40 kt at 00Z on the 7<sup>th</sup>, and 25 kt at 06Z. Revised winds in HURDAT from 06Z on the 6<sup>th</sup> through 06Z on the 7<sup>th</sup> are 75, 60, 40, 40, and 35 kt (65, 60, 50, 45, and 40 kt originally). The Category 3 impact in HURDAT for NW FL is unchanged. However, a Category 1 impact for SW FL is analyzed and added into HURDAT. When Easy passed between Key West and the Dry Tortugas, neither Key West nor the Dry Tortugas are analyzed to have experienced hurricane force winds. However, the Marquesas Keys (located west of Key West) are analyzed to have experienced Category 1 winds. Also, on 6 September between 06 – 12Z, Category 1 winds were likely felt at the border between the SW and NW FL dividing line north of Tampa. No hurricane force winds were felt in the eastern half of Florida. Easy is analyzed to have weakened to a tropical depression by 12Z on the 7<sup>th</sup>, 6 hours earlier than in HURDAT originally when it was located over southern Georgia. It weakened to a 20 kt tropical depression by 06Z on the 8<sup>th</sup> when located over north-central Alabama. The circulation remained closed as a tropical depression through the 9<sup>th</sup> of September, as in HURDAT, with a final position in extreme northeastern Arkansas at 18Z on the 9<sup>th</sup>.

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Some interesting quotes from the Air Weather Service post-season report...

“These reports clearly indicate that the storm was poorly organized south of Cuba and became increasingly well organized until it moved on shore near Cedar Keys. They show too that the wall of the eye is not static in either size or definition. It also seems that the area of strongest winds began on the SE side of the eye and gradually moved around it in a cyclonic direction arriving on the west side as the storm became stationary off Cedar Keys” (AWS).

“Storm Easy was well covered by reconnaissance and entirely by Navy aircraft. Seven penetrations of the storm center were made and five VX-4 Squadron radar flights obtained a total of 51 radar fixes. In addition, 22 land radar fixes were taken by the University of Florida at Gainesville. These fixes clearly confirm that some tropical cyclone centers follow an undulatory track as predicted by Dr. Veh in his theory on the

trochoid track. The fixes at the same time clearly show that the short period movement of the storm center is unrepresentative of the general movement of the storm” (AWS).

### 1950 Storm 6 (Fox)

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35145 09/08/1950 M=10 6 SNBR= 777 FOX          XING=0
35150 09/08* 0 0 0 0*156 401 40 0*157 411 40 0*157 423 40 0*
35150 09/08* 0 0 0 0*155 410 40 0*155 418 40 0*155 428 40 0*
          *** **
          *** **

35155 09/09*158 434 45 0*159 445 45 0*161 455 50 0*166 469 50 0*
35155 09/09*155 438 45 0*155 446 45 0*156 453 50 0*161 460 50 0*
          *** **
          *** **

35160 09/10*173 483 55 0*181 494 60 0*189 502 65 0*195 508 70 0*
35160 09/10*169 467 50 0*176 473 55 0*182 480 55 0*188 488 55 995*
          *** ** **
          *** ** **

35165 09/11*199 513 75 0*202 518 80 0*205 523 80 0*210 530 85 0*
35165 09/11*189 496 60 0*190 502 65 0*191 507 70 0*192 512 75 986*
          *** ** **
          *** ** **

35170 09/12*214 537 85 0*218 543 85 0*220 547 90 0*222 551 90 0*
35170 09/12*195 518 75 0*203 525 80 0*213 534 80 0*223 543 85 977*
          *** ** **
          *** ** **

35175 09/13*224 554 90 0*225 557 95 0*227 562 95 0*228 569 100 0*
35175 09/13*227 550 90 0*229 558 95 0*231 565 95 0*233 572 100 0*
          *** **
          *** **

35180 09/14*231 576 105 0*235 583 110 0*240 590 115 0*246 594 120 0*
35180 09/14*236 578 105 0*238 584 110 0*241 589 115 0*249 594 120 0*
          *** **
          *** **

35185 09/15*255 597 120 0*266 598 120 0*283 597 120 0*306 591 115 0*
35185 09/15*259 597 120 0*270 598 120 0*282 597 120 946*302 593 115 0*
          ***
          ***

35190 09/16*330 577 110 0*350 559 105 0*368 537 100 0*382 512 90 0*
35190 09/16*326 582 110 0*347 565 105 0*365 545 100 0*378 522 90 0*
          *** **
          *** **

35195 09/17E393 485 85 0E419 428 65 0* 0 0 0 0* 0 0 0 0 0*
35195 09/17*395 485 85 0*425 435 70 0E455 395 55 0* 0 0 0 0 0*
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          **** **

35200 HR

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Major track changes and minor intensity changes are analyzed for this hurricane that recurved around 60W. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

### September 8:

HWM analyzes a closed low of at most 1010 mb centered near 15.5N, 40.5W. HURDAT lists this as a 40 kt tropical storm at 15.7N, 41.1W. No gales or low pressures. “After 08/0630Z, the reports could not easily be ignored since they consistently indicated a vortex from this time on” (AWS).

**September 9:**

HWM analyzes a low of at most 1010 mb centered in the general vicinity of 15.5N, 45.0W. HURDAT lists this as a 50 kt tropical storm at 16.1N, 45.5W. No gales or low pressures.

**September 10:**

HWM analyzes a tropical storm of at most 1005 mb centered near 18.9N, 50.1W. HURDAT lists this as a 65 kt hurricane at 18.9N, 50.2W. The AWS best track lists a 0030Z position at 16.6N, 46.1W with 30 kt max winds and 1005 mb central pressure and a 1230Z position at 17.0N, 47.8W with 60 kt max winds and 998 mb central pressure. Aircraft highlights: Air Force center fix at 19Z at 19.0N, 49.0W with 995 mb central pressure and estimated maximum winds of 60 kt (micro, AWS, advisories). "This storm was discovered by aircraft reconnaissance on September 10 near 19N, 50W. At that time, it was a small hurricane with winds estimated at 70 to 80 mph. The wind speed increased to about 140 mph as it moved in a curving path toward the northwest and north during the next few days" (MWR). "Located hurricane at 1900Z at 19.0N, 49.0W. This is a corrected position using sun lines and visual fix on islands to correct DR navigation. Storm has small 10 mile ring of hurricane force winds in the northern sector. Encountered winds of 40 to 50 kt in southern sector so closed circulation is very well established. Pressure in eye is 994.8 mb. Unable to accurately measure wind. 60 kt estimate. Highest wind not over 75 kt" (micro). "Although still far out in the Atlantic a flight was dispatched on September 10" (AWS). A fairly well organized storm was found with a central pressure near 995 mbs and a narrow ring of hurricane force winds on the west side. An advisory was coordinated, and since no additional information was expected before the next reconnaissance mission, it was agreed to state in the advisory that the next advisory would not be issued until after the next reconnaissance flight" (AWS). "The ship Luclano Manara passed north of the storm center approximately 10/0300Z indicating quite definitely that the storm center was approximately two degrees further south than reported by the first aircraft flight. In this case, the ship's navigation was accepted over that of the aircraft because it yields a more consistent track for the storm. There may be other fixes which also are in error but since they are the only information available no attempt at correction can be made. On the basis of all information available, Storm Fox was moving WNW at 8 kt at 10/1900Z when first located by reconnaissance. It slowly turned to the right and accelerated to around 14 kt. (It is quite possible that the second fix is too far south and that a more constant speed was followed during that period)" (AWS). "Storm Fox was fairly well organized when first located on September 10<sup>th</sup> but appears to have been newly developed. A band of hurricane force winds 10 miles wide was observed on the north side of the eye; winds on the south side were 40-50 kt. Surface pressure was reported as 994.8 mbs. The cloud system of the storm covered a relatively small area" (AWS). "The eye appeared nearly formed when observed by aircraft in the late afternoon" (AWS).

**September 11:**

HWM analyzes a tropical storm of at most 1005 mb centered near 19.2N, 49.9W. HURDAT lists this as an 80 kt hurricane at 20.5N, 52.3W. The AWS best track lists a 0030Z position at 17.5N, 49.2W with 80 kt max winds and 993 mb central pressure and a

1230Z position at 18.4N, 50.7W with 95 kt max winds and 989 mb central pressure. Aircraft highlights: Air Force center fix at 1919Z at 19.0N, 51.3W with 986 mb central pressure 85 kt estimated max winds (AWS, micro). “Hurep Duck 09: Center of storm located by radar and visual observation at 1919Z at 19.0N, 51.3W. Diameter of eye 12 miles. Moderate to severe turbulence exist in all quadrants within 25 miles radius of center. NE quadrant extremely rough. Winds of 85 kt exist near center. [Central pressure 987 mb from code- probably central pressure.]” (micro). “The second flight 23 hours later found the eye 12 miles in diameter, circular and with a pressure of 986 mbs. The plane did not enter the NE quadrant because radar indicated severe weather there. Winds of 70 kt or better were found in all other quadrants and the maximum in the NE quadrant was estimated to be 100 kt. Hurricane winds were reported to cover a radius of 20 miles” (AWS).

#### September 12:

HWM analyzes a tropical storm of at most 1005 mb centered near 21.1N, 52.8W. HURDAT lists this as a 90 kt hurricane at 22.0N, 54.7W. The AWS best track lists a 0030Z position at 19.5N, 52.2W with 105 kt max winds and 984 mb central pressure and a 1230Z position at 21.9N, 53.6W with 110 kt max winds and 979 mb central pressure. The MWR post-season track map shows a 12Z position near 22.2N, 53.7W. The cyclone first enters the map area of microfilm at 18Z as a closed low of at most 999 mb centered near 22.4N, 54.8W at 18Z. Aircraft highlights: Air Force center fix at 18Z at 22.7N, 54.3W with 977 mb central pressure and 100-110 kt estimated max winds (highest measured flight-level wind was 100 kt at 1000 ft) (micro). Three other surface gales between 35-70 kt and two other flight-level hurricane force winds. “D-5: Max wind on west side 70 kt” (micro). “Duck report- in eye at 22.2N, 54.8W at 1800Z. Max winds 100-110 kt. Pressure in eye 977 mb” (micro). “Note change in coordinates of positions for obs no 8-13. These were corrected by sun lines and land fixes and by back navigation. This puts the storm center approximately at 22.7N, 54.3W. Hurricane winds extend 50 miles to the north of the eye but only are found [at the eyewall] in the southern sector. NW and NE quadrants have the lowest ceilings and the most weather. Estimate [cloud] buildups 16000 ft south of eye and 22000 feet to the north. Highest measured wind was 100 kt just on the edge of the western side of the eye at 1000 ft. The navigator... feels that the positions given are accurate to within 29 miles. [Central pressure 978 mb from obs in code- probably central pressure]” (micro). “At 12/1800Z the storm turned toward the WNW to W and slowed to 5-6 kt. The dip to the north in the track here is consistent with the synoptic pattern even though the speed of movement must be considered approximate” (AWS). “The flight on the 3<sup>rd</sup> day (12<sup>th</sup>?) reported hurricane winds 50 miles north of the center and only on the rim of the eye on the south side” (AWS).

#### September 13:

HWM analyzes a low of at most 1010 mb centered near 23.4N, 56.5W. HURDAT lists this as a 95 kt hurricane at 22.7N, 56.2W. The AWS best track lists a 0030Z position at 23.2N, 55.0W with 110 kt max winds and 977 mb central pressure and a 1230Z position at 23.4N, 56.1W with 115 kt max winds and 976 mb central pressure. The MWR post-season track map shows a 12Z position near 23.4N, 56.2W. Microfilm analyzes a low of

at most 999 mb centered near 23.4N, 56.7W. Aircraft highlights: center fix (radar/DR) at 1648Z at 23.5N, 57.1W (micro). "Center of hurricane as determined by radar is 23.5N, 57.1W at 1648Z. This is a reliable position. Eye is 15 miles in diameter. Radar returns indicate all quadrants near center as rough" (micro). "Post flight summary Hurricane Fox: Center of Hurricane Fox was located by radar and determined to be 23.5N, 57.1W at 1648Z. The center appeared as circular with a diameter of 15 miles. Radar returns indicated this storm is still very small in area with heavy cumulus buildups existing in all quadrants near the center. Judging by the dropsonde sounding made at 24.3N, 57.8W at 1656Z, it is believed the storm center may be 20 miles further than reported. Position of center was determined by DR navigation. Hurricane winds do not extend more than 20 miles from the center in NW quadrant and storm winds not more than 50 miles. Gale winds extend to 75 miles from center in NW quadrant. Hurricane winds extend to estimated 25 miles in SW quadrant and storm winds to 40 miles. Gale winds are prevalent to 60 miles in SW sector" (micro). "At 13/1830Z, Fox again accelerated slowly throughout recurvature reaching a velocity of NNE 45 kt at latitude 40N" (AWS). "The 4<sup>th</sup> flight on the 13<sup>th</sup> reached the storm area just before dark and gave only a center fix and the diameter of the eye as 15 miles (AWS)."

September 14:

HWM analyzes a tropical storm of at most 1010 mb centered near 24.1N, 59.3W. HURDAT lists this as a 115 kt hurricane at 24.0N, 59.0W. The AWS best track lists a 0030Z position at 23.7N, 57.7W with 120 kt max winds and 975 mb central pressure and a 1230Z position at 24.7N, 59.3W with 125 kt max winds and 975 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 24.2N, 59.0W with a 990 mb pressure. The MWR post-season track map shows a 12Z position near 24.3N, 58.5W. Microfilm analyzes a tropical storm of at most 1002 mb centered near 24.1N, 58.8W. Aircraft highlights: Navy center fix (radar) at 1408Z at 24.2N, 59.0W with lowest pressure encountered 975 mb three miles west of the eye edge and estimated maximum winds of 120 kt (ATS, micro, AWS); Air Force center fix (boxing) at 1740Z at 25.2N, 59.4W (micro). At least one other surface hurricane force wind, five other flight-level hurricane force winds, and two other low pressures. "Hurep Navy nine: Hurricane center by radar at 1418Z at 24.2N, 59.0W. Max winds all quadrants estimated over 120 kt. Max winds encountered at 24.2N, 59.2W north 90 kt; at 24.1N, 59.2W northwest 100 kt; at 24.0N, 59.2W west 75 kt. 40 kt winds exist 30 mi northwest and west, 40 miles south and southwest [of center]. Hurricane winds exist 25 miles from center in all quadrants. Minimum pressure 974.6 mb. Heavy rain 20 miles from center in all quadrants. Eye 20 miles diameter" (micro). "Hurep Duck post flight summary: Highest winds, lowest ceilings, most weather and rain located in the NE quadrant. Hurricane force winds extend 50 miles in the NE quadrant, 30 miles in SE quadrant, and 25 miles in SW quadrant. Storm winds extend 70 miles in NW and NE quadrant, 40 miles in SE quadrant, and 35 miles in SW quadrant. 45 kt winds extend 100 miles in NE quadrant, 60 miles in SE quadrant, and 40 miles in SW quadrant. Corrected position of storm at 1740Z is 25.2N, 59.4W [original 1740Z position was 25.7N, 59.7W by box method]" (micro). "Not until 2 days later [the 14<sup>th</sup>?] did another flight report hurricane winds as far as 50 miles from the center. The eye was reported 20 miles in diameter, pressure 977 mbs and winds 100-110 kt" (AWS). "Two flights were flown on the 14<sup>th</sup>. The first of

these reached the storm just as it was moving NE into recurvature and before it accelerated appreciably. As in most storms this appeared to be the point of maximum intensity. The central pressure was reported as 974.6 mbs and this winds 120 kt plus in all quadrants. Succeeding flights found the pressure rising but the winds speeds did not decrease appreciably until two days later on the 16<sup>th</sup> (AWS). From the ATS report... "The first Navy flight into this three day old hurricane departed Ramey AFB, Puerto Rico at 1004Z on 14 September. Shortly after 1230Z, definite indications of this hurricane presence became evident in the form of an altostratus shield to the northeast and prevailing northerly winds. At 1300Z, the wind was placed slightly forward of the port beam in order that the hurricane could be penetrated in the western quadrant. By 1400Z, the wind had increased to hurricane velocity and moderate continuous rain was being experienced. The wind increased rapidly from this time on to over 90 kt at a position three miles west of the eye edge where heading was altered to circumnavigate. When five miles south of the eye's edge, it was decided, due to the extended flight range of this hurricane, to return immediately to base, thereby canceling circumnavigation. The hurricane center was located by radar at 1408Z near 24.2N, 59.0W with an eye 20 miles in diameter. Flight returned to Ramey AFB at 1805Z" (ATS).

#### September 15:

HWM analyzes a tropical storm of at most 1005 mb centered near 28.5N, 60.2W. HURDAT lists this as a 120 kt hurricane at 28.3N, 59.7W. The AWS best track lists a 0030Z position at 26.7N, 59.9W with 120 kt max winds and 975 mb central pressure and a 1230Z position at 28.9N, 59.8W with 120 kt max winds and 975 mb central pressure. Both the MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, and the former is indicated with a 975 mb pressure. Microfilm analyzes a tropical storm of at most 1002 mb centered near 28.6N, 59.6W. Aircraft highlights: 85 kt N (90 kt NNW at flight-level of 400 ft) and 980 mb at 1445Z at 29.0N, 59.9W (ATS); Navy center fix at 1450Z at 29.2N, 59.5W with 976 mb min p encountered 19 miles SW of the center (and 7 miles from the eye edge) and estimated maximum winds in excess of 120 kt (ATS, micro); Air Force center fix (DR) at 1835Z at 30.4N, 59.5W with 975 mb pressure measured by dropsonde and estimated maximum winds of 100 kt (micro). "[Fox] passed more than 300 miles east of Bermuda on the 15<sup>th</sup>, and thereafter moved rapidly northeastward over the Atlantic. This hurricane remained small throughout its course, but maintained maximum velocities of about 140 mph until it moved out of range of reconnaissance" (MWR). "Hurricane center by radar DR position at 1450Z at 29.2N, 59.5W. Estimated max winds in all quadrants over 120 kt. Max winds encountered at 29.1N, 59.6W NW 100 kt; at 29.0N, 59.5W W 100 kt. Lowest pressure 976 mb 19 miles SW of eye's center. Eye 20 miles in diameter. Hurricane winds extend 35 miles from center in western semicircle. 40 kt winds extend 75 miles from center in western semicircle" (micro). "Hurep Duck 12 summary: Storm centered at 30.4N, 59.5W at 1835Z. Eye 35 miles in diameter. Maximum winds near center estimated 100 kt with gusts to 120 kt with hurricane winds extending 60 miles to NE, 70 to NW, 55 mi to SE, 50 mi to SE, and storm winds extending 70 mi to NE, 80 mi NW, 60 mi SW, 65 mi SE. Gale winds extend 85 mi NE, 95 mi NW, 75 mi SW, and 70 mi SW. Moderate turbulence. Sea rough. Heavy showery type precipitation. Lowest sea-level pressure by dropsonde 975 mb. Center located by dead reckoning and in

considered reliable” (micro). From the ATS report... “The second and last Navy flight into this hurricane departed Ramey AFB at 0941Z on 15 September. Prior to departure it was decided, because of the extended flight range of this hurricane, to penetrate the western quadrant until contact with the eye by radar was established and then immediately return to base. The hurricane was located by radar at 1450Z near 29.2N, 59.5W. Severe intermittent turbulence and backing winds of over 100 kt were experienced from 1447Z to 1450Z during which time the aircraft was located five to nine miles from the eye edge” (ATS).

#### September 16:

HWM analyzes a closed low of at most 1005 mb centered near 35.8N, 55.1W with many fronts plotted within 500 to 1000 nmi of the low on the west, north and east sides of the low. A cold front and warm front intersect near 43N, 62W. The cold front extends southwestward to 38N, 65W to 35N, 69W to 33N, 72W, and the warm front extends from the intersection eastward to 42N, 55W becoming a cold front there and continuing to 45N, 51W to 48N, 50W. Another warm front is plotted extending from 47N, 49W southeastward to 41N, 44W to 35N, 39W to 33N, 36W. HURDAT lists this as a 100 kt hurricane at 36.8N, 53.7W. The AWS best track lists a 0030Z position at 32.6N, 58.5W with 100 kt max winds and 977 mb central pressure and a 1230Z position at 36.5N, 54.6W with 90 kt max winds and 980 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 36.0N, 55.7W with a 980 mb pressure. The MWR post-season track map shows a 12Z position near 36.7N, 53.8W. Microfilm analyzes a hurricane of at most 999 mb centered near 36.4N, 54.2W. Ship highlights: 45 kt SW and 1010 mb at 12Z at 34.3N, 53.5W (micro); 60 kt SW and 991 mb at 18Z at 37.5N, 52.5W (micro). Two other low pressures between 1000-1002 mb. Aircraft highlights: center fix at 1550Z at 37.3N, 53.0W with 80 kt estimated maximum winds (AWS, micro). “Winds SW 80 kt. Storm broken up over wide spread area. Radar indicated indefinite wall clouds 80 miles apart. Storm center at 37.3N, 53.0W at 1550Z” (micro). “The wind speed was reported as 80 kt and the storm was observed to be breaking up and spreading over a wide area. Instead of an eye the flight found two indefinite squall line 80 miles apart” (AWS).

#### September 17:

HWM analyzes a tiny closed low of at most 1000 mb centered near 45.2N, 38.0W embedded within a much larger, extratropical cyclone of at most 980 mb centered near 55N, 53W. Numerous fronts are plotted in the very near environment of the feature of interest. HURDAT last lists this system at 06Z as a 65 kt extratropical cyclone at 41.9N, 42.8W. The AWS best track lists a 0030Z position at 39.8N, 48.2W with 70 kt max winds and 984 mb central pressure and a 1230Z position at 43.3N, 37.9W with 45 kt max winds and 990 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 45.1N, 38.0W with a 985 mb pressure. Ship highlights: 60 kt S and 1006 mb at 09Z at 43.2N, 40.0W (COA); 25 kt NW and 1002 mb at 12Z at 45.2N, 41.1W (COA). Several other low pressures.

#### September 18:

HWM analyzes a tiny closed low of at most 1010 mb centered near 49.2N, 19.7W with an occluded front extending from the low to a triple point near 44N, 26W. A warm front extends from the triple point southward to 40N, 28W, and a cold front extends from the triple point southwestward to 41N, 31W. HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 47.7N, 20.5W with a 1000 mb pressure.

Fox likely formed from an African Easterly Wave. HURDAT starts this as a 40 kt tropical storm at 06Z on 8 September at 15.6N, 40.1W with motion towards the west-northwest. Observations in the vicinity of the HURDAT positions are extremely sparse on the 8<sup>th</sup> and 9<sup>th</sup>, and little evidence exists to make any changes to the HURDAT positions or intensities on those days. No changes are made to the HURDAT intensity of the 8<sup>th</sup> and 9<sup>th</sup> (HURDAT brings Fox to 50 kt by 12Z on the 9<sup>th</sup>). A ship observation at 12Z on the 10<sup>th</sup> of 25 kt with 1007 mb indicates that the HURDAT position on the 10<sup>th</sup> is likely too far west. The first aircraft center fixes occurred on the 10<sup>th</sup> as well, and these indicate that the position should be moved 1 to 2 degrees east and a little south. Major track changes are made at 12 and 18Z on the 10<sup>th</sup> and the position is moved more than 2 degrees east-southeast of the previous HURDAT position. Positions on the 8<sup>th</sup> and 9<sup>th</sup> are adjusted eastward slightly as a result of the changes on the 10<sup>th</sup>. The aircraft at 19Z on the 10<sup>th</sup> measured a central pressure of 995 mb and this value is added into HURDAT at 18Z on the 10<sup>th</sup>. A central pressure of 995 mb yields 56 kt according to the Brown et al. southern pressure-wind relationship and 55 kt is chosen for the 18Z intensity on the 10<sup>th</sup> (down from 70 kt originally). Fox moved rather slowly to the northwest, and reached only near 24N, 59W by 14 September. Positions to the southeast of the previous HURDAT positions are analyzed from the 8<sup>th</sup> through 12Z on the 12<sup>th</sup>. In addition to the major track changes on the 10<sup>th</sup>, at certain times on the 11<sup>th</sup> and 12<sup>th</sup> the analyzed position is over 2 degrees southeast of the previous HURDAT positions, which constitute major track changes. These changes are weighed predominantly by aircraft fixes, with slight adjustments for a few ship observations. On the 13<sup>th</sup> and 14<sup>th</sup>, all track changes are less than six-tenths of a degree. On the 11<sup>th</sup> at 1919Z, an Air Force aircraft measured a central pressure of 986 mb, and this value is added into HURDAT at 18Z on the 11<sup>th</sup>. A central pressure of 986 mb equals 70 kt according to the southern pressure-wind relationship, but 75 kt is chosen for 18Z on the 11<sup>th</sup> (down from 90 kt originally), because the RMW was about half of the climatological value. On the 12<sup>th</sup> at 18Z, an Air Force aircraft measured a central pressure of 977 mb, and this value is added into HURDAT at 18Z on the 12<sup>th</sup>. A central pressure of 977 mb yields 81 kt according to the southern pressure-wind relationship and 85 kt is chosen for HURDAT (down from 90 kt originally). No peak intensity information is available on the 13<sup>th</sup>, but on the 14<sup>th</sup>, the storm was too intense for the aircraft to penetrate. The lowest pressure measured by aircraft was 975 mb, but this was outside of the RMW. The text and observations regarding the radii of the minimum pressure, peak winds, eye, and RMW are somewhat unclear. Depending on how the message is interpreted, the Schloemer equation yields either 943 or 956 mb for the central pressure. If 943 mb was the central pressure, wind speeds of 118, 112, 120, and 117 kt would be obtained from the southern, north of 25N, southern/intensifying, and north of 25N/intensifying pressure-wind relationships respectively. The aircraft also reported winds in excess of 120 kt. The 115 kt intensity in

HURDAT at 12Z on the 14<sup>th</sup> is not changed. On 15 September this hurricane recurved along 60W and accelerated, and by the 16<sup>th</sup> it was moving rapidly northeastward. All track changes are less than 1 degree on the 15<sup>th</sup> through 12Z on the 16<sup>th</sup>, and these changes are mostly based on aircraft center fixes. On the 15<sup>th</sup>, Fox was still too intense for penetration to be performed, but critical pressure and RMW information were obtained by other means, and the Schloemer equation was calculated based on a 976 mb pressure measured 19 nmi from the center of the eye, a 16 nmi RMW, and a 1016 mb environmental pressure. This yields a central pressure of 946 mb, and this value is added into HURDAT at 12Z on the 15<sup>th</sup>. A central pressure of 946 mb yields 109 kt north of 25N. Due to the fast forward motion of the storm, 5 kt should be added to this relationship. Since the fix occurred at 1450Z, no changes are made to the HURDAT intensities of 120 kt at 12Z and 115 kt at 18Z. In fact, no intensity changes are made to HURDAT from 13 September through 00Z on 17 September. HURDAT lists Fox as having become extratropical at 00Z on 17 September, but observations indicate that it did not become extratropical until 12Z that day. HURDAT previously listed a final 6-hourly point for Fox at 06Z on 17 September at 41.9N, 42.8W as 65 kt and extratropical. The new position at 06Z on 17 September is 42.5N, 43.0W as a 70 kt hurricane. The analysis suggests that Fox was not absorbed until just after 12Z on the 17<sup>th</sup>, and one additional point is added to HURDAT at 45.5N, 39.5W as 55 kt and extratropical. Thereafter, Fox was absorbed by a complex frontal system.

Some quotes from the Air Weather Service post-season report...

“Prior to the 1950 season, abnormal ship reports so far east only rarely were followed by the appearance of a hurricane, but having already had five full hurricanes in less than a month, the report were taken seriously this time” (AWS).

“For a hurricane so far out in the Atlantic, the life history of Storm Fox is well documented. A total of nine reconnaissance flights were flown into the storm, though not all of them penetrated the center. Navigation on several of these flights was almost entirely dead reckoning so that the positions obtained are questionable and consequently the path of the storm center itself. However, the first position report is the only one far off from the accepted smooth track” (AWS).

### 1950 Storm 7 (George)

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35205 09/27/1950 M=11 7 SNBR= 778 GEORGE XING=0
35210 09/27* 0 0 0 0*244 527 35 0*252 524 35 0*259 523 35 0*
35210 09/27* 0 0 0 0*246 510 35 0*252 515 35 0*257 520 35 0*
          *** ***          ***          *** ***
35215 09/28*266 524 35 0*274 528 35 0*281 534 35 0*287 542 35 0*
35215 09/28*263 525 40 0*271 531 40 0*278 540 40 0*283 550 40 0*
          *** *** **          *** *** **          *** *** **
35220 09/29*291 551 35 0*294 561 35 0*297 572 35 0*301 590 35 0*
35220 09/29*287 560 40 0*289 572 40 0*290 585 40 0*291 596 40 0*

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35225	09/30*	303	607	40	0*303	615	40	0*303	622	45	0*303	632	50	0*	
35225	09/30*	292	608	40	0*293	620	40	0*294	630	45	0*295	634	50	0*	
	***	***			***	***		***	***		***	***			
35230	10/01*	303	638	65	0*303	640	70	0*303	641	75	0*303	643	80	0*	
35230	10/01*	296	637	55	0*297	640	60	0*298	643	65	0*298	645	70	978*	
	***	***	**		***		**	***	***	**	***	***	**	***	
35235	10/02*	303	644	80	0*303	647	80	0*304	651	85	0*307	657	85	0*	
35235	10/02*	300	647	75	0*304	649	80	0*308	651	85	0*310	657	85	0*	
	***	***	**		***	***		***			***				
35240	10/03*	310	663	90	0*312	667	90	0*314	670	90	0*330	680	95	0*	
35240	10/03*	312	662	90	0*315	668	90	0*319	675	90	0*329	678	95	0*	
	***	***			***	***		***	***		***	***			
35245	10/04*	346	684	95	0*363	675	95	0*378	660	95	0*399	637	95	0*	
35245	10/04*	342	680	95	0*357	673	95	0*373	657	95	960*391	637	95	0*	
	***	***			***	***		***	***		***	***			
35250	10/05*	423	605	85	0E446	567	65	0E470	519	60	0E495	460	60	0*	
35250	10/05*	E414	607	85	0E443	566	70	0E472	512	65	0E499	459	60	0*	
	****	***			***	***	**	***	***	**	***	***			
35255	10/06*	E521	399	55	0E548	341	55	0E575	286	50	0E587	268	50	0*	
35255	10/06*	E525	397	55	0E549	341	55	0E573	286	55	0E587	247	55	0*	
	***	***			***			***		**	***	**			
35260	10/07*	E593	249	50	0E599	229	45	0E605	210	40	0*	0	0	0	0*
35260	10/07*	E595	210	55	0E605	152	55	0E618	75	55	0*	0	0	0	0*
	***	***	**		***	***	**	***	***	**					

35265 HR

Major track changes and minor changes to intensity are analyzed for this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

#### September 26:

HWM does not analyze any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures. "The surface disturbance first appeared as a trough in the easterly flow near 50W on the September 26/0030Z chart. The Del Rio, four degrees east of the axis, reported a light south wind while several ships to the west reported winds of NE force 4 [15 kt]" (AWS).

#### September 27:

HWM analyzes a closed low of at most 1010 mb centered near 25.2N, 52.2W with a NNE-SSW stationary front plotted from 39N, 52W to 32N, 58W, becoming a cold front there extending to 30N, 61W to 28N, 65W. HURDAT lists this as a 35 kt tropical storm at 25.2N, 52.4W. Ship highlights: 35 kt NE and 1009 mb at 12Z at 26.6N, 51.5W (micro). "A strong easterly wave was noted on September 27 over the Atlantic far to the southeast of Bermuda" (MWR). "Note from Llansishus [a ship]: Sea rough, swell heavy, confused, sky overcast, wind continuous sheet, lightning. Had one hour of lull with heavy rain commencing at 2200Z. Lowest reading 29.88, now 29.92, rising slowly"

(micro). Microfilm analyzes a low of at most 1011 mb (probably closed) on the very edge of the map centered in the vicinity of 25N, 52-52.5W. “The trough moved westward and by September 27<sup>th</sup> at least developed a vortex” (AWS).

#### September 28:

HWM analyzes a tropical storm of at most 1010 mb centered near 28.4N, 52.8W with a NE-SW stationary front plotted from 38N, 47W becoming a warm front at 35N, 52W, becoming a dissipating stationary front at 32N, 57W extending to 27N, 64W to 26N, 67W. HURDAT lists this as a 35 kt tropical storm at 28.1N, 53.4W. The MWR tracks of centers of cyclones shows a 12Z position near 29.2N, 53.1W with a 1005 mb pressure. Microfilm stamped a spot low near 26N, 54W located inside a very large 1014 mb isobar that might not be closed since the edge is off the map. Ship highlights: 40 kt ENE and 1013 mb at 00Z at 27.6N, 52.0W (micro). “The low level vortex moved north and west and approximately 28/1830Z joined the remnants of the cold front forming a large elongated low” (AWS).

#### September 29:

HWM analyzes a tropical storm of at most 1005 mb centered near 29.7N, 57.3W with a W-E stationary front plotted from 35N, 55W to beyond 36N, 46W. HURDAT lists this as a 35 kt tropical storm at 29.7N, 57.2W. The MWR tracks of centers of cyclones shows a 12Z position near 27.1N, 62.9W with a 1004 mb pressure. Microfilm analyzes a very large closed low of at most 1011 mb centered in the general vicinity of 27.7N, 62.5W. No gales or low pressures.

#### September 30:

HWM analyzes a tropical storm of at most 1005 mb centered near 30.6N, 63.8W. HURDAT lists this as a 45 kt tropical storm 30.3N, 62.2W. The MWR tracks of centers of cyclones shows a 12Z position near 30.2N, 63.2W with a 1000 mb pressure. Microfilm analyzes a broad closed low of at most 1008 mb centered in the general vicinity of 29.5N, 64.5W. Ship highlights: 45 kt NNE and 1014 mb at 12Z at 35.5N, 64.0W (micro); 25 kt NNE and 1007 mb at 12Z at 32.2N, 65.7W (micro). “By September 30<sup>th</sup> it was directly under an upper cold core, stationary low...” (AWS).

#### October 1:

HWM analyzes a closed low of at most 1000 mb centered near 30.2N, 64.2W. HURDAT lists this as a 75 kt hurricane at 30.3N, 64.1W. The AWS best track lists a 0030Z position at 28.5N, 63.5W with 75 kt max winds and 990 mb central pressure and a 1230Z position at 29.0N, 64.6W with 80 kt max winds and 985 mb central pressure. The MWR post-season track map shows a 12Z position at 28.6N, 63.4W. Microfilm analyzes a closed low of at most 996 mb centered near 30.2N, 64.7W. Ship highlights: 50-55 kt SSW and 998 mb at 1230Z at 29.8N, 64.7W (AWS, HWM, micro); 30 kt SSE and 996 mb at 18Z at 30.0N, 62.7W (micro). Aircraft highlights: center fix (loran) at 2012Z at 29.7N, 64.8W with 978 mb central pressure and 85 kt maximum estimated winds (AWS, micro). Three other hurricane force flight-level winds between 65-85 kt. “It developed a large low pressure system that drifted slowly northwestward, but daily reconnaissance failed to find a storm center of strong circulation until October 1. At 1230Z on the 1<sup>st</sup>, the

S.S. Alcoa Regasus, about 170 miles south of Bermuda at 29.5N, 64.4W, reported a southwest wind 65 miles per hour, which indicated hurricane development. An airplane later in the day found the center with highest wind about 100 mph" (MWR). "Post flight summary: Departed KAFB BDA at 1820Z to Storm George. 30N, 65W. Gale force winds were encountered 100 miles from BDA 80 degrees 40 kt. Storm located and position by radar and loran at 29.7N, 64.8W at 2012Z. Winds by quadrants: NW- 60 degrees at 64 kt; NE- 150 degrees at 75 kt; in the southern quadrants, 160 degrees at 85 kt by estimation. SW quadrant 300 degrees at 70 kt and SE quadrant 260 degrees at 80 kt. Eye very well defined. Circular shaped and 50 miles in diameter. Low pressure in eye 977.9 mb. Pressures at position 29.8N, 64.1W 994 mb" (micro). "Duck: In eye. Calm. SLP 977.9 mb. Center of storm 29.7N, 64.8W. Eye well formed circle 35 miles in diameter. Highest wind 85 kt from 150 degrees in the SE quadrant. Duck and remarks: Passed through eye. Pressure 979.2 at 29.5N, 64.8W. Going back in" (micro). "At 01/0030Z the Alcoa Pegasus reported near the center of the low. The report showed wind E force 6 [25 kt], pressure 1008.7 mb. Twelve hours later the Alcoa Pegasus reported again about 60 miles south of its previous report. This time it showed wind SSW force 10 [50 kt] and pressure 997.6 mb. The first advisory on the storm was coordinated on the basis of this report and was released at 01/1530Z" (AWS). "The first reconnaissance mission [around 1930Z] reported an eye well-formed, circular, 50 miles in diameter with highest winds of 85 kt in the SE quadrant and central pressure 977.9 mb" (AWS).

October 2:

HWM analyzes a closed low of at most 1000 mb centered near 30.7N, 64.9W with a dissipating cold front located north of the cyclone extending from 43N, 67W to 40N, 65W to 38N, 60W becoming a cold front at 37N, 57W extending to beyond 37N, 51W. HURDAT lists this as an 85 kt hurricane at 30.4N, 65.1W. The AWS best track lists a 0030Z position at 30.1N, 64.8W with 85 kt max winds and 978 mb central pressure and a 1230Z position at 31.0N, 65.1W with 90 kt max winds and 978 mb central pressure. The MWR post-season track map shows a 12Z position near 30.7N, 65.0W. Microfilm analyzes a low of at most 996 mb centered near 30.6N, 65.2W with the west-southwest end of a WSW-ENE front located slightly north of the cyclone near 33N, 65W extending to beyond 34N, 58W. Ship highlights: 35 kt NE and 1014 mb at 06Z at 35.7N, 65.6W (COA); 25 kt SSW and 996 mb at 06Z at 29.3N, 62.8W (micro); 40 kt ENE and 1016 mb at 12Z at 35.3N, 64.7W (COA, micro). Three other gales and one other low pressure. Land/station highlights: 30 kt ENE and 1005 mb at 12Z at Bermuda (HWM). Aircraft highlights: Air Force center fix at 1125Z at 30.8N, 65.0W with 988 pressure measured by dropsonde and reported max winds of 90 kt (AWS, micro); center fix at 1933Z at 30.0-30.1N, 65.8W with 974 mb pressure measured by dropsonde and 100 kt max winds (AWS); 95 kt WSW at flight-level of 700 ft at 1945Z at 30.7N, 66.5W (micro). At least one other surface gale, four other hurricane force flight-level winds and one other low pressure. "It moved slowly northward until the morning of October 2 with a threat to Bermuda since it was only 90 to 100 miles away. It changed course, however, and swung westward far enough to miss Bermuda before resuming a northward and northeastward course" (MWR). "Duck: 30.7N, 64.8W [I believe this is a center fix]. Eye is 45 miles diameter and is circular. West side is strongest. This report in eye at 1042Z. Eye well formed with circular bands of cu extending up to 15,000 feet" (micro). "Duck 1125Z?:"

Center by loran 30.9N, 65.0W. Eye well defined, hurricane well formed all quadrants. Highest winds 90 kt. Hurricane force winds extend 60 miles from center in all quadrants. Storm winds extend 80 miles from the center in all quadrants. Gale winds extend 95 miles from the center in all quadrants” (micro). “Duck position of eye at 1125Z by loran 30.9N, 65.0W. This is most accurate” (micro). “D-10: 50 miles out of Bermuda, surface winds 60 kt. Flight level 120 degrees, 60 kt” (micro). “The second flight at 02/1125Z found no change in the pressure but found winds to 90 kt. The eye had decreased to 45 miles in diameter and was equally well developed in all quadrants. Hurricane winds covered a diameter of 120 miles and gales a diameter of approximately 200 miles” (AWS).

#### October 3:

HWM analyzes a tropical storm of at most 1000 mb centered near 31.4N, 66.9W. HURDAT lists this as a 90 kt hurricane at 31.4N, 67.0W. The AWS best track lists a 0030Z position at 31.2N, 66.4W with 95 kt max winds and 973 mb central pressure and a 1230Z position at 32.0N, 67.6W with 100 kt max winds and 969 mb central pressure. The MWR post-season track map shows a 12Z position near 31.8N, 67.3W. Microfilm analyzes a hurricane of at most 996 mb centered near 31.8N, 67.3W. Ship highlights: 35 kt E and 1009 mb at 00Z at 33.0N, 65.2W (micro); 35 kt SSW and 1007 mb at 15Z at 30.5N, 66.1W (micro). Land/station highlights: 30-35 kt SSE and 1010 mb at Bermuda at 12Z (HWM, micro). Aircraft highlights: Air Force center fix (loran) at 1220Z at 31.9N, 67.6W with 969 mb pressure measured by dropsonde and estimated maximum surface winds on the west side 90 kt (AWS, micro); Air Force center fix (loran) at 2145Z at 33.5N, 67.8W with 980 mb pressure measured by dropsonde and 100 kt max winds (AWS, micro). “Post flight summary: Hurricane George was located at 31.9N, 67.6W at 1220Z. Position by 3 station loran fixes in eye. Eye is 35 miles in diameter. Surface winds in center of the eye were very light with no apparent swells. Estimated surface winds 90 kt on west edge of eye. Hurricane winds extend approximately 30 miles from center in all quadrants. 50 kt winds extend approximately 50 mi from center in SW and SE quadrants. 50 kt winds extend 70 mi in NW quadrant. Winds decrease very gradually in all quadrants after going out to fringe of 50 kt winds. Duck report 1220Z: In eye at 31.9N, 67.6W. Loran fix. Duck 8: Eye located at 33.5N, 67.8W at 2145Z by loran. Eye well defined. Winds 100 kt near center on all sides. Hurricane winds extend 50 miles from center” (micro). “After the storm turned toward the west it began to deepen and continued to do so until at least the afternoon of the 3<sup>rd</sup>.

#### October 4:

HWM analyzes a tropical storm of at most 995 mb centered near 37.8N, 65.2W with a cold front approaching from the northwest extending from 46N, 61W to 43N, 66W to 41N, 69W to 39N, 74W to 38N, 78W. HURDAT lists this as a 95 kt hurricane at 37.8N, 66.0W. The AWS best track lists a 0030Z position at 34.4N, 67.6W with 100 kt max winds and 975 mb central pressure and a 1230Z position at 37.5N, 65.3W with 90 kt max winds and 978 mb central pressure. The MWR post-season track map shows a 12Z position near 37.9N, 65.8W. Microfilm analyzes a hurricane of at most 984 mb centered near 37.8N, 65.5W with an analysis of a cold front approaching similar to the HWM analysis. Ship highlights: 70 kt N and 994 mb at 12Z at 38.0N, 66.6W (micro); 45 kt

SSW and 990 mb at 12Z at 36.0N, 65.1W (micro); 70 kt SSE and 998 mb at 18Z at 38.5N, 62.6W (micro). At least four other gales and nine other low pressures. Aircraft highlights: Navy center fix (low-level penetration, loran) around ~14Z at 37.6N, 65.3W with 960 mb central pressure and maximum flight-level winds encountered of 90 kt (AWS, ATS); Air Force center fix (loran) at 2305Z at 40.6N, 61.6W with 980 mb pressure measured by dropsonde and max winds estimated at least 65 kt (AWS, micro). At least two other surface gales, two other flight-level hurricane force winds, and six other low pressures between 979-999 mb. "The strongest wind reported was about 110 mph on the morning of October 4 when the center was near 39N, 65W" (MWR). "Navy hurep 1415Z: Position of eye by Loran 37.6N, 65.3W. Diameter of eye 10 miles-diffused" (micro). "Duck center at 2305Z 40.6N, 61.6W by Loran. Position reliable" (micro). From the ATS report... "This was the first and only Navy flight into this moderately severe hurricane, the storm being out of range through most of its life. The plane flew to Cherry Point the previous evening and departed before dawn in moderate ground fog. Winds increased slowly but steadily and passed under the cirrus shield while still 300 miles from the center. Winds increased to hurricane force 75 miles from the center, but dropped to 55 kt for a brief period closer in, then increased to a maximum of 90 kt. Entry into the eye was through very gradual decreasing winds, weather and turbulence, and though various altitudes in the eye were tried, the core failed to appear well-defined by radar. Considerable stratus at various levels prevailed, though blue sky showed through. Lowest pressure observed in the eye was 960 mb. Similar conditions in reverse were encountered on leaving the storm, but at similar distances from the observed center were milder, indicating rapid movement to the northeast, and it is believed that the storm was rapidly developing extratropical characteristics although insufficient fuel precluded further investigation. Entered eye 1353Z. Obtained loran fix. Lowest pressure 960 mb. Max winds 90 kt prior to entry." (ATS).

October 5:

HWM analyzes a low of at most 980 mb centered near 47.7N, 51.0W with the northeast end of a NE-SW cold front located 200-300 n mi SSE of the cyclone extending from 44N, 49W to 37N, 62W and the west end of a dissipating W-E stationary front located several hundred n mi east of the cyclone extending from 51N, 40W to beyond 51N, 28W. HURDAT lists this as a 60 kt extratropical cyclone at 47.0N, 51.9W. The AWS best track lists a 0030Z position at 41.3N, 60.5W with 75 kt max winds and 980 mb central pressure and a 1230Z position at 47.5N, 50.5W with 65 kt max winds and 975 mb central pressure. Ship highlights: 60 kt SW and 1006 mb at 00Z at 38.0N, 62.4W (micro); 20 kt NE and 968 mb at 06Z at 44.5N, 56.8W (COA); 60 kt S and 983 mb at 12Z at 47.5N, 49.5W (COA, HWM); 55 kt WNW and 1001 mb at 18Z at 48.1N, 49.7W (COA). Several other gales and low pressures. Land/station highlights: 35 kt W and 1000 mb at 06Z at 43.9N, 60.0W (micro); 25 kt NNW and 986 mb at 12Z at 47.6N, 52.9W (HWM, micro). One other low pressure. "It passed south of Newfoundland on the 5<sup>th</sup>" (MWR). "On October 5<sup>th</sup>, George ran into a cold front and appears to have acquired extratropical characteristics. Although already moving in excess of 40 kt, it continued to accelerate and the area of gale winds expanded. "It passed 50 miles off the SE tip of Newfoundland at [05/1000Z? or 0100Z?] and continued into the north Atlantic" (AWS).

## October 6:

HWM analyzes a low of at most 980 mb centered near 58.4N, 28.6W. A cold front extends from 53N, 21W to 50N, 24W to 44N, 35W. A weak spot low is plotted inside the same 990 mb contour as the feature of interest near 62N, 10W with an occluded front extending from this low eastward, southeastward, southward, and then southwestward to 49N, 9W. To the west of the feature of interest, an occluded front extends from another low, centered near 66N, 60W, to 65N, 55W to 62N, 52W to 60N, 51W to 56N, 52W to 54N, 49W. HURDAT lists this as a 50 kt extratropical cyclone at 57.5N, 28.6W. Ship highlights: 30 kt SSW and 981 mb at 12Z at 56.4N, 28.4W (COA, HWM); 50 kt SW and 1003 mb at 18Z at 53.2N, 28.0W (COA). At least three other gales between 45-50 kt between 09Z-22Z and several other low pressures.

## October 7:

HWM analyzes three closed lows, all located within the same closed 985 mb isobar, which stretches over a very huge distance. The feature of interest is analyzed as a closed low of at most 980 mb centered near 60.7N, 21.5W with an occluded front extending from the low to 57N, 20W to 53N, 23W becoming a cold front at 51N, 26W extending to 47N, 32W to 45N, 36W. The 2<sup>nd</sup> closed low, of at most 975 mb, is centered near 63N, 6W, and a cold front extends from this low wrapping around to the SE, S, and then SW. The 3<sup>rd</sup> closed low, of at most 980 mb, is centered near 70N, 6E. HURDAT lists this as a 40 kt extratropical cyclone at 60.5N, 21.0W. Ship highlights: 35 kt SW and 970 mb at 00Z at 58.5N, 18.5W (COA); 50 kt W and 991 mb at 06Z at 56.4N, 16.4W (COA); 50 kt SW and 983 mb at 11Z at 59.0N, 3.0W (COA); 10 kt WNW and 968 mb at 11Z at 61.5N, 9.5W (COA). Several other gales and low pressures.

George formed from a large trough covering the central Atlantic Ocean on 26 and 27 September. HURDAT starts this system as a 35 kt tropical storm at 24.4N, 52.7W at 06Z on 27 September. Although there is not certain evidence that a tropical cyclone existed on the 27<sup>th</sup>, there is a 35 kt gale from a ship 90 nmi north of the analyzed position of George. At 00Z on the 28<sup>th</sup>, there is a 40 kt ship gale 80 nmi north-northeast of the analyzed position. Due to this observation, the HURDAT intensity is increased from 35 to 40 kt at all times on the 28<sup>th</sup> and 29<sup>th</sup>. Another gale was observed on the 30<sup>th</sup> further away from the storm center. The data clearly show that the area of cyclonic turning associated with George was very large from 28 September until at least 1 October; however, by 1 October, there was evidence of a tight, TC-like inner core. Prior to 1 October, there may have been strong winds and low pressures near the center, but there was not a lot of data there from the 28<sup>th</sup> until 12Z on 1 October. Using today's classification system, George may have been classified as a subtropical cyclone from the 27<sup>th</sup> to the 30<sup>th</sup> of September. From the 27<sup>th</sup> to the 30<sup>th</sup> of September, George moved slowly in a northwesterly direction, gradually curving toward the west by the 30<sup>th</sup> near 30N, 63W. From the 30<sup>th</sup> to 2 October, George barely moved, and the analyzed position at 12Z on the 2<sup>nd</sup> was about 100 nmi south of Bermuda with an 85 kt intensity. Although there are no gale observations available from Bermuda, it is possible that Bermuda may have briefly experienced gale force winds. On the 29<sup>th</sup> and 30<sup>th</sup> of September, some minor southward and westward adjustments are made to the track based on ship data. On the 1<sup>st</sup>, a 50 kt ship observation with a 998 mb pressure (at 12Z) along with the first

aircraft center fix at (2012Z) both indicate that the HURDAT position only needs to be adjusted south-southwestward by about half a degree at those times. On the 2<sup>nd</sup>, very minor track changes are analyzed based on aircraft center fix positions. The aircraft on the 1<sup>st</sup> at 2012Z measured a central pressure of 978 mb and this value is added into HURDAT at 18Z on the 1<sup>st</sup>. A central pressure of 978 mb yields 75 kt according to the Brown et al. north of 25N pressure-wind relationship and 78 kt for intensifying systems. The RMW was much larger than the climatological RMW value and the speed was very slow (~2 kt). The maximum measured (low-level) flight level wind on this flight was 85 kt. 70 kt is chosen for the 18Z intensity on the 1<sup>st</sup> (down from 80 kt originally). The HURDAT intensities at all times on the 1<sup>st</sup> are lowered by 10 kt to show a gradual intensification from 50 kt at 18Z on the 30<sup>th</sup> to 70 kt by 18Z on the 1<sup>st</sup>. George is analyzed to have first attained hurricane strength 12 hours later than originally. On 2 October, aircraft dropsondes measured pressures of 988 and 974 mb at 1125 and 1933Z respectively, but no central pressures are added to HURDAT, and no changes are made to the HURDAT intensities on the 2<sup>nd</sup>. On the 3<sup>rd</sup>, George recurved west of Bermuda and began to accelerate. On the 4<sup>th</sup>, George was moving northeastward in the western Atlantic as it continued to accelerate. All track changes on the 3<sup>rd</sup> and 4<sup>th</sup> were less than 1 degree and are very much in agreement with the aircraft center fixes. Peripheral ship observations on the 4<sup>th</sup> were in agreement with the aircraft fixes. On the 3<sup>rd</sup> at 12Z, a dropsonde measured a pressure of 969 mb. A central pressure of less than or equal to 969 mb yields a wind speed of greater than or equal to 86 kt according to the pressure-wind relationship for north of 25N. 90 kt surface winds were estimated visually from the aircraft. The 90 kt intensity in HURDAT is not changed at 12Z on the 3<sup>rd</sup>. On the 4<sup>th</sup> around 14Z, a Navy aircraft penetrated the center and measured a central pressure of 960 mb. This value is added into HURDAT at 12Z on the 4<sup>th</sup>. A central pressure of 960 mb equals a wind speed of 90 kt using the pressure-wind relationship for north of 35N. The eye radius was very small and the speed of the storm was more than 20 kt by this time so the 95 kt intensity in HURDAT at 12Z on the 4<sup>th</sup> is not changed. No changes are made to the HURDAT intensity on the 3<sup>rd</sup> and 4<sup>th</sup>, and the 95 kt peak intensity shown in HURDAT is maintained, although it is possible that George could have attained Category 3 status from late on the 3<sup>rd</sup> through much of the 4<sup>th</sup>. HURDAT lists George as becoming extratropical at 06Z on the 5<sup>th</sup> near 45N, 57W, but it is analyzed that George was extratropical 6 hours earlier (by 00Z on the 5<sup>th</sup>) as surface observations indicate a large temperature gradient across the low. George moved northeastward very rapidly on the 5<sup>th</sup> through the 7<sup>th</sup>, and it remained a powerful cyclone. No significant track changes are analyzed on the 5<sup>th</sup> through 12Z on the 6<sup>th</sup>, and George was located at 57.5N, 28.6W at 12Z on the 6<sup>th</sup>. However, on the 7<sup>th</sup> at 12Z (the final point shown in HURDAT), the position is revised to be 400 nmi east of the previous HURDAT position (a very large, major track change). Another developing cyclone may have been located near the HURDAT position, but George was located much further east. This track change is high confidence because 6-hourly synoptic analyses were conducted in the reanalysis to track George. No changes are made to the timing of when this cyclone was absorbed, but the final position at 12Z on the 7<sup>th</sup> is changed to 62.0N, 7.5W (originally 60.5N, 21.0W). The intensity is increased slightly on the 6<sup>th</sup> and 7<sup>th</sup> at times due to numerous ship observations of 50 kt winds and pressures as low as 969 mb at 03Z on the 7<sup>th</sup>.

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A quote from the Air Weather Service post-season report...

“The first two reconnaissance fixes indicated that it was moving slightly west of north at 5 kt almost directly towards Bermuda. Because of this and the fact that the last fix showed the storm to be only 100 miles from Bermuda, Hurricane Warning was advised for the island even though westward movement was expected. With the next aircraft fix confirming westward movement, All Clear was advised” (AWS).

### 1950 Storm 8 (How)

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35270 10/01/1950 M= 4 8 SNBR= 779 HOW          XING=0
35275 10/01* 0 0 0 0*250 873 30 0*258 886 35 0*260 890 40 0*
35275 10/01* 0 0 0 0*256 884 30 0*258 885 30 0*260 886 35 0*
          *** ***          *** **          *** **
35280 10/02*262 895 45 0*263 901 50 0*264 907 50 0*265 917 50 0*
35280 10/02*261 889 35 0*263 895 35 0*264 903 35 1009*262 911 40 1007*
          *** *** **          *** **          *** ** ***** *** *** ** *****
35285 10/03*265 927 50 0*264 936 50 0*262 945 45 0*258 955 45 0*
35285 10/03*260 921 40 0*255 935 40 0*250 948 40 0*246 958 40 0*
          *** *** **          *** *** **          *** *** **          *** *** **
35290 10/04*251 964 40 0*243 971 35 0*235 978 30 0*225 988 25 0*
35290 10/04*242 965 40 0*238 974 35 0*232 983 30 0*227 990 25 0*
          *** ***          *** ***          *** ***          *** ***
35295 TS

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Minor changes to track and intensity are analyzed for this tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Connor (1956).

#### September 29:

HWM does not analyze any features of interest but suggests the presence of a weak trough in the eastern Gulf of Mexico extending south towards Yucatan. HURDAT does not yet list this system. No gales or low pressures.

#### September 30:

HWM does not analyze any particular features of interest on this day, but indicates the presence of some weak troughing near the Yucatan Peninsula and southern Gulf of Mexico. HURDAT does not yet list this system. No gales or low pressures.

#### October 1:

HWM does not analyze any particular features of interest on this day, but indicates the presence of some weak troughing near the northern Yucatan Peninsula and southern Gulf of Mexico. HURDAT lists a 35 kt tropical storm at 25.8N, 88.6W. Microfilm at 18Z analyzes a closed low of at most 1011 mb centered near 25.8N, 88.5W. No gales or low

pressures. “A tropical storm of less than hurricane force developed in the Gulf of Mexico October 1 near 25.5N, 89W” (MWR).

October 2:

HWM analyzes a closed low of at most 1010 mb centered near 23.4N, 91.2W. HURDAT lists this as a 50 kt tropical storm at 26.4N, 90.7W. The AWS best track lists a 1230Z position at 26.5N, 90.2W with 50 kt max winds and 1009 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 26.7N, 89.8W with a 1000 mb pressure. The MWR post-season track map shows a 12Z position near 26.4N, 90.5W. Microfilm analyzes a closed low of at most 1005 mb centered near 26.3N, 90.5W. Aircraft highlights: center fix at 1234Z at 26.5N, 90.2W with 1009 mb central pressure and 38 kt maximum winds (micro, AWS); 50 kt E at flight-level of 1000 ft (max wind encountered during flight) and 1010 mb at 2015Z at 26.6N, 91.1W (ATS); 14 kt ESE at flight-level of 1000 ft and 1008 mb at 2030Z at 26.0N, 90.9W (ATS); 10 kt NNE at flight-level of 900 ft and 1008 mb at 2045Z at 25.8N, 91.7W (ATS) [1008 mb was the lowest pressure encountered during this flight]. At least four other flight-level gales. “Post flight weather summary: Storm center located at 02/1234Z at 26.5N, 90.2W. Second center believed inaccurate due to poor definition of associated weather. Center at 02/1234Z was ten miles in diameter with no weather to west and southwest. Maximum winds sustained 38 kt with gusts to 45 kt. Storm appeared much weaker on seconds entry as indicated by strength of squalls, decrease in max wind velocity, and subsiding of easterly swells” (micro). “Navy: No closed circulation or eye apparent. Will continue to search area as long as possible” (micro). “Navy post flight summary: A thorough search of the entire disturbed area failed to disclose any signs to a closed circulation. An area of squalls with winds varying from ESE to ENE 30 to 50 kt was bounded by 88.0W, 27.3N and 91.7W, 26.2N. This area was bounded on the north by blue skies and moderate winds and on the west and south by clear skies, light winds and good flying conditions for as far as the eye could see. Highest winds 50 kt. Minimum pressure 1008 mb” (micro). “Maximum wind was reported [by aircraft] as 38 kt sustained, gusts to 45 kt. Minimum pressure [from aircraft] was 1009 mbs” (AWS). “A second flight [on the 2<sup>nd</sup>] in the afternoon left Miami and flew WNW toward the estimated storm position. Winds were generally easterly and gradually increased to 45 kt. At 91.5W the winds abruptly dropped off and the sky became clear to the west and north. The mission was summarized as follows: ‘A thorough search of the entire disturbed area failed to disclose any signs of a closed circulation. An area of squalls with winds varying from ESE to ENE 30 to 50 kt was bounded by 88W, 27.3N and 91.7W, 26.2N. This area was bounded on the north by blue skies and moderate winds, and on the west and south by clear, light winds and good flying conditions for as far as the eye could see. Highest winds 50 kt, minimum pressure 1008 mbs” (AWS). From the ATS report... “Ship reports indicated that a tropical disturbance had developed in a trough area formed by a stagnant cold front. The disturbance was apparently centered at 26.5N, 91.0W. Flying west-northwest from Miami, the winds held generally easterly and gradually increased to 45 kt. At 2000Z, the winds dropped off abruptly and clear area was observed as far as the eye could see to the north and west. Thorough investigation of the area to the south and east led to the determination that there was no closed circulation. The maximum winds encountered were from 080 degrees 50 kt with a minimum observed pressure of 1008 mb” (ATS).

## October 3:

HWM does not analyze a closed low, but instead indicates a strong trough with an apparent NW-SE axis from 25N, 96W to 21N, 92W. HURDAT lists this as a 45 kt tropical storm at 26.2N, 94.5W. The AWS best track lists a 0030Z position at 25.2N, 92.8W with 50 kt max winds and 1008 mb central pressure and a 1230Z position at 24.4N, 95.4W with 50 kt max winds and 1008 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 26.9N, 94.3W with a 1005 mb pressure. The MWR post-season track map shows a 12Z position near 26.0N, 94.6W. Microfilm at 18Z analyses a closed low of at most 1008 mb centered near 26.3N, 95.9W. Land/station highlights: 25-35 kt (max w) at Brownsville, TX (Connor); gust 52 kt (max gust) at 1730Z at Brownsville (AWS, Connor). Aircraft highlights: 18 kt SE at flight-level of 700 ft and 1007 mb (lowest pressure reported during flight) at 1315Z at 25.8N, 94.3W (ATS); 40 kt NE (43 kt NNE at flight-level of 1400 ft) and 1010 mb at 1630Z at 25.3N, 96.0W (ATS); 40 kt NE (45 kt NNE at flight-level of 900 ft) (max flight-level wind encountered during flight) at 1645Z at 25.8N, 96.4W (AWS, ATS). At least one other surface gale and one other flight-level gale. “On the last leg of the flight [on the 3<sup>rd</sup>, which took off from Pensacola and eventually landed in Corpus Christi] on a northwesterly course to Corpus Christi, a marked wind shift and lowest pressure were noted. The winds shifted nearly 180 degrees from SSW 7 kt to NNE 15 kt and increased rapidly to 45 kt gusting to 55 kt in a series of squalls in this NW quadrant with a sustained [wind] NNE 37 kt to within 60 miles of Corpus Christi” (AWS). “Brownsville did report gusts to 60 mph at 1730Z on the 3<sup>rd</sup> with gusts to 28-29 mph for several hours, but this report [of 60 mph] appears to have been a local condition” (AWS). From the ATS report... “The 0630Z synoptic chart showed a trough system lying NE-SW over the center Gulf, and the mission of the flight was to scout a suspicious area about 25N, 95W. Semicircular squalls were located on the NE side of this area, outflying from Pensacola, but little winds were encountered. South of latitude 25N, the winds diminished to 10-15 kt. On the last leg of the flight on a northwesterly course to Corpus Christi, a marked wind shift and lowest pressure were noted at 24.5N, 95.7W. The winds shifted nearly 180 degrees; from SSW 7 kt to NNE 15 kt and increased rapidly to 45 kt gusting to 55 kt in a series of squalls in this NW quadrant, with a sustained NNE 37 kt to within 60 miles off Corpus Christi” (ATS).

## October 4:

HWM no longer analyzes any features of interest on this day other than a cold front from 32N, 105W to 30N, 99W to 31N, 93W to 33N, 89W. HURDAT lists How as a 30 kt tropical depression at 23.5N, 97.8W. The AWS best track lists a 0030Z position at 23.3N, 96.9W with 45 kt max winds and 1008 mb central pressure and a 1230Z position at 22.5N, 97.4W with 35 kt max winds and 1008 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 24.6N, 97.8W with a 1010 mb pressure. The MWR post-season track map shows a 12Z position near 23.2N, 98.0W. Microfilm no longer analyzes a closed low, but still indicates some troughiness around the Mexican coast in the vicinity of 22-25N. No gales or low pressures. “It moved on a northwest, west, and then southwest course and entered Mexico north of Tampico on the 4<sup>th</sup>. The strongest winds reported in connection with this storm were about 55 mph. Squally

winds of 45 to 55 mph prevailed during most of its life in the Gulf of Mexico, and were confined mostly to the northern semicircle of the disturbance. This was the only disturbance of the season that did not develop hurricane force” (MWR). “Navy 4 position 27.1N, 91.8W, altitude 3300 ft. Clear above, lower scattered below, and radar scope void of significant weather. Since 0100Z light to moderate turbulence” (micro). “By 2130Z the storm was moving slowly a few miles east of Tampico. No land station reported winds above force 6 [25 kt] from Storm How.”

October 5:

The AWS best track lists a 0030Z position at 22.0N, 97.4W with 30 kt max winds.

An area of cyclonic turning was evident from observations in the east-central Gulf of Mexico on 30 September and 1 October. HURDAT starts this system at 06Z on 1 October as a 30 kt tropical depression at 25.0N, 87.3W. HURDAT previously showed too fast of an acceleration during the first 6 hours of the life of this cyclone, so the 06Z position on the 1<sup>st</sup> is shifted more than 1 degree west-northwest of the previous HURDAT position. HURDAT brings the depression to tropical storm strength by 12Z on the 1<sup>st</sup>, but ship data near the center indicates that the circulation was still very weak, and it is analyzed that this cyclone attained tropical storm strength at 18Z on the 1<sup>st</sup> (6 hours later than indicated in HURDAT originally). This tropical storm remained weak throughout its lifetime and is analyzed to have made landfall on the Mexican coast on the 4<sup>th</sup> of October at 09Z at 23.5N, 97.8W as a 35 kt tropical storm. This landfall point and the 35 kt landfall intensity are unchanged from the previous HURDAT; however, the landfall is analyzed to have occurred at 09Z whereas HURDAT previously showed landfall at about 12Z. Aircraft flew into How on the 2<sup>nd</sup> and 3<sup>rd</sup>. Apparent center fixes were obtained both days, but they were reported with no clouds or precipitation on the south side. The aircraft also did not fly far enough south to confirm the existence of a closed wind circulation. The authors of the post-season report on How believed that it was more likely than not that a closed circulation existed. Available ship data on several synoptic maps also indicate the possibility that this circulation was closed. Therefore, this tropical storm cannot be removed from HURDAT. However, the text from the operational Weather Bureau Advisories indicates that the forecasters were skeptical that a closed circulation existed. The lowest pressure for the entire storm from all data platforms was 1007 mb. There were no observed gales from any ships or land stations; however, aircraft estimated surface winds as high as 40 kt and measured flight-level winds as high as 50 kt. The peak intensity for this storm shown previously in HURDAT is 50 kt from 06Z on the 2<sup>nd</sup> to 06Z on the 3<sup>rd</sup>. The new peak intensity is 40 kt from 00Z on the 3<sup>rd</sup> to 00Z on the 4<sup>th</sup>. Central pressures of 1009 and 1007 mb are added into HURDAT at 12 and 18Z on the 2<sup>nd</sup> because these values were the lowest pressures encountered by aircraft and it is believed that they flew into the “center” to measure these pressures. The 50 kt intensities in HURDAT are lowered to 35 kt at those times. Some track changes are analyzed as well. The reanalyzed track shows more of a straight west-southwestward track between the 2<sup>nd</sup> and the 4<sup>th</sup> instead of a track that gradually curves from west to south as shown in HURDAT previously, but observations only provide a little evidence to make these track changes. The most weight was placed on the “apparent” aircraft center fixes on the 2<sup>nd</sup> and 3<sup>rd</sup>. After making landfall, How weakened to a depression,

and no changes are made to the timing of dissipation which occurred after 18Z on the 4<sup>th</sup> as a 25 kt tropical depression at 22.7N, 99.0W.

Some quotes from the Air Weather Service post-season report...

“No synoptic reports were received with winds above force 6 or pressures below 1009.8 mbs” (AWS). From a detailed study of the data available it seems quite probably that a closed circulation existed in the Gulf of Mexico from the 1<sup>st</sup> until the 4<sup>th</sup> of October” (AWS).

“A definite center which could be pinpointed and tracked was located only once and even then it was questionable. Reconnaissance flights concerned themselves only with the area of strong winds and squally weather. They did not search southward in the area of relatively clear weather to locate the center of the wind field or conclusively prove that no closed center existed. Southwestward movement was forecast consistently from 3 October on but could not be verified until the storm reached the western Gulf and failed to move inland. Meanwhile, current positions in the advisories were pessimistically kept further north in the absence of reliable information on the storm’s position” (AWS).

#### 1950 Storm 9 (Item)

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35300 10/08/1950 M= 3 9 SNBR= 780 ITEM XING=0
35300 10/08/1950 M= 4 9 SNBR= 780 ITEM XING=0
*
35305 10/08* 0 0 0 0*208 906 40 0*208 910 45 0*209 916 45 0*
35305 10/08* 0 0 0 0*233 904 35 0*233 910 40 0*231 916 45 0*
*** ** ** *** **
35310 10/09*210 922 50 0*210 927 55 0*210 932 65 0*209 939 65 0*
35310 10/09*224 922 45 1002*218 927 50 0*213 932 55 0*208 938 60 0*
*** ** **** ** ** *** **
35315 10/10*206 946 80 0*203 949 90 0*199 953 95 0*188 959 65 0*
35315 10/10*205 943 65 990*202 947 70 0*198 951 75 0*194 954 80 980*
*** ** ** *** ** ** *** **
(The 11th is new to HURDAT.)
35315 10/11*191 957 80 *188 959 75 0*185 960 40 0* 0 0 0 0*
35320 HR

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Major track changes and major intensity changes are analyzed for this hurricane that made landfall near Vera Cruz, Mexico. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, Mexican station observations, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Connor (1956).

October 7:

HWM analyzes a closed low of at most 1010 mb centered near 21.2N, 88.7W. HURDAT does not yet list a system on this day. Microfilm analyzes a closed low of at most 1011 mb centered near 21.8N, 88.8W. No gales or low pressures.

October 8:

HWM analyzes a closed low of at most 1010 mb centered near 18.9N, 92.8W. HURDAT lists this as a 45 kt tropical storm at 20.8N, 91.0W. Microfilm at 18Z analyzes a closed low of at most 1005 mb centered near 22.5N, 91.9W. Ship highlights: 30-35 kt SSW and 1011 mb at 15Z at 22.7N, 90.4W (AWS, micro). Aircraft highlights: 5 kt S (7 kt NNE at flight-level of 1000 ft) and 1003 mb (min p encountered during flight) at 2215Z at 22.9N, 91.9W (ATS); 30 kt [N?] (33 kt N at flight-level of 1000 ft) and 1007 mb at 2315Z at 23.0N, 92.5W (ATS); 35 kt max wind encountered during flight (AWS). "This small hurricane began to develop on the 8<sup>th</sup> in the Gulf of Mexico northwest of the Yucatan Peninsula" (MWR). "Navy 6: Marked wind shift 150 degrees 19 kt to 25 degrees at 2200Z. Winds have been steady at 170 degrees 39 kt during the past half hour. "Post flight summary: Southerly winds to 22.6N, 91.7W with associated showers and marked wind shift 180 degrees 18 kt to 020 degrees 7 kt increasing rapidly to 38 kt. Marked trough line. No evidence of complete circulation" (micro). "The lowest surface pressures in the vortex as it moved over Yucatan were 1005 mbs" (AWS). "At 15Z the Andrew A. Humphries, located just northwest of Yucatan, reported a force seven wind [30 kt] from the SSW with a rough sea from the same direction. The Joint Hurricane Center dispatched a Navy reconnaissance aircraft to the area that same day. The plane found maximum winds of 35 kt with a cyclonic shift in direction from 150 degrees to 25 degrees accompanied by deteriorating weather conditions in the general area. The aircraft observer recommended the area be checked again the following day" (AWS). "The first reconnaissance flight on the afternoon of the 8<sup>th</sup>... approaching the storm center from the east, the plane reported the wind 170 degrees at 39 kt for 30 minutes, then a marked wind shift and winds northerly at 27-35 kt on the west wide. The lowest pressure reported was 1003 mbs, however no statement was made as to the minimum observed" (AWS). From the ATS report... "Flight was made to investigate the area near 23N, 91W. Light southeast to south winds prevailed over the route outflying from Miami to a position near 22.2N, 92.8W except in a few moderate squalls. At this point, the winds shifted from 150 degrees 19 kt to 025 degrees 22 kt and course was changed to northeast to further investigate for possible circulation or frontal zone. Little increase in winds indicated that at least for the present, there was no 'closed' circulation, but that from the general character of the weather in this area it would bear continued watching. During the next 24 hour period that followed this reconnaissance, this convergence area actually did deepen and develop into a full hurricane" (ATS).

October 9:

HWM analyzes a closed low of at most 1005 mb centered near 21.2N, 93.6W. HURDAT lists this as a 65 kt hurricane at 21.0N, 93.2W. The AWS best track shows a 0030Z position at 22.5N, 92.4W with 35 kt max winds 1003 mb central pressure and a 1230Z position at 21.3N, 93.6W with 65 kt max winds and 997 mb central pressure. The MWR post-season track map shows a 12Z position near 21.2N, 93.1W. Microfilm analyzes a low of at most 993 mb centered near 20.8N, 93.8W. Ship highlights: 30 kt NNW and

1009 mb at 00Z at 22.1N, 93.3W (micro); 20 kt WNW and 1004 mb at 12Z at 20.9N, 94.0W (COA, HWM); 25 kt SW and 1003 mb at 18Z at 20.3N, 93.8W (COA). Aircraft highlights: 80-90 kt at flight-level of 800 ft (max flight-level wind encountered on flight) around ~1607-1610Z at 20.7N, 93.7W (ATS, AWS, micro); Navy center fix at 1615Z at 20.7N, 93.8W (micro, ATS, AWS); 25 kt W (25 kt WSW at flight-level of 800 ft) and 1002 mb at 1615Z at 20.5N, 93.7W (micro); Navy center fix at 2315Z at 20.6N, 94.3W with 990 mb central pressure and max winds of greater than 90 kt (AWS, ATS). At least five other surface gales, six other flight-level hurricane force winds between 65-80 kt, and six other low pressures between 991-1003 mb. “On the morning of the 9<sup>th</sup>, a reconnaissance plane located the small center with 90 mph winds at 21N, 94W, about 200 miles northeast of Vera Cruz, Mexico” (MWR). “Corrected center fix at 1615Z at 20.7N, 93.8W. Surface winds estimated 50 to 60 mph from 60 degrees” (micro). “Navy nine [center] 20.5N, 94.3W [with central pressure 990 mb]. Blue skies and light winds [inside eye]. True center may be slightly north of 20.5N, 94.3W. Navy ten: Max winds 90 kt from 330 degrees just west of previously reported clear. Post-flight summary: A small, intense disturbance was located at 20.5N, 93.7W at 1610Z with full hurricane winds of 85 kt. Maximum extending outward 35 miles in the northwest quadrant and 60 miles in the northeast quadrant and winds over 45 kt outward for nearly 100 miles from the center in the northern semicircle. Weather is generally good in the area with the exception of a well-defined wall around the center which has about a 20 to 25 mile diameter. Post flight summary: Hurricane force winds extend approximately 120 miles southeast and 60 to 100 miles northwest of apparent center. Very heavy swell emanating from center position in all quadrants. Minimum pressure at center position is 990 mb. Max winds encountered were from 330 degrees at 90 kt in squall line...” (micro). “Morning reconnaissance on the 9<sup>th</sup> found the storm had developed to hurricane intensity with maximum winds of 90 kt and a well defined eye 20 to 25 miles in diameter” (AWS). “On 9 October two flights were made. A small, intense center 20-25 miles in diameter was located with winds to 85 kt and hurricane force winds extending 60 miles to the NE and 35 miles to the NW [of the center]. The third Navy flight penetrated the eye at 2315Z on the 9<sup>th</sup> and found winds over 90 kt and a minimum observed pressure of 990 mbs. The eye was elongated and ragged, oriented N-S about 30 miles long and 10 to 15 miles wide” (AWS). From the ATS report... “On a southeasterly course from Corpus Christi, winds increased gradually from the ENE at 22N, 93.6W, long southeasterly swells were noted, so a more southerly course was made. The winds began to increase more rapidly and at 21.5N, 93.8W, the east-northeasterly winds had reached a velocity of 60-65 kt. It was then decided to put the winds on our port beam and fly into the increasing wind gradient. A heavy wall, or single heavy squall line was entered with maximum winds of 80-90 kt. After penetrating this wall, we suddenly broke out into a relatively calm area of about 25 miles in diameter, located at 20.7N, 93.7W. Course was changed to easterly and again the heavy ‘Weather Wall’ was encountered. A heading was taken for Miami. This proved to be the first position indication of such a storm in this area” (ATS). From the next ATS report... “This was the third Navy reconnaissance flight into this hurricane. The flight left Miami at 1746Z, and a course was set for Progreso, on the northwest tip of the Yucatan Peninsula. No noteworthy weather was observed until after departure was taken from Progreso. As the flight crossed the Gulf of Campeche on a westerly course, the winds were generally from the southeast, veering slowly and gradually increasing to 80 kt. At

2315Z, the eye was penetrated. It was a ragged, elongated eye, oriented north-south about 30 miles along the long axis, and from 10 to 15 miles wide. Minimum observed pressure in the eye was 991 mb. Departure from the eye was taken to the southwest, and winds of over 90 kt were observed in a narrow band just out of the calm area” (ATS).

October 10:

HWM analyzes a large closed low of at most 1010 mb centered near 17N, 93W. HURDAT lists this as a 95 kt hurricane at 19.9N, 95.3W. The AWS best track lists a 0030Z position at 20.1N, 94.5W with 90 kt max winds and 990 mb central pressure and a 1230Z position at 19.2N, 95.2W with 100 kt max winds and 984 mb central pressure. The MWR post-season track map shows a 12Z position near 19.8N, 95.8W. Microfilm analyzes a hurricane of at most 1005 mb centered near 19.8N, 95.1W. Ship highlights: 30 kt SSW and 1000 mb at 00Z at 19.9N, 93.2W (COA); 45 kt SSW and 1002 mb at 06Z at 19.8N, 93.3W (COA); 55 kt E and 1007 mb at 12Z at 20.2N, 93.7W (COA); 70 kt ESE and 1009 mb at 18Z at 19.8N, 94.4W (micro). Land/station highlights: 40 kt NW and 1004 mb at 18Z at Vera Cruz (19.2N, 96.2W) (micro); 50 kt NW at 2230Z at Vera Cruz (micro). Aircraft highlights: 105 kt NNE (at flight-level of 500 ft) and 987 mb at 1530Z at 19.6N, 95.6W (ATS, micro); Navy center fix at 1535Z at 19.5N, 95.3W with 980 mb central pressure and 105 kt max flight-level winds encountered (ATS, AWS, micro); 95 kt (at flight-level of 700 ft) and 985 mb at 16Z at 19.8N, 95.2W (ATS). At least two other flight-level hurricane force winds between 75-80 kt and three other low pressures. “It moved southwestward and entered Mexico a short distance south of Vera Cruz on the morning of the 10<sup>th</sup>. The strongest wind reported was 110 mph at Vera Cruz. Damage in Vera Cruz and vicinity was reported in the press as ‘heavy’ but no estimate of the amount of damage or number of casualties has been received” (MWR). “Navy six: In eye at 1530Z at 19.6N, 95.6W. Wind just west of eye 20 degrees, 105 kt. Min pressure 980 mb [assume central pressure]. Post flight summary (Navy): Storm appears to be very extensive and severe to the northwest, north, and northeast of the center position. Very heavy swells from the southeast were observed as far north as Cape Rojo. Westerly winds on the coast veered rapidly and increased in velocity to 45 kt due east of Tuxipan about 60 miles. Winds backed very slowly and gradually increased until winds of over 100 kt were observed in circular cloud bands just outside the eye. The eye appeared to be extensive and ragged in outline. Blue skies with some fracto stratus were observed. Minimum pressure was 980 mb. Seas were moderate but confused. Winds to the north and east were neither as strong nor as extensive as winds observed to northwest of center position” (micro). “Penetrating from the west side the plane found maximum winds of 105 kt and a minimum pressure of 980 mbs indicating that further intensification had occurred since the previous day. The eye was clearly defined, oval shaped, about 20 miles N-S and 15 miles W-E. The NW quadrant was reported as being the most intense sector of the hurricane in both speed and extent of winds. The storm was centered about 40 miles east of Vera Cruz” (AWS). From the ATS report... “This was the fourth and final Navy flight into this hurricane. The flight departed Corpus Christi at dawn and flew south to Tuxipan, Mexico. From Tuxipan, a course was set due east. At 1500Z, the wind was from the northeast at 45 kt, with heavy intermittent rain and tremendous swells from the southeast. Course was changed to the south, and then wind was placed on the port beam in attempt to enter the eye. Winds backed slowly and increased in strength rapidly

until a maximum of 105 kt from 050 degrees was observed. Pressure had dropped very rapidly. At 1535Z the eye was entered. It was oval, about 20 miles north and south, about 15 miles east-west, and clearly defined. The minimum pressure was recorded as 987 mb. Because of proximity to land, departure from the eye was taken to the north. Here torrential rain, severe turbulence, mountainous seas, and winds of better than 95 kt were encountered. The storm entered the coast of Mexico at Vera Cruz early the next morning” (ATS).

October 11:

HWM no longer analyzes a closed low on this day, but analyzes a spot low within a trough near 17N, 93W. HURDAT no longer lists a system on this day. The AWS best track lists a 0030Z position at 18.9N, 95.6W with 105 kt max winds and 980 mb central pressure and a 1230Z position at 18.6N, 96.1W with 60 kt max winds and 995 mb central pressure. Microfilm at 06Z analyzes a closed low of at most 1005 mb centered near 19.0N, 95.4W. At 12Z, microfilm no longer analyzes a closed low, but indicates a trough over the southern Bay of Campeche and southern Mexico. Land/station highlights: 65 kt NNW and 1002 mb at 00Z, 60 kt NNW G 70 kt at 2Z, G 95 kt (max gust), 70 kt NE and 1006 mb at 06Z all at Vera Cruz (19.2N, 96.2W) (micro, AWS, advisories, Connor). From the final New Orleans WB advisory on Item... “The hurricane has moved inland, and at 0930Z, the center was about 30 miles south of Vera Cruz, Mexico. Highest wind reported was 110 mph in gusts at Vera Cruz. The intensity was decreased rapidly since moving inland...” (WB advisories). “By 04Z, the storm had moved inland just south of Vera Cruz and the city reported winds to 75 mph with gusts from 75 to 100 mph for 5 hours. Rapid filling occurred as the storm progressed into the mountainous Mexican coast and the last bulletin was issued at 0930Z. Item was a small intense storm. Nautla, a city located 60 miles NW of Vera Cruz, received no strong winds from the hurricane even though it was on the north side of the disturbance which was the most intense quadrant reported by reconnaissance [some 18 hours prior to landfall]” (AWS).

The origin of Item was likely associated with a trough or front that extended from the western Atlantic southwestward to the Yucatan Peninsula area. On 8 October, a circulation was evident due to a 15Z ship observation of 35 kt SSW and 1011 mb at 22.7N, 90.4W. Although no changes are made to the timing of genesis (06Z on 8 October), the 15Z ship observation is assumed to be accurate and the positions for Item on the 8<sup>th</sup> are shifted 2.5 degrees north of the previous HURDAT positions (major track changes). Item moved generally southwestward at a nearly constant speed for its entire lifetime and made landfall about 25 to 30 nmi southeast of Veracruz, Mexico on a southwestward course. After the major track changes on the 8<sup>th</sup>, all track changes on the 9<sup>th</sup> and 10<sup>th</sup> are minor (less than 2 degrees). Track changes from 12Z on the 9<sup>th</sup> through 12Z on the 10<sup>th</sup> were very tiny (less than half of a degree). A reconnaissance flight late on the 8<sup>th</sup> did not explicitly report a central pressure, but observations from this flight indicate that the central pressure was likely very close to 1002 mb (plus or minus about 1 mb). A central pressure of 1002 mb is added into HURDAT at 00Z on the 9<sup>th</sup>. A central pressure of 1002 mb equals 43 kt according to the Brown et al. southern pressure-wind relationship, and 45 kt is chosen for 00Z on the 9<sup>th</sup> (down from 50 kt originally). On the 9<sup>th</sup> around 1615Z, aircraft reported maximum flight-level winds of 80 to 90 kt, and by

2315Z, aircraft measured a central pressure of 990 mb and reported maximum flight-level winds of greater than 90 kt. A central pressure of 990 mb is added into HURDAT at 00Z on the 10<sup>th</sup>. This value yields 64 kt according to the southern pressure-wind relationship and 65 kt is chosen for the intensity at 00Z on the 10<sup>th</sup> (down from 80 kt originally). It is analyzed that Item became a hurricane at 00Z on the 10<sup>th</sup> (12 hours later than originally). On the 10<sup>th</sup>, there were some gale observations from ships, but these observations alone are not enough to determine the reanalyzed intensity for HURDAT. On the 10<sup>th</sup> at 1535Z, Navy aircraft penetrated the center and recorded a central pressure of 980 mb after measuring maximum flight-level winds of 105 kt. A central pressure of 980 mb is added into HURDAT at 18Z on the 10<sup>th</sup>, and 980 mb yields 78 kt according to the southern pressure-wind relationship. 75 kt is chosen for 12Z (down from 95 kt originally) and 80 kt is chosen for 18Z (up from 65 kt originally) on the 10<sup>th</sup>. At 18Z on the 10<sup>th</sup>, there was also a 70 kt ship observation. The last point shown in HURDAT for Item is 18Z on the 10<sup>th</sup> on the coastline southeast of Vera Cruz. However, several sources indicate that Item did not make landfall until 04Z on the 11<sup>th</sup>. In fact, Item likely was at its peak intensity from 18Z on the 10<sup>th</sup> until landfall on the 11<sup>th</sup>. 18 hours are added into HURDAT for Item (through 12Z on 11 October). Only a small handful of observations are available from Vera Cruz, but one observation at 06Z on the 11<sup>th</sup> is a 70 kt wind at that time. The highest available observations of the wind at Vera Cruz from all sources ranged from 65 to 70 kt with gusts to 95 kt. Item made landfall at 04Z on the 11<sup>th</sup> at 18.9N, 95.9W (25 nmi SE of Vera Cruz). It is estimated that Item made its closest approach to Veracruz at 03Z on the 11<sup>th</sup> when it was located 20 to 25 nmi east-southeast of Vera Cruz. The final aircraft fix at 1535Z on the 10<sup>th</sup> suggested an RMW of 13 to 14 nmi at that time. Hurricane force winds were observed at Vera Cruz for at least the 6 hours between 00Z – 06Z on the 11<sup>th</sup>. There is not much data available to make significant changes to the approximate landfall point in HURDAT. The observations from Vera Cruz were the main observations that aided in the track analysis around the time before and at landfall. The highest available wind observation from Veracruz is 70 kt but the lowest available observed pressure from that city is only 1002 mb. There is medium to high confidence that Vera Cruz did not experience the RMW of this hurricane. These factors indicate the possibility that Item may have strengthened to a Category 2 or even a Category 3 hurricane prior to landfall, but there is no direct evidence that would indicate a reason to analyze an intensity higher than 80 kt at any time. 80 kt is the landfall intensity at 04Z on the 11<sup>th</sup>. Runs of the Kaplan and DeMaria Inland Decay Model yield 67 kt for 06Z on the 11<sup>th</sup> and 51 kt for 12Z. The highest observed wind within 2 hr of synoptic times are 70 kt at 06Z on the 11<sup>th</sup> and 20 kt at 12Z. Analyzed intensities are 75 kt at 06Z on the 11<sup>th</sup> and 45 kt at 12Z. By 12Z on the 11<sup>th</sup>, Item was entering the higher terrain of Mexico, and it is analyzed that Item dissipated before 18Z on the 11<sup>th</sup>.

### 1950 Storm 10 (Jig)

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35325 10/11/1950 M= 7 10 SNBR= 781 JIG          XING=0
35325 10/11/1950 M= 8 10 SNBR= 781 JIG          XING=0

35330 10/11*   0  0  0  0*  0  0  0  0  0*243 472 40  0*242 482 40  0*
35330 10/11*   0  0  0  0*  0  0  0  0  0*224 470 40  0*227 480 40  0*
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35335	10/12*242	492	45	0*242	502	45	0*242	512	50	0*244	524	55	0*
35335	10/12*230	490	45	0*233	501	45	0*236	512	50	0*239	523	55	0*
	***	***		***	***		***			***	***		
35340	10/13*247	537	55	0*250	546	60	0*254	555	65	0*261	567	70	0*
35340	10/13*243	534	55	0*248	544	60	0*254	555	65	0*261	567	70	0*
	***	***		***	***								
35345	10/14*269	578	75	0*276	586	75	0*284	593	80	0*295	600	80	0*
35345	10/14*270	577	75	0*280	586	75	0*290	594	80	0*299	601	80	0*
	***	***		***			***	***		***	***		
35350	10/15*308	605	85	0*320	602	90	0*332	592	100	0*342	582	105	0*
35350	10/15*308	603	85	0*319	602	90	0*330	597	100	0*341	585	105	0*
	***			***			***	***		***	***		
35355	10/16*351	572	100	0*359	562	95	0*368	550	90	0*388	515	90	0*
35355	10/16*351	574	95	0E360	561	85	0E369	546	75	0E381	522	75	0*
	***	***		****	***	**	****	***	**	****	***	**	
35360	10/17*408	471	85	0*419	445	65	0E430	420	60	0E441	399	60	0*
35360	10/17E395	492	75	0E410	460	75	0E430	428	70	0E450	399	65	0*
	****	***	**	****	***	**	***	**		***			
(The 18th is new to HURDAT.)													
35360	10/18E475	375	65	0*	0	0	0	0*	0	0	0	0	0*
35365 HR													

Major track changes and minor revisions to intensity are analyzed for Hurricane Jig. A major change is also analyzed for the timing of extratropical transition. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), and U.S. Weather Bureau public advisories.

#### October 11:

HWM analyzes a closed low of at most 1010 mb centered near 23.7N, 47.8W. HURDAT lists this as a 40 kt tropical storm at 24.3N, 47.2W. No gales or low pressures. "The ship Del Cro reported SW wind force 3 [10 kt] pressure 1013.2 mbs at 1230Z" (AWS).

#### October 12:

HWM analyzes a tropical storm of at most 1010 mb centered near 23.1N, 51.2W. HURDAT lists this as a 50 kt tropical storm at 24.2N, 51.2W. The AWS best track lists a 0030Z position at 22.2N, 48.7N with 25 kt max winds and a 1230Z position at 23.6N, 51.9W with 30 kt max winds. No gales or low pressures.

#### October 13:

HWM analyzes a tropical storm of at most 1010 mb centered near 24.0N, 56.0W. HURDAT lists this as a 65 kt hurricane at 25.4N, 55.5W. The AWS best track lists a 0030Z position at 24.3N, 53.7W with 35 kt max winds and a 1230Z position at 25.2N, 55.4W with 40 kt max winds. The MWR post-season track map shows a position near 25.6N, 56.0W. Microfilm analyzes a closed low of at most 1005 mb centered near 26.2N, 55.8W. Ship highlights: 35-45 kt NE and 1011 mb at 13Z at 26.1N, 57.0W (micro, AWS); 45 kt NW and 1005 mb at 15Z at 25.9N, 56.8W (micro, MWR); 35 kt SSW and 1005 mb at 18Z at 25.5N, 56.3W (micro); 35 kt SE and 1011 mb at 18Z at

27.0N, 54.8W (micro). “At 1300Z on October 13 the S.S. Rio Primero reported a northeast gale wind and rapidly falling pressure at 27N, 57W, which indicated that a hurricane center was in the vicinity of 25.5N, 56.5W at the time. A subsequent report at 1500Z from the Rio Primero gave northwest gales and rapidly rising pressure indicating the passing of the small but sharp hurricane center nearby to the east” (MWR). “Ship reports continued to indicate some type of disturbance until 131300Z when the ship Rio Primero reported as follows: Wind NE force 8 [35 kt], pressure 1010.9 falling at position 26.1N, 57.0W. On the basis of this report, AFBUL JIG ONE was issued at 1830Z naming Jig a tropical cyclone and indicating that it had probably already reached hurricane intensity. Bermuda was advised Hurricane Alert at this time as the storm center was then located 520 miles SE of this island” (AWS).

October 14:

HWM analyzes a tropical storm of at most 1010 mb centered near 24.8N, 60.1W. HURDAT lists this as an 80 kt hurricane at 28.4N, 59.3W. The AWS best track lists a 0030Z position at 26.6N, 57.8W with 60 kt max winds and a 1230Z position at 29.0N, 59.6W with 80 kt max winds and 973 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 29.2N, 59.9W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near 28.7N, 59.3W. Microfilm analyzes a hurricane of at most 999 mb centered near 29.0N, 59.4W. Ship highlights: 30-35 kt S and 1012 mb at 00Z at 25.9N, 56.2W (COA, micro). Aircraft highlights: center fix (boxing, radar) at 1130Z at 29.0N, 59.3-59.5W with 80 kt estimated surface winds 20 mi from eye in NE quadrant (micro, AWS); center fix at 20Z at [29.5N, 61.0W or 30.3N, 60.0W?] with 100 kt max winds just outside the eye (AWS, micro). Several gales and low pressures. “A plane out of Bermuda on the 14<sup>th</sup> located the small, mature hurricane at 29N, 59.3W” (MWR). “Hurricane Jig recon report: Box position 29.0N, 59.5W at 1130Z. Post flight narrative: Located hurricane at 1130Z at 29.0N, 59.3W. Boxed storm. Had loran within 100 miles of eye. Navigation was excellent, so feel confident that position is good within 10 miles. Eye is 20 miles in diameter. Radar got heaviest returns in the NW and NE quadrants. Gale winds extend 90 n mi from center in NW and NE quadrants and 65 miles in SW and SE quadrants. Light to moderate rain in all quadrants. Encountered moderate turbulence occasionally in NW and NE quadrants. Estimated surface winds 80 kt 20 miles from eye in NE quadrant” (micro). “Post flight summary Duck 12: Eye 20 miles in diameter and well defined. Maximum winds just outside eye are 100 kt. Hurricane winds extend 40 miles from center in northern sectors and 30 miles in southern sector. Storm winds extend 60 miles to north and 50 miles to south. Gale winds extend 90 miles to north and 70 miles to south. Air Force fix on Jig at 2000Z is 29.5N, 61.0W” (micro). “An Air Force reconnaissance flight was made into the storm on 14 October and located the center by box and radar [not penetration]. Maximum surface winds were estimated at 80 kt 20 miles NE of the center. Only one aircraft penetration was made (at 20Z). This aircraft reported maximum winds of 100 kt just outside the eye” (AWS).

October 15:

HWM analyzes a tropical storm of at most 1005 mb centered near 33.8N, 59.0W with the SSW end of a SSW-NNE stationary front located near 42N, 52W extending to beyond

46N, 49W. HURDAT lists this as a 100 kt hurricane at 33.2N, 59.2W. The AWS best track lists a 0030Z position at 31.2N, 59.9W with 100 kt max winds and 973 mb central pressure and a 1230Z position at 33.7N, 58.9W with 75 kt max winds and 980 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 33.6N, 59.6W with a 995 mb pressure and the MWR post-season track map shows a 12Z position near 32.8N, 59.4W. Microfilm analyzes a tropical storm of at most 993 mb centered near 33.2N, 59.2W with a trough or front-like feature extending from 35N, 59W northeastward to beyond 40N, 54W. Ship highlights: 50 kt SSE and 1007 mb at 12Z at 32.4N, 57.9W (COA). At least three other gales. Aircraft highlights: Air Force center fix (boxing) at 1145Z at 32.9N, 60.0W (micro); 75 kt ESE at flight-level of 800 ft and 991 mb at 1230Z at 34.0N, 59.0W (micro). Other gales and low pressures. "It moved on a curving path passing 300 miles east of Bermuda during the night of October 14 and turned northeastward over the Atlantic. This was a small hurricane throughout, and strongest winds were estimated 115 to 120 mph [during the lifetime of Jig]" (MWR). "AF fix 32.9N, 60.0W at 1145Z by boxing" (micro).

October 16:

HWM analyzes a tropical storm of at most 1005 mb centered near 36.9N, 54.5W with the southwest end of a SW-NE stationary front plotted near 41N, 52W extending northeastward to beyond 45N, 47W. HURDAT lists this as a 90 kt hurricane at 36.8N, 55.0W. The AWS best track lists a 0030Z position at 35.2N, 56.7W with 55 kt max winds and 983 mb central pressure and a 1230Z position at 36.8N, 54.0W with 45 kt max winds and 985 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 37.8N, 53.9W with a 1002 mb pressure and the MWR-post season track map shows a 12Z position near 38.4N, 52.5W. Microfilm analyzes a closed low of at most 1011 mb centered near 38.2N, 52.3W with indications of troughiness extending from the low northeastward. Ship highlights: 35 kt S and 1018 mb at 12Z at 36.0N, 51.0W (micro); at least 45 kt SSE and 1005 mb at 18Z at 36.0N, 52.5W (micro). "Storm Jig continued its recurvature until 0030Z when it was 450 miles NE of Bermuda moving NE at a rate of 13 kt" (AWS).

October 17:

HWM analyzes a closed low of at most 995 mb centered near 43.7N, 42.2W with a SW-NE stationary front extending from the low northeastward to beyond 51N, 32W. HURDAT lists this as a 60 kt extratropical storm at 43.0N, 42.0W. The AWS best track lists a 0030Z position at 40.1N, 49.0W with 50 kt max winds and 985 mb central pressure and a 1230Z position at 44.2N, 42.7W with 65 kt max winds and 985 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 43.0N, 42.9W with a 985 mb pressure. Microfilm at 06Z analyzes a closed low of at most 1005 mb centered in the general vicinity of 40N, 46.8W. Ship highlights: 35 kt SSW and 1001 mb at 06Z at 41.3N, 46.9W (COA); 45 kt N and 1005 mb at 06Z at 42.2N, 46.7W (COA); 70 kt SSW and 1004 mb at 38.4N, 46.8W (micro); 60 kt NW and 1009 mb at 12Z at 41.5N, 47.0W (COA); 50 kt N and 997 mb at 12Z at 44.4N, 43.0W; 60 kt SSE and 999 mb at 18Z at 45.7N, 39.3W (COA). Several other gales and low pressures. "The storm accelerated considerably along a northeasterly track so that by 1230Z it was moving NE at a rate of 25 kt and becoming disorganized. Areas of gale winds spread

during 17 October with areas of storm and hurricane winds decreasing and disappearing entirely between 1830Z and 0030Z [on the 18<sup>th</sup>]. The last AFBUL on this storm was issued at 1530Z [on the 17<sup>th</sup>]. The storm had lost its tropical characteristics by this time” (AWS).

October 18:

HWM analyzes a closed low of at most 995 mb centered near 55.6N, 28.5W with a warm front extending from the low northeastward to 59N, 22W and a cold front extending southward from the low to 52N, 27W becoming a dissipating cold front near 49N, 28W continuing to 43N, 33W. HURDAT no longer lists a system on this day. The AWS best track lists a 0030Z position at 51.7N, 34.5W with 50 kt max winds and 985 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 54.5N, 29.7W with a 992 mb pressure. Ship highlights (through 06Z only): 55 kt SW and 992 mb at 00Z at 46.7N, 37.4W (COA); 60 kt S at 00Z at 47.5N, 37.0W (COA); 40 kt W and 998 mb at 06Z. At least two other gales and five other low pressures.

October

19:

HWM analyzes a closed low of at most 990 mb centered near 64N, 3W with a warm front extending from the low to 67N, 7E and a cold front extending from the low to 63N, 1E to 60N, 2W to 55N, 8W becoming a dissipating cold front near 53N, 10W continuing to 51N, 16W. I should investigate whether this cyclone is still purely extratropical Jig or whether it is the combination of the former TC and another extratropical cyclone that merged with Jig.

On 11 October at 12Z, HURDAT indicates the formation of Tropical Storm Jig in the central Atlantic, and no changes are made to the timing of genesis. Available observations on the 11<sup>th</sup> suggest the presence of a tropical cyclone, but more than 2 degrees south of the previous HURDAT position. The only major track change analyzed during the tropical portion of the lifetime of Jig was at the first point at 12Z on 11 October. The analyzed position for that time is 22.2N, 47.0W (originally 24.3N, 47.2W). Jig moved on a broad curving arc through the Atlantic Ocean. It recurved east of Bermuda around 00Z on the 15<sup>th</sup> around 31N, 60W. Jig had already begun moving northeastward on the 16<sup>th</sup> before it finally began to accelerate in that direction on the 17<sup>th</sup> as an extratropical system. The 14<sup>th</sup> and 15<sup>th</sup> were the only two days for which aircraft reconnaissance investigated this cyclone, but on the 13<sup>th</sup>, a nice ship times series reveals that the 1005 mb isobar was approximately 40 nmi from the center of Jig at two different azimuths between 13Z – 18Z. There are too many uncertain variables to obtain an accurate central pressure by running the Schloemer equation, but the equation was still run to obtain a general idea of what the intensity might have been. Central pressure values ranging from 987 to 994 mb were obtained by running the Schloemer equation a few different times and tweaking the environmental pressure and RMW to allow for the uncertainty. If the central pressure was 987 mb, that value yields 68 kt according to the Brown et al. southern pressure-wind relationship, 64 kt for north of 25N, and 66 kt for the intensifying subset of north of 25N. Since it is possible that Jig could have been that intense, no changes are made to the 65 and 70 kt intensities in HURDAT at 12 and 18Z on the 13<sup>th</sup>. There were three flights to monitor Jig- two on the 14<sup>th</sup> and one on the 15<sup>th</sup>,

but no aircraft central pressures were reported with Jig. During the flight on the morning of the 14<sup>th</sup>, 80 kt maximum surface winds were visually estimated 20 nmi from the center in the northeast quadrant. The RMW at the time was about 15 nmi. The aircraft probably did not reach the RMW since the center was fixed by the boxing method. During the afternoon flight on the 14<sup>th</sup>, the eye was penetrated and maximum flight-level winds encountered were 100 kt. It is fairly certain that this was a 700 mb penetration, which may have been why the central pressure was not reported. The flight on morning of the 15<sup>th</sup> located Jig by boxing method, so peak intensity information was probably not observed; however, available aircraft observations from that flight show surface winds were visually estimated at hurricane force and flight-level winds as high as 75 kt (at 800 ft) were encountered. There were also some 50 kt ship observations on the 15<sup>th</sup> around the 1007 mb isobar about 100 nmi from the center. HURDAT shows a peak intensity for Jig of 105 kt at 18Z on the 15<sup>th</sup>. No intensity changes are made to HURDAT from genesis on the 11<sup>th</sup> through the 15<sup>th</sup>, so the peak intensity of 105 kt in HURDAT at 18Z on the 15<sup>th</sup> is maintained due to a lack of intensity information. By the 16<sup>th</sup>, Jig was moving northeastward over the central north Atlantic far from any land areas. By 00Z on 16 October it became clear that Jig was beginning to take on extratropical characteristics, and Jig is analyzed to have become extratropical by 06Z on the 16<sup>th</sup> (30 hours earlier than originally) at 36N, 56W. Observations on the 16<sup>th</sup> indicate that the intensity of Jig was probably weaker than the intensities shown in HURDAT so downward adjustments of 5 kt (at 00Z) to 15 kt at 12 and 18Z are analyzed for HURDAT on the 16<sup>th</sup>. A 75 kt intensity is maintained through 06Z on the 17<sup>th</sup> (up from 65 kt originally at 06Z on the 17<sup>th</sup>) due to a ship observation of 70 kt at 06Z on the 17<sup>th</sup>. A major track change is made at 00Z on the 17<sup>th</sup> and the position is shifted 2 degrees southwest of the previous HURDAT position. A few of the ship observations around that time may have contained errors and thus made the analysis complicated, but some of the observations are more believable than others and indicate that the HURDAT position was too far northeast at the time. The final position listed in HURDAT for Jig originally was at 18Z on the 17<sup>th</sup> at 44.1N, 69.9W as a 60 kt extratropical cyclone. Ship observations indicate that the cyclone was not absorbed or dissipated until after 00Z on the 18<sup>th</sup>, so one 6-hourly point is added to HURDAT. The final position at 00Z on the 18<sup>th</sup> is analyzed to be 48.0N, 37.5W as a 65 kt extratropical cyclone. Thereafter, no more east winds were found north of the center, because Jig was interacting with a very large, broad, weak low to its north.

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A quote from the Air Weather Service post-season report...

“Error in the 24 hour forecast for this hurricane were quite large averaging 238 miles due to three reasons: 1. Because the storm did not seriously threaten any land area, only three flights were made into it, two of these being on one day. 2. The acceleration of this storm, particularly in its latter stages served to magnify the forecast errors, and 3. the fact that after 12 October the storm continued on a NE course instead of continuing its curvature to the right” (AWS).

1950 Storm 11 (King)

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35370 10/13/1950 M= 7 11 SNBR= 782 KING          XING=1 SSS=3
35370 10/13/1950 M= 8 11 SNBR= 782 KING          XING=1 SSS=4
*
35375 10/13* 0 0 0 0*160 842 35 0*160 839 35 0*160 834 35 0*
35375 10/13* 0 0 0 0*160 842 25 0*160 839 25 0*160 838 25 0*
** ** ** **
35380 10/14*160 830 35 0*160 827 40 0*162 824 40 0*165 818 45 0*
35380 10/14*160 837 30 0*161 836 30 0*162 835 30 0*163 833 35 0*
*** ** *** ** *** ** *** ** *** **
35385 10/15*168 812 50 0*170 808 50 0*173 804 55 0*177 800 60 0*
35385 10/15*166 827 40 0*169 820 45 0*172 810 50 0*177 800 55 992*
*** ** ** *** ** ** *** ** ** *** ** **
35390 10/16*182 796 65 0*189 791 75 0*196 787 85 0*202 785 95 0*
35390 10/16*184 793 65 0*189 790 70 0*193 787 75 985*200 783 80 0*
*** ** *** ** *** ** *** ** ** *** ** **
35395 10/17*209 785 100 0*219 786 105 955*230 790 105 0*238 793 100 0*
35395 10/17*211 782 75 0*222 783 65 0*232 790 70 988*240 795 90 0*
*** ** ** *** ** ** *** ** ** *** ** ** *** **
35400 10/18*247 797 95 0*258 802 90 0*270 808 75 0*286 815 65 0*
35400 10/18*247 798 115 0*258 802 115 955*270 808 75 975*286 815 70 983*
*** ** *** ** *** ** *** ** ** *** ** **
35405 10/19*300 824 35 0*311 835 25 0*321 846 25 0* 0 0 0 0*
35405 10/19*300 824 65 989*311 835 45 992*317 845 35 996*321 853 25 999*
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(The 20<sup>th</sup> is new to HURDAT.)

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35405 10/20*325 860 20 1000*329 865 20 1002* 0 0 0 0* 0 0 0 0*

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35410 HRCFL3
35410 HRCFL4DFL1
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#### U.S. Landfall:

10/18/1950 - 05Z - 25.7N, 80.2W – 115 kt – 955 mb – 1005 mb OCI – 200 nmi ROCI – 5 nmi RMW – 11 kt speed

Minor track changes and major intensity changes are analyzed for this hurricane which made landfall in Cuba and at Miami, FL. Major changes are made to the time King became a tropical storm, and changes are made to the U.S. landfall Saffir-Simpson categories. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, National Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, Barnes (1998), Ho et al. (1987), Dunn and Miller (1960), Perez et al. (2000), Schwerdt et al. (1979), and Jarrell et al. (1992).

#### October 11:

HWM analyzes a spot low near 11.4N, 80.4W along with an elongated trough over central America. HURDAT does not yet list a system on this day. No gales or low pressures.

#### October 12:

HWM analyzes a spot low near 14.3N, 79.5W with an elongated trough of low pressure less than 1010 mb extending from there westward across central America to the eastern Pacific. HURDAT does not yet list a system on this day. No gales or low pressures.

October 13:

HWM analyzes a spot low near 16.2N, 83.5W located within a trough of low pressure elongated E-W. HURDAT lists this as a 35 kt tropical storm at 16.0N, 83.9W. Microfilm analyzes a closed low of at most 1008 mb centered near 15.7N, 83.4W. "During October 13<sup>th</sup> it became evident on the surface chart that there was an area of disturbed weather in the western Caribbean centered near Swan Island. At 15Z, the winds aloft at Swan Island were easterly while at Puerta Cabeyas 200 miles to the south the winds aloft were almost due west to 10,000 feet, the top of the pibal" (AWS). No gales or low pressures.

October 14:

HWM analyzes a closed low of at most 1005 mb centered near 16.1N, 82.8W. HURDAT lists this as a 40 kt tropical storm at 16.2N, 82.4W. Microfilm analyzes a broad closed low of at most 1008 mb centered in the general vicinity of 16N, 83.5W. Land/station highlights: 5 kt WSW and 1005 mb at 12Z at 15.0N, 83.2W (HWM, micro); 1005 mb at 2130Z at Swan Island (17.3N, 83.9W) (micro). "By 1830Z, the 24-hr surface pressure change at Swan Island was -4.4 mbs" (AWS).

October 15:

HWM analyzes a closed low of at most 1005 mb centered near 17.3N, 81.1W. HURDAT lists this as a 55 kt tropical storm at 17.3N, 80.4W. The MWR tracks of centers of cyclones shows a 12Z position near 17.3N, 79.9W with a 1002 mb pressure and the MWR post-season track map shows a 12Z position near 17.4N, 81.0W. Microfilm analyzes a large closed low of at most 1005 mb centered in the general vicinity of 17.4N, 81.0W. Ship highlights: 15 kt S and 1001 mb at 06Z at 16.5N, 82.1W (COA); 20 kt W and 1004 mb at 12Z at 15.0N, 81.7W (COA). A few other low pressures. Land/station highlights: 5 kt SSE and 1004 mb at 00Z at 15.0N, 83.2W (micro); 15 kt NE and 1005 mb at 15Z at Grand Cayman (micro). Aircraft highlights: 35 kt S (38 kt SSE at flight-level of ~1000 ft) and 999 mb at 1830Z at 18.1N, 79.2W (ATS); center fix at 1915Z at 18.1N, 79.6W with 992 mb central pressure and 45 kt maximum observed winds on the southeast side (AWS, ATS). At least three other low pressures between 997-1004 mb. "This hurricane formed in the northwestern Caribbean Sea on October 15 and moved on a northeasterly course at first, past the western end of Jamaica" (MWR). "Post flight summary: Storm appears to be in development stage with poorly defined center. Low pressure of 992 mb would indicate rapid future development. Max winds in southeast quadrant near 40 to 45 kt with gusts to 55 kt in a few squalls. Moderate rain east and north of the center. Showers southeast through southwest. Cloud west through northwest. Winds fall to average 9 kt in center. Navy ten: Very small closed center-poorly defined at 1915Z at 18.1N, 79.5W. Lowest pressure 992 mb" (micro). "Aircraft reconnaissance was dispatched on the 15<sup>th</sup> and found a small poorly defined center with gusts to 55 kt and central pressure 992 mbs. By this time, the storm had drifted east-northeastward from the area south of Swan Island and was swinging north toward Cuba"

(AWS). “Development of the storm occurred slowly until the 15<sup>th</sup> and rapidly after that time” (AWS). From flight... “15/1915Z: Storm appears to be in development stage with very small poorly defined center. Central pressure 992 mbs. Max wind in SE quadrant near 40-45 kt and a few squalls gusty to 55 kt. Moderate rain E and N of center. Showers SE through SW, cloudy W through NW. Winds fall to average 9 kt in center” (AWS). From the ATS report... “This was the first flight into a suspicious area south of Cuba. The flight was briefed to investigate the area from Miami, to Swan Island, to Jamaica and back to Miami, departing from this course at the discretion of the aerologist aboard. A very small closed circulation was located with a minimum surface pressure of 992 mb. 1915Z: Very small closed center poorly defined. Lowest sfc pressure 992 mb” (ATS).

October 16:

HWM analyzes a tropical storm of at most 1000 mb centered near 20.1N, 79.0W. HURDAT lists this as an 85 kt hurricane at 19.6N, 78.7W. The AWS best track lists a 0030Z position at 18.4N, 79.3W with 60 kt max winds and 990 mb central pressure and a 1230Z position at 19.3N, 78.6W with 110 kt max winds and 985 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 19.8N, 78.5W with a 987 mb pressure and the MWR post-season track map shows a 12Z position near 19.6N, 78.4W. Microfilm analyzes a closed low of at most 993 mb centered near 19.5N, 78.8W. Ship highlights: 35 kt E and 1002 mb at 03Z at 19.8N, 78.3W (micro); 45 kt ENE and 999 mb at 14Z at 20.2N, 78.4W (micro); 50 kt NNW and 994 mb at 17Z at 20.0N, 78.4W (micro). Four other gales of 35 kt and seven other low pressures between 1001-1005 mb. Land/station highlights: 50 kt SW and 1000 mb at 00Z at Pt. Negrito, Jamaica (18.3N, 78.3W (micro, AWS); 35 kt ESE and 998 mb at 12Z at 19.8N, 77.6W (micro); 35 kt S and 998 mb at 15Z at 19.8N, 77.6W (micro). Three other gales between 35-40 kt and nine other low pressures. Aircraft highlights: center fix at 1445Z at 19.5N, 78.5W with 985 mb central pressure and maximum flight-level winds encountered of 95 kt around ~150-180 m, [which reduces to 73 to 75 kt surface winds after multiplying by 0.77-0.79] (ATS, AWS). At least one other surface gale, two other flight-level gales, and six other low pressures. “Then [King] turned northward across Cuba just west of Camaguey during the night of the 16<sup>th</sup>. It was a small hurricane at that time; strongest winds at Camaguey were only around 65 mph” (MWR). “Navy 6 at 1445Z: 19.5N, 78.5W. Wind WNW 95 kt with gusts to 100 kt. Entered eye, 10 mi diameter. Post flight summary: It was found to be 10 to 15 miles in diameter” (micro). “During the night [of the 15-16<sup>th</sup>] it passed 40 miles NW of Jamaica” (AWS). “As the storm passed NW of Jamaica, one report of force 10 [50 kt] winds was received from Point Negrito. The winds probably rose above this but no more information is available” (AWS). From flight... “16/1445Z: Center was 10-15 miles across in diameter with winds over 75 kt extending out 25-30 miles and max wind of 95-110 kt near center. 50 kt winds extend outward 60 miles from center in NW quadrant. The eye though not clear of lower clouds was relatively calm with diffuse winds and clearly visible on radar” (AWS). From the ATS report... “Flight was made south from Miami to Grand Cayman and Cayman Brac, obtaining fixes visually on these islands before proceeding to center. Increasing winds and southeasterly swells gave ample indication of both the intensity and proximity of the storm. Penetration was made directly into the west side of the storm and the center was fixed at

19.5N, 78.5W. Lowest pressure was 985 mb” (ATS). [It looks like max flight level wind was 95 kt with flight level gusts to 110 kt. Also, there is a slight chance that 985 mb may not have been a central pressure (ATS). “King – Oct. 16-17 – Cat 1 in Cuba” (Perez et al. 2000).

October 17:

HWM analyzes a tropical storm of at most 1000 mb centered over Cuba near 22.3N, 79.8W. HURDAT lists this as a 105 kt hurricane at 23.0N, 79.0W. The AWS best track lists a 0030Z position at 21.2N, 78.1W with 90 kt max winds and 989 mb central pressure and a 1230Z position at 23.1N, 79.0W with 100 kt max winds and 988 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 23.4N, 78.9W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near 23.1N, 78.9W. Microfilm analyzes a hurricane of at most 996 mb centered near 23.3N, 79.1W. Ship highlights: 65 kt E and 999 mb at 09Z at 22.9N, 78.9W (micro). At least two other gales and seven other low pressures. Land/station highlights: 60 kt SE and 989 mb at 0130Z at 21.2N, 77.9W (micro); 70 kt (max w) and 989 mb (min p) at 0130Z Camaguey, Cuba (21.4N, 77.9W) (AWS) [may not have occurred simultaneously- but probably almost at same time]; 50 kt ENE and 996 mb at 05Z at 22.5N, 78.3W (micro); Key West radar center fixes at 19Z and 20Z between 23.9-24.0N, 79.7-79.8W (micro); 50 kt E and 997 mb at 21Z at 24.6N, 81.1W (micro). At least 19 other gales and 30 other low pressures. Aircraft highlights: radar center fix at 0329Z at 22.2N, 77.8W (micro); Navy radar center fixes at 1130Z, 1230Z, and 1333Z between 23.2-23.3N, 79.2W (micro); center fix at 1354Z at 23.4N, 79.7W with 988 mb central pressure and 90 kt maximum flight-level winds encountered [which reduces to 69 kt surface winds after multiplying by 0.77] (AWS, ATS); Navy radar center fixes at 1630Z, 1840Z, 2240Z, 2305Z, and 2330Z between 23.5-24.7N, 79.4-79.8W (micro). At least seven other flight-level winds between 50-70 kt and four other low pressures between 999-1005 mb between 1315Z-1500Z. “The course turned more to north-northwest as it moved through the Florida Straits on the 17<sup>th</sup>. A reconnaissance plane entered the ‘eye’ at about 1400Z on the 17<sup>th</sup> north of the Cuban coast and found strongest winds about 85 to 90 kt with some gusts to estimated at 100 kt. The minimum pressure in the center at that time was 988 mb, and the ‘eye’ was about 20 miles in diameter” (MWR). “Navy hurricane radar 17/0329Z position 22.2N, 77.8W. Reliable” (micro). “Navy-2: 23.2N, 79.2W at 1130Z. Navy-3: 23.2N, 79.2W at 1230Z. Navy-4: 23.3N, 79.2W at 1333Z. Entered eye 1354Z- north side. 23.6N, 79.7W. 988 mb. Sustained wind 090 degree 90 kt with gusts to 100 kt. Navy 5: 23.5N, 79.5W. Course of eye is 317 degrees at 14 kt. Navy 7: Eye centered 23.6N, 79.5W (radar and land fix). Navy-8: 1630Z position of eye 23.5N, 79.4W. Eye appears to have slowed and intensified. Scope presentation becoming clearer and better defined. Plane position of hurricane at 1830Z is 23.8N, 79.8W. Reliability uncertain because of unclear picture on scope. 1840Z: 23.8N, 79.6W. Key West radar 1900Z: 23.9N, 79.8W. 1915Z: 23.9N, 79.8W. Key West radar 2000Z: 24.0N, 79.7W (pos uncertain). 2015Z: 24.2N, 79.8W. Definite NE track. Increasing speed. 2100Z: 24.3N, 79.4W. Eye poorly defined. Fix average to good. 2200Z: 24.5N, 79.4W. Eye appears to be splitting into two formations. Due to gear reliability, uncertain. 2240Z: Plane radar position 24.6N, 79.5W. Scope presentation average. Eye open to SW. Storm bears 148 degrees, 78 miles [from Miami?]. 2305Z from [Tampa?]:

Position 24.7N, 79.7W. Eye open to SW. 2330Z: Plane radar position 24.7N, 79.8W. Eye completely closed” (micro). “Continuing a curve to the left, it crossed Cuba on the morning of the 17<sup>th</sup>, straightened out on a NNW heading, and passed directly over Miami on the morning of the 18<sup>th</sup>” (AWS). “Hourly reports from Camaguey show a minimum pressure of 989 mb and force 12 wind [hurricane force] at 0130Z. This was the only hour the wind was reported above force 7 [30 kt]. Cayo Paredon Grande off the north coast of Cuba reported winds above force 7 for four hours with a maximum of force 10. Outside of the reconnaissance flight on the morning of October 17<sup>th</sup> which reported 90 kt with gusts to 100 kt there was no indication of the severe intensity of the storm until it reached Miami. Due to the small size of the storm, the automatic weather station in the Florida Straits and the Coast Guard stations along the Keys gave little indication of a severe storm. Before the storm center reached Miami, forecasters were ready to admit that the storm had weakened or had been overestimated by reconnaissance. As the center reached Miami, however, it became apparent that despite its minute size, King packed a terrific punch” (AWS). From Navy Radar flight... “1<sup>st</sup> Navy Radar flight- 17/1130Z: Eye open to south. 1230Z: Eye closed eastern semicircle. West open on scope. Eye diameter 20 miles. 1330Z: Eye open to SW. Diameter 30 miles. 1354Z: Eye circular, well defined, 20 miles in diameter, broken to south. Lowest pressure 988 mb, max sustained wind 90 kt for 5 miles north edge of eye. 65 kt extends 30 miles N of eye. Sustained wind 75 kt for 25 miles on ESE side of eye. Gusts to 100 kt on north side. 1430Z: Course and speed of eye estimated 317 degrees at 14 kt. 1530Z: Eye appears to be curving toward north. 1630Z: Eye appears to have slowed and intensified. Scope presentation becoming clearer and better defined. 2<sup>nd</sup> Navy Radar flight- 1840Z: Scope presentation fairly good. 1915Z: Diameter of eye fluctuating 16-24 miles. 2100: eye poorly defined. 2200Z: Eye appears to be splitting into two formations within 10 degrees of each other. 2240Z: No more indication of split eye, eye open to SW. 2330Z: Diameter of eye completely closed” (AWS). “Cape Canaveral experienced winds above hurricane force while Storm King was still over Cuba. As King approached the area the high weakened and the winds abated” (AWS). “Between the time King left Cuba and arrived at Miami, 26 aircraft fixes on the storm center were received. One was by visual penetration and 25 by AEW radar” (AWS). From the ATS report... “During the night of 16-17 October this storm passed over Cuba in the vicinity of Camaguey. A VX-4 radar plane was dispatched to the hurricane early in the morning of 17 October to be stationed at 10,000 feet. Low-level reconnaissance was made to determine size and extent of storm. 50 kt winds were encountered from Miami to about 25 miles north of the eye when winds of 65 kt were encountered. The wall of the eye was 5 miles wide with 90 kt sustained and gusts to 100 kt on the northern side [at flight level]. Navy four, plain language message: Entered eye 1354Z north side. Position 23.4N, 79.7W. Pressure 988 mb. Max sustained wind 090 degrees 90 kt gust 100 kt. Eye not completely solid to south. Diameter [of eye] 20 miles and circular. Departed eye on the east-southeast side at 1408Z sustained winds of 75 kt backing from 230 degrees to 155 degrees extended outward 25 miles from eye” (ATS).

October 18:

HWM analyzes a low of at most 1000 mb centered near 26.5N, 80.6W. HURDAT lists this as a 75 kt hurricane at 27.0N, 80.8W. The AWS best track lists a 0030Z position at 25.0N, 80.0W with 120 kt max winds and 966 mb central pressure and a 1230Z position

at 27.0N, 81.0W with 100 kt max winds and 970 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 27.3N, 80.5W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near 27.1N, 80.7W. Microfilm analyzes a low of at most 984 mb centered near 27.1N, 80.9W. Ship highlights: 35 kt ENE and 1004 mb at 00Z at 26.3N, 80.1W (COA); 60 kt E and 1001 mb at 18Z at 29.7N, 80.5W (COA); 70 kt E and 1005 mb at 18Z at 29.0N, 80.0W (COA, micro); 65 kt ESE and 1004 mb at 21Z at 29.3N, 79.6W (micro). At least 11 other gales between 35-70 kt and four other low pressures. Land/station highlights: 100 kt NE and 962 mb at 0430Z at Miami WBO (Weather Bureau Office in Downtown Miami- near Miami River and Biscayne Bay) (25.8N, 80.2W) (micro); 957 mb (min p) at 0448Z at Miami WBO (WB advisories, MWR, state climo); 30 kt SE (min wind inside RMW) at Miami WBO (state climo); 70 kt NE (max w/1-min) G 109 kt at 0459Z at Miami Airport (NW 36<sup>th</sup> street- 25.8N, 80.3W) (AWS, MWR, state climo); 960 mb (min p) at 0500Z at Miami Airport (MWR, state climo); 16 kt NW (min wind inside RMW) at Miami Airport (state climo); 955 mb (central pressure) and [presumably calm] around ~05Z at residence of off-duty Weather Bureau employee (Barnes); 106 kt S (max w/1-min) G 130 kt at ~0515-0530Z at WBO Miami (AWS, MWR, climo, state climo, Barnes); 90 kt SW and 968 mb at 0530Z at Miami WBO (micro); 15-20 kt W and 967 mb at 0530Z at Miami Airport (micro); center fix- calm and 962 mb at 0530Z at NAS Miami [Opa Locka?] (state climo); center fix- calm at 07Z at Davie (26.1N, 80.2W) (micro); 92 kt ESE (max w) and 985 mb (min p) around ~0720Z at Bahia Mar, Ft. Lauderdale (26.1N, 80.1W) (micro); 74 kt E (max w/1-min) at 0820Z at Belle Glade Exp. Station (state climo); 60 kt NE and 979 mb at 09Z at Clewiston (26.8N, 80.9W) (micro); 20 kt NNW and 975 mb at 10Z at Clewiston (micro); 975 mb (min p) with 16 kt (min wind inside RMW) at 1006Z at Clewiston (state climo); 70 kt ENE and 998 mb at 10Z at Vero Beach (micro); 63 kt max w/1-min G 74-83 kt at 1125Z at Vero Beach (state climo) 36 kt ESE and 979 mb at 1230Z at Okeechobee (27.2N, 80.8W (micro); 64 kt E (max w/1-min) G 87 kt at 1308Z at Banana River NAS (28.2N, 80.6W) (state climo); center fix at 1616Z near 27.8N, 81.4W (micro); 65 kt NE (max w/1-min) at 17Z at Cape Canaveral (28.4N, 80.6W) (state climo); 55 kt NE G 81 kt and 995 mb at 17Z at Daytona Beach (29.2N, 81.1W) (micro); 40 kt E G 45 kt and 988 mb at 17Z at Orlando (28.6N, 81.4W) (micro); 987 mb (min p) at 1750Z at Orlando WBAS (state climo); center fix- calm around 1800Z-1830Z at Clarcona (28.6N, 81.5W) (micro); Gainesville radar center fixes at 2000Z and 2040Z between 28.9-29.2N, 81.6W (micro); 63 kt E (max w/1-min) at 2306Z [probably around 22Z] at Jacksonville WBAS (30.4N, 81.7W) (AWS, state climo). Several dozen other gales and low pressures. Aircraft highlights: Navy radar center fixes at 0000Z, 0030Z, 0100Z, 0130Z, 0200Z, 0230Z, 0320Z, 0330Z, 0400Z, and 0533Z between 24.8-25.9N, 79.9-80.1W (micro). “When it reached Miami at midnight, the central pressure was 955 mb, and the central calm area was only about 5 miles in diameter. Maximum sustained winds had increased to 122 mph with gusts of about 150 mph. Thus in the period from around 1400Z [on the 17<sup>th</sup> to 0500Z on the 18<sup>th</sup>] (a 15 hour period), there was considerable intensification; central pressure fell 33 mb [in 15 hr] the wind increased greatly, and the central ‘eye’ contracted from 20 miles to 5 miles in diameter. The barograph traces for Miami indicate a small, intense vortex. The [Downtown Miami station and the 36<sup>th</sup> street Airport station] were on the edges of the ‘eye,’ with center midway between them. The principle damage zone [through the greater Miami area] was

only 14 miles wide. In this narrow strip, structural damage was extensive, and it was so sharply outlined that many at first thought the damage was caused by a tornado or a series of them. In a distance of about  $\frac{1}{4}$  to  $\frac{1}{2}$  miles, damage increased from light to heavy, but a careful examination immediately after the storm by experienced meteorologists failed to find evidence of tornadic action. The damage was simply that of violent hurricane winds, the most severe to visit Miami since the great hurricane that devastated the city in 1926. There have been numerous reports of lightning and thunder in hurricane vortices, especially in the tropics, and numerous other instances of thunder in peripheral areas, but this is the first occasion observed in Florida, to this writer's knowledge, of lightning and thunder right near the center where wind velocities were 95 to 125 mph. There were several brilliant lightning flashes with thunder during the height of the storm, observed by the writer, and one discharge occurred very near the Weather Bureau Office with a sharp crack of thunder heard about the deafening scream of the wind, only a few minutes before the lull occurred. After leaving the Miami area, the center continued a north-northwesterly course, crossed over Lake Okeechobee, and continued through eastern Florida into Georgia. Hurricane force winds in squalls extended nearly to the Georgia line, especially along the Atlantic coast, and considerable damage resulted in all the eastern counties of Florida. Very heavy squalls extended out a considerable distance northeast of the barometric center after it reached the middle peninsula. By this time, however, the center was beginning to spread out and break up, and winds were weakening on the south and west sides" (MWR). Regarding the damage and casualties... "This small, but violent, hurricane passed directly over the city of Miami about midnight of the October 17 and caused property damage that amounted to an estimated \$15,000,000 in the city and its vicinity. Total damage for Florida in crops and property was about \$27,750,000, which, when increased by the \$250,000 damage done in Georgia, brings the grand total for this hurricane to \$28,000,000. Three persons were killed in Florida and one in Georgia, with injuries to 199 others, 16 of whom were injured seriously" (MWR). "0000Z plane radar position of center: 24.8N, 79.9W. Eye well defined with center 30 mi from Key Largo" (micro). "Radar positions 0030Z: 24.8N, 79.9W. 0100Z: 24.9N, 79.9W. Observed definite north movement. Eye well defined 29 miles off Keys. 0130Z: 25.0N, 79.9W. Presentation good. Eye open in SW quadrant. Center 25 miles off beach. 0200Z: 25.1N, 79.9W. Eye well defined. Closed all quadrants. Center of eye 20 miles off Keys. 0230Z: 25.2N, 79.9W. 0300Z: 25.3N, 78.0W. Leading edge of eye 4 miles from beach. 0320Z: 25.5N, 80.0W. 0330Z: 25.5N, 80.0W. Leading edge of eye 3 miles south of Cape Florida. 0400Z: 25.6N, 80.1W. Diameter of eye 17 mi. Open S. NW edge 2 miles south of Miami. 0533Z: 25.9N, 80.1W. Course 349 degrees. Speed 12 kt. Eye poorly defined. Center on coastline. Eye very small" (micro). "Lowest pressure at Bahia Mar, Ft. Lauderdale 985 mb at about 0720Z. Highest winds 80 kt from the ESE. At 0735Z, SSE 57-59 kt. Complete lull at Davie at 0700Z. From the WB advisories... "The center of the hurricane passed between the downtown weather bureau office and the 36<sup>th</sup> street Airport office here in Miami between midnight and 12:15 am. Highest sustained wind at the city office was 106 mph and the Miami Weather Bureau Office at the Airport had gusts of 125 mph. Lowest pressure observed at the downtown office was 28.25 inches (957 mb)" (WB advisories). From the WB advisory issued at 1330Z... "Late reports from around the Lake Okeechobee area indicate the hurricane center passed between Belle Glade and Clewiston

and about over the center of the lake. The center is now located between Lake Okeechobee and Lake Istokpoga still moving towards the NNW at about 12 to 14 mph. Winds of 50 to 60 with gusts of 70 to as much as 90 mph were reported from some of the stations on Lake Okeechobee” (WB advisories). “At 1616Z highway patrol reported lull with sun shining east of Lake Wales at intersection of route 630 and 60” (micro). “DAB evacuated 1704Z, ORL at 1708Z” (micro). “Calm and lull at Clarcona lasted for about 39 minutes” (micro). “Radar fix- Gainesville 2000Z: 28.9N, 81.6W. Barometer at Gainesville 997 mb. Wind NE. 2040Z Gainesville radar fixed storm over Aster Park east of Ocala National Forest. Both fixes were poorly defined” (micro). “At the [Miami] Weather Bureau city office which was closest to the center and to the right of the track the barometer was below 29.00 inches for approximately an hour and thirty minutes. During that time the barometer dropped to 28.32 inches and rose again. The wind instrument was a cup anemometer. In only one hour did more than 75 miles of wind pass the station. Five minute maximums were of hurricane force only two hours. The one-minute maximum was 122 mph and top gusts were estimated at 150 mph. At the airport station on the left side of the track a gust of 125 mph was recorded. Nearly all stations around Lake Okeechobee and along the east coast as far north as Jacksonville reported winds of hurricane force. Jacksonville itself which has never experienced hurricane winds due to a tropical cyclone recorded a one-minute maximum of 72 mph with gusts estimated at 82 mph. The size of the eye of King appears to have decreased considerably as it approached Florida. Over Miami, it passed between the Weather Bureau City and Airport stations which are approximately eight miles apart. From this and other data the calm eye was computed to be approximately five miles in diameter. Less than 18 hours previously, the diameter had been determined as 20 miles by visual observation and 30 miles by radar. As can be seen from the flight summaries, later radar reports indicated the eye to be fluctuating between 7 or 17 miles in diameter. The extent of destructive winds was also erratic. Chief Forecaster Grady Norton personally inspected the storm area and reported that the path of principal destruction was only 7-10 miles wide through the greater Miami area and northward to west Ft. Lauderdale. So sharply defined was this principal damage zone that he passed from the severe damage into the minor damage area within half a mile. The strong winds on the east coast farther north were associated with a band of strong winds which extended across central Florida for several days before the storm arrived” (AWS). “It then traversed the entire Florida peninsula and in Georgia again curved to the left and crossed southern Alabama” (AWS). “In Florida, it caused damages estimated at \$27,750,000, killed three people and injured 199. In Georgia one person was killed and damages were estimated at \$250,000” (AWS). “It is interesting to note that King is the first recorded hurricane to enter the east coast of Florida during the month of October” (AWS). Continued from the 2<sup>nd</sup> Navy Radar flight on the 17<sup>th</sup>... “18/0000Z: Eye well defined. 0230Z: Scope presentation good. Eye open SW quadrant. Diameter of eye 7 miles. 0400Z: Diameter of eye 17 miles, open to south” (AWS). “King – Oct. 18, 1950 – 955 mb landfall pressure based upon 955 mb observed at Miami, FL – RMW 6 nm – Speed 6 kt – Landfall point 26.1N, 80.1W” (Ho et al. 1987). “Tropical Cyclones in Florida – Oct. 17-18 – Peninsula – Major – Miami bar. 28.20 in., wind 122 mph” (“Major” is equivalent to Saffir-Simpson Hurricane Scale 2 or 3; Dunn and Miller 1960). “King – 1014 mb [environmental pressure at landfall] – 98 kt

[estimated max 1-min wind at landfall]” (Schwerdt et al. 1979). “King – FL, SE – 955 mb” (Jarrell et al. 1992).

October 19:

HWM analyzes a tropical storm [King] of at most 1000 mb centered near 31.6N, 84.4W. HWM also analyzes another tropical storm [Love] of at most 1000 mb centered near 25.7N, 91.4W with a single 1005 mb isobar encircling both tropical cyclones. HURDAT lists this as a 25 kt tropical depression at 32.1N, 84.6W. The AWS best track lists a 0030Z position at 30.0N, 82.7W with 60 kt max winds and 990 mb central pressure and a 1230Z position at 31.6N, 84.3W with 35 kt max winds and 996 mb pressure. The MWR tracks of centers of cyclones shows a 12Z position near 32.4N, 83.7W with a 998 mb pressure and the MWR post-season track map shows a 12Z position near 32.1N, 84.4W. Microfilm analyzes a low of at most 999 mb centered near 31.7N, 84.5W. Ship highlights: 70 kt SSE and 1000 mb at 00Z at 30.1N, 80.6W (COA). At least one other relevant gale and one other low pressure. Land/station highlights: 40 kt ESE and 997 mb at 00Z at Jacksonville (micro); 15 kt S and 993 mb at 00Z at Ocala (micro); 992 mb (uncorrected) (min p) at 00Z at Raiford, FL (30.1N, 82.2W (state climo); 40 kt NNE and 999 mb at 06Z at 31.5N, 84.1W (micro); 30 kt SSE and 1000 mb at 10Z at Valdosta, GA (micro); 25 kt ENE and 1001 mb at 12Z at 32.2N, 84.9W (micro); 20 kt SE and 1004 mb at 18Z at 32.8N, 83.6W (micro). “By the 19<sup>th</sup>, the 300 mb trough in the Gulf had expanded to form a large low which now included both King and Love and caused both storms to follow the Fujiwhara pattern” (AWS).

October 20:

HWM no longer analyzes a closed low associated with King on this day. A cold front is plotted extending from 38N, 86W to 39N, 78W. Tropical Storm Love is shown by HWM to be centered near 27N, 87W. HURDAT no longer lists King on this day. The MWR tracks of centers of cyclones shows a 12Z position for King near 33.3N, 87.1W with a 1000 mb pressure. Microfilm at 12Z still analyzes a closed low associated with King of at most 1002 mb centered near 33.1N, 87.8W. Microfilm also shows the front as well as Love, similar to the HWM analysis in that sense. Land/station highlights (through 06Z only): 5 kt W and 1001 mb at 00Z at 32.4N, 86.3W (micro); 10 kt SW and 1003 mb at 06Z 32.4N, 86.3W. Thirteen other low pressures between 1003-1005 mb.

On 11 and 12 October, an elongated trough of lower than normal pressure was located over Central America. Although HURDAT starts this at 06Z on the 13<sup>th</sup> as a 35 kt tropical storm just off the coast of Honduras, there is not much conclusive evidence of a TC until 12Z on the 14<sup>th</sup>. There is also not enough evidence to remove a portion of the HURDAT track, so no changes are made to the timing of genesis. However, there are enough observations close enough to the analyzed position of the center to lower the intensity to tropical depression status from 06Z on the 13<sup>th</sup> through 12Z on the 14<sup>th</sup>, so King is analyzed to have become a tropical storm 30 hours later than originally. Also, the forward speed from the 13<sup>th</sup> to the 14<sup>th</sup> is analyzed to be much slower so that by the 14<sup>th</sup> at 18Z, the analyzed position is lagging behind the HURDAT position by 1.5 degrees. On the 14<sup>th</sup> at 18Z, the analyzed position is 16.3N, 83.3W, and the cyclone was moving very slowly towards the east-northeast. The lowest pressures from surface observations

on the 14<sup>th</sup> were 1005 mb, and on the 15<sup>th</sup> at 06Z, a ship measured 1001 mb 20 nmi from the analyzed center position. However, no gales had been observed from surface observation platforms by the time the first aircraft center fix was performed at 1915Z on the 15<sup>th</sup>. During the 15<sup>th</sup> and 16<sup>th</sup>, King was moving northeastward passing between Jamaica and the Cayman Islands. It approached the southern coast of eastern Cuba by late on the 16<sup>th</sup>. At 1915Z on the 15<sup>th</sup>, the aircraft measured a central pressure of 992 mb, measured maximum winds of 45 kt, and reported that the center was very small but poorly defined. A 992 mb central pressure is added into HURDAT at 18Z on the 15<sup>th</sup>. A central pressure of 992 mb yields 61 kt according to the Brown et al. southern pressure-wind relationship. The environmental pressure was low and the ROCI was very large. 55 kt is chosen for the intensity at 18Z on the 15<sup>th</sup> (down from 60 kt originally). From 06Z on the 13<sup>th</sup> until 18Z on the 15<sup>th</sup>, the HURDAT intensity is reduced by 5 to 10 kt at each 6-hourly point. On the 16<sup>th</sup> at 00Z, the first gales from surface observations were recorded. Point Negrito on the western tip of Jamaica recorded 50 kt with 1000 mb at 00Z on the 16<sup>th</sup>. The center was 60 nmi away at that time. At 1445Z on the 16<sup>th</sup>, aircraft measured a central pressure of 985 mb, and this value is added into HURDAT at 12Z. A central pressure of 985 mb yields 71 kt according to the southern pressure-wind relationship. The 95 kt maximum flight-level wind encountered around 500-600 ft reduces to about 73 to 75 kt at the surface depending on whether a factor of 0.77 or 0.79 is used. The RMW is about half of the climatological RMW size. 75 kt is chosen for 12Z and 80 kt is chosen for 18Z on the 16<sup>th</sup> (down from 85 and 95 kt respectively). The new track, which had been lagging behind the original track due to the slower analyzed speed on the 13<sup>th</sup> and 14<sup>th</sup>, caught up with the original track by 18Z on 15 October at 17.7N, 80.0W. On the 16<sup>th</sup>, the largest track change was only three-tenths of a degree, which is in very good agreement with the aircraft center fixes. King is analyzed to have made landfall in Cuba at 22Z on 16 October at 20.9N, 78.3W as an 80 kt hurricane. This analysis is supported by the assessment from Perez et al. of a Category 1 in Cuba. King passed just west of Camaguey around 0130Z on the 17<sup>th</sup> and emerged over water north of Cuba around 06Z. Runs of the Kaplan and DeMaria inland decay model yield 65 kt for 00Z on the 17<sup>th</sup> and 62 kt for 0130Z on the 17<sup>th</sup>. Camaguey recorded a minimum pressure of 989 mb simultaneously with 60 kt winds around 0130Z, which means the central pressure at landfall was likely lower than 982 mb and might have been even lower than that. It is possible that King deepened to a Category 2 prior to landfall but there are no concrete observations to support that. If the assumption is made that the central pressure was less than or equal to 982 mb when King passed Camaguey, that pressure yields winds of at least 74 kt (over water exposure). It is analyzed that King weakened to 75 kt by 00Z on the 17<sup>th</sup> and to 65 kt by 06Z on the 17<sup>th</sup> (down from 100 and 105 kt respectively at these times). The HURDAT intensities on the 17<sup>th</sup> as well as the central pressure of 955 mb in HURDAT at 06Z on the 17<sup>th</sup> were likely placed in the wrong 6-hourly time slots during the original HURDAT compilation. The reanalyzed track over Cuba is a few tenths of a degree east of the previous HURDAT track over Cuba. If the previous HURDAT track was correct, a category 2 would have had to been analyzed for Cuban landfall. The track was shifted eastward closer to the city of Camaguey. After King emerged over water north of Cuba, it made a turn to the north-northwest and headed toward Miami. At 09Z on the 17<sup>th</sup>, a ship recorded 65 kt with 999 mb, and at 1354Z, aircraft measured a central pressure of 988 mb, and this value is added into HURDAT at

12Z on the 17<sup>th</sup>. A central pressure of 988 mb yields 67 kt according to the southern pressure-wind relationship. The maximum flight-level winds encountered of 90 kt reduces to 69 kt surface winds using a reduction factor of 0.77. 70 kt is chosen for the 12Z intensity (down from 105 kt originally). Numerous center fixes were obtained by the Navy radar aircraft between 1130Z on the 17<sup>th</sup> all the way until landfall near Miami, which occurred on the 18<sup>th</sup> between 04Z – 05Z. At 0230Z on the 18<sup>th</sup>, the aircraft reported King at 25.2N, 79.9W with an eye radius of 3.5 nautical miles. The eye radius had contracted from a reported 8 to 12 nautical miles around 1915Z on the 17<sup>th</sup>.

The center of Hurricane King made its first and only Florida landfall near Grove Isle (located about 2 miles south-southwest of downtown Miami) around 0430Z on the 18<sup>th</sup>. In more general terms, landfall is analyzed to have occurred at 05Z at 25.7N, 80.2W. King moved from south-southeast to north-northwest on its approach. Therefore, the center of King passed between Elliot Key and Key Biscayne and moved north-northwestward through Biscayne Bay before making landfall near Coconut Grove and Vizcaya. King was a tiny storm, and the analyzed landfall RMW is 5 nmi, but the RMW may have possibly been as tiny as 3 nmi at landfall. The MWR post-season article shows that the radius of the calm eye was 2.6 miles, and the width of the swath of significant damage caused by this hurricane was only 14 miles wide (confirmed by meteorologists conducting post-storm surveys). King was compared to a “large tornado.” The eye was so tiny that it passed in between the Weather Bureau office in Downtown Miami (located near the location of present day Bayside, American Airlines Arena, and the Miami Herald Building... or near Biscayne Boulevard and I-395) and the 36<sup>th</sup> Street Airport station (located in the vicinity of NW 36<sup>th</sup> Street and Red Road). At the Downtown Miami Weather Bureau Office, a 5-minute maximum wind of 84 kt from the NE was recorded at 0440Z. The minimum pressure of 957 mb at that station was recorded about eight minutes later at 0448Z. The Downtown Miami Weather Bureau Office experienced the inside of the RMW, but not the calm eye. The wind decreased briefly to a minimum of 30 kt inside the RMW. The maximum recorded 1-minute wind at the Downtown Weather Bureau office was 106 kt from the south [likely sometime between 0515 and 0530Z after the short lull] and gusts were estimated as high as 130 kt. At the Miami Airport, the maximum 1-minute wind reported was 70 kt NNE-NE at 0459Z. Gusts were measured as high as 109 kt at the Airport station. The minimum pressure at the Airport station was 960 mb at 0500Z. The RMW was experienced at the Airport station, but not the calm eye. The wind decreased to a minimum of 16 kt NW inside the RMW (likely just before 0530Z). Although both stations were inside the RMW for a few brief moments, neither station reported the calm eye. A central pressure of 955 mb was recorded at the residence of an off-duty Miami Weather Bureau Employee (exact location and time both unknown). The analyzed landfall central pressure is 955 mb, and this value is added into HURDAT at 06Z on the 18<sup>th</sup>. A central pressure of 955 mb yields 108 and 105 kt respectively according to the intensifying set of the pressure wind relationship for south and north of 25N respectively. The central pressure of King deepened by 33 mb during the 14 hr prior to landfall at Miami. The forward speed of 11 kt is average, the ROCI of 200 nmi is average, but the OCI of 1005 mb is very low. However, the low OCI should be discounted in this case, because Tropical Storm Love was forming just to the west in close proximity to Hurricane King, and no isobars greater

than 1005 could be closed off around King. The pressure gradient on the northeast side of King was very strong, and there was a very strong high located over the Mid-Atlantic and Northeast coasts of the United States (the pressure at Cape Hatteras was 1027 mb as King approached Miami). The analyzed RMW is 5 nmi, which is tiny compared to the climatological RMW of 17 nmi. Landsea et al. (2008) states that for landfalling U.S. tropical storms and hurricanes for which the RMW is significantly smaller (>50%) than the climatological value, 10 kt should be added to the pressure-wind relationship. A 115 kt intensity is chosen for the 05Z landfall near Miami. The revised intensities in HURDAT leading up to landfall from 12Z on the 17<sup>th</sup> through 06Z on the 18<sup>th</sup> are 70, 90, 115, and 115 kt (originally 105, 100, 95, and 90 kt). The Category 3 impact in HURDAT for southeast Florida is revised upwards to a Category 4 impact. No hurricane impact is analyzed for southwest Florida, but Category 1 winds likely came very close to southwest Florida as King moved north-northwestward across Lake Okeechobee. After King passed through the heart of the Miami Metro area, the eye was observed at Davie and 80 kt winds occurred in Fort Lauderdale around 07Z on the 18<sup>th</sup>. King then passed over Lake Okeechobee between 10Z – 12Z. The center passed over Clarcona, a suburb of Orlando, FL, around 18Z. The land-based radar at Gainesville, FL last located the center at 2040Z on the 18<sup>th</sup> over Aster Park near 29.2N, 81.6W. King tracked into southwestern Georgia on the 19<sup>th</sup> and curved slightly from north-northwest to northwest. King dissipated over Alabama on the 20<sup>th</sup>. The largest track change on the 18<sup>th</sup> is one-tenth of a degree and on the 19<sup>th</sup> three-tenths of a degree. Runs of the Kaplan and DeMaria inland decay model after the Miami landfall yield 95 kt for 06Z on the 18<sup>th</sup>, 68 kt for 12Z, 51 kt for 18Z, 39 kt for 00Z on the 19<sup>th</sup>, and 32 kt for 06Z. The highest wind observation within 2 hr of synoptic times are: 106 kt at 06Z on the 18<sup>th</sup>, 70 kt at 12Z, 70 kt at 18Z, 70 kt at 00Z on the 19<sup>th</sup>, and 40 kt at 06Z. Revised intensities in HURDAT from 06Z on the 18<sup>th</sup> through 06Z on the 19<sup>th</sup> are: 115, 80, 70, 65, and 45 kt (90, 75, 65, 35, and 25 kt originally). King is analyzed to have remained a hurricane 6 hours later than in HURDAT originally. A Category 1 impact for northeast Florida is added into HURDAT. The analysis indicates that King did not weaken to a tropical storm until after it entered Georgia, although no hurricane force winds were felt in Georgia. The following central pressures are added into HURDAT between 12Z on the 18<sup>th</sup> and 12Z on the 19<sup>th</sup> based on sufficient observational coverage over land: 975, 983, 989, 992, and 996 mb. The last point listed in HURDAT for King is at 12Z on the 19<sup>th</sup> as a 25 kt tropical depression over southwestern Georgia. It is analyzed that King was still a 35 kt tropical storm at that time and that dissipation did not occur until 18 hours later than shown in HURDAT. King is analyzed to have weakened to a tropical depression by 18Z on the 19<sup>th</sup> (12 hours later than originally). The following central pressure values are added into HURDAT between 18Z on the 19<sup>th</sup> and 06Z on the 20<sup>th</sup>: 999, 1000, and 1002 mb. King dissipated after 06Z on the 20<sup>th</sup> with a final point of 32.9N, 86.5W as a 20 kt tropical depression at 06Z.

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Some quotes from the Air Weather Service post-season report and Monthly Weather Review...

“The hurricane of October 1950 [King] will be remembered long after the rest of the storms of that year have been forgotten. To Miamians, it will be remembered as the greatest storm since 1926. To the forecasters of the Air Force Hurricane Office it will be remembered as the smallest severe storm of their experience” (AWS).

“The warning service was excellent and provided ample time for all possible hurricane preparation. This doubtless saved many lives and much property. A hurricane alert was ordered for south Florida 36 hours ahead of the storm, and hurricane warnings were ordered 18 hours ahead of the hurricane winds by the Miami Hurricane Center. [An “alert” back then is synonymous with a hurricane watch today.] Despite the good warning service, many people remained complacent and failed to take adequate precautions. This resulted in increased damage when glass windows blew out, and the interiors and contents of buildings were damaged by rainwater” (MWR).

## 1950 Storm 12

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35415 10/17/1950 M= 8 12 SNBR= 783 NOT NAMED XING=0
35420 10/17* 0 0 0 0*220 420 35 0*225 427 35 0*229 433 35 0*
35425 10/18*234 438 35 0*242 445 40 0*249 448 40 0*254 449 40 0*
35430 10/19*259 448 45 0*265 446 45 0*272 439 45 0*282 430 50 0*
35435 10/20*292 420 50 0*301 410 55 0*308 400 55 0*314 388 55 0*
35440 10/21*320 376 60 0*324 368 60 0*330 360 60 0*346 346 60 0*
35440 10/21*322 370 60 0*333 348 60 0*345 330 60 0*358 318 60 0*
      *** ***          *** ***          *** ***          *** ***

35445 10/22*364 329 60 0*381 318 55 0*396 292 55 0*395 274 50 0*
35445 10/22*368 308 60 0*379 298 55 0*392 287 55 0*393 274 50 0*
      *** ***          *** ***          *** ***          ***

35450 10/23*386 259 50 0*378 249 45 0*370 240 40 0*362 231 40 0*
35450 10/23*386 261 50 0*378 249 45 0*370 240 40 0*362 231 40 0*
      ***

35455 10/24*354 224 35 0*347 220 30 0*340 217 30 0*316 226 25 0*
35455 10/24*354 224 35 0*345 220 30 0*334 217 30 0*321 217 25 0*
      ***          ***          ***

35460 TS

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Major track changes are analyzed for this tropical storm that moved through the Azores. Evidence for these alterations comes from the Historical Weather Map series and the COADS ships database.

### October 17:

HWM analyzes a spot low near 22.3N, 47.8W. HURDAT lists this as a 35 kt tropical storm at 22.5N, 42.7W. No gales or low pressures.

### October 18:

HWM analyzes a closed low of at most 1010 mb centered near 26.1N, 44.8W. HURDAT lists this as a 40 kt tropical storm at 24.9N, 44.8W. No gales or low pressures.

### October 19:

HWM analyzes a low of at most 1005 mb centered near 27.6N, 43.8W. HURDAT lists this as a 45 kt tropical storm at 27.2N, 43.9W. Ship highlights: 25 kt NE and 1004 mb at 18Z at 28.8N, 44.4W (COA).

October 20:

HWM analyzes a low of at most 1005 mb centered near 30.8N, 38.8W with a dissipating stationary front analyzed from 37N, 37W to 41N, 30W. HURDAT lists this as a 55 kt tropical storm at 30.8N, 40.0W. Ship highlights: 10 kt E and 1004 mb at 12Z at 31.9N, 38.6W (COA, HWM); 15 kt NNE and 1004 mb at 18Z at 31.6N, 40.3W (COA).

October 21:

HWM analyzes a low of at most 1005 mb centered near 33.2N, 34.8W. HURDAT lists this as a 60 kt tropical storm at 33.0N, 36.0W. Ship highlights: 50 kt SE and 1006 mb at 14Z at 36.0N, 30.0W (COA); 45 kt S and 1002 mb at 18Z at 36.0N, 30.0W (COA); 15 kt W and 1004 mb at 22Z at 36.0N, 31.0W (COA).

October 22:

HWM analyzes a low of at most 1000 mb centered near 39.7N, 29.7W. A large, occluded, extratropical cyclone is centered up near 57N, 45W. An occluded front extends from the extratropical cyclone to 57N, 35W to 53N, 33W to 49N, 34W to a triple point near 45N, 36W. A warm front extends southward from this triple point to 42N, 37W and a cold front extends from the triple point to 42N, 41W to 40N, 44W to beyond 39N, 48W. Therefore, HWM analyzes the nearest front to be located about 350 n mi northwest of the feature of interest. HURDAT lists this as a 55 kt tropical storm at 39.6N, 29.2W. Ship highlights: 25 kt S and 1001 mb at 00Z at 36.7N, 31.0W (COA); 45 kt NNW and 1003 mb at 02Z at 36.0N, 31.0W (COA); 35 kt ESE and 1003 mb at 12Z at 40.9N, 28.8W (HWM); 35 kt N and 1007 mb at 18Z at 38.5N, 31.2W (COA). Two other gales and three other low pressures. Land/station highlights: 35 kt NNW and 1003 mb at 12Z at 39.9N, 31.4W (Azores) (HWM); 25 kt SSE and 1003 mb at 12Z at 38.8N, 27.3W (Azores) (HWM).

October 23:

HWM analyzes a closed low of at most 1005 mb centered near 35.5N, 23.4W with an occluded front plotted from 51N, 23W, becoming a dissipating occluded front near 46N, 26W, becoming a cold front near 41N, 29W, continuing to 39N, 30W to 37N, 33W to 36N, 36W, meaning that the front is plotted about 350 n mi northwest of the center of the cyclone of interest. HURDAT lists this as a 40 kt tropical storm at 37.0N, 24.0W. Ship highlights: 35 kt NW and 1009 mb at 06Z at 38.9N, 29.3W (COA); 30 kt W and 1004 mb at 06Z at 36.4N, 26.1W (COA); 25 kt SSE and 1004 mb at 18Z at 35.7N, 22.0W (COA). One other low pressure. Land/station highlights: 15 kt NE and 1005 mb at 12Z at 27.0N, 25.1W (Azores) (HWM).

October 24:

HWM analyzes a closed low of at most 1010 mb centered near 34.7N, 20.5W with a dissipating cold front extending from near the low (36N, 19W), to 33N, 20W to 30N,

22W to 28N, 28W to 28N, 32W to 30N, 36W to 34N, 39W. HURDAT lists this as a 30 kt tropical depression at 34.0N, 21.7W. No gales or low pressures.

The 12<sup>th</sup> tropical storm listed in the original HURDAT for 1950 occurred in the eastern Atlantic from 17 – 24 October. From the 16<sup>th</sup> to 18<sup>th</sup>, there are no observations close to the center and there is no definite evidence of a closed circulation. By the 19<sup>th</sup>, observations indicate the strong likelihood of a compact, closed TC-like vortex near the HURDAT position of 27.2N, 43.9W. No changes can be made to the timing, position, or intensity of the genesis time listed in HURDAT. The first low pressure from a ship was a 1004 mb pressure recorded at 18Z on the 19<sup>th</sup>, but wind speeds at the time were only reported as high as 30 kt. Regardless, since the 1004 mb ship was not a central pressure, the intensity at 18Z on the 19<sup>th</sup> was likely in excess of 40 kt. The 50 kt intensity listed in HURDAT is not changed, and the position is not changed either. In fact, no track or intensity changes are made to HURDAT from the 17<sup>th</sup> through the 20<sup>th</sup>. On the 17<sup>th</sup>, this cyclone moved northwestward. It recurved on the 18<sup>th</sup> near 25N, 40W, and moved northeastward until it was in the vicinity of the Azores on the 22<sup>nd</sup>. On the 21<sup>st</sup>, observations from ships indicate that the HURDAT position is too far southwest, and major track changes are analyzed from 06Z to 18Z on the 21<sup>st</sup>. The largest track change for the lifetime of this cyclone was made at 12Z on the 21<sup>st</sup>. The reanalyzed position is 34.5N, 33.0W (33.0N, 36.0W originally). A ship observation of 50 kt with 1006 mb was recorded at 14Z on the 21<sup>st</sup>, and 45 kt with 1002 mb occurred at 18Z. The 50 kt observation was the highest wind observation for this cyclone. The lowest observed pressure during the lifetime of this cyclone was 1001 mb at 00Z on the 22<sup>nd</sup> which occurred simultaneously with a 25 kt wind. The peak intensity of 60 kt listed in HURDAT is unchanged. In fact, no intensity changes are made for the entire lifetime of this cyclone. On the 22<sup>nd</sup>, the cyclone turned eastward and then southeastward. It took a path very close to the Azores Islands, first passing west of the islands, then north, and then east of the islands on a southeastward course. After 06Z on the 22<sup>nd</sup>, only very minor track changes are analyzed at 12 and 18Z on the 22<sup>nd</sup>. No track changes are analyzed for the 23<sup>rd</sup> as the cyclone was moving southeastward. On 24 October, this cyclone turned towards the south and weakened to a tropical depression. The last 6 hours in HURDAT contain an unrealistic acceleration from 12 to 18Z on the 24<sup>th</sup>, and the track is adjusted slightly to allow for a more realistic speed. The 25<sup>th</sup> was searched, but no closed circulation is evident due to sparse data coverage, and no changes are made to the timing of dissipation. The circulation was large during some of the days, and this may have been classified as a subtropical cyclone using modern designation techniques.

### 1950 Storm 13 (Love)

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35465 10/18/1950 M= 4 13 SNBR= 784 LOVE          XING=1          L
35465 10/18/1950 M= 5 13 SNBR= 784 LOVE          XING=1          *
      *
35470 10/18*275 892 35    0*275 908 65    0*270 919 70    0*267 921 75    0*
35470 10/18*  0  0  0    0*  0  0  0    0*267 910 60    0*267 913 60    0*
      *** **  **          *** **  **          *** **  **
35475 10/19*265 922 75    0*263 923 75    0*261 922 80    0*254 911 80    0*
35475 10/19*266 915 60    0*264 916 60    0*260 916 60    990*256 910 65    990*

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35480 10/20*253 894 80    0*257 882 75    0*261 870 75    0*265 861 70    0*
35480 10/20*254 896 70    987*257 883 70    0*260 873 70    0*264 865 70    991*
*** ** **      *** ** **      *** ** **      *** ** **      ***
35485 10/21*271 852 70    0*282 839 60    0*298 830 35    0*301 831 30    0*
35485 10/21*271 852 70    0*285 840 60    0*298 832 45    0*304 827 30    0*
*** ** **      *** ** **      *** ** **      *** ** **      ***

(The 22nd is new to HURDAT.)
35485 10/22*310 822 30    0*316 818 30    0*323 814 30    0E330 812 30    0*

35490 HR

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#### U.S. Landfall:

10/21/1950 – 10Z – 29.5N, 83.4W – 60 kt

Minor track changes and major intensity changes are analyzed for this hurricane. A major change is made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, National Monthly Climatological Data Summaries from NCDC, NHC microfilm of synoptic weather maps, U.S. Air Weather Service (post-season report), U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Connor (1956).

#### October 17:

HWM analyzes a trough extending west from King with some curvature in the 1005 mb isobar around 24-25N, 85-88W. HURDAT does not yet list a system on this day. Microfilm analyzes a spot low near 25N, 86.5W. Ship highlights: 45 kt NE and 1006 mb at 18Z at 27.4N, 88.5W (COA, micro). At least five other gales of 35-45 kt.

#### October 18:

HWM indicates a trough extending from King (which is analyzed to be centered near 26.5N, 80.6W) extending to the general locations of 25N, 82W to 24N, 85W to 26N, 88W to 28N, 90W and indicating something might be forming in the vicinity of 25-28N, 86-91W. HURDAT lists a 70 kt hurricane at 27.0N, 91.9W. The MWR tracks of centers of cyclones first shows a position at 06Z at 26.2N, 89W, and it shows a 12Z position near 27.0N, 89.3W with a 1000 mb pressure. Microfilm analyzes a hurricane of at most 999 mb centered near 27.0N, 90.9W. Ship highlights: 60 kt NE and 1009 mb at 00Z at 28.2N, 89.4W (COA); 25 kt N and 1001 mb at 12Z at 26.5N, 91.8W (COA). At least one other gale of 35 kt and 14 other low pressures between 1000-1005 mb. Aircraft highlights: 35 kt N (40 kt NNE at flight-level of 800 ft) and 998 mb at 1830Z at 27.7N, 91.5W (ATS); 30 kt NE (32 kt ENE at flight-level of 600 ft) and 996 mb (min pressure encountered by aircraft during flight) at 1845Z at 27.1N, 91.1W (ATS, micro). At least two other surface gales, two other flight-level gales, and five other low pressures. “[Love] began forming in the Gulf of Mexico south of the Louisiana coast at the time the severe hurricane was moving northward through Florida on the 18<sup>th</sup>, and in some respects was an ‘offshoot’ of it. As the Florida hurricane was moving north-northwestward from the Caribbean Sea, an elongation of low pressure extended ahead of it over Florida. As the hurricane progressed, this pressure trough moved northwest and west, with a tendency to move counter-clockwise around the hurricane. On the 18<sup>th</sup>, it develop a center of

circulation of its own south of the Louisiana coast” (MWR). “Position [of plane] 27.8N, 91.7W at 1715Z. Altitude 7500 ft. Wind north 50 kt. Tops of clouds 7000 ft. 180 mi south of New Orleans- thunderstorms over area 60 by 30 miles” (micro). From aircraft flight... “18/1900Z: Found definite characteristics of an unstable easterly wave with closed circulation probably to south, could not be confirmed due to insufficient fuel. Observed surface pressure of 996 mbs and wind from 20 degrees at 60 kt in squall” (AWS). From the ATS report... “This was the first flight into a suspicious area in the Gulf of Mexico south of New Orleans. The flight departed Miami and proceeded to the assigned area, but found that the suspicious area was still in the development stages and over 100 miles farther south than anticipated. The results of the flight showed definite characteristics of an unstable easterly wave with a closed circulation probable on the southern end of the frontal zone. However, this closed circulation could not be confirmed by this flight due to insufficient fuel” (ATS).

October 19:

HWM analyzes a tropical storm of at most 1000 mb centered near 25.7N, 91.4W and HWM analyzes another tropical storm [King] of at most 1000 mb near 31.6N, 84.4W. HWM analyzes both tropical storms to be located within a single 1005 mb contour. HURDAT lists Love as an 80 kt hurricane at 26.1N, 92.2W. The AWS best track lists a 0030Z position at 27.0N, 91.5W with 60 kt max winds and 995 mb central pressure and a 1230Z position at 26.2N, 92.0W with 60 kt max winds and 990 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 25.6N, 91.6W with a 990 mb pressure. The MWR post-season track map shows a 12Z position near 26.2N, 91.3W. Microfilm analyzes a low of at most 990 mb centered near 26.0N, 91.8W. Ship highlights: 35 kt NNE and 1007 mb at 06Z at 29.0N, 93.2W (micro); 55 kt ENE and 1002 mb at 17Z at 27.7N, 90.0W (micro); 35 kt WSW and 999 mb at 18Z at 25.3N, 91.3W (micro). At least two other gales of 35 kt and 12 other low pressures between 1000-1005 mb. Aircraft highlights: Navy center fix at 1329Z at 25.7N, 91.5W with 990 mb central pressure and maximum winds encountered of 48 kt (AWS, ATS); center fix at 1921Z at 25.8N, 90.7W with 990 mb central pressure and 60 kt maximum winds (AWS, ATS). “This center continued its counter-clockwise movement and swung down into the central Gulf on the 19<sup>th</sup> and increased to hurricane force” (MWR). “Navy six center 1232Z 25.8N, 91.5W. Center poorly defined and 30 mi in diameter. Lowest pressure 999 mb. Max wind west side 341 degrees 48 kt. Course flown on east side- max wind 40 kt. Navy eight: Storm center estimated 25.8N, 90.7W at 1921Z. Diameter 10 miles. Semicircular squalls. Max wind 60 kt. Lowest pressure 990” (micro). From aircraft flight... “19/1329Z: Center poorly defined approximately 30 miles diameter. Radar shows eastern semicircle closed, western semicircle scattered squalls. Min pressure 990 mbs. Max wind on west side 48 kt, east side 40 kt” (AWS). From next aircraft flight... “19/1921Z: The eye was 10-15 miles in diameter and winds of 50-60 kt extend 20-25 miles in east and south quadrants and 100 miles in north and west quadrants. Semicircular squalls tailed out of the northwest quadrant through the north to east within the 45 kt [wind?] perimeter. Lowest pressure in center 990 mbs” (AWS). From the ATS report... “This was the second flight into the area of disturbance south of New Orleans by the same crew, and this time a closed circulation was located. The storm had the characteristics of many previous storms this year; that is, the western half was relatively

dry while the heaviest weather was northeast and east of the center” (ATS). ATS indicates a center fix at 1329Z at 25.7N, 91.5W. [990 looks correct for central pressure.] From the next ATS report... “At 2019Z, a disturbance was located centered at 25.8N, 90.7W [fix at 1921Z]. The eye was 10-15 miles in diameter, and winds of 50 to 60 kt extended outward 20-25 miles in the eastern and southern quadrants. In the western and northern quadrants, these winds extended outward 100 miles. Lowest pressure in the center was 990 mb” (ATS).

October 20:

HWM analyzes a tropical storm of at most 1000 mb centered near 26.8N, 86.9W. HURDAT lists this as a 75 kt hurricane at 26.1N, 87.0W. The AWS best track lists a 0030Z position at 25.7N, 90.0W with 60 kt max winds and 991 mb central pressure and a 1230Z position at 26.1N, 87.7W with 60 kt max winds and 992 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 26.4N, 87.4W with a 995 mb pressure. The MWR post-season track map shows a 12Z position near 26.0N, 87.3W. Microfilm analyzes a tropical storm of at most 993 mb centered near 26.6N, 86.4W. Ship highlights: 25 kt S and 990 mb at 00Z at 25.1N, 89.6W (micro); 35 kt NNE and 1004 mb at 00Z at 28.7N, 92.1W (COA); 35 kt SW and 1000 mb at 15Z at 25.3N, 85.5W (micro); 70 kt SW and 999 mb at 20Z at 26.2N, 85.3W (micro). At least two other gales of 35-50 kt and 26 other low pressures between 999-1005 mb. Aircraft highlights: center fix at 16Z at 26.3-26.4N, 86.8W with 992 mb central pressure and 80-90 kt maximum flight-level winds reported (AWS, ATS, micro); center fix at 2003Z at 26.5N, 86.3W with 990 mb lowest pressure encountered [probably a central pressure, but the central pressure could have been perhaps 5 mb lower- look at ATS] and maximum [flight-level?] winds encountered of 75-85 kt (AWS, ATS). “On the 20<sup>th</sup>, aircraft reported maximum winds of 75 to 85 kt (85 to 98 mph), especially in the northeastern quadrants. The movement by this time had completed the swing to the east and northeast, which caused it to offer a threat of hurricane winds to the upper west Florida coast” (MWR). “Navy two 0650Z: No indication of hurricane. Squall line extending from 26.9N, 89.4W to 28.2N, 86.2W. Navy six 1608Z: Low pressure center at 16Z 26.4N, 86.8W. No weather on W side. Max wind SW quadrant 45 kt. Center calm. Min pressure 992 mb” (micro). “Winds in the northeastern quadrant are 60 to 70 kt and gusting to an estimated 75 to 85 kt in squall centers. Winds over 45 kt extend outward 80 miles” (micro). From Navy Radar flight... “20/0845Z: Have covered entire area of weather indications (squall line) with no indication of a hurricane” (AWS). From aircraft flight... “20/1600Z: This was the third flight by the same crew [into this cyclone]. Storm had become a hurricane and was quite different than anticipated. The west side had become very dry with practically no cloudiness. This lack of cloudiness included all the western side of the storm, the eye, and the first few miles of the eastern side. The center was almost missed because of the lack of weather and clouds near it but the wind field showed a closed circulation and a low central pressure of 992 mbs. The major surprise came in departing the east side where severe turbulence in heavy weather was encountered and maximum winds of 80-90 kt [at 5,000 ft]. Max wind in SW quadrant was 45 kt. Radar shows heaviest weather in NE quadrant” (AWS). From the next aircraft flight... “20/2003Z: The storm had entirely reversed its active quadrants during the past 24 hours with heavy weather squalls confined nearly exclusively to the NE quadrant rather than the N and NW ones of the day

before. NE quadrant has winds of 75-85 kt within 25 miles of the center and severe, extremely turbulent thunderstorms. Winds over 45 kt extend 90 miles in NE quadrant. Western side has winds of 35-40 kt extending 90 miles from center with light, scattered showers. Min pressure 990 mb” (AWS). From the ATS report... “This was the third flight into the storm by this crew on three consecutive days and they thought they were becoming familiar with its appearance. But on this day, the storm had become a hurricane and was quite different than anticipated. [After the central pressure of 992 mb was recorded], the plane was taken to 5,000 ft in the center and the wind field could be seen around the center” (ATS). ATS indicates a center fix at 1600Z at 26.3N, 86.8W with 992 mb central pressure. From the next ATS report... “The return flight from Corpus Christi showed the storm to have entirely reversed its active quadrants during the previous 24 hours. The center was fixed at near 26.5N, 86.3W. This position proved an east-northeasterly movement of the storm at 9 kt. Its low pressure of 990 mb had remained rather constant” (ATS). [990 mb may not be a central pressure].

October 21:

HWM analyzes a closed low of at most 1000 mb centered near 29.2N, 83.7W. A W-E stationary front is plotted from 34N, 83W to beyond 36N, 70W. HURDAT lists this as a 35 kt tropical storm at 29.8N, 83.0W (inland over Florida). The AWS best track lists a 0030Z position at 27.2N, 85.4W with 85 kt max winds and 989 mb central pressure and a 1230Z position at 29.4N, 82.9W with 40 kt max winds and 993 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1002 mb pressure, and the MWR post-season track map shows a 12Z position near 29.8N, 82.8W. Microfilm analyzes a closed low of at most 1002 mb centered near 29.8N, 83.6W with a W-E front plotted from 35N, 80W to beyond 35N, 76W. Ship highlights: 30 kt ENE and 998 mb at 00Z at 28.0N, 84.8W (micro); 35 kt WSW at 05Z at 25.8N, 86.0W (micro). Seven other low pressures. Land/station highlights: 35 kt E and 999 mb at 10Z at Cedar Key (29.1N, 83.0W) (micro). Several other low pressures. Aircraft highlights: center fixes at 0815Z, 0900Z, and 0945Z between 29.2-29.4N, 83.4-83.5W (micro). “During the night of the 20<sup>th</sup>, however, it lost force rapidly, apparently due to dry air having completely encircled the center, and when it reached the coast on the early morning of the 21<sup>st</sup>, winds were of only moderate gale force. The presence of dry air from the West Gulf States had been noted on its western side since the time of its development, but it continued to increase in force, despite this, until the dry air had worked its way around to the south and east of the center. When this stage was reached, the loss of intensity was rapid” (MWR). “21/0140Z: We believe hurricane center somewhere along line 070 degrees true from 26.7N, 86W, or close to that course in vicinity 26.9N, 85.1W. Hurricane described as semi-circular and wide open with clear weather in the western semicircle. 21/0815Z: Nothing in nature of squall areas on scope except one large solid cloud to north roughly 20 miles wide and 30 miles long centered at 29.2N, 83.5W. Vivid lightning within cloud. My position [where he is at?] 28.3N, 84.5W. Do you require second plane to believe us? 21/0900Z: Small hole discovered in center of large solid cloud mentioned in previous message. Believed to be eye of small hurricane. Present position 29.4N, 83.4W moving north 12 kt. Our position 29.3N, 86.5W. Proceeding toward storm. 21/0955Z: Center of storm over coast at time 0945Z[?] at position 29.4N, 83.4W” (micro). “Amateur [radio?] reports mobile until

Cedar Key area reports storm centered coast there about 1030Z” (micro). “Coast guard phoned 1610Z: 1430Z- Front Cedar Keys. Wind 200 degrees 18 kt. Ceiling 1800 ft. Sea moderately choppy” (micro).

October 22:

HWM no longer analyzes a closed low on this day but instead analyzes a sharp trough with lowest pressure in the area between 30-35N, 76-84W. A warm front is plotted from 34N, 79W to 35N, 77W to east of 35N, 68W. HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 32.3N, 80.8W with a 1008 mb pressure. Microfilm analyzes a spot low (no longer closed) near 32.6N, 81.3W with a front extending from the low eastward and then east-northeastward into the Atlantic. No gales or low pressures.

October 23:

HURDAT no longer lists this system. The MWR tracks of centers of cyclones shows a 12Z position near 36.8N, 75.4W with a 1008 mb pressure.

October 24:

HWM analyzes a closed low of at most 1000 mb centered near 39N, 60.5W with a warm front extending from the low east-northeastward and a cold front extending from the low southward, southwestward, and then westward, but this cyclone appears to be the combination of the remnants of Love with another extratropical cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 41.0N, 56.9W with a 999 mb pressure.

Before Hurricane King made landfall at Miami, FL early on 18 October, a strong pressure gradient existed between Hurricane King and a strong high located near the mid-Atlantic coast. Hurricane force winds were occurring off the Atlantic coast of northern Florida and Georgia since 17 October, when Hurricane King was over Cuba, and these winds continued to blow at that strength well into the 19<sup>th</sup> of October. The strong pressure gradient and Hurricane King were not the only interesting phenomena on the 17<sup>th</sup> and 18<sup>th</sup> of October. On the 17<sup>th</sup>, an area of cyclonic turning accompanied by strong winds and low pressure began to take shape in the eastern Gulf of Mexico. This weather eventually formed into Tropical Storm Love on the 18<sup>th</sup>. There is little doubt that the motion of both King and Love was somewhat influenced by the Fujiwara Effect on the 18<sup>th</sup> and 19<sup>th</sup>. The origin of Love is somewhat unclear, but observations suggest that King spawned Love, similar to how Eve was created from one of Adam’s ribs in the book of Genesis.

HURDAT starts this system at 00Z on the 18<sup>th</sup>, but it is analyzed that a closed low did not exist until 12Z on the 18<sup>th</sup> at 26.7N, 91.0W with a 60 kt intensity. From 12Z on the 18<sup>th</sup> to 12Z on the 19<sup>th</sup>, Love moved very slowly westward and then southward to 26.0N, 91.6W by 12Z on the 19<sup>th</sup>. After that time, Love accelerated toward the east-southeast and turned toward the east-northeast by 00Z on the 20<sup>th</sup> at 25.3N, 89.6W. The largest track change made from 12Z on the 18<sup>th</sup> through 00Z on the 20<sup>th</sup> was about 1 degree. Although aircraft could not locate a definite center fix during the flight on the 18<sup>th</sup>, a lowest pressure of 996 mb was recorded, but is it uncertain whether this is a central

pressure value. A central pressure of less than or equal to 996 mb yields a wind speed of at least 50 kt according to the Brown et al. pressure-wind relationship for north of 25N. Aircraft reported central pressures of 990 mb at both 1329 and 1921Z on the 19<sup>th</sup>, and these are added into HURDAT at 12 and 18Z on the 19<sup>th</sup>. The central pressure of 990 mb at 1329Z equals 59 kt according to the pressure-wind relationship for north of 25N, and 60 kt is chosen for 12Z on the 19<sup>th</sup> (down from 80 kt originally- a major intensity change). The 990 mb central pressure at 1921Z equals 64 and 59 kt according to the southern and north of 25N pressure-wind relationships respectively. Although the central pressure did not change during the 6 hours, the eye significantly contracted during that time, the forward speed of Love increased, and the cyclone lost latitude. 65 kt is chosen for 18Z on the 19<sup>th</sup> (down from 80 kt originally). Love is analyzed to have first attained hurricane strength 36 hours later than originally. On the 20<sup>th</sup> at 00Z, a ship recorded a 990 mb pressure with 25 kt winds. This ship is analyzed to be located inside the RMW, suggesting a central pressure of about 987 mb. A central pressure of 987 mb is added into HURDAT at 00Z on the 20<sup>th</sup>. This value yields wind speeds of 68 and 64 kt respectively according to the southern and north of 25N pressure-wind relationships, and 70 kt is chosen for HURDAT at 00Z on the 20<sup>th</sup> (down from 80 kt originally) because of the small eye radius reported just 5 hours earlier. On the 20<sup>th</sup>, Love moved east-northeastward in the Gulf of Mexico, and it reached a location of 26.4, 86.5W by 18Z on the 20<sup>th</sup>. The largest track change on that day was four-tenths of a degree, and the analysis was aided by aircraft fixes at 16 and 20Z on the 20<sup>th</sup>. The former measured a central pressure of 992 mb and the latter measured a central pressure of 990 mb. A central pressure of 991 mb is added into HURDAT at 18Z on the 20<sup>th</sup>, and this value yields 58 kt according to the north of 25N pressure-wind relationship. However, a ship at 20Z observed winds of 70 kt. The 70 kt intensity analyzed at 00Z on the 20<sup>th</sup> is held through 00Z on the 21<sup>st</sup>, and 70 kt is the analyzed peak intensity for this storm (previously, HURDAT showed a peak intensity of 80 kt from 12Z on the 19<sup>th</sup> through 00Z on the 20<sup>th</sup>). On 21 October, Love made a turn to the northeast. Love made landfall near the big bend of Florida at 10Z on 21 October at 29.5N, 83.4W as a 60 kt tropical storm. The previous HURDAT intensity of 60 kt at 06Z on the 21<sup>st</sup> is not changed. Love is analyzed to have weakened from 70 kt to 60 kt during the final 10 hours before landfall. The strongest wind observations on the 21<sup>st</sup> were 35 kt from a ship and 35 kt at Cedar Key, FL. The lowest pressures on the 21<sup>st</sup> were 998 mb from a ship at 00Z, 999 mb from Cedar Key, FL at 10Z, and 999 mb again at Cedar Key at 12Z. The 10Z observation at Cedar Key was 35 kt simultaneously with 999 mb. The HURDAT track is shifted one to two tenths of a degree to the left before and at landfall due to aircraft center fixes just before landfall. Also, if the intensity was really as strong as 60 kt at landfall, moving the track slightly further away from Cedar Key in accordance with the aircraft center fixes is appropriate. There is no change to the timing of when Love weakened to a tropical depression (18Z on the 21<sup>st</sup>), but the position at that time is moved three-tenths of a degree to the northeast of the previous HURDAT position. The final point listed in HURDAT for this cyclone is 18Z on the 21<sup>st</sup>, but observations indicate that Love did not dissipate until after 18Z on the 22<sup>nd</sup>, so 1 day is added into HURDAT for Love (a major change). At 12Z on the 22<sup>nd</sup>, the analyzed position is 32.3N, 81.4W (inland over extreme eastern Georgia) as a 30 kt tropical depression. Tropical Depression Love is analyzed to have become an extratropical cyclone at 18Z on the 22<sup>nd</sup> still with a 30 kt intensity

moving east-northeastward. However, after 18Z on the 22<sup>nd</sup>, Love opened up into a sharp trough so 18Z on the 22<sup>nd</sup> is the last point listed for Love in the reanalysis. A complex frontal system approaching from the west combined with the trough left over by Love to produce a powerful extratropical cyclone that was centered near 39N, 60W by 24 October. Although this powerful, baroclinic system was partially due to Love, it resulted from the combination of Love with the other extratropical system, so the track for Love is not extended any further.

#### 1950 Storm 14 (Mike) - (new to HURDAT)

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35465 10/25/1950 M= 4 14 SNBR= 785 MIKE          XING=0
35470 10/25* 0 0 0 0* 0 0 0 0*247 422 25 0*253 437 25 0*
35470 10/26*258 451 30 0*262 463 30 0*265 472 35 0*268 478 40 0*
35470 10/27*271 482 40 0*274 486 40 0*277 490 35 0*282 494 35 0*
35470 10/28*289 498 30 0*297 502 30 0*306 505 30 0*318 505 25 0*
35460 TS

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HWM, COADS, NHC microfilm of synoptic weather maps, and the U.S. Air Weather Service post-season report indicate that a tropical storm, previously undocumented in HURDAT, occurred from 25 to 29 October in the central Atlantic Ocean. This system was also listed in Jack Beven's list of suspects.

#### October 24:

HWM analyzes a trough or wave axis extending from 30N, 39W south-southwestward to 27N, 41W to 23N, 42W. HWM also analyzes a dissipating cold front from 33N, 38W to 30N, 36W to 28N, 32W to 28N, 29W. HURDAT does not list this system. The AWS post-season report suggests a 15 kt tropical depression is centered near 26.4N, 40.5W at 1230Z. Ship highlights: 15 kt SSW and 1013 mb at 18Z at 25.4N, 40.6W (COA). "Storm Mike first showed evidence of a closed circulation and westerly movement on the 1230Z 24 October map. Highest winds on this day are estimated at 15 kt. The center of the low area at this time was near 26.4N, 40.5W and the movement was toward the west at a rate of 5 kt" (AWS).

#### October 25:

HWM analyzes a trough or wave axis extending from 28N, 41W to 25N, 45W to 19N, 47W. The AWS post-season report suggests a tropical depression centered in the general vicinity of 26.5N, 43.3W (I interpolated the AWS positions from the 24<sup>th</sup> and 26<sup>th</sup>, and the interpolated intensity would be 25 kt). Ship highlights: 5 kt SSW and 1014 mb at 06Z at 23.5N, 40.6W (COA); 15 kt E and 1016 mb at 12Z at 25.6N, 40.0W (HWM).

#### October 26:

HWM analyzes a closed low of at most 1015 mb centered near 25.5N, 47W with a trough axis extending from the low southwestward to 20N, 55W. The AWS best track first lists a tropical storm with a 1230Z position at 26.7N, 46.1W with 35 kt max winds. Ship highlights: 25 kt ESE and 1011 mb at 12Z at 27.8N, 45.9W (COA). "The storm continued to accelerate until 26/1830Z when we find it at 26.9N, 47.1W moving WNW at 10 kt, with maximum winds of 35 kt" (AWS).

October 27:

HWM analyzes a closed low of at most 1015 mb centered near 28N, 48.5W. A cold front is approaching from the northwest located about 400 nmi away from the feature of interest. The AWS best track lists a 0030Z position at 27.3N, 48.1W with 45 kt max winds and a 1230Z position at 27.7N, 48.9W with 35 kt max winds. Microfilm at 12Z plots a tropical storm of at most 1014 mb near 29.8N, 48.8W. Ship highlights: 35 kt SSE and 1006 mb at 00Z at approximately 27.3N, 47.9W (AWS); 20 kt SW and 1015 mb at 06Z at 25.6N, 48.5W (COA). “The storm now slowed considerably... so that on 0030Z 27 October we find it moving WNW 5 kt with maximum winds of 45 kt in a small area. At this time the ship Alvelos reported SSE force 8, minimum pressure 1005.8 mb. The ship at this time was about 10-15 miles east of the storm center. This was the only ship report on this storm that was near enough the center to report gale winds... and in conjunction with other ship reports, [it was found] that this storm was not very intense and covered a very small area” (AWS). “Storm Mike had winds of gale force from 1230Z 26 Oct. to 0030Z 28 Oct. These winds reached a maximum of 45 kt at 0030Z 27 Oct. Minimum pressure at the center probably approached closely to 1000 mb as indicated by the ship report mentioned above of 1005.8 mb 10-15 miles from the center” (AWS). “The fact that Storm Mike was small and of little intensity is ascribed to the fact that it occurred late in the season when cooler temperatures of both air and water prevented the accumulation of sufficient energy to develop a full hurricane” (AWS).

October 28:

HWM analyzes a closed low of at most 1015 mb centered near 30.5N, 50.3W with a NE-SW cold front approaching from the northwest located only 200 nmi from the feature of interest. The AWS best track lists a 0030Z position at 28.3N, 50.1W with 35 kt max winds and a 1230Z position at 30.3N, 50.6W with 25 kt max winds. Ship highlights: 20 kt SE and 1015 mb at 00Z at 29.7N, 48.7W (COA); 20 kt SSW and 1015 mb at 12Z at 29.3N, 50.3W (micro); 15 kt NE and 1020 mb at 12Z at 32.4N, 50.0W (COA). “The storm continued a curvature toward the east with increasing speed so that on 28 October 1830Z we find it at 31.5N, 49.6W moving NE at a rate of 15 kt, with maximum winds of force 3 (10 kt). Shortly after this time a cold front from the NW caused the storm to lose identity altogether” (AWS).

The Air Weather Service (AWS) post-season report listed this system as Tropical Storm Mike. On 24 October, a trough with westerly movement was evident from observations in the central Atlantic along 40W between 23-30N. There is not enough evidence of a closed low until 12Z on 25 October, and a 25 kt tropical depression is analyzed to have formed at that time at 24.7N, 42.2W. The cyclone moved west-northwestward and was located near 26.5N, 46.3W by 12Z on the 26<sup>th</sup>. At 00Z on the 27<sup>th</sup>, a ship reported the only observed gale (35 kt) associated with this cyclone. The lowest pressure reported by the ship was 1006 mb. The ship is believed to have been located 10 to 15 miles from the center at the time the 1006 mb observation was recorded. Due to the closed circulation with westerly motion, temperatures in the 70s surrounding the system from the 24<sup>th</sup> through the 28<sup>th</sup>, the 35 kt gale, and the 1006 mb pressure, this system is added into HURDAT as a tropical storm. A peak intensity of 40 kt is analyzed from 18Z on the 26<sup>th</sup> to 12Z on the 27<sup>th</sup>. The position at 12Z on the 27<sup>th</sup> is analyzed at 27.7N, 48.9W with a 40

kt intensity. Thereafter, an approaching cold front caused the cyclone to begin recurving, and it turned to the north-northwest. The tropical storm weakened to a tropical depression at 00Z on the 28<sup>th</sup>. By 12Z on the 28<sup>th</sup>, the depression was located at 30.3N, 50.6W, which is the same position listed in the AWS post-season report for 12Z. The analyzed intensity for 12Z on the 28<sup>th</sup> is still 30 kt. According to the AWS report, Mike recurved on the 28<sup>th</sup> because AWS indicates northeastward motion between 12 and 18Z on the 28<sup>th</sup>. The AWS report indicates that Mike was absorbed by the front shortly after 18Z on the 28<sup>th</sup>. However, it is analyzed that Mike was not absorbed/dissipated by the cold front until after 00Z on the 29<sup>th</sup> as a 25 kt tropical depression. It is analyzed that this cyclone did not become extratropical prior to dissipation. If this system is accepted by the NHC Best Track Change Committee as a new system for HURDAT, it can be argued that it should be named Mike, due to its designation as Tropical Storm Mike in the AWS post-season report.

#### 1950 Storm 15 (new to HURDAT)

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35465 10/27/1950 M= 3 15 SNBR= 786 UNNAMED XING=0
35470 10/27* 0 0 0 0* 0 0 0 0*260 260 35 0*267 266 45 0*
35470 10/28*273 272 50 0*277 279 50 0*280 286 45 0*280 294 40 0*
35470 10/29*279 303 35 0*278 313 30 0*275 325 30 0*270 338 30 0*
35460 TS

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HWM and COADS indicate that a tropical storm, previously undocumented in HURDAT, occurred from 27-29 October in the far eastern subtropical Atlantic.

#### October 27:

HWM analyzes a closed low of at most 1015 mb centered near 26N, 28.2W. HURDAT does not list this system. Ship highlights: 25 kt NE and 1015 mb at 12Z at 27.0N, 26.9W (COA); 30 kt NE and 1015 mb at 12Z at 28.6N, 29.6W (COA, HWM); 30 kt NE and 1012 mb at 18Z at 29.0N, 28.4W (COA).

#### October 28:

HWM analyzes a closed low of at most 1015 mb centered near 28N, 29W. Ship highlights: 45 kt NE and 1010 mb at 00Z at 29.2N, 28.0W (COA); 40 kt E and 1010 mb at 06Z at 29.5N, 27.5W (COA); 20 kt NNW and 1015 mb at 12Z at 25.7N, 31.7W (COA); 30 kt SE and 1015 mb at 12Z at 29.6N, 26.1W (COA, HWM).

#### October 29:

HWM analyzes a broad, closed low of at most 1015 mb centered in the general vicinity of 28.3N, 32.5W with a cold front plotted from 40N, 29W becoming a stationary front at 35N, 41W extending to west-southwest of 32N, 48W. This WSW-ENE frontal feature is plotted several hundred nautical miles northwest of the feature of interest. No gales or low pressures.

#### October 30:

HWM analyzes a closed low of at most 1015 mb centered in the general vicinity of 27.2N, 37.5W. A cold front is plotted from 36N, 29W to 35N, 32W becoming a warm

front at 34N, 39W, extending to 35N, 47W to beyond 37N, 52W. The frontal features are located about 400 nmi north of the feature of interest. No gales or low pressures.

HWM plots a 1015 mb low with one closed isobar in the subtropical eastern Atlantic Ocean every day from 27 to 30 October. The combination of COADS and HWM ship data indicates the likelihood of the existence of a tropical storm early on the 28<sup>th</sup> between 26-29N, 26-29W. Two gales were observed- a 45 kt NE wind at 00Z (northwest of the center) and a 40 kt E wind at 06Z (north of the center). Both of those gales were observed simultaneously with pressures of 1010 mb (the lowest observed pressures for this system). A 30 kt SE wind was observed at 12Z (northeast of the center). It is believed that all three of these observations are from the same ship. This ship made a report every 6 hours from 00Z on 27<sup>th</sup> through 12Z on the 28<sup>th</sup>. The lowest wind reported by this ship was 25 kt at 00 and 06Z on the 27<sup>th</sup>. It is believed that the winds for this ship are biased at least 5 kt too high, and they might be biased 10 kt too high. But there are not really enough surrounding observations to be confident about this assessment. There was only one other ship in the vicinity reporting 5 kt winds a few hundred nmi from this ship. If the 5 kt ship is biased too low, then the ship that reported the gales may not actually be biased too high. Regardless, there is pretty good evidence that the low is closed on the 28<sup>th</sup> due to a separate ship observation of 20 kt NW and 1015 mb about 210 nmi SW of the center. Also, temperatures in the 70s surround the low on all sides. In addition, the observations indicate the circulation is compact with the highest winds and lowest pressures close to the center. Even if the ship that reported the gales is biased 5 kt too high, two pieces of evidence exist that this cyclone was of tropical storm intensity. If it can somehow be determined that the ship is biased 10 kt too high, then only one piece of evidence would exist. If the ship is biased 15 kt too high, then no pieces of evidence exist. The best guess is that the ship is biased only 5 kt too high.

It is analyzed that a 35 kt tropical storm formed at 12Z on 27 October at 26.0N, 25.6W. It moved northwestward to a position of 28.0N, 28.6W by 12Z on the 28<sup>th</sup>. The 35 kt tropical storm intensified to 45 kt by 18Z on the 27<sup>th</sup>. The 45 kt intensity is the analyzed peak intensity for the cyclone from 18Z on the 27<sup>th</sup> to 12Z on the 28<sup>th</sup>. Observations on the 29<sup>th</sup> are very sparse and the uncertainty in the analyzed position is higher on the 29<sup>th</sup>, but the cyclone is analyzed to have moved westward to a position of 28.0N, 32.5W by 12Z on the 29<sup>th</sup>. The tropical storm is analyzed to have weakened to a tropical depression by 06Z on the 29<sup>th</sup>. There is little to no information on the 29<sup>th</sup> or 30<sup>th</sup> that proves the existence of a closed circulation on those days. The last point is chosen for 18Z on the 29<sup>th</sup> as a 30 kt tropical depression before dissipation occurred.

#### 1950 Storm 16 (new to HURDAT)

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35465 11/10/1950 M= 4 16 SNBR= 787 UNNAMED XING=0
35470 11/10*337 0 45 0*337 596 55 0*337 604 60 0*339 610 60 0*
35470 11/11*343 610 55 0*349 603 45 0*354 592 40 0*359 581 35 0*
35470 11/12*369 570 30 0*380 557 30 0* 0 0 0 0* 0 0 0 0*
35460 TS

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HWM, COADS, the MWR tracks of lows, and NHC microfilm of synoptic weather maps indicate that a tropical storm, previously undocumented in HURDAT, occurred in the western Atlantic Ocean from 10 – 13 November.

November 10:

HWM analyzes a closed low of at most 1005 mb centered near 33N, 59W. HURDAT does not list this system. The MWR tracks of centers of cyclones first shows a position at 12Z near 34.1N, 59W with a 1005 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered in the general vicinity of 32N, 61W. Ship highlights: 30 kt SSE and 1005 mb at 06Z at 34.9N, 58.2W (COA); 45 kt NW and 1001 mb at 16Z at 33.4N, 61.4W (micro); 60 kt NW and 1002 mb at 18Z at 33.4N, 62.4W (micro).

November 11:

HWM analyzes a closed low of at most 1005 mb centered near 36N, 58W with a front approaching from the west plotted from northeast of 50N, 53W to 45N, 58W to 42N, 61W becoming a stationary front at 40N, 64W extending southwestward becoming a cold front again at 36N, 71W extending southwestward to beyond 30N, 79W. The MWR tracks of centers of cyclones shows a 00Z position near 30.4N, 60.1W and a 12Z position near 36.4N, 58.8W with a 996 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 36.5N, 58W. Ship highlights: 25 kt SW and 1003 mb at 00Z at 32.7N, 59.6W (COA, micro); 20 kt NNE and 1004 mb at 06Z at 34.2N, 61.1W (COA).

November 12:

HWM analyzes a closed low of at most 1010 mb centered near 33.5N, 57.5W with a NE-SW cold front located northwest of the low extending from 50N, 40W to 45N, 47W to 41N, 55W to 38N, 60W to 35N, 65W to 33N, 70W to 31N, 75W. The MWR tracks of centers of cyclones shows a 00Z position near 36.7N, 56.8W and last shows a position at 12Z near 37.1N, 55.2W with a 1008 mb pressure. Microfilm at 12Z analyzes a slightly elongated closed low of at most 1005 mb centered in the general vicinity of 33N, 57W. No gales or low pressures.

November 13:

HWM analyzes a closed low of at most 1010 mb centered near 39.5N, 53W with a warm front extending from the low east-northeastward to 44N, 33W, and a cold front extending from the low southwestward to 33N, 65W. The MWR tracks of centers of cyclones shows a different low from the one shown on the 10<sup>th</sup> through the 12<sup>th</sup>. This low, which is shown to have been moving eastward, is plotted near 39.7N, 56.8W at 12Z with a 1009 mb pressure. A 3<sup>rd</sup> low in the vicinity is first shown at 18Z on the 13<sup>th</sup> near 43.3N, 44.1W with northeastward motion thereafter. Microfilm at 12Z analyzes a very large closed low of at most 1014 mb. The 1014 mb contour extends from 30-42N, 50-61W; however, the area south of 37N appears to be where a front should be located, and the area of some cyclonic turning is located between 38-42N, 52-58W. No gales or low pressures.

A very broad, large trough of low pressure was located over the western Atlantic during the days leading up to 10 November between 15-35N, 50-70W. Observations on the 10<sup>th</sup>

indicate that a cyclonic circulation is definitely closed on that day centered near 33.7N, 60.4W at 12Z. At 06Z on the 10<sup>th</sup>, a ship about 120 nmi northeast of the center observed a 30 kt wind with a pressure of 1005 mb. At 16Z, a ship less than 1 degree from the center of the cyclone recorded 45 kt winds with a 1001 mb pressure. At 18Z, a different ship located not more than 80 nmi from the center observed 60 kt winds with a 1002 mb pressure. Only a slight temperature gradient across the low of about 5 degrees is suggested by observations. There were no fronts analyzed on either HWM or the microfilm maps on the 10<sup>th</sup>. Since this cyclone was rather large, it would likely be classified as a subtropical cyclone using modern designation techniques, so this system is added into HURDAT. This cyclone is started at 00Z on the 10<sup>th</sup> as a 55 kt tropical storm. A 60 kt intensity is analyzed from 06Z on the 10<sup>th</sup> to 06Z on the 11<sup>th</sup>. The center of cyclone started out moving west-northwestward on the 10<sup>th</sup>, but it reached its furthest west point by 00Z on the 11<sup>th</sup> and recurved. The position at 00Z on the 11<sup>th</sup> was near 34.3N, 61.0W. It moved northeastward to 35.2N, 59.2W by 12Z on the 11<sup>th</sup>, and by that time, the analyzed intensity is down to 40 kt. After that, the cyclone turned towards the east and then southeast, reaching a position of 34.5N, 57.0W by 18Z on the 12<sup>th</sup>. The cyclone is analyzed to have weakened to a 30 kt tropical depression by 00Z on the 12<sup>th</sup>. After moving southeastward on the 12<sup>th</sup>, the cyclone moved northeastward briefly on the 13<sup>th</sup>, before it opened up into a trough and merged with another cyclonic circulation. A final position of 35.0N, 56.5W is analyzed at 06Z on the 13<sup>th</sup> as a 25 kt tropical depression.

#### 1950 additional notes

1)

HWM, COADS, the MWR tracks of lows, microfilm, and Jack Beven's list of suspects indicate that a trough of low pressure was evident near the Bahamas, Cuba, and south Florida on 24 May. The low became closed around 00Z on the 25<sup>th</sup> near 26N, 78W, but the highest observed winds were 10-15 kt and the lowest observed pressures were about 1012 mb. Despite the low environmental pressure to the south and east, it appears as if the weak cyclonic turning was occurring a small scale. It is possible that this may have been a tropical depression on the 25<sup>th</sup>, but the winds remained very weak. The low moved rather rapidly northeastward through 12Z on the 26<sup>th</sup>; however, by the 26<sup>th</sup>, the low was very large and broad. Although it was still non-frontal on the 26<sup>th</sup>, the radius of the OCI (1014 mb) was 400 nmi. Furthermore, no gales or low pressures were observed between the 24<sup>th</sup> and 26<sup>th</sup> of May. By the 27<sup>th</sup>, analyses and observations indicate that a W-E warm front may have been taking shape with the west end of the warm front located not far to the east of the low. This low remained very large and perhaps frontal through at least the 28<sup>th</sup> of May. On the 27<sup>th</sup> and 28<sup>th</sup>, several pressures between 1001-1005 mb were observed; however, only one gale was reported. At 00Z on 28 October, a ship plotted on microfilm shows 50 kt with 1004 mb. This observation does not fit in too well with surrounding observations. This combined with the fact that there were no other gales of even 35 kt reported suggests that the ship observation of 50 kt may have been too high. Even if the ship observation was correct, the low was very broad, and it is analyzed

to have a weak warm front to the east. On the 29<sup>th</sup>, the low may become somewhat smaller, but it also starting filling on the 29<sup>th</sup>, and it was still frontal on the 29<sup>th</sup>. By the 30<sup>th</sup>, it weakened even more and opened up into a trough/front on the 31<sup>st</sup>. Although this suspect is the closest suspect in 1950 listed in the additional notes section to being a tropical cyclone and added into HURDAT, it was not close to being a tropical storm or subtropical on any of the days. Thus, this suspect in not added to HURDAT.

DAY	LAT	LON	STATUS
May 24			Open trough 27N, 75W to 20N, 82W
May 25	28N	74W	Broad low
May 26	33N	67W	Broad low
May 27	33N	67W	Broad low; extratropical
May 28	33N	66W	Broad low; extratropical
May 29	33N	62W	Broad low; extratropical
May 30	34N	60W	Broad low; extratropical
May 31			Open trough 37N, 46W to 34N, 58W

2)

A weak, broad low appeared in the north Atlantic on 19 August. The low strengthened slightly on the 20<sup>th</sup> and 21<sup>st</sup>, but it was still broad. NHC microfilm maps show a broad, weak, closed low with little to no temperature gradient. However, no gales or low pressure were observed with this system from any source. Thus, this suspect is not added to HURDAT.

DAY	LAT	LON	STATUS
Aug 19	39N	49W	Broad low/trough
Aug 20	38N	49W	Broad low
Aug 21	35N	52W	Broad low
Aug 22	33N	57W	Broad low

3)

Microfilm indicates that an easterly wave moved through the Caribbean Sea from the 18<sup>th</sup> to the 24<sup>th</sup> of September. The weak easterly wave was near 70W on the 19<sup>th</sup>, with max winds of 20 kt gusting to 35 kt. By the 21<sup>st</sup>, the wave was near 80W. On the 23<sup>rd</sup>, a very weak low formed near 21N, 84W, and it may have made landfall in Cuba as a tropical depression around 00Z on the 24<sup>th</sup>. No gales or low pressures were observed for the duration of the lifetime of this system, thus it is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 18			Open wave along 65W in Caribbean Sea
Sep 19			Open wave along 70W in Caribbean Sea
Sep 20			Open wave along 75W in Caribbean Sea

Sep 21			Open wave along 80W in Caribbean Sea
Sep 22			Open wave along 83W in Caribbean Sea
Sep 23	21N	84W	Broad low/trough
Sep 24	22N	83W	Broad low/trough
Sep 25			Dissipated

4)

HWM, COADS, and Jack Beven's list of suspects indicates that there may have been a closed low in the far eastern Atlantic between 28 September and 2 October. HWM analyzes a closed isobar, but there are not sufficient observations to indicate that the low was definitely closed.

DAY	LAT	LON	STATUS
Sep 27			Open trough over Africa
Sep 28	19N	18W	Broad low; trough
Sep 29	22N	21W	Broad low; trough
Sep 30	25N	26W	Broad low; trough
Oct 1	25N	33W	Broad low; trough
Oct 2			Open trough along 42W, 20-25N

5)

A trough of low pressure was present on 3 – 4 October from the Florida Keys extending south-southwestward to Central America. On the 4<sup>th</sup>, two separate weak vortices appeared to have been forming- one near western Cuba and the other just north of Honduras. The former migrated northward to near Florida Bay by late on the 5<sup>th</sup>, and this one never producing any gales, and it probably was not a tropical depression either. It did not spin up any further. The latter moved west-northwestward and was approaching the Yucatan Peninsula near 19.5N, 86.5W by 18Z on the 5<sup>th</sup>. At 06Z on the 6<sup>th</sup>, a coastal station in Belize recorded 30 kt W and 1008 mb (microfilm ob). During this time, the low was moving westward into the Yucatan Peninsula just to the north of the station. A 30 kt wind from a tropical coastal station seems anomalous and is not a normal occurrence.

Both of the lows previously mentioned were embedded in the same trough area. Additionally, there was a front moving southward across the Gulf of Mexico on the 5<sup>th</sup>, and the front merged with the trough on the 6<sup>th</sup>. One of these disturbances or a combination of them likely led to the eventual formation of Tropical Storm Item on 8 October. It is possible that a tropical depression or tropical storm made landfall in the Yucatan Peninsula around 06Z on the 6<sup>th</sup> (alluded to above) but it is impossible to determine whether this low is the same low that was later named Item. During the 7<sup>th</sup>, several stations over the Yucatan Peninsula reported calm winds, a low cannot be tracked. There is an equal or greater chance that Item formed later (on the 8<sup>th</sup>) from

interactions of the front and trough. The track of Item therefore cannot be extended back in time. Also, the potential system that may have made landfall in the Yucatan Peninsula around 06Z on the 6<sup>th</sup> cannot be added into HURDAT since there were no gales observed.

Low #1

DAY	LAT	LON	STATUS
Oct 3			Open trough over northwestern Caribbean
Oct 4	22N	83W	Spot low
Oct 5	24N	83W	Spot low
Oct 6			Merged with front

Low #2

DAY	LAT	LON	STATUS
Oct 3			Open trough over northwestern Caribbean
Oct 4	17N	86W	Broad low/trough
Oct 5	19N	87W	Tropical depression
Oct 6	19N	89W	Tropical depression
Oct 7			Dissipated into trough

6)

HWM indicates that an area of low pressure began to take shape on 15 October around 8N, 50W. It moved northwestward and slowly organized into a possible tropical depression by the 18<sup>th</sup> near 12N, 59W. The low may have remained a depression through the 21<sup>st</sup> as it moved near Puerto Rico. After that, it dissipated into an open trough. There was only one gale observed in the vicinity of this system (on NHC microfilm), and no low pressures were observed. At 00Z on the 22<sup>nd</sup>, a ship reported 35 kt ESE and 1012 mb at 17.3N, 66.4W, but the gale is probably not related to the low because the feature of interest is analyzed to have been well north of that location by that time. Also, by the 22<sup>nd</sup>, there is no longer evidence that the low is definitely closed, and this system is not added into HURDAT.

DAY	LAT	LON	STATUS
Oct 15			Open wave/trough 12N, 49W to 6N, 53W
Oct 16	9N	51W	Spot low
Oct 17	11N	54W	Spot low
Oct 18	12N	59W	Tropical depression
Oct 19	13N	64W	Tropical depression
Oct 20	13N	69W	Tropical depression
Oct 21	18N	68W	Tropical depression
Oct 22			Open wave/trough 26N, 70W to 20N, 76W

7)

COADS, HWM, the MWR tracks of lows, and microfilm indicate that an extratropical cyclone emerged over the northeastern coast of the United States on 23 October moving eastward. It produced many gales and low pressures on the 24<sup>th</sup> of October. This system qualified for the 1950 additional notes section due to the following quote found on the Oct. 24<sup>th</sup> 18Z NHC microfilm map from a ship: “[Oct. 24] 2015 GMT- 39.8N, 53.3W- Passed through storm’s eye. Barometer 29.60”. Temperature 70. Area of clear 10 miles wide. Wind shifted SW 30 kt to N 30 kt.” Despite this quote, observations indicate a very large temperature gradient, and there is no doubt that this cyclone was extratropical. After the 24<sup>th</sup>, the extratropical cyclone continued to moved northeastward, and it weakened.

DAY	LAT	LON	STATUS
Oct 23	37N	71W	Extratropical
Oct 24	40N	57W	Extratropical Storm

8)

HWM, NHC microfilm, COADS, and the MWR tracks of lows were utilized to obtain information on this suspect. On 28 October, as a tropical storm near 30N, 50W was being approached by a cold front, which extended from 40N, 42W to 35N, 49W to 31N, 58W to 30N, 64W, a weak, broad area of low pressure began to form well south or south-southwest of the tail end of the cold front. The broad low moved quickly northeastward towards the tail end of the front, and they essentially merged around 00Z on the 30<sup>th</sup>. The winds around the area were not of gale force by that time, and the pressures were not very low yet either since the front had been in the dissipating stages and the low was weak as well. However, the combined system soon began to intensify as an extratropical system, and it the new extratropical low moved northeastward. There were no gales or low pressures observed with this system until 12Z on the 30<sup>th</sup>. This system is analyzed to have become extratropical by 12Z on the 30<sup>th</sup>. The first low pressure of 1005 mb was observed at 12Z on the 30<sup>th</sup> and the first gale (40 kt) was observed at 00Z on the 31<sup>st</sup>. Even before the low became extratropical, it was too broad to be considered a tropical depression at any time.

DAY	LAT	LON	STATUS
Oct 28	21N	65W	Broad low/trough
Oct 29	28N	63W	Broad low/trough
Oct 30	34N	62W	Extratropical storm
Oct 31	44N	50W	Extratropical storm
Nov 1	47N	50W	Extratropical storm/occluding

9)

HWM, microfilm, and COADS indicate that a broad trough of low pressure existed between 22-35N, 55-62W on the 17<sup>th</sup>. On the 17<sup>th</sup>, there was one gale of 35 kt along with a pressure of 1019 mb at 32N, 61W. But observations indicate that the trough was very broad at that time and covered a large area of the Atlantic with no evidence of a closed circulation on a smaller scale. On the 18<sup>th</sup>, a somewhat smaller, but weak low emerged from this trough and moved northward, and it became extratropical. At 00Z on the 18<sup>th</sup>, it was not extratropical yet, and the low was located near 35N, 58W at that time. Winds of 15 kt and pressures of 1008 and 1009 mb were observed on the east side and west side of the low. After it became extratropical, there were a few low pressure observations between 1000-1005 mb directly related to this low on the 18<sup>th</sup> before it merged with another extratropical low on the 19<sup>th</sup>, no more gales were observed. This system is not added into HURDAT.

DAY	LAT	LON	STATUS
Nov 17			Broad low/trough 35N, 55W to 26N, 58W to 22N, 62W
Nov 18	41N	57W	Extratropical
Nov 19			Absorbed

10)

HWM, NHC microfilm, and COADS indicate that a broad low moved northward into the central Atlantic from the tropical central Atlantic during 20-23 November. Although the low appears to have remained too broad for its entire lifetime to be considered a tropical cyclone, observations are very sparse on most of the days. Within the large trough, it is possible that a TC may have existed, but all data sources were utilized, and we may never know if there was a TC there due to a lack of observations in the data-sparse area. There were no observed gales or low pressures from the 20<sup>th</sup> through the 22<sup>nd</sup>. The NHC microfilm maps at 18Z on the 22<sup>nd</sup> and 00Z on the 23<sup>rd</sup> are interesting, but this low lies on the eastern edge of the map, and only winds as high as 25 kt and pressures as low as 1008 mb are found. On the 23<sup>rd</sup>, the HWM analysis is complicated, and it is difficult to track where the low traveled to from the 22<sup>nd</sup> position (although the microfilm map at 00Z on the 23<sup>rd</sup> shows the low located perhaps only slightly northeast of the 22/12Z position. In addition to no highlights observed from the 20<sup>th</sup> through the 22<sup>nd</sup>, no gales were observed on the 23<sup>rd</sup> either. However, there were a few low pressures observed between 1004-1005 mb (COADS) on the 23<sup>rd</sup>. But the broad low appears to have lacked organization. This system is not added into HURDAT.

DAY	LAT	LON	STATUS
Nov 20	20N	55W	Broad low/trough
Nov 21	22N	55W	Broad low/trough
Nov 22	28N	49W	Broad low/trough
Nov 23			Broad low/trough- box between 20-38N, 37-53W

## 1951

## 1951 Storm 1 (new to HURDAT)

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35845 01/02/1951 M=11 1 SNBR= 791 NOT NAMED XING=0
35850 01/02* 0 0 0 0* 0 0 0 0E305 580 50 0E299 568 45 0*
35850 01/03E290 557 45 0E275 548 45 0E265 545 45 0E261 552 45 0*
35850 01/04E258 561 45 0E255 570 45 0E251 579 45 0*240 589 45 0*
35855 01/05*227 600 45 0*221 607 45 0*217 611 45 0*215 613 45 0*
35855 01/06*213 615 50 0*210 617 50 0*207 620 55 0*203 624 55 0*
35855 01/07*202 629 55 0*202 637 55 0*206 645 55 0*210 652 55 0*
35855 01/08*213 658 55 0*216 662 55 0*219 665 55 0*223 665 55 0*
35855 01/09*230 661 55 0*243 655 55 0*260 649 50 0*275 642 50 0*
35855 01/10E289 634 50 0E306 621 50 0E326 605 50 0E342 588 50 0*
35855 01/11E352 572 50 0E370 555 50 0E390 535 45 0E413 507 45 0*
35855 01/12E425 480 45 0E436 450 40 0E447 410 40 0* 0 0 0 0*
35860 TS

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HWM, COADS, NHC microfilm of synoptic weather maps, the January 1951 MWR tracks of centers of cyclones chart, MWR 1951 p. 189 (Moore and Davis 1951), MWR 1956 p. 13 (Colon 1956), Hector (1975), David Roth, and Jack Beven indicate that a tropical storm, previously undocumented in HURDAT, occurred during January, 1951 in the central tropical Atlantic Ocean.

## January 1:

HWM analyzes a NNE-SSW cold front extending from 45N, 52W to 40N, 56W through an "L" plotted at 36.5N, 61W to 30N, 65W to 25N, 70W. HURDAT does not previous list this system. The MWR tracks of centers of cyclones shows a 12Z position near 35.5N, 63.2W with a 1000 mb pressure. Microfilm at 12Z shows an analysis very similar to the HWM analysis, except that microfilm analyzes an elongated, closed low of most 1002 mb centered near 37N, 60W in addition to the cold front. At 12Z, Roth lists this as a 65 kt extratropical cyclone at 34.5N, 63.5W. Ship highlights: 70 kt NW and 1000 mb at 06Z at 34.0N, 67.0W (COA); 60 kt N and 1009 mb at 12Z at 34.1N, 66.9W (HWM, COA); 50 kt N and 1017 mb at 18Z at 36.5N, 66.0W (COA). Several other gales and low pressures. "The storm started as a frontal wave cyclone during January 1 around 34N, 69W. It moved first eastward and then curved southward toward tropical latitudes" (Colon 1956). "At 1230Z on the 1<sup>st</sup>, a frontal wave is shown in the analysis near 36N, 61W just as there are indications of a 500 hPa closed low pinching off of the southern end of a polar trough" (Roth).

## January 2:

HWM analyzes a closed low of at most 1000 mb centered near 29.8N, 57.5W with a stationary front extending from the low northeastward to 37N, 47W and a dissipating cold front extending from the low southward and southwestward to 25N, 58W to 21N, 61W. The MWR tracks of centers of cyclones shows a 12Z position near 31.6N, 57.3W with a 996 mb pressure. Microfilm at 12Z analyzes an elongated, closed low of at most 1008 mb centered near 31.7N, 55.8W with frontal analyses similar to the HWM analysis. At 12Z, Roth lists this as a 60 kt extratropical cyclone at 31.5N, 56.5W. Ship highlights: 40 kt NE and 1002 mb at 06Z at 32.5N, 60.2W (COA). Three other gales of 35 kt and one other low pressure of 998 mb. "By the 2<sup>nd</sup>, this [frontal] wave deepens as it moves southeast in tandem with the upper cyclone, which at the time is quite cold core, with -

20X temperatures indicated at 500 hPa. The northern portion of the parent upper trough moves eastward toward western Europe, and shortwave ridging builds north of the closed low” (Roth).

January 3:

HWM analyzes a closed low of at most 1005 mb centered near 26.6N, 54.7W with a dissipating stationary front extending from the low northeastward to 30N, 53W to 32N, 50W to 34N, 45W. At 12Z, Roth lists this as a 50 kt extratropical cyclone at 27.5N, 55.5W. Ship highlights: 30 kt SW and 1004 mb at 12Z at 25.0N, 55.0W (HWM, COA). Three other low pressures between 1003-1005 mb. “By January 3 it was already isolated from the polar air and no fronts were distinguished in the circulation after this date” (Colon 1956). “By the 3<sup>rd</sup>, the system is nearly barotropic at the surface, with essentially zero temperature and dewpoint contrast within almost 1,000 km east, south, and west of the circulation center. There are still indications of a draping warm front to its northeast. The upper cyclone moves farther into a data void, and from this point onward in the map series a 500 hPa temperature of -12C is shown over the center, an 8C warming from the 1<sup>st</sup> and 2<sup>nd</sup>” (Roth).

January 4:

HWM analyzes a closed low of at most 1005 mb centered near 23.9N, 57.5W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 25.5N, 57.3W. At 12Z, Roth lists this as a 45 kt subtropical cyclone at 25.5N, 57.0W. Ship highlights: 35 kt NE and 1013 mb at 12Z at 27.5N, 59.0W and at 18Z at 27.7N, 59.0W (COA); 25 kt S and 1004 mb at 12Z at 25.5N, 56.4W (COA, micro). One other low pressure of 1005 mb. “Between January 4 and January 9, 1951, this storm exhibited properties resembling a true tropical storm. Winds of force 7 to 10 (28-55 kt) were reported, the stronger winds generally observed closer to the center. The central pressure ranged from 1000-1005 mb, perhaps lower. The wind and pressure fields indicated a warm-core structure” (Colon 1956). “At this point, the surface low takes on a southwesterly track, approaching Puerto Rico from the northeast, while becoming smaller in scale as the wind field substantially contracts when compared to previous days, indicating it could be nearly tropical in character by the 5<sup>th</sup>” (Roth).

January 5:

HWM analyzes a closed low of at most 1005 mb centered near 21.3N, 60.6W. The MWR tracks of centers of cyclones shows a 12Z position near 22.3N, 61.2W with a 1000 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 21.8N, 60.6W. At 12Z, Roth lists this as a 45 kt subtropical storm at 22.5N, 61.0W. Ship highlights: 35 kt SE and 1008 mb at 18Z at 21.9N, 59.3W (micro); 30 kt S and 1004 mb at 18Z at 20.8N, 60.9W (COA).

January 6:

HWM analyzes a closed low of at most 1010 mb centered near 21.3N, 61.0W. The MWR tracks of centers of cyclones shows a 12Z position near 21.8N, 62.5W with a 999 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 21.2N, 62.0W. At 12Z, Roth lists this as a 50 kt tropical storm at 21.0N, 62.0W. Ship

highlights: 35 kt SSE and 1005 mb at 12Z at 20.7N, 61.0W (micro); 50 to 55 kt NE at 17Z at 20.5N, 62.7W (micro, Moore and Davis, Colon); 25 kt SW and 1004 mb at 18Z at 19.8N, 62.0W (micro). “It continued on a southward track reaching latitude 20N on January 6. A recurvature to the west occurred at this point, just in time to prevent the storm from striking land” (Colon). “The surface chart for 1230 GMT, January 6, 1951, shows the storm centered at 21N, 61.5W, with a minimum pressure of around 1004 mb and a wind report of force 8 (37 kt). Six hours after this map a ship reported winds of force 10 (48-55 kt) close to the center” (Colon, Hector). “The Atlantic maps reveal an example as recently as January 1951 in which a storm, devoid of fronts and exhibiting most of the characteristics of a tropical storm, produced a wind speed of over 60 mph north of the Leeward Islands” (Moore and Davis 1951). “It didn’t gain cyclone status until the 6<sup>th</sup> at ~ 21N, 61.8W...” (Hector).

#### January 7:

HWM analyzes a closed low of at most 1010 mb centered near 20.7N, 65.9W. The MWR tracks of centers of cyclones shows a 12Z position near 20.3N, 63.6W with a 1002 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered in the general vicinity of 21N, 64W. At 12Z, Roth lists this as a 45 kt tropical storm at 20.5N, 65.0W. No gales or low pressures. “The system makes its closest approach to Puerto Rico on the 7<sup>th</sup>, and their temperature at 500 hPa falls from a steady -6/-7C reading -10C, indicating that if there is a warm core, it is embedded still within a larger relatively cool pocket of air at 500 hPa. This would be a similar development sequence to Karl of 1980, the Unnamed Hurricane of 1991 off the East Coast of the United States, and recent South Atlantic Hurricane of March 2004” (Roth). “During the 7<sup>th</sup> and 8<sup>th</sup>, there are indications in the map series of south to southwesterly wind shear impacting the cyclone. The 500 hPa low is analyzed northeast of the surface low, which is consistent with a deep trough approaching the system from the west” (Roth).

#### January 8:

HWM analyzes a closed low of at most 1005 mb centered near 22.3N, 66.5W. A cold front is beginning to approach the cyclone but is located still 400 nmi northwest of the cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 21.9N, 65.3W with a 998 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 22.2N, 66.3W. At 12Z, Roth lists this as a 45 kt tropical storm at 22.0N, 66.5W. Ship highlights: 25 kt N and 1004 mb at 12Z at 22.0N, 67.3W (COA) and 22.3N, 67.3W (COA); 40 kt E and 997 mb at 18Z at 22.3N, 66.4W (micro); 35 kt WSW at 18Z at 22.2N, 66.5W (COA); 25 kt NE and 999 mb at 18Z at 23.0N, 66.6W (COA). “On the 8<sup>th</sup>, when it passed just north of Paso de la Mona, it recurved NE toward the southeastern Bahamas (where it originated [several] days before) to become an extratropical storm” (Hector).

#### January 9:

HWM analyzes a closed low of at most 1005 mb centered near 26.2N, 64.6W with a NE-SW cold front approaching the low, now located only 150 to 175 nmi NW of the cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 23.9N, 65.8W with a 1000 mb pressure. Microfilm at 12Z does not analyze a closed low; the microfilm

analysis could be indicating that the cyclone is getting absorbed by or merging with a front or another low pressure system. At 12Z, Roth lists this as a 45 kt tropical storm at 25.0N, 64.5W. Ship highlights: 40 kt W and 1008 mb at 00Z at 21.2N, 66.0W (micro); 25 kt NNE and 1005 mb at 00Z at 24.0N, 66.7W (COA).

January 10:

HWM analyzes a closed low of at most 1000 mb near 31.9N, 60.2W with a warm front extending from the low northeastward to 35N, 57W to 38N, 51W to 39N, 47W and a cold front extending from the low south-southwestward to 27N, 62W becoming a dissipating cold front at 24N, 64W to 20N, 67W. The MWR tracks of centers of cyclones shows a 12Z position near 30.5N, 59.5W with a 999 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 33.3N, 61.0W with the SW end of a possible warm front located at 36N, 56W extending northeastward to 39N, 47W. At 12Z, Roth lists this as a 45 kt extratropical cyclone at 32.0N, 61.0W. Ship highlights: 35 kt N and 1008 mb at 06Z at 31.0N, 62.9W (COA); 45 kt N and 1008 mb at 06Z at 29.5N, 62.5W (COA); ~45 kt NE and 1008 mb at 12Z at 33.7N, 61.0W (COA, micro, HWM). "The storm turned northward and joined a polar front on January 10 and became again an extratropical storm" (Colon). "The system slowly weakens, with the system becoming a frontal wave by 1230 GMT on the 10<sup>th</sup> as a new 500 hPa cyclone develops to its northwest out of the based of the approaching cold upper trough" (Roth).

January 11:

HWM analyzes a closed low of at most 1005 mb near 39.6N, 53.9W (probably the feature of interest) with a warm front extending from the low eastward to 41N, 48W to 39N, 37W and a cold front extending from the low southward to 35N, 54W, becoming a stationary front there extending to a spot low in the trough near 31N, 57W and a cold front extending south-southwestward from there. The MWR tracks of centers of cyclones shows a 12Z position near 37.9N, 53.9W with a 1007 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered in the general vicinity of 39.7N, 53.6W with a warm front extending from the low eastward and a likely cold front extending from the low south-southwestward. At 12Z, Roth lists this as a 45 kt extratropical cyclone at 39.0N, 54.0W. Ship highlights: 45 kt S at 00Z at 33.1N, 56.8W (COA); 35 kt (S or E?) and 1007 mb at 00Z at 35.5N, 55.7W (COA, micro); 25 kt S and 1003 mb at 18Z at 41.6N, 49.8W (COA); 35 kt S and 1009 mb at 18Z at 40.1N, 47.8W (COA, micro). Five other gales of 35 kt.

January 12:

HWM analyzes a closed low of at most 1005 mb centered near 45.3N, 40.3W (probably the feature of interest) with a warm front extending from the low east-southeastward and a cold front extending from the low southwestward for a short distance, becoming a warm front at 42N, 44W, and extending to another closed low of at most 1005 mb centered near 40.5N, 47.5W. A cold front extends southward from this low. The MWR tracks of centers of cyclones shows a 12Z position near 44.7N, 40.7W with a 1004 mb pressure. Microfilm at 00Z (the last time before the low travels off the northeast edge of the map) shows a closed low of at most 1008 mb centered near 41.3N, 49.3W within a trough of low pressure. Roth last lists this at 12Z as a 35 kt extratropical cyclone at

46.0N, 40.0W. Ship highlights: 35 kt NNW and 1012 mb at 00Z at 41.8N, 52.7W (COA, micro); 35 kt SSW at 06Z and 35 kt WSW at 12Z and 1007 mb at 44.0N, 41.0W (COA, HWM); 15 kt W and 999 mb at 18Z at 45.5N, 32.5W (COA). One other gale of 35 kt and at least five other low pressures between 1002-1005 mb. “The deepening extratropical cyclone rides northeastward along the frontal boundary, with the surface wave eventually dampening out somewhere east-northeast of 46N, 40W on the 12<sup>th</sup> as its 500 hPa cyclone starts shearing out in advance of the next closed cyclone dropping through New England” (Roth).

January 13:

The HWM analysis suggests that the feature of interest was absorbed by 12Z on the 13<sup>th</sup>. The MWR tracks of centers of cyclones shows a 12Z position near 44.0N, 38.6W with a 995 mb pressure. [This MWR chart appears to following the incorrect low starting on the 13<sup>th</sup> because HWM maps and available observations indicate that the feature of interest was either absorbed or dissipated and no longer closed by the 13<sup>th</sup>. The MWR chart is tracking the low referred to above in the HWM analysis sentence of the January 12<sup>th</sup> paragraph... “another closed low of at most 1005 mb centered near 40.5N, 47.5W”].

January 14:

The MWR tracks of centers of cyclones shows a 12Z position near 48.5N, 30.7W with a 989 mb pressure. [This MWR chart is not tracking the feature of interest on this day, as in the January 13<sup>th</sup> paragraph].

An intense frontal system was located in the northwestern Atlantic on New Years Day, 1951 aligned from about 45N, 52W to 25N, 70W. On the 1<sup>st</sup>, winds behind the front were as high as hurricane force and temperatures were cold. Since the flow east of that frontal system was all from the SSW, and the flow west of the frontal system was all from the north, a closed low did not yet exist on the 1<sup>st</sup>. On the 2<sup>nd</sup>, an extratropical cyclone developed along the front and is analyzed to have been sufficiently closed by 12Z to be considered an extratropical cyclone. The first point will be at 12Z on 2 January as a 50 kt extratropical cyclone at 30.5N, 58.0W. The cyclone moved southeastward and curved southward on the 3<sup>rd</sup> to a position near 26.5N, 54.5W by 12Z on the 3<sup>rd</sup> as a 45 kt extratropical cyclone. From the 3<sup>rd</sup> to the 6<sup>th</sup> of January, the cyclone moved southwestward and decelerated on the 5<sup>th</sup>, and it was located only a short distance north of the northern Leeward Islands and Virgin Islands before it turned westward on the 6<sup>th</sup>. The extratropical cyclone is analyzed to have transitioned to a tropical cyclone by 18Z on the 4<sup>th</sup> (today it may have been considered a subtropical cyclone from about 18Z on the 4<sup>th</sup> through 06Z on the 6<sup>th</sup>, but then it may have been considered purely tropical from the 6<sup>th</sup> through the 9<sup>th</sup> of January). On the 6<sup>th</sup> it turned westward and is analyzed to have been located at 20.7N, 62.0W at 12Z on the 6<sup>th</sup>. The cyclone reached its furthest south latitude of 20.2N, on the 7<sup>th</sup> from 00-06Z. On the 8<sup>th</sup>, it curved northward and on the 9<sup>th</sup> it turned north-northeastward ahead of an approaching frontal system. The analyzed furthest west position of the cyclone occurred at 12-18Z on the 8<sup>th</sup> around 22N, 66.5W. It interacted with a front, and the tropical cyclone is analyzed to have become extratropical by 00Z on the 10<sup>th</sup>. The cyclone maintained its identity through 12 January as it rode

northeastward along the front before it was absorbed or dissipated by the 13<sup>th</sup>. At 12Z on the 12<sup>th</sup>, the analyzed position is 44.7N, 41.0W as a 40 kt extratropical storm.

There were numerous gales and low pressures observed with this cyclone during both the tropical and extratropical phases. On the 4<sup>th</sup> and 5<sup>th</sup> a few gales of 35 kt were observed and a couple of 1004 mb pressures were also observed. The analyzed intensity on the 4<sup>th</sup> and 5<sup>th</sup> is 45 kt- consistent with David Roth's analysis. On the 6<sup>th</sup>, a ship recorded a force 10 wind (~50 kt) at 17Z (the highest wind recorded during the tropical portion of the lifetime of this cyclone), and on the 8<sup>th</sup> at 18Z, a 997 mb pressure was recorded (the lowest pressure recorded during the tropical phase) simultaneously with 40 kt winds. A peripheral pressure of 997 mb yields a wind speed to greater than 53 kt according to the Brown et al. southern pressure-wind relationship. The highest available wind observation on the 8<sup>th</sup> was 40 kt, and 40 kt was observed again on the 9<sup>th</sup>. A 55 kt peak intensity is analyzed from 12Z on the 6<sup>th</sup> through 06Z on the 9<sup>th</sup>. When the cyclone became tropical at 18Z on the 4<sup>th</sup>, 45 kt was analyzed, increasing to 55 kt by 12Z on the 6<sup>th</sup>. The 55 kt intensity at 06Z on the 9<sup>th</sup> is analyzed to have decreased to 50 kt by 12Z. This 50 kt intensity is maintained until 06Z on the 11<sup>th</sup> (well after the cyclone became extratropical). The intensity is analyzed to have decreased to 40 kt by 06Z on the 12<sup>th</sup>. No central pressures are analyzed to be added to HURDAT with this storm, but observations suggest a central pressure of near or possibly slightly less than 993 mb at 18Z on the 8<sup>th</sup>.

#### 1951 Storm 2 (Able) - (originally Storm 1)

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35495 05/15/1951 M=10 1 SNBR= 785 ABLE      XING=0
35495 05/16/1951 M= 9 2 SNBR= 785 ABLE      XING=0
      **          ** *
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(The 15<sup>th</sup> is removed from HURDAT.)

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35500 05/15* 0 0 0 0*280 646 25 0*300 665 25 0*308 671 25 0*
35505 05/16*314 685 25 0*319 708 30 0*318 732 30 0*310 753 35 0*
35505 05/16E320 680 30 0E319 708 30 0E316 738 35 0*306 764 35 0*
      **** *** ** *      **** *** **      *** ***
35510 05/17*301 771 40 0*294 782 55 0*287 786 65 0*280 788 65 0*
35510 05/17*294 775 45 0*288 784 55 0*282 788 65 0*275 789 70 983*
      *** *** **      *** ***      *** ***      *** *** ** ***
35515 05/18*273 787 70 0*269 782 70 0*270 777 75 0*272 773 80 0*
35515 05/18*271 786 75 0*269 783 75 0*270 779 75 982*272 775 70 985*
      *** *** **      *** **      ***      *** *** ** ***
35520 05/19*274 770 80 0*277 767 80 0*281 763 80 0*288 760 80 0*
35520 05/19*274 772 70 0*277 769 70 0*281 766 75 982*287 763 75 0*
      *** **      *** **      *** **      *** *** **
35525 05/20*297 758 80 0*306 756 85 0*315 754 90 0*324 753 90 0*
35525 05/20*295 760 75 980*305 757 75 0*314 754 75 0*324 752 75 979*
      *** *** **      *** *** **      *** **      *** ** ***
35530 05/21*332 752 95 0*344 747 100 0*355 742 100 0*359 736 100 0*
35530 05/21*335 750 75 0*347 746 75 0*356 742 75 978*361 738 80 0*
      *** *** **      *** *** **      ***      *** *** **
35535 05/22*362 730 95 0*365 722 90 0*366 712 85 0*366 702 80 0*
35535 05/22*363 732 80 0*365 723 80 0*366 711 80 973*367 699 80 0*
      *** *** **      *** **      *** **      *** *** **
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35540 05/23*365 690 70 0*364 670 60 0*365 650 50 0E371 636 45 0*
35540 05/23*368 687 80 0*370 670 80 0*373 650 75 984*376 635 65 0*
      *** ** *      *** **      *** **      ***** ** **

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35545 05/24E379 623 45 0E387 612 45 0E395 600 45 0E401 592 45 0*
35545 05/24*380 622 55 0*387 612 50 0*397 600 45 0*405 587 35 994*
      **** ** *      *      **      ****      **** ** **

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35550 HR

### U.S. Close approach:

#### Tropical storm impact for the east coast of Florida

Minor track changes and major intensity changes are analyzed for this May hurricane. Major changes are also made to the genesis and the decay of this cyclone. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (1951) (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Moore and Davis (1951), Tannehill, and Roth.

#### May 15:

HWM analyzes a spot low located near 25.3N, 66.7W located within a trough from around 22N, 69W to the southwest end of a SW-NE warm front from 29N, 67W to 37N, 53W. HURDAT lists this as a 25 kt tropical depression at 30.0N, 66.5W. The MWR post-season track map shows a 12Z position near 29.5N, 66.3W. Microfilm at 12Z analyzes a spot low near 28.4N, 66.1W located along a trough or front (similar to the HWM analysis). Ship highlights: 35 kt ENE and 1026 mb at 06Z at 28.5N, 79.8W (COA). “The wave is shown amplifying on the 15/0030Z and 15/1230Z surface charts, and an initial vortex developing on the 16/0630Z surface chart after having moved rather rapidly west-northwestward” (ATS).

#### May 16:

HWM analyzes a closed low of at most 1010 mb centered near 23.6N, 70.5W. HURDAT lists this as a 30 kt tropical depression at 31.8N, 73.2W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a closed low of at most 1011 mb centered near 31.5N, 73.2W. Ship highlights: 35 kt NE and 1013 mb at 12Z at 33.0N, 75.5W (COA, micro); 35 kt NE and 1017 mb at 12Z at 33.4N, 76.3W (COA); 35 kt NE and 1018 mb at 12Z at 34.2N, 75.6W (COA). “It might be noted that up until 16/1500Z, convergence was taking place aloft over the surface vortex, and after that time, the vortex came under the effects of northerly winds aloft, or in effect, divergent winds. The divergent winds allowed outflow to take place above the surface vortex... This allowed the surface vortex to deepen and also caused it to moved southwestward at 12 to 15 kt” (ATS).

#### May 17:

HWM analyzes a hurricane of at most 995 mb centered near 28.4N, 78.7W. HURDAT lists this as a 65 kt hurricane at 28.7N, 78.6W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1002 mb pressure and the MWR

post-season track map also shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 28.7N, 79.0W. Ship highlights: 40 kt NE and 1011 mb at 00Z at 30.9N, 79.5W (COA); 50 kt N and 994 mb at 12Z at 28.2N, 79.6W (micro). Three other gales between 35-50 kt and four other low pressures between 997-1005 mb. Land/station highlights: 38 kt W (max w/1-min) at Miami, FL (climo); 31 kt NE (max w/1-min) at Jacksonville, FL (climo). Aircraft highlights: center fix at 1845Z at 27.3N, 78.9W with a 983 mb central pressure and 65 kt max estimated winds (ATS). “[Able] reached tropical storm intensity after 17/0030Z. It reached hurricane intensity after 17/1230Z [after slowing its southward motion to 8 to 10 kt]. [Able] then slowed and began to curve towards the southeast at about 4 to 6 kt as it came under the effects of northwesterly winds associated with the low aloft, as shown on the 17/1500Z upper air charts” (ATS). “The earliest fully developed hurricane of record in the Atlantic developed east of Florida during the night of May 16. At 0700 EST (1200Z) on the 17<sup>th</sup>, the steamship R. P. Smith reported winds of Beaufort force 9 to 10, falling pressure, and waves 25 to 30 feet high near 28.5N, 79.5W. This was the first definite information that a severe storm had formed. The Navy recon squadron was ordered out immediately. During the 17<sup>th</sup>, they reported a storm of full hurricane strength moving southward” (MWR). “The hurricane was fixed by Navy Hurricane Reconnaissance aircraft reports at 27.3N, 78.9W at 17/1845Z. The eye was described as poorly defined insofar as clouds were concerned but clearly defined by pressure and winds. The maximum winds were estimated to be 65 kt to the east of the center and the minimum pressure was 983 mb in the eye” (ATS). From the May, 1951 National Climatic Data Summary... “A pre-season hurricane, the earliest on record, appeared off the Florida coast on the 17<sup>th</sup>... Its nearest approach to [Florida] was about 100 miles east of Ft. Pierce, FL and its only effects on land were fresh winds and light showers...” (climo).

May 18:

HWM analyzes a hurricane of at most 1005 mb centered near 26.8N, 78.4W. HURDAT lists this as a 75 kt hurricane at 27.0N, 77.7W. The MWR tracks of centers of cyclones shows a 12Z position near 27.3N, 77.9W with a 982 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a hurricane of at most 999 mb centered near 27.2N, 78.0W. Ship highlights: 20 kt ENE and 1005 mb at 00Z at 31.2N, 79.0W (COA); 35 kt S and 1007 mb at 06Z at 25.8N, 77.4W (COA). One other low pressure of 1005 mb. Land highlights: 80-85 kt for 5 hours sometime between 00Z-12Z at Walker’s Cay (27.1N, 78.3W) (MWR); ~65-70 kt at Grand Bahama Island and Little Abaco Island (MWR). One other low pressure of 1004 mb. Aircraft highlights: Navy radar center fixes at 0520Z, 0800Z, and 0830Z between 26.9-27.0N, 78.2W (micro); center fix at 1215Z at 27.0N, 78.1W with 982 mb central pressure and 70 kt max winds (ATS, micro); center fix at 2047Z at 27.4N, 77.5W with 985 mb central pressure and 80 kt max winds. “It was later determined that the hurricane was moving on a broad curving loop which brought it over Little Bahama Banks during the night of the 17<sup>th</sup> and on the 18<sup>th</sup>. Walker’s Cay on these banks reported 90 to 95 mph [80 to 85 kt] winds for 5 hours during the night of the 17-18<sup>th</sup>, and Grand Bahama and Little Abaco islands both reported about the lower limits of hurricane force” (MWR). “The hurricane curved slowly eastward at about 4 kt after 18/0630Z under the westerly

flow aloft... and was fixed by a Navy Hurricane Reconnaissance plane at 27N, 78.1W at 18/1215Z. The central pressure in the eye was 982 mb. The maximum winds had increased to 70 kt to the east of the eye with 55 kt winds extending outward to the east and northeast about 40 miles from the [eye] edge. Maximum winds to the west and southwest of the eye were 60 kt and extended about 25 miles from the [eye] edges. After this fix, the hurricane began curving northeastward at about 4 kt under southwesterly flow aloft. The hurricane was fixed by Navy Hurricane Reconnaissance aircraft at 27.4N, 77.5W with 18/2047Z with a minimum pressure in the eye of 985 mb and maximum winds of 80 kt” (ATS).

May 19:

HWM analyzes a hurricane of at most 1005 mb centered near 28.4N, 76.3W. HWM analyzes another low of at most 1015 mb centered near 36.5N, 74W with a dissipating cold front extending southwestward from the low 34N, 76W becoming a stationary front at 32N, 80W, which extends to 32N, 83W to 34N, 85W to 40N, 83W. HURDAT lists this as an 80 kt hurricane at 28.1N, 76.3W. The MWR tracks of centers of cyclones shows a 12Z position near 28.7N, 77.2W with a 982 mb pressure. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 996 mb centered near the HURDAT position. Aircraft highlights: Navy radar center fixes at 0200, 0300, 0400, 0500, 0600, 0700, 0800, and 0900Z between 27.4-27.9N, 76.8-77.1W (micro); center fix (loran) at 1237Z at 28.1N, 76.7W with a 982 mb central pressure and 75 kt max winds (micro, ATS); center fix at 2233Z at 29.1N, 76.1W with 980 mb central pressure and 85 kt max winds (micro, ATS); 65 kt WSW at flight-level of 800 ft and 1005 mb at 2315Z at 28.9N, 76.2W (micro). “A fix by the Navy at 28.1N, 76.7W at 19/1237Z verified a continued northeasterly movement at 4 kt. The maximum winds reported... were 75 kt. A central pressure of 982 mb was reported in the eye. Navy Hurricane Reconnaissance aircraft reports... fixed the eye of the hurricane at 29.2N, 76.1W at 19/2233Z. Maximum winds had increased to 85 kt. Lowest pressure had decreased to 980 mb in the eye. This fix showed more of a north-northeasterly movement with acceleration to 8 to 10 kt” (ATS).

May 20:

HWM analyzes a hurricane of at most 1005 mb centered near 31.3N, 75.0W with a WSW-ENE stationary front located from 32N, 73W to 34N, 67W to east of 34N, 55W and a dissipating stationary front plotted from 32N, 78W to 31N, 80W to 31N, 82W to 33N, 84W to 36N, 84W. HURDAT lists this as a 90 kt hurricane at 31.5N, 75.4W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1002 mb pressure and the MWR post-season track map also shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 999 mb centered near the HURDAT position with the west-southwest end of a WSW-ENE frontal boundary located a few hundred nm north of the cyclone. Ship highlights: 75 kt NNE and 1013 mb at 06Z at 32.3N, 77.7W (micro). Aircraft highlights: center fix estimate at 1300Z at 31.2N, 75.5W (ATS, micro); 65 kt at flight-level and 1001 mb at 1435Z at 31.0N, 75.6W (micro); Air Force center fix at 1855Z at 32.6N, 75.2W with 979 mb central pressure and 90 kt max winds (micro, ATS); Navy radar center fixes at 2000 and 2100Z between 32.7-33.1N, 74.8-75.0W (micro). “The hurricane continued moving

north-northeastward at 11 kt and was fixed by Navy Hurricane Reconnaissance aircraft at 31.2N, 75.5W at 20/1300Z, and by Air Force reconnaissance reports at 32.6N, 75.2W at 20/1855Z. During the latter reconnaissance, the maximum winds were reported to have increased to 90 kt and the lowest pressure in the eye was 978.6 mb” (ATS).

May 21:

HWM analyzes a hurricane of at most 1000 mb centered near 35.6N, 73.1W with the west end of a W-E warm front located several hundred miles northeast of the cyclone and a cold front approaching from the northwest located over the Great Lakes region of the U.S. HURDAT lists this as a 100 kt hurricane at 35.5N, 74.2W. The MWR tracks of centers of cyclones shows a 12Z position near 35.6N, 74.9W with a 998 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a closed low of at most 993 mb centered near 35.7N, 73.8W. Ship highlights: 50 kt WNW and 1000 mb at 12Z at 35.3N, 74.9W (micro); 55 kt SE and 1016 mb (ship pressure biased 7 to 11 mb too high) at 18Z at 39.1N, 73.3W (COA). Four other gales between 35-50 kt and three other low pressures between 1000-1003 mb. Land/station highlights: 20 kt NNW and 1005 mb at 06Z at Cape Hatteras, NC (micro). Aircraft highlights: Navy radar center fix at 0540Z at 34.8N, 74.6W (micro); center fix at 1345Z at 35.8N, 74.1W with 978 mb central pressure and 100 kt max winds (ATS, MWR); 700 mb height in eye of 9320 feet during the afternoon (micro); center fix at 2015Z at 36.6N, 74.0W (ATS). “The completion of the loop turned the hurricane northeastward over the Atlantic and it passed 70 miles east of Cape Hatteras on the 21<sup>st</sup>” (MWR). Regarding the intensity... “The strongest winds [for the lifetime of the cyclone] were estimated by aircraft at 100 knots (115 mph) on the 21<sup>st</sup>” (MWR). “North-northeastward movement continued at 11 kt, and a Navy Hurricane Reconnaissance aircraft reported the eye of the hurricane fixed at 35.8N, 74.1W at 21/1345Z. The lowest pressure in the eye was 978 mb and maximum winds of 100 kt were reported in the northwest quadrant. Winds of 65 kt extended outwards from the center for a distance of 50 miles and 40 kt winds outward for a distance of 100 miles. Moderate to heavy turbulence was encountered. The eye was poorly defined. Air Force aircraft reconnaissance [fixed Able] at 36.6N, 74W at 21/2015Z. The hurricane was described as a very small, well-defined one with maximum winds estimated at 90 kt and hurricane force winds extending outward to 50 miles in all quadrants. The hurricane was described as very symmetrical” (ATS). From the May, 1951 National Climatic Data Summary... “Moving on a northerly course [the cyclone] curved out into the Atlantic on the 21<sup>st</sup>. Its nearest approach to [North Carolina] was about 100 miles east of Cape Hatteras, NC, and its only effects on land were fresh winds and light showers...” (climo).

May 22:

HWM analyzes a hurricane of at most 1000 mb centered near 36.6N, 71.3W with the east end of a W-E stationary front located more than 250 nmi ENE of the cyclone and another frontal system approaching from the northeast located over Lakes Ontario and Erie. HURDAT lists this as an 85 kt hurricane at 36.6N, 71.2W. The MWR tracks of centers of cyclones shows a 12Z position near 38.1N, 70.7W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 993 mb centered near 37.3N, 71.3W.

Ship highlights: 40 kt WSW and 1002 mb at 18Z at 36.0N, 70.0W (COA); 50 kt SSE and 998 mb at 18Z at 36.5N, 69.3W (micro); 60 kt W and 1002 mb at 18Z at 36.1N, 70.8W (micro). Five other gales between 35-40 kt and two other low pressures of 1003 mb. Aircraft highlights: Navy radar center fixes at 0415, 0515, 0630, 0730, and 0820Z between 36.0-36.6N, 72.2-73.0W (micro); Navy radar center fix at 1105Z at 36.8N, 71.1W with 973 mb central pressure and 90 kt max winds (ATS, micro); Air Force center fix (loran) at 1955Z at 36.7N, 69.2W with 80-90 kt estimated surface winds. “[Able curved sharply eastward at 8 kt after the last reconnaissance fix [on the 21<sup>st</sup>]. Navy radar aircraft from Patuxent River, Maryland tracked the hurricane during the night, and a Navy Hurricane Reconnaissance aircraft reported the hurricane fixed early the next morning at 36.8N, 71.1W at 22/1105Z indicating a continued eastward movement at 10 to 12 kt. The aerologist reported the eye of the hurricane well defined, but open in the southwest quadrant with a minimum pressure of 973 mb. Maximum winds reported were 90 kt in the southwest quadrant. Air Force reconnaissance fixed the hurricane at 36.7N, 69.2W at 22/1955Z. The eye was approximately 15 miles in diameter and maximum winds of 80 to 90 kt were encountered on the outer edge of the eye. The 45 kt wind circle extended outward to only 50 miles from the center” (ATS). From the May, 1951 State Climatological Data Summary for Maryland and Delaware... “An early season hurricane made threatening gestures at Atlantic coastal areas on the 22<sup>nd</sup> but moved too far offshore to produce any high winds or rain over land areas” (climo).

May 23:

HWM analyzes a tropical storm of at most 995 mb centered near 36.3N, 65.0W. HWM analyzes a separate, extratropical low of at most 1000 mb centered near 48N, 66W with a cold front extending from that low to 45N, 68W to 43N, 71W to 41N, 75W to 39N, 80W. HURDAT lists this as a 50 kt tropical storm at 36.5N, 65.0W. The MWR tracks of centers of cyclones shows a 12Z position near 36.9N, 65.1W with a 993 mb pressure, and the MWR post-season track map shows a 12Z position near 37.3N, 65.3W. Microfilm at 12Z analyzes a closed low of at most 987 mb centered near 37.5N, 65.0W. Ship highlights: 30 kt WNW and 1005 mb at 00Z at 36.0N, 70.0W (COA, micro); 75 kt SSE at 12Z at 37.6N, 64.6W (micro); 60 kt SSW at 12Z at 36.4N, 65.3W (micro); 45 kt W [with pressure illegible and possibly inside RMW] at 13Z at 37.5N, 65.0W (micro); 10 kt ESE and 1002 mb at 18Z at 39.2N, 66.0W (COA, micro). One other legible low pressure of 1004 mb. Aircraft highlights: Air Force center fix at 1457Z at 36.9N, 64.3W with 984 mb central pressure and 90 kt maximum flight-level winds encountered (ATS). “On the 23<sup>rd</sup> of May, an Air Force reconnaissance aircraft reported that the hurricane was crescent-shaped with the entire north sector open with very little weather present. Maximum winds of 45 kt were encountered in the north sector while winds of 90 kt were encountered on the south side. A lowest pressure of 994 mb was reported in the center and the eye was reported fixed at 36.9N, 64.3W at 23/1457Z. After 23/1830Z, the hurricane began to curve northeastward at 12 kt” (ATS).

May 24:

HWM analyzes a closed low of at most 1000 mb centered near 39.3N, 60.0W, with the west end of a W-E stationary front located about 150-200 nmi east of the low. HWM analyzes a more powerful (extratropical) low of at most 990 mb centered near 39.5N,

70.5W with a warm front extending northeastward from this low and a cold front extending south-southwestward and then southwestward from the low. HURDAT lists this as a 45 kt extratropical storm at 39.5N, 60.0W. The MWR tracks of centers of cyclones shows a 12Z position near 39.3N, 59.7W with a 995 mb pressure and the MWR post-season track map shows a 12Z position near 39.9N, 60.0W. The 12Z microfilm analysis is nearly identical to the HWM analysis. Ship highlights: 15 kt E and 1000 mb at 12Z at 40.5N, 59.7W (COA, micro, HWM); 15 kt E and 998 mb at 18Z at 40.8N, 58.5W (COA). Three other low pressures between 1002-1005 mb. Aircraft highlights: Air Force center fix (loran) at 38.9N, 60.3W (micro); Air Force center fix at 1547Z at 40.3N, 59.3W with 994 mb central pressure and 45 kt max winds (ATS). "Thereafter, it turned towards the east-northeast and dissipated over the Atlantic near 40N, 60W on May 24" (MWR). "The hurricane weakened as it moved to higher latitudes and encountered cooler, drier air. It decreased to tropical storm intensity after 24/0030Z and dropped below tropical storm intensity after 24/1230Z. This was verified by an Air Force reconnaissance aircraft which reported that a closed circulation had been located at 40.2N, 59.3W at 24/1547Z with a lowest pressure of 994 mb. No winds were observed to be over 45 kt. The disturbance continued moving northeastward and dissipated shortly after the last fix..." (ATS).

May 25:

HWM and microfilm (at 12Z) no longer analyze the feature of interest on this day. HURDAT no longer lists a system on this day.

On 14 and 15 May, a sharp trough extended through the area of the western Atlantic east of the Bahamas. HURDAT started this system at 06Z on 15 May as a 25 kt tropical depression. Observations indicate that no closed circulation was present on 15 May so the 15<sup>th</sup> is removed from HURDAT. By 00Z on the 16<sup>th</sup>, there was a closed circulation present. This cyclone is started at 00Z on the 16<sup>th</sup> (18 hours later than HURDAT originally) as a 30 kt extratropical cyclone half a degree longitude east of the previous HURDAT position at that time. HURDAT originally did not list the beginning portion of the lifetime of Able as extratropical. By 12Z on 16 May, the wind speed of the extratropical cyclone is analyzed to have increased to 35 kt (6 hours earlier than originally), and by 18Z, it is analyzed that the cyclone transitioned to a tropical cyclone [today it may have been subtropical at 18Z on the 16<sup>th</sup>]. The rapid westward motion on the 16<sup>th</sup> along with the wind structure observed indicates that the cyclone was extratropical for the first 18 hours of its lifetime. This system is analyzed to have become a tropical cyclone 36 hours later than HURDAT originally (a major change). On the 17<sup>th</sup>, Able rapidly intensified to hurricane strength, decelerated, and made a gradual turn toward the south just east of Florida. At 12Z on the 17<sup>th</sup>, a ship recorded 50 kt with a 994 mb pressure and at 1845Z, an aircraft measured a central pressure of 983 mb, which yields 72 kt according to the Brown et al. north of 25N, pressure wind relationship for intensifying systems. This 983 mb central pressure is added to HURDAT at 18Z on the 17<sup>th</sup>. A 70 kt intensity is chosen for HURDAT at 18Z on the 17<sup>th</sup> (up from 65 kt originally). No change is made to the time Able became a hurricane (12Z on the 17<sup>th</sup>). Able produced a tropical storm impact in Florida (as evidenced by the 38 kt recorded in Miami and the 31 kt recorded at Jacksonville). Early on the 18<sup>th</sup>, Able reached its

furthest south point not far from Walker's Cay in the Bahamas (where 80-85 kt winds were reported lasting for 5 hours), and then it turned eastward, and eventually north-northeastward by the 19<sup>th</sup>, moving slowly on the 18<sup>th</sup> and slowly accelerating on the 19<sup>th</sup>. Aircraft central pressures of 982 and 985 mb were measured on the 18<sup>th</sup> at 12Z and 2045Z respectively, and these central pressures are added to HURDAT at 12 and 18Z respectively on the 18<sup>th</sup>. The central pressures yield 70 and 66 kt respectively, making use of the north of 25N pressure-wind relationship. At 12Z on the 18<sup>th</sup>, the RMW was near climatology, and the forward speed of the cyclone was about 5 kt. A 75 kt intensity is chosen from 00Z through 12Z on the 18<sup>th</sup> under the assumption that the winds recorded at Walker's Cay were biased a little too high. A 70 kt intensity is chosen for 18Z on the 18<sup>th</sup> (down from 80 kt originally at that time). On the 19<sup>th</sup>, aircraft central pressures of 982 and 980 mb were recorded at 1237Z and 2233Z respectively, and these central pressures are added to HURDAT at 12Z on the 19<sup>th</sup> and 00Z on the 20<sup>th</sup> respectively. These central pressures yield 70 and 73 kt respectively making use of the pressure-wind relationship for north of 25N. The RMW on the 19<sup>th</sup> was near climatology and the speed of the storm accelerated from 5 kt to 8 kt during the day. Intensities of 75 kt are chosen from 12Z on the 19<sup>th</sup> through 00Z on the 20<sup>th</sup> (all down from 80 kt originally). No track changes of larger than three-tenths of a degree were made from the 18<sup>th</sup> through the 22<sup>nd</sup>. On the 20<sup>th</sup>, Able move northward and passed east of Cape Hatteras, NC early on the 21<sup>st</sup>, but no tropical storm force winds were felt in North Carolina. At 1855Z on the 20<sup>th</sup>, a 979 mb central pressure was recorded by aircraft and this value is added to HURDAT at 18Z on the 20<sup>th</sup>. A central pressure of 979 mb yields 74 kt according to the north of 25N pressure-wind relationship and 75 kt is chosen for HURDAT at 18Z on the 20<sup>th</sup> (down from 90 kt originally). At 1345Z on the 21<sup>st</sup>, an aircraft central pressure of 978 mb was recorded and the 75 kt analyzed intensity is maintained through 12Z on the 21<sup>st</sup> (down from 100 kt originally at 06 and 12Z on the 21<sup>st</sup>). The 978 mb central pressure is added to HURDAT at 12Z on the 21<sup>st</sup>. Late on the 21<sup>st</sup>, Able turned eastward around 36N and moved in a direction between east and east-northeast through the 23<sup>rd</sup> followed by a northeastward turn in the 24<sup>th</sup> in the vicinity of 40N, 60W. On the 23<sup>rd</sup>, the position is adjusted eight-tenths of a degree north based on a ship observation of a west wind very near the center at 37.5N at 13Z on the 23<sup>rd</sup>, and on the 24<sup>th</sup> track changes are half a degree or less. On the 21<sup>st</sup> around 19Z, aircraft measured a 700 mb height in the eye of 9,320 ft, suggesting a central pressure in the range of 954-972 mb, and at 1105Z on the 22<sup>nd</sup>, a 973 mb central pressure [the lowest recorded for the lifetime of the cyclone] was recorded by aircraft. A central pressure of 973 mb is added to HURDAT at 12Z on the 22<sup>nd</sup>. Since the previous central pressure measurement of 978 mb was recorded about 22 hours prior to the 973 mb measurement, it possible that the cyclone deepened to below 973 mb between the two observations and subsequently rose again to 973 mb; but it is not reasonable to assume that a significantly deeper cyclone existed within than short span of time. A central pressure of 973 mb yields 80 kt according to the north of 35N pressure-wind relationship. The RMW and speed of the storm were near average, and 80 kt [the peak analyzed intensity of the cyclone] is chosen at all times from 18Z on the 21<sup>st</sup> through 06Z on the 23<sup>rd</sup> (down from 100 kt at 18Z on the 21<sup>st</sup> and up from 60 kt at 06Z on the 23<sup>rd</sup>). The last hurricane force wind recorded by a ship was 75 kt at 12Z on the 23<sup>rd</sup>, and after that, Able weakened rather quickly as it moved northeastward over very cold waters. Aircraft measured a central pressure of 984 mb at 1457Z on the 23<sup>rd</sup>, which

equals 69 kt north of 35N, and the 984 mb central pressure is added to HURDAT at 12Z on the 23<sup>rd</sup>. Intensities of 75 and 65 kt are chosen for 12 and 18Z on the 23<sup>rd</sup> (up from 50 and 45 kt respectively). HURDAT previously listed this cyclone as becoming extratropical at 18Z on 23 May with dissipation occurring after 18Z on 24 May. Observations indicate that Able never became extratropical, and on the 24<sup>th</sup>, it was located in the warm sector of a large extratropical cyclone emerging off the northeast coast of the U.S. On the 24<sup>th</sup> at 1547Z, aircraft measured a central pressure of 994 mb, and this value is added to HURDAT at 18Z on the 24<sup>th</sup>. A central pressure of 994 mb yields 58 kt according to the north of 35N pressure-wind relationship. The environmental pressure was very low, and ship observations very near the center indicate a closed circulation with very light winds. Intensities of 45 and 35 kt are analyzed for 12 and 18Z on the 24<sup>th</sup> (down from 45 kt originally at 18Z). No change is made to the timing of dissipation of this cyclone. After 18Z on the 24<sup>th</sup>, Able dissipated before it could be absorbed by the approaching extratropical cyclone.

Additional info and interesting quotes regarding Able:

“The central ‘eye’ was well formed and about 20 miles in diameter during much of the storm’s life and the central pressure was well below 29 inches” (MWR).

“The first disturbance of the season set a new record. It was the first storm of full hurricane force ever recorded in the month of May” (Tannehill).

“Although this hurricane was unique in that it was the first of its type noted so near to the United States coast outside the usual tropical storm season, a study of weather maps of the Atlantic area reveals quite similar cases of hurricanes, or near hurricanes, in the subtropic Atlantic even in midwinter. These have been far at sea for the most part, in the lesser-traveled portions of the Atlantic, and have therefore attracted little notice... The Atlantic maps reveal an example as recently as January 1951 in which a storm, devoid of fronts and exhibiting most of the characteristics of a tropical storm, produced a wind speed of over 60 mph north of the Leeward Islands... Many such cases of cyclogenesis in the subtropical north Atlantic outside the usual hurricane season do not lend themselves to frontal analysis, nor do they have the exact characteristics expected of a tropical storm. The May hurricane falls in this category” (Moore and Davis 1951).

“The analysis... indicates that a combination of several favorable circumstances led to the pre-season occurrence of the hurricane in May 1951. The hurricane began in connection with a cold high-level low at subtropic latitudes. It appears that a superposition of a divergent wind field at upper levels over the incipient storm was an important feature of the intensification... Such storms as this one are believed to comprise a category distinct from the extratropical, and the usual tropical cyclone. They are associated with a cold-core low which becomes warm-core in the lower levels with intensification. The top of this warm core, and consequently of the steering level, appears to be at a considerably lower level than for a pure tropical storm with a similar radial pressure gradient” (Moore and Davis 1951).

The following two quotes are regarding a suspect that occurred just east of Able from May 16-20:

“It might be noted that a second vortex with quite similar characteristics, failed to produce winds of more than 45 mph” (Moore and Davis).

“The life cycle of the subtropical/tropical storm to [Able’s] east is covered in Moore and Davis, and through the Daily Weather Map and Historical Weather Map Series. The cyclone formed east of Able at around the same time Able’s circulation formed. As Able rapidly intensified and was swung southward by their parent 500 hPa low, the steering flow was strongly out of the south, and this eastern cyclone was swept northward towards the stationary frontal zone offshore North Carolina. The pressure gradient was depicted as tight in both map series, so there is a strong likelihood that it was tropical through much of its life. After briefly occluding along this zone and becoming extratropical, which is depicted in the Daily Weather Map series, it was quickly absorbed into the larger circulation of Able, which at that time was moving northward in response to its presence offshore North Carolina” (Roth).

### 1951 Storm 3 (Baker) – (originally Storm 2)

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35555 08/02/1951 M= 4 2 SNBR= 786 BAKER XING=0
35555 08/02/1951 M= 4 3 SNBR= 786 BAKER XING=0
*

35560 08/02* 0 0 0 0*210 520 25 0*220 543 35 0*227 554 40 0*
35560 08/02* 0 0 0 0*209 529 30 0*218 539 35 0*227 549 45 0*
*** ** ** *** **

35565 08/03*237 565 45 0*249 575 50 0*262 585 50 0*274 593 50 0*
35565 08/03*237 559 45 0*250 569 50 0*264 579 50 0*277 589 50 0*
*** ** ** *** **

35570 08/04*286 600 50 0*299 605 45 0*313 608 45 0*328 610 40 0*
35570 08/04*290 598 50 0*304 605 50 0*319 608 45 999*334 610 40 0*
*** ** ** *** **

35575 08/05*343 610 40 0*354 609 35 0*362 608 35 0*390 590 30 0*
35575 08/05*349 605 35 0*364 601 30 0* 0 0 0 0* 0 0 0 0*
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35580 TS

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Minor track changes and minor intensity changes are analyzed for this tropical storm that stayed out over the open Atlantic. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

July 31:

HWM analyzes a spot low in an open trough near 14N, 51.8W. HURDAT does not yet list a system on this day. No gales or low pressures. ATS shows a low near 14N, 51W. “The 30/1230Z surface chart fixed the position of the vortex at 13N, 50W. As the vortex intensified it began to slow its movement to about 5 kt until 31/1230Z” (ATS).

## August 1:

HWM analyzes a tropical storm of at most 1010 mb centered near 15.1N, 50.3W. HURDAT does not yet list a system on this day. No gales or low pressures.

## August 2:

HWM analyzes a tropical storm of at most 1010 mb centered near 18.3N, 53.7W. HURDAT lists this as a 35 kt tropical storm at 22.0N, 54.3W. Ship highlights: 40-45 kt E and 1014 mb at 20Z at 23.6N, 54.0W (micro). “An ‘easterly wave’ developed into a tropical storm far to the northeast of the Leeward Islands on August 2, near 23N, 56W” (MWR). “The analysis of the 02/1830Z surface chart showed ship NRDC at 23.4N, 53.8W reported ESE force seven... This report [in conjunction with additional reports] indicated the vortex had intensified to tropical storm intensity and fixed the position at 22.8N, 54.1W with a NNW movement, widespread precipitation and force four to seven winds (15-30 kt) spread over an area four to seven hundred miles to the northwest” (ATS).

## August 3:

HWM analyzes a tropical storm of at most 1005 mb centered near 25.1N, 57.8W. HURDAT lists this as a 50 kt tropical storm at 26.2N, 58.5W. The MWR tracks of centers of cyclones shows a 12Z position near 27.2N, 58.7W with a 1008 mb pressure, and the MWR post-season track map shows a 12Z position near 26.9N, 58.3W. Microfilm at 12Z analyzes a hurricane of at most 1008 mb centered near 27N, 58W. Ship highlights: 35-40 kt E and 1015 mb at 00Z at 24.1N, 54.0W (micro); 45 kt E and 1015 mb at 12Z at 28.5N, 57.7W (COA, micro); 45 kt SE and 1017 mb at 18Z at 29.4N, 57.0W (COA, micro). Three other gales. Aircraft highlights: possible Air Force center fix at 12Z at 27.5N, 57.5W (micro); possible center fix at 1715Z at 26.0N, 58.3W with 35 kt highest wind encountered [plane may have been searching too far south].

## August 4:

HWM analyzes a closed low of at most 1005 mb centered near 32N, 60.1W. HURDAT lists this as a 45 kt tropical storm at 31.3N, 60.8W. The MWR tracks of centers of cyclones shows a 12Z position near 32.1N, 60.3W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near 32.5N, 61.0W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 32.2N, 60.5W. Ship highlights: 45 kt SE and 1013 mb at 00Z at 30.0N, 59.1W (COA, micro); 45 kt SE and 1008 mb at 06Z at 31.1N, 60.2W (COA, micro); 20 kt NNW and 1006 mb at 12Z at 32.1N, 61.1W (COA); 30 kt SE and 1015 mb at 18Z at 34.9N, 58.7W (COA). Three other gales between 00Z–06Z between 35-40 kt. Aircraft highlights: center fix at 1225Z at 32.0N, 60.9W with 999 mb central pressure and 40 kt estimated maximum winds (micro). “It moved on a broad curving path to the northwest and north and passed about 275 miles east of Bermuda on August 4 and thereafter turned northeastward over the Atlantic” (MWR). “An Air Force Reconnaissance aircraft fixed the center of the storm at 32.1N, 61.2W at 04/1200Z. This aircraft fix in conjunction with the numerous ship reports on the 04/1230Z surface chart showed that the more northerly course had been established” (ATS)

August 5:

HWM analyzes a tropical storm of at most 1010 mb centered near 36.4N, 56.4W with a frontal system approaching, which extends from 50N, 56W to 45N, 59W to 40N, 63W to 35N 69W. HURDAT lists this as a 35 kt tropical storm at 36.2N, 60.8W. The MWR tracks of centers of cyclones shows a 12Z position near 36.0N, 55.6W with a 1000 mb pressure and the MWR post-season track map shows a 12Z position near 38.8N, 57.9W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 39.8N, 57W with an elongated, extratropical low approaching from the west. "The ship NRDC apparently altered her course to follow the center of the storm and gave reports on the storm until 05/0030Z, at which time the storm has passed 180 miles east of Bermuda and began to diminish in intensity. A regeneration of the wind force in the storm was noticed during the period from 05/0630Z until 05/1830Z as the storm approached a strong frontal wave off the northeastern coast. While the center of the storm was indiscernible, force eight to ten winds (35-50 kt) were reported in the vicinity of 41N, 55W for a short time as the frontal system intensified" (ATS).

August 6:

HURDAT no longer lists this system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 43.6N, 55.6W with a 1002 mb pressure. "By 06/0630Z, the high winds had dissipated and only the frontal wave was evident on the chart" (ATS).

August 7:

The MWR tracks of centers of cyclones shows a 12Z position near 50.2N, 46.6W with a 1002 mb pressure.

August 8:

The MWR tracks of centers of cyclones shows a 12Z position near 55.9N, 34.1W.

August 9:

The MWR tracks of centers of cyclones shows a 12Z position near 57.2N, 25.0W with a 999 mb pressure.

The disturbance that would eventually become Tropical Storm Baker was noted as early as 30 July in the Navy post-season tropical cyclone summary book (ATS) around 13N, 50W. On the 31<sup>st</sup>, HWM and ATS show the position of a disturbance or low near 14N, 51W. Ryan Truchelut (a graduate student at FSU) mentions the possibility of a TS Baker track extension back to near 17N, 50W on 1 August via his warm anomaly research, but he also mentions that a search through COADS indicates no evidence of a closed circulation on the 1<sup>st</sup> of August. The analysis conducted here agrees with Truchelut and finds no west winds, low pressure, or gales on 1 August. The COADS was obtained back to 30 July, and there is no evidence of a TC on the 30<sup>th</sup> or 31<sup>st</sup> either. HURDAT starts this system at 06Z on 2 August at 21N, 52W as a 25 kt tropical depression. Since observations are sparse early on the 2<sup>nd</sup>, no change is made to the timing of genesis. No change is made to the time that this cyclone attained tropical storm strength (12Z on the 2<sup>nd</sup>). Baker moved northwestward on the 2<sup>nd</sup> and 3<sup>rd</sup>, and it turned northward on the 4<sup>th</sup>

near 32N, 61W. All track changes on the 2<sup>nd</sup> through the 4<sup>th</sup> are one degree or less. At 06Z on the 2<sup>nd</sup>, the position is adjusted westward by a degree, but for the rest of the 2<sup>nd</sup> and the 3<sup>rd</sup>, the revised track is to the right of the previous HURDAT track. Track changes on the 2<sup>nd</sup> are based on a few ships and a more realistic initial motion, and track changes on the 3<sup>rd</sup> and 4<sup>th</sup> take into account the aircraft information available. At 20Z on the 2<sup>nd</sup>, a ship in the periphery recorded a wind speed of either 40 or 45 kt, and the 18Z intensity on the 2<sup>nd</sup> is increased from 40 to 45 kt. On the 3<sup>rd</sup> and early on the 4<sup>th</sup>, there were a few more ships that recorded wind speeds of 45 kt. The only reliable aircraft center fix that contained a central pressure measurement for Baker was at 1225Z on the 4<sup>th</sup>. A central pressure of 999 mb was recorded, and this value is added to HURDAT at 12Z on the 4<sup>th</sup>. A central pressure of 999 mb yields 45 kt according to the Brown et al. north of 25N pressure-wind relationship. The speed of the cyclone at this time was about 15 kt. The aerologist on this flight estimated maximum winds of 40 kt. The HURDAT intensity at 12Z on the 4<sup>th</sup> of 45 kt is unchanged. The 50 kt peak lifetime intensity for Baker shown in HURDAT (from 06Z on the 3<sup>rd</sup> to 00Z on the 4<sup>th</sup>) is maintained except the HURDAT intensity at 06Z on the 4<sup>th</sup> is increased from 45 to 50 kt due to a 45 kt ship observation at 06Z on the 4<sup>th</sup>. Ship observations indicate that Baker began to weaken on the 4<sup>th</sup> (possibly due to wind shear from an approaching trough from the northwest), and on the 5<sup>th</sup>, Baker continued to weaken until it dissipated later that day before it could be absorbed by the trough. Baker is analyzed to have weakened back to a tropical depression (from a tropical storm) at 06Z on the 5<sup>th</sup> (six hours earlier than in HURDAT originally). The last time that observations clearly show that the circulation is still closed is 18Z on the 4<sup>th</sup>. HURDAT lists a final position for Baker at 18Z on 5 August as a 30 kt tropical depression at 39N, 59W. A scarcity of observations on the 5<sup>th</sup> at 00 and 06Z prevent the removal of the HURDAT points at 00 and 06Z, but an abundance of observations at 12Z on the 5<sup>th</sup> indicate that Baker was likely no longer closed, and the final 12 hours are removed from HURDAT since dissipation is analyzed to have occurred before 12Z on the 5<sup>th</sup>. Numerous ship observations available on the 5<sup>th</sup>/12Z microfilm map show no north winds with continued increasing pressure in an eastward direction away from the extratropical low approaching from the west. On the 5<sup>th</sup> at 1630Z, aircraft reported a center fix with a 996 mb central pressure and maximum winds of 50 to 70 kt, but the aircraft was likely sampling the extratropical low since observations indicate that Baker no longer existed at that time. The analysis of an earlier dissipation is further justified in that Baker would have had to undergo an unrealistic rapid acceleration between the 4<sup>th</sup>/18Z and the 5<sup>th</sup>/12Z. Furthermore, the 5<sup>th</sup>/12Z microfilm map shows question marks plotted next to the operational position estimates of Baker for 00Z and 06Z points on the 5<sup>th</sup>, indicating that the estimates were pure position extrapolations from the more reliable positions on the 4<sup>th</sup>.

Additional quotes regarding Baker:

“This storm did not develop hurricane force; the strongest winds reported were only 60 mph” (MWR).

1951 Storm 4 (Charlie) – (originally Storm 3)

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35585 08/12/1951 M=12 3 SNBR= 787 CHARLIE XING=0
35585 08/09/1951 M=15 4 SNBR= 787 CHARLIE XING=0
      **      **      *

(The 9th to 11th are new to HURDAT.)
35590 08/09*120 288 30 0*120 299 30 0*121 310 35 0*121 321 40 0*
35590 08/10*121 332 40 0*121 343 40 0*121 355 40 0*121 368 40 0*
35590 08/11*121 382 40 0*121 396 40 0*121 410 35 0*121 426 35 0*

35590 08/12* 0 0 0 0*122 457 25 0*123 462 25 0*124 468 25 0*
35590 08/12*121 441 30 0*121 453 30 0*122 462 30 0*124 469 30 0*
      *** *** **      *** *** **      *** **      *** **

35595 08/13*126 475 25 0*128 484 25 0*130 492 25 0*132 499 25 0*
35595 08/13*126 476 30 0*127 484 30 0*128 492 30 0*129 500 30 0*
      *** **      *** **      *** **      *** *** **

35600 08/14*134 506 25 0*136 513 25 0*138 522 30 0*140 535 30 0*
35600 08/14*130 508 35 0*132 516 40 0*134 524 40 0*136 536 40 0*
      *** *** **      *** *** **      *** *** **      *** *** **

35605 08/15*143 553 35 0*146 572 45 0*149 590 50 0*152 607 60 0*
35605 08/15*138 553 45 0*141 571 50 0*144 589 55 999*148 607 60 0*
      *** **      *** *** **      *** *** **      *** ***

35610 08/16*154 625 65 0*157 648 70 0*160 670 75 0*161 687 80 0*
35610 08/16*152 626 60 0*156 646 65 0*159 667 65 992*162 686 70 0*
      *** *** **      *** *** **      *** *** **      *** *** **

35615 08/17*162 703 85 0*164 721 95 0*168 739 95 0*174 757 95 964*
35615 08/17*163 702 75 0*164 717 80 0*166 731 85 978*171 746 95 971*
      *** *** **      *** **      *** *** **      *** *** *** **

35620 08/18*181 774 75 0*182 789 80 0*182 805 85 0*185 817 90 0*
35620 08/18*176 762 110 0*181 778 80 0*183 794 75 0*186 809 75 0*
      *** *** ***      *** ***      *** *** **      *** *** **

35625 08/19*190 831 95 0*193 841 100 0*195 850 105 0*198 861 110 0*
35625 08/19*189 822 80 982*192 834 85 0*194 845 85 976*198 856 100 0*
      *** *** **      *** *** *** ***      *** *** ***      *** *** ***

35630 08/20*202 872 115 0*206 884 115 0*211 897 100 0*214 909 95 0*
35630 08/20*202 867 115 0*206 879 90 0*210 892 70 0*214 904 65 0*
      ***      *** ***      *** ***      *** *** ***      *** **

35635 08/21*216 920 90 0*216 930 90 0*216 938 90 0*216 943 90 0*
35635 08/21*216 916 65 989*216 927 65 0*216 937 65 0*216 943 65 988*
      *** **      *** **      *** **      *** **      *** **

35640 08/22*217 949 95 0*218 958 110 0*220 967 115 0*221 973 110 0*
35640 08/22*217 949 70 982*219 957 80 0*221 966 85 972*222 975 100 0*
      **      *** *** *** ***      *** *** ***      *** *** ***

35645 08/23*222 980 65 0*223 987 45 0*225 994 35 0*219 999 25 0*
35645 08/23*223 982 65 0*224 988 45 0*224 994 35 0*224 999 25 0*
      *** ***      *** ***      ***      ***      ***

35650 HR

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Minor track changes and major intensity changes are analyzed for this straight-moving Caribbean hurricane that made four landfalls- all with major hurricane intensity. Major changes were also made to the genesis and the timing that tropical storm intensity was attained. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, (Fowler 1952), Caribbean station observations, Connor, and Tannehill.

August 9:

HWM analyzes a closed low of at most 1012.5 mb centered near 14N, 32W. HURDAT does not yet list a system on this day. Ship highlights: 35 kt WNW and 1012 mb at 18Z at 11.5N, 33.0W (COA).

August 10:

HWM analyzes a spot low near 15N, 33W. HURDAT does not yet list a system on this day. No gales or low pressures.

August 11:

HWM analyzes a closed low of at most 1010 mb centered near 10.8N, 33.5W. HURDAT does not yet list a system on this day. No gales or low pressures. "A suspicious area on an easterly wave was first noticed on the 11/1230Z surface chart at about 13N, 45W. A streamline analysis clearly showed a weak but closed vortex. The vortex cannot be traced to an earlier chart; however, the isobars on the 11/0630Z chart give a slight indication of a trough in the easterlies which may be an easterly wave" (ATS).

August 12:

HWM analyzes a closed low of at most 1012.5 mb centered near 10N, 46W. HURDAT lists this as a 25 kt tropical depression at 12.3N, 46.2W. No gales or low pressures.

August 13:

HWM analyzes a closed low of at most 1012.5 mb centered near 11.5N, 47.5W. HURDAT lists this as a 25 kt tropical depression at 13.0N, 49.2W. No gales or low pressures.

August 14:

HWM analyzes a closed low of at most 1010 mb centered near 13.5N, 50.0W. HURDAT lists this as a 30 kt tropical depression at 13.8N, 52.2W. Aircraft highlights: center fix at 1842Z at 11.2N, 53.5W with 1005 mb central pressure and 25 kt max winds encountered (micro). "A partially developed 'easterly wave' appeared east of the Lesser Antilles on August 14 and moved northwestward through the islands early on the 15<sup>th</sup> without causing damage. Aircraft reported squalls of 90 knots east of Martinique on the afternoon of the 14<sup>th</sup>, but the island weather stations did not report winds stronger than 35 mph" (MWR). "The vortex could be traced on subsequent charts [after the 11/1230Z chart] up to the 14/0030Z chart at a speed of 7 kt on a westerly course" (ATS). "A Navy Hurricane Reconnaissance Aircraft was dispatched from Trinidad on 14 August to investigate this area around 11.5N, 54W. A streamline analysis of the flight plot shows a closed vortex. It is believed that if the aircraft had been able to reconnoiter further to the east, the winds in this area would have substantiated the closed vortex. Although the winds were observed at reconnaissance level of 400 to 1000 feet, the vortex seemed to just maintain itself rather than intensify. The aircraft fix showed the vortex speed increased to 13 kt since the 14/0030Z chart" (ATS). "As a slight disturbance, [Charlie] moved through the Lesser Antilles on August 14, but developed destructive force in its movement across the Caribbean" (Tannehill).

## August 15:

HWM analyzes a tropical storm of at most 1010 mb centered near 14.9N, 59.2W. HURDAT lists this as a 50 kt tropical storm at 14.9N, 59.0W. The MWR post-season track map shows a 12Z position near 14.4N, 59.3W. Microfilm at 18Z analyzes a tropical storm of at most 1008 mb centered near 15.3N, 60.5W. Aircraft highlights: center fix at 1450Z at 14.5N, 59.7W with 999 mb central pressure and 90 kt max flight-level winds encountered (ATS, micro, MWR). “There is some evidence that a small center of strong winds passed between Dominica and Guadeloupe during the morning of the 15<sup>th</sup>. At any rate, there was regeneration to full hurricane force again during the next 24 hours” (MWR). “The presence of this vortex was also supported on the time cross-section for Martinique. [This cross section indicated] a probable vortex to the northeast [around 15/1000Z]” (ATS). “On 15 August, a Navy Hurricane Reconnaissance plane fixed the hurricane at 1450Z at 14.5N, 59.7W, which gave the hurricane a northwest movement. The aerologist reported an oval eye 15 to 20 miles in a NNE-SSW direction and 10 miles wide. 90 kt winds were encountered in the NW quadrant and 75 kt winds in the SE quadrant” (ATS). “It was noted that the microseisms at Roosevelt Roads began rising on the morning of 15 August indicating intensification of the vortex to hurricane intensity” (ATS).

## August 16:

HWM analyzes a tropical storm of at most 1005 mb centered near 15.4N, 67.4W. HURDAT lists this as a 75 kt hurricane at 16.0N, 67.0W. The MWR tracks of centers of cyclones shows a 12Z position near 17.1N, 66.6W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a low of at most 996 mb centered near 15.8N, 66.5W. Ship highlights: 1000 mb (min p encountered) at 1220Z near ~16.2N, 66.7W (micro); 55 kt G 65 (max w encountered) sometime between 1200Z – 1300Z near ~16.2N, 66.7W (micro). Three other gales of 40-45 kt, and one other low pressure of 1004 mb. Land/station highlights: 35 kt ESE G 40-45 kt and 1010 mb at 0828Z at San Juan, Puerto Rico. Aircraft highlights: Navy center fix at 1415Z at either 16.0N, 67.3W or 16.2N, 67.9W with 992 mb central pressure and 70 kt max winds (ATS, micro); Air Force center fix (DR) at 1830Z at 16.2N, 68.8W with 50 kt max winds encountered at 700 mb at high-levels and 700 mb height in the eye of 9,870 ft (micro). One to two other surface gales, two other low pressures, and one other flight-level hurricane force wind. “On the morning of 16 August, a Navy Hurricane Reconnaissance plane located the hurricane at 1415Z at 16.2N, 67.9W. Maximum winds reported were 70 kt, minimum pressure 992 mb” (ATS).

## August 17:

HWM analyzes a tropical storm of at most 1000 mb centered near 16.5N, 72.8W. HURDAT lists this as a 95 kt hurricane at 16.8N, 73.9W. The MWR tracks of centers of cyclones shows a 12Z position near 17.1N, 72.8W with a 978 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a hurricane of at most 996 mb centered near the HWM position. Aircraft highlights: Navy center fix (radio, penetration) at 1230Z at 16.4N, 72.9W with 978 mb central pressure and 90 kt max flight-level winds encountered (ATS, micro); Air Force

center fix at 1837Z at 17.1N, 74.8W with 971 mb central pressure, 110 kt max high-level winds, and 700 mb height in the eye of 9,400 ft (ATS, micro). From aircraft flight... "Max winds in southern quadrant 90 kts within 35 miles of center and 45 kt within 50 miles" (micro). "A Navy Hurricane Reconnaissance plane staging out of San Juan, PR located the hurricane at 16.4N, 72.9W at 17/1230Z. This fix gave the hurricane a westward course at 13 kt during the past 24 hr. The aerologist reported the eye to be 22 miles in diameter and lowest pressure was 978 mb. Maximum winds reported were 90 kt in the NE and SE quadrants. At 1837Z, the high-level Air Force Reconnaissance plane located the center by radar at 17.1N, 74.8W. A minimum pressure of 971 mb was reported with maximum winds of 110 kt in the NE quadrant" (ATS).

August 18:

HWM analyzes a hurricane of at most 1000 mb centered near 17.7N, 80.1W. HURDAT lists this as an 85 kt hurricane at 18.2N, 80.5W. The MWR tracks of centers of cyclones shows a 12Z position near 18.2N, 79.6W with a 980 mb pressure and the MWR post-season track map shows a 12Z position near 18.2N, 80.0W. Microfilm analyzes a closed low of at most 1002 mb centered near 18.1N, 79.8W. Land/station highlights: 75-80 kt estimated highest average wind speed, 95 + kt estimated max wind, and 105-110 kt estimated max gusts around 0215Z to possibly after 0315Z at Kingston, Jamaica (micro, MWR, met mag); 973 mb (min p) around ~0245Z at Kingston, Jamaica (micro, MWR, met mag); 55 kt ENE G 80 kt and 1000 mb at 21Z at Grand Cayman (micro, MWR, advisories). One other gale and low pressure at 20Z at Grand Cayman. Aircraft highlights: Air Force center fix at 2112Z at 18.8N, 81.6W with 982 mb central pressure and 75 kt max flight-level winds encountered at 5,500 feet at 19.8N, 81.5W (ATS, micro). One other low pressure. "The center skirted the south coast of Jamaica during the night of the 17<sup>th</sup> and the entire island had destructive winds, which caused the worst hurricane disaster of the century on Jamaica. Property and crop damage was estimated at \$50,000,000, 152 persons killed, and 2,000 others injured, and about 25,000 made homeless. The strongest wind at Kingston was estimated at over 110 mph; lowest pressure [measured] 28.74 inches (973 mb); and rainfall 17 inches. The center passed several miles south of the city" (MWR). "Center of hurricane passed just south of Palisadoes at 18/0315 GMT. Wind exceeded 100 kt. Lowest pressure 973 mb by barograph. Rainfall 430 mm plus. Weather office wrecked and all coms dislocated" (micro). "After the hurricane left Jamaica, Grand Cayman experienced 92 mph winds in gusts" (MWR). "The strongest wind at Jamaica was 110 miles per hour" (Tannehill). "The eastern parishes [of Jamaica] were the first to be affected... torrential rain and winds of 80-90 mph being experienced by about [0130Z]. These conditions moved slowly westward over the southern half of Jamaica and finally cleared the extreme west by [10Z]. The hurricane struck Kingston at [0245Z] when the wind suddenly increased to an average speed of over 85 mph with gusts in excess of 110 mph. This approximation is necessary as the two recording wind instruments in the district ceased to register above these limits. There have been rumors that other anemometers recorded gusts of 140-160 mph before being wrecked but these instruments are of the revolving-cup pattern, which over-read considerably at high speeds. It is considered that a reasonable approximation may be given as an average wind speed of 85-90 mph with gusts to 120-125 mph. These hurricane force winds continued for about six hours, during which time trees were blown

down, roofs blown off and much general damage was done by flying debris, such as branches of trees, pieces of timber and sheets of corrugated iron, the latter being used extensively for garage roofs and outbuildings. The number of deaths in Kingston was 56 and the total for the whole island was 152. There was considerable damage to shipping in Kingston Harbor and five large vessels were driven ashore. The minimum value recorded at Palisadoes was 973 mb. It is estimated that the center passed about eight miles south of Palisadoes Airport- that is, about ten miles south of Kingston- and that the pressure at the center, allowing for a five-miles area of uniform pressure in the 'eye', was about 964 mb" (Met Mag). "Damage in Jamaica was estimated at \$15,000,000 to property and \$50,000,000 to crops" (ATS). "An Air Force Reconnaissance aircraft flying out of Ramay AFB, Puerto Rico, located the hurricane on 18/2112Z at 18.8N, 81.6W. This fix showed the hurricane had continued on its WNW track at a speed of 15 kt and had weakened somewhat [from its passage over Jamaica]. Maximum winds reported were 75 kt in the northern semicircle, extending 15 miles from the eye. Minimum pressure reported was 982 mb" (ATS).

#### August 19:

HWM analyzes a hurricane of at most 990 mb centered near 19.4N, 83.9W. HURDAT lists this as a 105 kt hurricane at 19.5N, 85.0W. The MWR tracks of centers of cyclones shows a 12Z position near 19.8N, 84.1W and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a closed low of at most 987 mb centered near the HURDAT position. Ship highlights: 50 kt E and 1011 mb at 18Z at 22.0N, 85.2W (COA); 50 kt SE G 60 kt and 1000 mb at 22Z at 20.2N, 84.3W (micro). One other gale of 35 kt and two other low pressures between 1002-1005 mb. Land/station highlights: 50 kt ESE and 1003 mb at 00Z at Grand Cayman (micro); 30 kt NE G 45 kt and 1005 mb at 1830Z at Cozumel, Mexico (micro); 40 kt NE G 50 kt at 2130Z at Cozumel (micro). Two other gales and one other low pressure. Aircraft highlights: Navy center fix (DR, penetration) at 1330Z at 19.3N, 84.7W with 976 mb central pressure and 115 kt max flight-level winds encountered (ATS, micro). At least five other low pressures and at least three other flight-level hurricane force winds. At 19/1330Z, a Navy Hurricane Reconnaissance plane located the hurricane at 19.3N, 84.7W. The aerologist reported maximum winds of 115 kt and minimum pressure of 976 mb. The 19/1330Z fix was the last fix before the hurricane crossed over the Yucatan Peninsula" (ATS).

#### August 20:

HWM analyzes a hurricane of at most 990 mb centered near 21.2N, 89.6W. HURDAT lists this as a 100 kt hurricane at 21.1N, 89.7W. The MWR tracks of centers of cyclones shows a 12Z position near 20.5N, 88.2W with a 996 mb pressure and the MWR post-season track map shows a 12Z position near 21.5N, 89.6W. Microfilm analyzes a hurricane of at most 996 mb centered near the HWM position. Ship highlights: 30 kt SW and 1000 mb at 00Z at 19.1N, 86.2W (COA, micro); 50 kt ESE at 00Z at 20.5N, 84.6W (micro). Two other gales of 40 kt and three other low pressures between 1003-1005 mb. Land/station highlights: 80 kt NNE G 95 kt at 0130Z at Cozumel (micro); 965 mb (min p) [probably] between ~0130Z – 0230Z at Cozumel (micro); 30 kt WNW G 35 kt and 986 mb at 1330Z at Merida, Mexico (micro); 40 kt SE G 47 kt at 2030Z at Merida

(micro). Nine other gales in the Yucatan Peninsula between 35-55 kt and 12 other low pressures between 988-1005 mb. Aircraft highlights: center fix at 2243Z at either 21.9N, 91.1W or 20.6N, 91.5W with 989 mb central pressure and max winds either 70 or 115 kt (ATS, micro); 115 kt SE at flight-level of 500 ft and 996 mb at 2315Z at 20.9N, 90.9W (micro). At least three other flight-level hurricane force winds and seven other low pressures. "The next land area seriously affected was the Yucatan Peninsula, which the hurricane crossed during the night of the 19<sup>th</sup>. Reports indicate heavy crop losses running to 70 percent, but no loss of life in the Yucatan area. The storm entered the Gulf near Merida and Progreso on the morning of the 20<sup>th</sup> considerably reduced in force" (MWR). "Hourly reports from Merida commencing at 20/0230Z showed an increasing northerly wind backing slowly to the south by 20/1530Z, indicating that the eye was passing to the north of Merida..." (ATS). "At 20/2243Z, a Navy Hurricane Reconnaissance plane located the eye at 21.9N, 91.1W about 60 miles west of the Yucatan Peninsula. The aerologist reported the eye to be poorly defined. Severe turbulence and winds up to 115 kt were encountered ENE of the eye. The lowest pressure reported was 989 mb" (ATS).

#### August 21:

HWM analyzes a hurricane of at most 990 mb centered near 21.0N, 94.0W. HURDAT lists this as a 90 kt hurricane at 21.6N, 93.8W. The MWR tracks of centers of cyclones shows a 12Z position near 21.2N, 91.9W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 990 mb centered near the HURDAT position. Ship highlights: 40 kt ENE and 1009 mb at 00Z at 24.0N, 92.2W (COA). Three other gales between 35-40 kt. Aircraft highlights: Navy center fix at 1538Z at 21.7N, 94.3W with 988 mb central pressure and 70 kt max winds (ATS, micro); 100 kt E at flight-level of 500 ft and 995 mb at 1915Z at 22.6N, 93.6W (micro); center fix (DR, penetration) at 2247Z at 20.5N, 94.4W with 982 mb central pressure and 100 kt max flight-level winds. Several other flight-level hurricane force winds and low pressures. "On 21 August, two Navy Hurricane Reconnaissance planes were dispatched to the Gulf of Campeche to obtain low level fixes on the hurricane. The first flight entered the eye at 1538Z at 21.7N, 94.3W and the second flight entered the eye at 2247Z at 20.5N, 94.4W. The aerologist stated in his report the eye had an elongated axis oriented NNE-SSW and the above position is the SW extremity of the eye. At first it was thought that the hurricane was making a tight counterclockwise loop, but upon studying the post-flight summaries and the wind circulation of the second reconnaissance flight it was seen that the hurricane had slowed to about three kt on a WNW course, or possibly even became stationary for a few hours" (ATS).

#### August 22:

HWM analyzes a hurricane of at most 990 mb centered near 22.8N, 96.7W. HURDAT lists this as a 115 kt hurricane at 22.0N, 96.7W. The MWR tracks of centers of cyclones shows a 12Z position near 21.8N, 96.1W with a 960 mb pressure and the MWR post-season track map shows a 12Z position near 22.1N, 96.9W. Microfilm analyzes a hurricane of at most 990 mb centered near 22.4N, 96.5W. Ship highlights: 40 kt NW and 1008 mb at 00Z at 19.8N, 96.3W (COA); 40 kt and 1005 mb at 09Z at 20.6N, 96.9W (micro); 35 kt W and 1005 mb at 12Z at 20.9N, 97.1W (COA); 40 kt SSW at 18Z at

22.2N, 97.3W (micro). One other gale of 35 kt. Land/station highlights: 45 kt WNW G 75 kt and 990 mb at 1530Z at Tampico, Mexico (micro); 87 kt WNW G 95 kt and 976 mb at Tampico at 1730Z (micro); 95 kt (max w) at Tampico (MWR); calm between 1900-1930Z at Tampico (micro); 45 kt NE and 973 mb at 1930Z at Tampico (micro); 60 kt WSW at 2315Z at Tampico (micro). Three other gales between 35-60 kt and six other low pressures between 974-1003 mb. Aircraft highlights: Navy center fix at 1326Z at 22.3N, 96.8W with 972 mb central pressure and 130 kt max flight-level winds encountered at around 600 ft. One other flight-level wind of 120 kt and two other low pressures. “The last aircraft fix before it passed into Mexico was on 22/1326Z at 22.3N, 96.8W. The aerologist reported winds of 50 kt 100 miles to the NW [of the center] and 120 kt winds 30 miles south of the center. The hurricane crossed the coast of Mexico just north of Tampico about noon on the 22<sup>nd</sup>...” (ATS). “[Charlie] regained its former force before entering Mexico near Tampico on August 22. Tampico was near the southern edge of the ‘eye’ and reported winds of 110 mph, but winds were doubtless stronger to the north of the calm center. Property damage was estimated at \$1,160,000 in the city of Tampico and 4 persons were killed; torrential rains flooded rivers and burst dams in the country west and northwest of the city and caused more than 100 deaths by drowning, according to the final press reports. The exact number of casualties could not be ascertained since many bodies were evidently not recovered in the flooded area. Property damage was in the millions of dollars, but actual estimates are not available” (MWR). “The pressure at Tampico dropped to 28.81 inches (975.7 mb)” (MWR). “The ‘eye’ passed over [Tampico] between 1 pm and 1:30 pm on August 22 and the inhabitants there experienced the calm period, associated with the center, between hurricane force winds of 100 mph from opposite points of the compass” (Met mag). “Aug 22, 1951 – entered coast near Tampico- 973 mb lowest observed pressure at Tampico – 972 mb estimated lowest pressure – Tampico has NW 100 mph, then SE 110 mph – cyclone was moving W at 10 kt” (Connor). “[Charlie] moved across the southern Gulf and the center passed inland a short distance north of Tampico on August 22, where the winds reached 110 miles per hour. Property damage in the city was estimated at \$1,160,000. Four persons in Tampico were killed. Torrential rains flooded rivers, bursting dams in the country northwest of Tampico, and caused the death of another one hundred persons, according to news dispatches, but this estimate is believed to be incomplete. It is possible that total damage from this storm, including Jamaica and the area northwest of Tampico was near \$75 million and the total loss of life was more than 250” (Tannehill). “Hurricane Charlie, often called the ‘Killer Hurricane’ by the press, took 242 lives (152 in Jamaica and 90 were killed in floods caused by the failure of a dam in Mexico)” (ATS).

#### August 23:

HWM analyzes a tropical storm of at most 1005 mb centered near 21.7N, 99.5W. HURDAT lists this as a 35 kt tropical storm at 22.5N, 99.4W. The MWR tracks of centers of cyclones shows a 12Z position near 22.4N, 99.0W with a 1004 mb pressure. Microfilm analyzes a low of at most 1005 mb centered near 21.6N, 98.6W. Land/station highlights: 45 kt ESE G 70 kt and 999 mb at 00Z at Tampico (22.2N, 97.8W) (micro).

The origins of a tropical disturbance that would soon become Charlie took shape in the eastern tropical Atlantic Ocean in early-mid August, 1951. The tropical cyclone might

have formed from the interaction of a tropical wave with the ITCZ. HURDAT starts this system on 12 August at 06Z near 12N, 46W as a 25 kt tropical depression. The 7<sup>th</sup> through the 11<sup>th</sup> of August was searched for data between that location and the African coast, and an observation of 35 kt WNW with 1012 mb at 18Z on 9 August was found at 11.5N, 33.0W (COA). The time series for this ship as well as another ship located somewhat farther away from the center were plotted, and the data indicates the likely existence of a tropical storm at that location. Genesis is analyzed to have begun August 9<sup>th</sup> at 00Z as a 30 kt tropical depression at 12.0N, 28.8W (78 hours earlier and 17 degrees longitude further east than in HURDAT originally). The depression is analyzed to have strengthened to a tropical storm by 12Z on the 9<sup>th</sup> (5 and a half days earlier than in HURDAT originally). A 40 kt intensity is analyzed from 18Z on the 9<sup>th</sup> through 06Z on the 11<sup>th</sup> as the cyclone moved westward in a data sparse region. On the 12<sup>th</sup>, an abundance of ship data in the storm area indicates a very weak closed circulation, and the cyclone is analyzed to have weakened to a tropical depression at 00Z on the 12<sup>th</sup>. A 30 kt intensity is analyzed at all times on the 12<sup>th</sup> and 13<sup>th</sup> (up from 25 kt in HURDAT originally), as data was sparse on the 13<sup>th</sup>. On the 14<sup>th</sup> at 1842Z, an aircraft reconnaissance flight in the area reported a minimum pressure of 1005 mb. There is conflicting information with this report that spreads considerable uncertainty as to whether this value is a central pressure. A central pressure of less than or equal to 1005 mb yields a wind speed of greater than or equal to 37 kt according to the Brown et al. southern pressure-wind relationship. The tropical depression is analyzed to have attained tropical storm strength again by 00Z on the 14<sup>th</sup> (which is still 24 hours earlier than HURDAT lists this cyclone becoming a tropical storm for the first time). Charlie continued westward, and on the 15<sup>th</sup> at 1450Z, aircraft located the center at 14.5N, 59.7W, and a central pressure of 999 mb was measured. Maximum flight-level winds of 90 kt were reported to have been encountered, but the central pressure value recorded indicates that the wind speed is likely too high. The 999 mb central pressure is added to HURDAT at 12Z on the 15<sup>th</sup>. A central pressure of 999 mb yields 49 kt according to the southern pressure-wind relationship. The RMW was slightly smaller than the climatological value and the speed of the storm was 18 kt, so 55 kt is chosen for the intensity at 12Z (up from 50 kt originally) and the 60 kt intensity listed in HURDAT at 18Z on the 15<sup>th</sup> is maintained. All track changes from the 12<sup>th</sup> through the 15<sup>th</sup> are half a degree or less. All intensity changes from the 12<sup>th</sup> through 12Z on the 15<sup>th</sup> are minor upward adjustments. Charlie passed between Dominica and Martinique late on the 15<sup>th</sup>. The position at 18Z on the 15<sup>th</sup> is shifted four-tenths of a degree south of the previous HURDAT position, showing that the center passed closer to Martinique than Dominica whereas HURDAT previously showed a possible landfall on Dominica. Observations are only available from the islands every six hours, and no observations of gale force winds from any of the island stations are found. Nevertheless, the HURDAT intensity of 60 kt at Charlie's passage through the islands is maintained. The cyclone then moved west-northwestward into the central Caribbean Sea, and it intensified. On the 16<sup>th</sup> at 1415Z, a central pressure of 992 mb was measured by Navy Aircraft, and this value is added to HURDAT at 12Z on the 16<sup>th</sup>. A central pressure of 992 mb yields 61 kt according to the southern pressure-wind relationship. The RMW was near the climatological value but the speed of the storm was about 19 kt, so 65 kt is chosen for the 12Z intensity on the 16<sup>th</sup> (down from 75 kt originally). It is analyzed that Charlie attained hurricane strength by

06Z on the 16<sup>th</sup> (6 hours later than in HURDAT originally). Later on the 16<sup>th</sup>, at 1935Z, an Air Force plane recorded a 700 mb height in the eye of 9,870 ft which implies a central pressure in the range of 970-990 mb. The next day (17<sup>th</sup>) at 1230Z, a Navy aircraft measured a central pressure of 978 mb, and this value is added to HURDAT at 12Z on the 17<sup>th</sup>. A central pressure of 978 mb yields a wind speed of 78 kt according to the southern pressure-wind relationship for steady state and for intensifying systems, and 85 kt is chosen for 12Z on the 17<sup>th</sup> (down from 95 kt originally). The intensity adjustments made to HURDAT from 00Z on the 16<sup>th</sup> through 12Z on the 17<sup>th</sup> are all minor downward adjustments. At 1837Z on the 17<sup>th</sup>, an Air Force aircraft measured a central pressure of 971 mb, and on the same flight, a 700 mb height in the eye of 9,400 feet was measured, implying a central pressure in the range of 956-974 mb. The 964 mb central pressure in HURDAT at 18Z on the 17<sup>th</sup> is removed and replaced by the 971 mb value, which yields a wind speed of 90 kt according to the intensifying subset of the southern pressure-wind relationship. The 964 mb central pressure that was removed from HURDAT was likely placed into the original HURDAT because of an estimate of the central pressure at Jamaican landfall provided in the *Meteorological Magazine*, but this landfall occurred well after 00Z on the 18<sup>th</sup>, so even if correct, it was listed in the incorrect time slot. The eye diameter reported by the Air Force plane on the flight that measured the 971 mb central pressure was very small and indicates an RMW of about 5 nmi, which is much smaller than the 14 nmi climatological RMW. The maximum high-level (700-mb) wind encountered by the aircraft was 110 kt. The intensity of 95 kt listed in HURDAT at 18Z on the 17<sup>th</sup> is unchanged.

The center of Hurricane Charlie passed very near Kingston, Jamaica and the observation site at Palisadoes Airport (18.0N, 76.8W) around 03Z on 18 August, and landfall in Jamaica occurred around the same time at 17.9N, 76.9W. The vast literature and numerous sources that discuss the hurricane's impact in Jamaica do not mention any lull being experienced at Kingston. All information is consistent and indicates that the right RMW of Charlie passed either over or just south of Kingston around 03Z as the cyclone was moving west-northwestward. Due to the descriptions of the damage and impacts in Jamaica and in Kingston itself, which are indicative of major hurricane winds, along with available meteorological observations, the RMW could not have been very far from Kingston. The minimum pressure recorded at the Kingston (Palisadoes) airport located on the southern coast was 973 mb. The description of Charlie's impact in Jamaica provided in the July, 1952 issue of the *Meteorological Magazine* estimates [using crude methodology] a central pressure of 964 mb. A run of the Schloemer equation was performed to obtain the central pressure. Two of the four parameters needed are known (the peripheral pressure of 973 mb at Kingston and the OCI of 1010 mb). The RMW and the distance from the 973 mb observation to the storm center are unknown. However, these two values were both estimated in the *Meteorological Magazine*. Also, aircraft reconnaissance provided an eye radius value about nine hours earlier (mentioned above) which indicates an RMW of about 5 nmi. In the Schloemer equation, the ratio of the RMW to the distance from the 973 observation to the storm center is what matters, not the individual values. According to the revised track, the center of Charlie passed 7 nmi from the airport at closest approach, and this is also consistent with the publication. The Schloemer equation was run twice using RMWs of 5 and 7 nmi respectively for each run

to obtain a possible range of central pressure values. The run with a 5 nmi RMW yields a 938 mb central pressure and the run that assumes the airport was at the RMW at the time of the minimum pressure yields a central pressure of 951 mb. Since there is some uncertainty in the parameters used, it was decided to average the 951 mb obtained here with the 964 mb central pressure reported by the *Meteorological Magazine*, and a central pressure of 958 mb is chosen for landfall. Although the reliable data indicates that the central pressure was likely 964 mb or lower, there is considerable uncertainty as to how much lower than 964 mb (if any) the central pressure was as Charlie passed south of Kingston and made landfall southwest of Kingston. If 964 mb is assumed to be the central pressure, 964 mb yields a wind speed of 98 kt according to the intensifying subset of the southern pressure-wind relationship. After adding 5 kt for the speed/size of Charlie, 105 kt would be chosen for the landfall intensity. Since a landfall central pressure of 958 mb is decided upon, this value yields a wind speed of 105 kt using the same pressure-wind relationship, and after adding 5 kt for speed/size, 110 kt is chosen for 00Z on the 18<sup>th</sup> (up from 75 kt originally) and Jamaican landfall at 03Z. Although there is little doubt that Charlie impacted Jamaica as a major hurricane, it could have been a Category 4 at landfall. It should be mentioned that the previous HURDAT was faster with Charlie and showed landfall occurring about five hours earlier than the analyzed landfall. The HURDAT intensity at the point just before Jamaican landfall was previously 95 kt, and this intensity is revised upward to 110 kt. The center of Charlie was over Jamaica from 03Z to 07Z on the 18<sup>th</sup>. A run of the Kaplan and DeMaria inland decay model yields an intensity of 84 kt for 06Z on the 18<sup>th</sup>. The next time intensity information is available is 15 hours later. At 2112Z on the 18<sup>th</sup>, aircraft measured a central pressure of 982 mb, and this value is added to HURDAT at 00Z on the 19<sup>th</sup>. A central pressure of 982 mb yields 75 kt according to the southern pressure-wind relationship. Analyzed intensities on the 18<sup>th</sup> for 06, 12, and 18Z are 80, 75, and 75 kt respectively (80, 85, and 90 kt originally). The position of the aircraft fix at 2112Z on the 18<sup>th</sup> is consistent with the 21Z observations of 55 kt and 1000 mb recorded at Grand Cayman, about 50 nmi north-northeast of the center fix. The revised track late on the 18<sup>th</sup> and on the 19<sup>th</sup> is still slower than the previous HURDAT track, and also slightly to the right (north), and these track changes are in agreement with aircraft fixes. On the 19<sup>th</sup>, Charlie continued moving west-northwestward through the western Caribbean Sea. At 1330Z on the 19<sup>th</sup>, a Navy aircraft measured a central pressure of 976 mb and encountered maximum flight-level winds of 115 kt at around 500 ft. A central pressure of 976 mb is added to HURDAT at 12Z on the 19<sup>th</sup>, and this value yields 83 kt according to the southern pressure-wind relationship and 84 kt for the intensifying subset. An intensity of 85 kt is chosen for 12Z on the 19<sup>th</sup> (down from 105 kt originally- a major change). Next, Charlie approached Cozumel, Mexico, where a minimum pressure of 965 mb was recorded around 0200Z (could have been anytime between 0130Z and 0230Z) on 20 August, but it was unlikely to have been a central pressure measurement. A central pressure of less than 965 mb yields a wind speed of greater than 97 kt according to the intensifying subset of the southern pressure-wind relationship. Cozumel only reported winds at hourly observations, and the highest wind reported at these hourly intervals was 80 kt G 95 kt from the NNE at 0130Z. The previous HURDAT track has the center of Charlie passing south of the island, but the revised track, which is shifted about two-tenths of a degree to the right, shows the center of Charlie passing over the extreme

southern tip of the island. The weather station on the island is located on the northern part of the island and likely did not experience calm conditions associated with the eye. It is unknown whether Cozumel experienced a lull associated with the center. The Schloemer equation was run three times, keeping three of the four variables constant and only changing the RMW each time. A value of 1008 mb is used for environmental pressure, 965 mb for the measured peripheral pressure at Cozumel, and 12 nmi for the distance from the station to the center. RMWs of 10, 15, and 20 nmi were used for the three different runs, and central pressures of 932, 947, and 954 mb are obtained. These values yield wind speeds of 130, 116, and 109 kt respectively according to the intensifying subset of the pressure-wind relationship. The HURDAT intensity of 115 kt at 00Z on the 20<sup>th</sup> is unchanged. The aircraft fix 12 hours before Charlie reached Cozumel reported a 976 mb central pressure with a RMW of about 15 nmi. Charlie then deepened rapidly during the final 12 hours before reaching Cozumel, so there is a distinct possibility that the eye contracted during this time. Charlie is analyzed to have made landfall on the southern tip of Cozumel Island (20.3N, 87.0W) at 01Z on 20 August as a 115 kt hurricane. Landfall in the Yucatan Peninsula is analyzed to have occurred at 03Z at 20.4N, 87.3W with a 115 kt intensity. Charlie was still moving west-northwestward, and the center was over the Yucatan Peninsula from 03Z to 16Z on the 20<sup>th</sup>. Observations from Merida, Mexico indicate that the center passed just north of that station around 14Z. Runs of the Kaplan and DeMaria inland decay model yield wind speeds of 84 and 63 kt at 06 and 12Z on the 20<sup>th</sup> respectively, and intensities of 90 and 70 kt are chosen for 06 and 12Z respectively (down from 115 and 100 kt originally). The minimum pressure recorded at Merida was 986 mb experienced simultaneously with 30 kt winds at 1330Z. Seven hours after the center of Charlie moved into the Bay of Campeche, an aircraft central pressure of 989 mb was recorded at 2243Z on the 20<sup>th</sup>, and this value is added to HURDAT at 00Z on the 21<sup>st</sup>. A central pressure of 989 mb yields 65 kt according to the southern pressure-wind relationship. Charlie is analyzed to have weakened from 115 kt to 65 kt while over the Yucatan Peninsula, and a 65 kt intensity is also analyzed for 18Z on the 20<sup>th</sup> and 00Z on the 21<sup>st</sup> (down from 95 and 90 kt originally). The new positions analyzed for the 20<sup>th</sup> are still about half a degree slower than the previous HURDAT track, continuing the trend that began on 17 August, but by the 21<sup>st</sup> at 12Z, the revised track caught up with the previous HURDAT track at 21.6N, 93.8W (position unchanged). Aircraft central pressures of 988 and 982 mb were measured at 1538 and 2247Z on the 21<sup>st</sup> respectively. These values are added to HURDAT at 18Z on the 21<sup>st</sup> and 00Z on the 22<sup>nd</sup>. A central pressure of 988 mb yields 67 kt and 982 mb yields 75 kt according to the southern pressure-wind relationship. The RMW was larger than climatology and the speed was about 8 kt. The 65 kt intensity analyzed from 18Z on the 20<sup>th</sup> through 00Z on the 21<sup>st</sup> is kept through 18Z on the 21<sup>st</sup> and increased to 70 kt by 00Z the 22<sup>nd</sup>. At all times on the 21<sup>st</sup>, the 90 kt intensity previously listed in HURDAT is lowered to 65 kt. On the 22<sup>nd</sup> at 1326Z, with Charlie located about 60 nmi east of Tampico, aircraft measured a central pressure of 972 mb, and this value is added to HURDAT at 12Z on the 22<sup>nd</sup>. This flight encountered a maximum flight-level wind of 130 kt around 600 ft. A central pressure of 972 mb yields 89 kt according to the intensifying subset of the southern pressure-wind relationship, and the RMW is larger than climatology. An 85 kt intensity is chosen for 12Z on the 22<sup>nd</sup> (down from 115 kt originally). Major downward intensity adjustments of between 25-30 kt are analyzed at

all times from 06Z on the 20<sup>th</sup> through 12Z on the 22<sup>nd</sup>. Charlie is analyzed to have made its fourth (third Mexican) and final landfall at 19Z on 22 August at 22.3N, 97.8W. All information is consistent in that Tampico experienced the calm associated with the eye for 30 minutes. The revised HURDAT track is one-tenth of a degree to the north of the previous track at landfall. The previous track shows the center passing a hair south of the station and the revised track shows the center passing a hair north of the station. The time series of observations reported from Tampico yields uncertainty as to whether the center of the eye passed north or south of the station, but commentary from both MWR and ATS states that Tampico was in the southern edge of the eye and that the center passed just north of the station. The highest wind recorded at Tampico before the passage of the eye was 85 kt from the WNW (or NW) with a 976 mb pressure, and the highest wind recorded after the passage of the eye was 95 kt from the SE. The central pressure was either not recorded or is not available. The lowest available pressure observation at Tampico was 973 mb with 45 kt NE winds inside the RMW. This observation came two hours after the observation with the 85 kt WNW-NW, and it came 30 minutes to 1 hour before the calm eye. Charlie was therefore likely to have been moving slowly. A conservative estimate of the central pressure at landfall is 968 mb (using the 10 kt per mb rule inside the RMW, but this rule is for marine exposure, and Tampico is located somewhat inland). The central pressure was likely slightly lower than that but not significantly lower. The MWR tracks of centers of cyclones chart shows a 960 mb pressure, but it is not known how this value was attained. A central pressure of less than or equal to 968 mb yields a wind speed of greater than or equal to 93 kt according to the intensifying subset of the southern pressure-wind relationship. From this information combined with the 95 kt max wind recorded at Tampico, 100 kt is chosen for 18Z on the 22<sup>nd</sup> and for the 19Z landfall. HURDAT previously listed a 110 kt intensity at 18Z on the 22<sup>nd</sup>, but this intensity was listed in HURDAT previously likely due to the 115 kt placed into HURDAT at 12Z, which was likely based on misleading aircraft winds. Runs of the Kaplan and DeMaria inland decay model yield 69, 50, and 36 kt for 00, 06, and 12Z respectively on 23 August. Highest observed winds within 2 hr of synoptic times are 60, 20, and 30 kt at 00, 06, and 12Z on the 23<sup>rd</sup> respectively. The intensities of 65, 45, and 35 kt listed in HURDAT previously at 00, 06, and 12Z on the 23<sup>rd</sup> are all unchanged. Charlie continued westward and weakened to a tropical depression at 18Z on the 23<sup>rd</sup> as it moved further inland. No changes are made to the timing of dissipation, but the final point is adjusted half a degree north at 22.4N, 99.9W at 18Z on the 23<sup>rd</sup> as a 25 kt tropical depression. Thereafter, the depression dissipated in the high terrain of Mexico.

Additional quote:

“The strongest winds reported in this hurricane were about 130 mph (by aircraft) just before it entered Yucatan, and again in the Gulf off Tampico. The total loss of life in this hurricane was almost certainly over 250, while property and crop damage will probably reach a total of \$75,000,000” (MWR).

1951 Storm 5 (Dog) – (originally Storm 4)

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35655 08/27/1951 M=10 4 SNBR= 788 DOG          XING=0
35655 08/27/1951 M=10 5 SNBR= 788 DOG          XING=0
*

35660 08/27* 0 0 0 0*123 256 25 0*123 266 25 0*123 276 25 0*
35665 08/28*122 287 25 0*121 298 25 0*120 310 25 0*120 323 25 0*
35665 08/28*123 287 25 0*123 298 25 0*123 310 25 0*123 323 25 0*
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35670 08/29*120 336 25 0*120 349 25 0*121 363 25 0*122 380 25 0*
35670 08/29*123 336 25 0*123 349 25 0*123 363 25 0*124 380 25 0*
*** ***

35675 08/30*124 397 25 0*127 413 30 0*130 430 30 0*132 447 30 0*
35675 08/30*126 396 25 0*128 412 30 0*130 428 30 0*132 444 30 0*
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35680 08/31*134 465 35 0*137 484 40 0*140 502 45 0*140 517 45 0*
35680 08/31*134 461 35 0*136 477 40 0*137 494 45 0*138 511 45 0*
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35685 09/01*140 532 50 0*141 547 50 0*141 562 55 0*141 576 60 0*
35685 09/01*139 528 50 0*140 544 50 0*141 560 55 0*141 573 60 0*
*** ***

35690 09/02*141 588 65 0*141 600 80 0*141 613 95 0*142 628 100 0*
35690 09/02*141 584 65 0*141 597 70 0*142 611 80 0*142 627 75 0*
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35695 09/03*143 644 100 0*144 659 95 0*146 674 90 0*147 697 85 0*
35695 09/03*143 643 70 992*144 658 65 0*146 674 65 0*148 694 60 993*
*** ***

35700 09/04*148 718 80 0*149 731 75 0*151 743 60 0*153 754 60 0*
35700 09/04*150 714 55 0*151 730 50 0*151 742 45 1004*152 753 40 0*
*** ***

35705 09/05*154 765 50 0*156 778 45 0*157 791 35 0*161 824 25 0*
35705 09/05*154 764 35 0*155 779 30 0*155 795 25 0* 0 0 0 0*
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35710 HR

Minor track changes and major intensity changes are analyzed for this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Tannehill.

#### August 26:

HWM analyzes a closed low elongated W-E of at most 1010 mb centered near 11.3N, 19.1W. HURDAT does not yet list a system on this day. No gales or low pressures.

#### August 27:

HWM analyzes a spot low near 11.2N, 27.0W. HURDAT lists this as a 25 kt tropical depression at 12.3N, 26.6W. No gales or low pressures.

#### August 28:

HWM analyzes a closed low of at most 1010 mb centered near 13.5N, 28.5W. HURDAT lists this as a 25 kt tropical depression at 12.0N, 31.0W. Ship highlights: 15 kt NE and

1003 mb at 06Z at 14.7N, 25.0W (COA); 15 kt W and 1005 mb at 12Z at 13.0N, 26.0W (COA).

August 29:

HWM analyzes a closed low of at most 1010 mb centered near 11.5N, 36.0W. HURDAT lists this as a 25 kt tropical depression at 12.1N, 36.3W. No gales or low pressures.

August 30:

HWM analyzes a closed low of at most 1010 mb centered near 13.3N, 42.4W. HURDAT lists this as a 30 kt tropical depression at 13.0N, 43.0W. No gales or low pressures.

August 31:

HWM analyzes a closed low of at most 1010 mb centered near 14.5N, 50.5W. HURDAT lists this as a 45 kt tropical storm at 14.0N, 50.2W. No gales or low pressures. “On 31 August at 1830Z an easterly wave, which had been progressing westward at about 15 kt, was taken under [closer] observation” (ATS).

September 1:

HWM analyzes a closed low of at most 1010 mb centered near 15.2N, 57.5W. HURDAT lists this as a 55 kt tropical storm at 14.1N, 56.2W. No gales or low pressures. “Reconnaissance planes located a disturbance several hundred miles east of Barbados on September 1” (MWR). “Ship reports [from 0030Z on September 1] in conjunction with a streamline analysis placed the easterly wave along a line extending southwest from 17N, 45W through 12.3N, 51.6W, where streamline analysis showed a vortex to have formed, to a point about 4N, 57W” (ATS). ATS mentions that data leads them to believe that this became a tropical storm by 1830Z on the 1<sup>st</sup>. “However, it was very weak and small at this point” (ATS).

September 2:

HWM analyzes a tropical storm of at most 1005 mb centered near 14.1N, 61.4W. HURDAT lists this as a 95 kt hurricane at 14.1N, 61.3W. The MWR post-season track map shows a 12Z position near the HURDAT and HWM positions. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 14.3N, 61.0W. Land/station highlights: 25 kt W and 1001 mb at 12Z at St. Lucia (14.0N, 61.0W) (ATS, micro); 50 kt ENE and 1004 mb at 12Z at Martinique (14.5N, 61.1W) (HWM); 100 kt (max w) [Elevated? Gust? Estimated?] at Fort-de-France, Martinique at 12Z (ATS, MWR); 1001 mb (min p) at Martinique [uncertain] (ATS). Aircraft highlights: center fix at 2122Z at 14.2N, 63.5W with 992 mb central pressure and 58 kt max winds encountered (ATS, micro). At least 12 other aircraft gales between 35-60 kt (some at surface and some at flight-level). “Extrapolation of the storm center gave a position of 14.5N, 59W at the 02/0030Z surface chart. Surface reports from Martinique, Santa Lucia, and Barbados at this time continued to point to the fact that the storm was small and weak... with Martinique reporting NNE [10 kt], Santa Lucia ENE [3 kt] and Barbados NNW [3 kt]. The only strong wind reported – ENE [20 kt] – was reported by Desirade, 150 miles NW of the storm center. Reports from Martinique and Barbados on the 02/0630Z surface chart indicated that the storm had slowed drastically from 20 kt to about 7 kt during the

previous six hr. However, the intensification [that must have] started between the time of this and the previous map still did not show on the surface chart; for the above mentioned stations only reported 15 and 10 kt winds. The area of hurricane winds was extremely small, for the center was only 75 miles away from each of these stations. At 02/1200Z, a report received from Martinique was relayed via the Weather Bureau of this activity. The report came from a Pan American Airways control tower operator who estimated that the hurricane was over Martinique with winds of 100 kt. As this report was received prior to the aircraft reconnaissance [which later that day found maximum winds of 60 kt], it was the first concrete information which showed the winds in the small center had reached hurricane force. That the center was extremely small was shown on the 02/1230Z surface chart. Santa Lucia reported west wind 25 kt, Dominica reported an east wind 5 kt and Barbados reported a SSE 20 kt. Analysis closed the hurricane center over Martinique with 1001.4 mb, the lowest pressure reported” (ATS). “On the morning of the 2<sup>nd</sup> it was found to be a partially developed wave, with squalls of hurricane force in its northeastern quadrant, a short distance east of Martinique. Winds on the southern side were weak. On September 2, it moved through the Lesser Antilles between Santa Lucia and Martinique. Both islands suffered considerable damage. On Martinique 1,000 homes were reported destroyed and many others unroofed; 5 persons lost their lives by drowning; trees which were uprooted blocked roads and tore down telephone and power lines; 90 percent of the banana crop and 30 percent of the sugarcane crop were lost; damage was about \$3,000,000. On Santa Lucia, two persons lost their lives by drowning, and one sailing vessel was destroyed and two others damaged; flooding and high winds destroyed 70 percent of the banana crop in the northern part of the island. The strongest wind reported in the islands was 100 knots at Fort-De-France (Martinique) Airport [tower] on September 2. Total damage was well over \$3,000,000 and seven people were killed” (MWR). Description of damage, deaths, and wind observation in Tannehill matches the MWR description. “The 02/1830Z surface chart bore out the surmise that intensification was still taking place as the weather pattern and area of strong winds was spreading considerably. Martinique, over 180 miles from the center, reported steady rain with an east wind 30 kt; Desirade, 240 miles to the NE [of the center], was overcast with an ENE wind 30 kt; and St. Croix, 300 miles to the northeast, reported overcast, showers, and a NE 25 kt. The second reconnaissance of 2 September departed San Juan, Puerto Rico for the hurricane at 1832Z. At a distance of 58 miles NNW of the storm center, an east wind of 58 kt, the highest reported, was encountered. The plane entered the SW quadrant, which was open and with light winds from the SW at 18 kt. They reported the center at 14.1N, 63.5W at 02/2122Z with confused winds and seas. This fix showed that the hurricane had moved at about 15 kt since the 02/1200Z fix over Martinique. The aircraft radar showed heavy weather to the northeast and the plane circumnavigated that sector of the hurricane on its return to San Juan. The track of the return flight took the plane around the hurricane at a distance of about 70 miles from the center. Until darkness prohibited further observations, SSE winds of 50 to 54 kt were reported [assumed in the NE quadrant 70 miles from the center]” (ATS).

### September 3:

HWM analyzes a hurricane of at most 1005 mb centered near 13.6N, 66.9W. HURDAT lists this as a 90 kt hurricane at 14.6N, 67.4W. The MWR tracks of centers of cyclones

shows a 12Z position near 15.2N, 67.4W with a 993 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 1002 mb centered slightly west of the HURDAT position. Ship highlights: 45 kt SE and 1011 mb at 06Z at 16.2N, 64.7W (COA). Aircraft highlights: approximate center fix at 1315Z at 14.6N, 67.7W with 1000 mb lowest pressure encountered (ATS, micro); center fix at 1845Z at 15.2N, 69.9W with 993 mb central pressure and 90 kt max flight-level winds encountered (ATS, micro). Four other flight-level hurricane force winds and two other low pressures. "At 03/0958Z a Navy reconnaissance plane departed San Juan for the hurricane area. At 15.7N, 67W the plane encountered 75 kt winds for a brief period. An area of light variable winds and confused seas, opening to the south, with westerly winds of 12 kt was found at 14.7N, 67.7W. Radar showed no definite eye. The lowest pressure of 1000 mb was found at 14.6N, 67.7W at 03/1315Z. [Another] flight departed San Juan at 1652Z. The eye of the hurricane was located at 15.2N, 69.9W with a central pressure of 993 mb and maximum winds about the center from east at 90 kt. Winds of 65 kt extended 140 miles to the north of the center. Winds to the south were light, 15 kt the maximum. The eye was estimated to be 50 miles along an east-west diameter and 70 miles along the north-south diameter and open on the southern side" (ATS).

#### September 4:

HWM analyzes a tropical storm of at most 1005 mb centered near 15.4N, 74.7W. HURDAT lists this as a 60 kt tropical storm at 15.1N, 74.3W. The MWR tracks of centers of cyclones shows a 12Z position near 15.3N, 74.4W with a 1005 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a low of at most 1008 mb centered near the HURDAT position. Land/station highlights: 35 kt ENE and 1012 mb at 12Z at Kingston, Jamaica (HWM). Aircraft highlights: center fix at 14Z at 15.1N, 74.6W with 1004 mb central pressure and max flight-level winds encountered of 50 kt (micro); 35 kt E at flight-level of 500 ft and 1009 mb at 2030Z at 15.1N, 74.0W (micro). Four other flight-level gales. "Surface reports on the 04/0030Z chart were very sparse in the hurricane area. The gradient winds at Ciudad Trujillo, Port Au Prince and Kingston were all from the east at 35 kt. These reports were the bases on which the storm was extrapolated along its west course at 12 to 13 kt. At 04/1634Z a PB4Y-2 departed San Juan for the hurricane. The flight had great difficulty locating the disturbance. However, at 15.7N, 73.2W the apparent NW edge of the eye was discovered. Visibility was excellent to the west, south and east with the lowest pressure of 1000.0 mb and a maximum wind of 38 kt" (ATS). The 04/1500Z upper-air charts led [forecasters] to believe that filling/weakening would take place (ATS).

#### September 5:

HWM analyzes a tropical storm of at most 1005 mb centered near 16.0N, 78.7W. HURDAT lists this as a 35 kt tropical storm at 15.7N, 79.1W. The MWR post-season track map shows a 12Z position near 16.5N, 81.5W. Microfilm analyzes a closed low of at most 1008 mb centered near 16.6N, 81.2W. Ship highlights: 25 kt ESE and 1008 mb at 00Z at 15.8N, 76.3W (micro). "After the hurricane entered the Caribbean Sea, it began losing force and by the time its westward course brought it to a position some 200 miles

southeast of Swan Island on the 5<sup>th</sup>, it had dissipated into moderate squalls and thereafter disappeared entirely” (MWR). “On the 05/0630Z surface chart, a well spread low is all that remained of Dog. The flight which departed Miami on 5 September at 0957Z searched the area thoroughly around the coordinates given and found no signs of a disturbance. The 05/1500Z upper air charts, at all levels, showed that easterly flow again prevailed” (ATS).

Dog apparently formed from an easterly wave or an easterly wave’s interaction with the ITCZ. HURDAT starts this cyclone at 06Z on 27 August at 12.3N, 25.6W as a 25 kt tropical depression. The 25<sup>th</sup> and the 26<sup>th</sup> were searched between 30W and the African coast, and no closed circulation could be found. No changes are made to the genesis of this cyclone. The depression moved westward through the tropical Atlantic Ocean for the next several days. On 28 August, a ship reported 1003 mb at 06Z and 1005 mb at 18Z, but these observations are both from the same ship, and both about 5 degrees east of the analyzed position at those times, so these observations are not associated with the circulation and are likely biased too low. This suspicion was confirmed on the 29<sup>th</sup>, when the same ship reported observations of 1005 and 1007 mb about 12 degrees east of the analyzed position. On the 29<sup>th</sup>, a couple of ship observations near the depression allow for a relatively accurate placement of the position on that day near the HURDAT position in the vicinity of 12N, 36W. These observations were 5 to 10 kt winds with 1013 mb pressures, and the 25 kt intensity in HURDAT is maintained. There is not any data on the 30<sup>th</sup> in the vicinity of the cyclone, but on the 31<sup>st</sup>, a ship recorded 15 kt SW with 1012 mb, and this ship is analyzed to be located just over one degree ESE of the center of the cyclone. The HURDAT position on the 31<sup>st</sup> at 12Z is moved about nine-tenths of a degree ESE of the previous HURDAT position- the largest single track change for the entire lifetime of this system. No intensity changes were made to HURDAT from genesis on the 27<sup>th</sup> through 00Z on 2 September, and the main reason for this is lack of observations/lack of evidence to make a change to HURDAT. The depression became Tropical Storm Dog at 00Z on 31 August. By the 1<sup>st</sup> of September, it was approaching the Lesser Antilles. On the 1<sup>st</sup> at 12Z, a ship observation of 35 kt NE with 1011 mb may have been 5 degrees too far east. If this assumption is made, the HURDAT position and intensity appear accurate. At this time, the 55 kt tropical storm was located near 14N, 56W. On 2 September sometime around 12Z, the center of Dog passed between St. Lucia and Martinique on a westward course. At the 12Z observation, St. Lucia recorded 25 kt WSW with 1001 mb, and Martinique recorded 50 kt ENE with 1004 mb. A report from the observer at the Martinique Fort-de-France Airport of 100 kt was received. It is unknown whether this was recorded/estimated, an elevated observation, and/or perhaps a gust. Using the distance from these islands to the analyzed position of Dog at 12Z, two different runs of the Schloemer equation yield central pressures of 996 and 999 mb. The descriptions of the damage inflicted with thousands of homes destroyed producing millions of dollars in damage on the two islands indicate that this cyclone was extremely likely to have been at hurricane intensity during its passage through the islands. Nine hours later, at 2122Z of 2 September, aircraft reconnaissance measured a central pressure of 992 mb with maximum flight-level winds encountered of 58 kt (although surface winds of 60 kt were estimated by aircraft at 1730Z). A central pressure of 992 mb is added to HURDAT at 00Z on the 3<sup>rd</sup>, and this value yields a wind speed of 61 kt

according to the Brown et al. southern pressure wind relationship. An intensity of 80 kt is chosen for 12Z during Dog's passage through the islands (down from 95 kt originally), and 70 kt is chosen for 00Z on the 3<sup>rd</sup> (down from 100 kt originally- a major change). Dog continued westward, and on the 3<sup>rd</sup> at 1845Z, aircraft reconnaissance recorded a central pressure of 993 mb, and this value is added to HURDAT at 18Z on the 3<sup>rd</sup>. A central pressure of 993 mb yields 59 kt according to the southern pressure-wind relationship. The RMW was much larger than climatology, but the storm had a forward speed of 21 kt. Aircraft reconnaissance measured a maximum flight-level wind of 90 kt around 600 ft. A 60 kt intensity is chosen for 18Z on the 3<sup>rd</sup> (down from 85 kt originally- another major change). Dog is analyzed to have weakened to a tropical storm 18 hours earlier than in HURDAT originally. On the 4<sup>th</sup> of September, as Dog was moving westward into the central Caribbean Sea, it weakened further. At 14Z on the 4<sup>th</sup>, aircraft measured a central pressure of 1004 mb with maximum flight-level winds of 50 kt around 600 ft. A central pressure of 1004 mb is added to HURDAT at 12Z on the 4<sup>th</sup>, and this value yields 41 kt according to the weakening subset of the southern pressure-wind relationship. A 45 kt intensity is chosen for HURDAT at 12Z on the 4<sup>th</sup> (down from 60 kt originally), and 40 kt is chosen for 18Z (down from 60 kt- a major change). Major downward intensity adjustments of 25 to 30 kt are analyzed for Dog at all times from 18Z on 2 September to 06Z on 4 September, and a major downward adjustment of 20 kt is implemented at 18Z on the 4<sup>th</sup>. The storm continued to weaken as it moved westward. At 1955Z in the 4<sup>th</sup>, aircraft recorded a flight-level wind of 38 kt. Two ship observations at 00Z on the 5<sup>th</sup> confirm that the circulation was still closed. One of these observations is a pressure of 1008 mb with 25 kt ESE winds located half a degree NNE of the center, and the other is 5 kt NNW with 1011 about 1 degree SW of the center. 00Z on the 5<sup>th</sup> is the last time that there is confirmation of a closed circulation. The circulation may have still been closed at 06Z, but by 18Z on the 5<sup>th</sup>, observations indicate that the circulation had opened up into a remnant trough/wave. Dog is analyzed to have weakened to a tropical depression at 06Z on the 5<sup>th</sup> (12 hours earlier than in HURDAT originally). HURDAT lists a final position at 18Z on the 5<sup>th</sup> as a 25 kt tropical depression at 16.1N, 82.4W, but the final point is eliminated from HURDAT. The last position is now shown to be at 12Z on the 5<sup>th</sup> as a 25 kt tropical depression at 15.5N, 79.5W before it became an open wave.

### 1951 Storm 6 (Easy) – (originally Storm 5)

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35715 09/02/1951 M=12 5 SNBR= 789 EASY XING=0
35715 09/01/1951 M=14 6 SNBR= 789 EASY XING=0
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(The 1<sup>st</sup> is new to HURDAT.)

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35720 09/01* 0 0 0 0*125 320 30 0*132 333 35 0*140 345 40 0*
35720 09/02* 0 0 0 0* 0 0 0 0* 0 0 0 0*140 370 40 0*
35720 09/02*146 355 40 0*148 364 40 0*150 374 40 0*153 386 40 0*
*** ** ** *** ** ** *** ** ** *** **
35725 09/03*157 396 40 0*163 411 55 0*166 426 65 0*167 438 70 0*
35725 09/03*157 402 45 0*161 418 55 0*164 433 65 0*166 445 70 0*
*** ** *** ** *** ** *** **
35730 09/04*166 449 75 0*167 459 80 0*170 470 85 0*178 487 90 0*
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35730 09/04*167 457 75 0*169 469 75 0*172 482 80 0*178 497 80 0*
      *** ***          *** *** **      *** *** **      *** **
35735 09/05*187 505 95 0*197 521 95 0*206 537 100 0*211 555 100 0*
35735 09/05*187 513 85 0*197 529 85 0*206 544 85 0*212 559 85 0*
      *** **          *** **      *** ***      *** *** ***
35740 09/06*215 573 105 0*219 593 105 0*223 612 110 0*227 625 120 0*
35740 09/06*215 574 85 0*219 591 85 0*223 606 85 967*226 619 95 957*
      *** ***          *** ***      *** ***      *** *** *** ***
35745 09/07*230 637 130 0*234 649 135 0*240 660 140 0*248 670 140 0*
35745 09/07*230 632 105 0*236 646 115 0*245 660 120 0*254 669 125 937*
      *** ***          *** *** ***      *** ***      *** *** *** ***
35750 09/08*258 676 140 0*271 678 135 0*283 674 130 0*292 667 120 0*
35750 09/08*262 675 130 0*271 676 130 0*279 674 125 0*286 671 120 0*
      *** *** ***          *** ***      *** ***      *** ***
35755 09/09*299 660 115 0*303 653 100 0*308 644 95 0*320 627 90 0*
35755 09/09*294 664 110 0*299 655 100 0*305 643 95 0*316 626 90 0*
      *** *** ***          *** ***      *** ***      *** ***
35760 09/10*332 608 85 0*341 597 85 0*350 585 85 0*362 571 80 0*
35760 09/10*330 611 85 0*342 597 85 0*354 581 85 0*367 567 80 0*
      *** ***          ***          *** ***      *** ***
35765 09/11*373 557 80 0*381 541 75 0*386 526 70 0*389 513 70 0*
35765 09/11*379 555 80 0*390 541 75 0*395 526 70 0E395 512 70 0*
      *** ***          ***          ***          *** ***
35770 09/12*390 499 65 0*390 484 65 0E390 469 65 0E390 455 65 0*
35770 09/12E395 499 65 0E395 486 65 0E395 470 60 0E395 455 60 0*
      ****          **** ***          *** *** **      *** **
35775 09/13E396 438 65 0E408 415 60 0E420 393 50 0E458 374 45 0*
35775 09/13E397 440 60 0E407 415 60 0E419 393 60 0E432 370 60 0*
      *** *** **          ***          ***          *** *** **
(The 14th is new to HURDAT.)
35775 09/14E442 322 60 0E452 280 65 0E463 225 65 0E475 171 60 0*
35780 HR

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Major track changes and major intensity changes are analyzed for this powerful hurricane. Major changes are made to both the genesis and the dissipation of this cyclone, and a major change is made to the timing of when Easy became a major hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

#### August 30:

HWM analyzes a closed low of at most 1010 mb centered near 10.9N, 25.4W. HURDAT did not yet list a system on this day. No gales or low pressures.

#### August 31:

HWM analyzes a closed low of at most 1010 mb centered near 14.0N, 28.8W. HURDAT did not yet list a system on this day. No gales or low pressures.

#### September 1:

HWM analyzes a closed low of at most 1010 mb centered near 12.3N, 32.3W. HURDAT did not yet list a system on this day. Ship highlights: 35 kt NE and 1010 mb at 18Z at 16.0N, 36.9W (COA). It was determined on the 3<sup>rd</sup> of September by forecasters/analysts “that the vortex of what was not yet a tropical storm [on the 1<sup>st</sup> of September] had formed between 1230Z and 1830Z on 1 September at about 14.5N, 34.7W” (ATS).

#### September 2:

HWM analyzes a closed low of at most 1010 mb centered near 14.4N, 38.5W. HURDAT firsts lists this system at 18Z as a 40 kt tropical storm at 14.0N, 37.0W. No gales or low pressures. “ ‘Easy’ gave the first indication of its presence on the 02/1830Z surface chart” (ATS). ATS mentions that one ship south of the developing storm had a SW wind of 15 kt and several ships displayed negative pressure tendencies.

#### September 3:

HWM analyzes a tropical storm of at most 1005 mb centered near 16.9N, 42.9W. HURDAT lists this as a 65 kt hurricane at 16.6N, 42.6W. Ship highlights: 35 kt NNE and 1000 mb at 07Z at 16.5N, 43.6W (ATS); 30 kt WNW and 1005 mb at 12Z at 15.6N, 43.7W (ATS). “The steamship *Barn* sent three special reports on the morning of September 3 which indicated the existence of a circulation, probably of hurricane force, near 16.5N, 42.5W” (MWR). “On the 03/1230Z surface chart, the ship *Barn* at 15.6N, 43.7W reported overcast sky with continuous rain, WNW 30 kt wind, and a pressure at 1005 mb. At this time, two delayed reports from *Barn* were also received [including a 0700Z report of 35 kt NNE with 1000 mb]. These reports from the *Barn* definitely established that it had intensified to tropical storm intensity” (ATS). An aircraft on the 3<sup>rd</sup> of September, which left from Ramay AFB, Puerto Rico, reached “the extreme end of its search range at 12.8N, 51.8W and was forced to turn back. The report from this position gave scattered altocumulus clouds with NNE winds of 10 kt” (ATS).

#### September 4:

HWM analyzes a tropical storm of at most 1005 mb centered near 18.6N, 48.6W. HURDAT lists this as an 85 kt hurricane at 17.0N, 47.0W. The MWR post-season track map shows a 12Z position just northwest of the HURDAT position near 17.2N, 47.2W. Aircraft highlights: possible center fix at 1750Z near 20.3N, 49.0W with 989 mb lowest pressure encountered and 58 kt max flight-level winds encountered [position may be in error; not sure if center fix; not sure if central pressure] (ATS). “Aircraft reported it to be of hurricane force and increasing [in intensity] as it moved on a west-northwestward course” (MWR). “At 04/1123Z an Air Force B-29 departed Ramey Air Force Base for the storm area. At 04/1750Z the reconnaissance plane reported the disturbance, located by DR, consisting of twin cells with centers at 20.3N, 49W and 20.8N, 49W respectively. The maximum measured continuous winds were 58 kt. The pressure of the southern most eye reported was 992 mb. No pressure report was given for the more northern eye; however, the lowest pressure [for the flight] (989 mb) was reported on the east side of the disturbance. As there was no indication of wind shift of shear between these and around those two reported centers it was assumed that the eye was elongated along a north-south axis... The position of the hurricane center was taken as 20.5N, 49W” (ATS).

**September 5:**

HWM analyzes a hurricane of at most 1000 mb centered near 21.5N, 54.1W. HURDAT lists this as a 100 kt hurricane at 20.6N, 53.7W. The MWR post-season track map shows a 12Z position just southwest of the HURDAT position. Microfilm at 18Z analyzes a closed low of at most 993 mb centered close to the 18Z HURDAT position. Ship highlights: 40 kt S and 994 mb at 18Z at 21.1N, 55.4W (micro). Three other gales of 35 kt and four other low pressures between 997-1005 mb. Aircraft highlights: Air Force center fix at 1627Z at 21.0N, 55.7W with 120 kt max flight-level winds encountered (ATS, micro). "The 05/1230Z surface chart yielded enough [ship] reports to establish the position of Easy. An 'off-time' ship at 23N, 55.5W reported a pressure of 997 mb with a minus 5.2 mb tendency. At 05/1230Z, an Air Force Reconnaissance plane departed Ramay Air Force Based for the hurricane. At 05/1627Z the Air Force reconnaissance aircraft reported the position of the hurricane center at 21N, 55.7W. Maximum winds reported were 120 kt in the northern quadrant. The hurricane was still on a westerly course and was maintaining its 12 kt speed of advance" (ATS).

**September 6:**

HWM analyzes a hurricane of at most 995 mb centered near 21.7N, 60.7W. HURDAT lists this as a 110 kt hurricane at 22.3N, 61.2W. The MWR tracks of centers of cyclones shows a 12Z position near 22.6N, 60.1W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a tropical storm of at most 999 mb centered near 22.3N, 60.8W. Ship highlights: 35 kt SE and 1006 mb at 00Z at 21.2N, 55.4W (COA); 35 kt E and 1006 mb at 00Z at 23.2N, 56.4W (micro). Aircraft highlights: Air Force center fix (DR) at 1406Z at 22.5N, 61.2W with 967 mb central pressure and 110 kt max flight level winds (ATS, micro); Navy center fix (DR) at 2006Z at 22.6N, 61.9W with 957 mb central pressure and 125 kt max flight-level winds encountered (ATS, micro); 120 kt NW (at flight-level of 500 ft) and 987 mb at 22.5N, 62.5W (micro); 120 kt SE (at flight-level of 500 ft) and 987 mb at 22.5N, 61.3W (micro); 95 kt ENE (at flight-level of 500 ft) at 2100Z at 23.4N, 62.1W (micro). "At 06/1406Z the Air Force reconnaissance plane fixed the center of Hurricane Easy at 22.5N, 61.2W. The eye was described as being 70 mi in diameter with maximum winds in the NE quadrant at 110 kt. A Navy Hurricane reconnaissance plane departed San Juan for Hurricane Easy at 06/1745Z. Penetration gave the center at 22.5N, 61.9W at 06/2028Z. The crew described the eye as 30 mi in diameter with winds of 125 kt from the WNW" (ATS).

**September 7:**

HWM analyzes a hurricane of at most 990 mb centered near 23.7N, 65.8W. HWM analyzes Hurricane Fox near 22.0N, 50.3W, or about 860 nmi east of Easy. HURDAT lists Easy with a 140 kt intensity at 24.0N, 66.0W. The MWR tracks of centers of cyclones shows a 12Z position near 24.0N, 65.0W with a 960 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a low of at most 987 mb centered near the HURDAT position. Ship highlights: 45 kt ESE and 1011 mb at 06Z at 26.0N, 62.2W (COA, micro); 40 kt ENE and 1002 mb at 18Z at 27.4N, 67.1W (COA, micro). One other gale of 35 kt and one other low pressure of 1004 mb. Aircraft highlights: Estimated storm position (by Navy) at 1442Z

at 25.1N, 66.5W with 968 mb (peripheral) lowest pressure encountered and 140 kt + maximum flight-level winds encountered (ATS, micro); 140 kt + (at flight-level- low-level) and 968 mb at 1442Z at 25.2N, 66.8W (micro); Air Force center fix (loran) at 1925Z and 2022Z at 25.6N, 66.9W with 937 mb central pressure, 110 kt visual surface winds, 140 kt max flight-level winds, and 700 mb height in the eye of 8,620 feet (ATS, micro). “By the time it began recurving northward on the 7<sup>th</sup> near 25N, 67W, aircraft reported it to be too severe for penetration. The wind reached an estimated 140 knots at deepest penetration on the south side when the plane had to turn back. This indicated that a possible wind of between 160 and 200 mph was prevailing near the center and on the stronger northern side. This was by far the most severe hurricane of the 1951 season” (MWR). “At 07/1155Z a Navy Hurricane reconnaissance plane departed San Juan for Hurricane Easy. The Navy plane gave the position of the center of Easy at 07/1442Z at 25.1N, 66.5W. This was an estimated position for due to extreme turbulence and very high winds (140 kt from the NNW were encountered in the western semi-circle), penetration was not possible. A second reconnaissance flight to hurricane Easy departed Bermuda at 07/1700Z and gave a fix on its center at 07/1925Z at 25.6N, 66.9W with maximum winds of 140 kt to the south of the eye” (ATS).

#### September 8:

HWM analyzes a hurricane of at most 990 mb centered near 28.2N, 67.8W with a dissipating cold front located well northwest of the cyclone extending from 39N, 64W to 35N, 68W to 33N, 71W to 31N, 75W. HWM also analyzes Hurricane Fox to be located near 26.6N, 57.1W, or about 580 nmi ESE of Easy. HURDAT lists Hurricane Easy with a 130 kt intensity at 28.3N, 67.4W. The MWR tracks of centers of cyclones shows a 12Z position near 27.2N, 67.2W with a 937 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a low of at most 987 mb centered near 28.0N, 67.3W. Ship highlights: 80 kt E and 988 mb at 00Z at 27.2N, 67.2W (COA, micro); 120 kt SSW and 983 mb at 06Z at 27.1N, 67.2W (COA, micro); 120 kt E and 986 mb at 12Z at 28.0N, 68.0W (COA); 65 kt SW and 985 mb at 18Z at 27.9N, 67.8W (COA); 60 kt SSW and 996 mb at 21Z at 27.8N, 66.1W (micro). 14 other gales between 35-60 kt and nine other low pressures between 997-1005 mb. Land/station highlights: 15 kt ESE and 1005 mb at 21Z at Bermuda (micro); 10 kt E and 1005 mb at 2230 and 2330Z at Bermuda (micro). Aircraft highlights: Air Force center fix (DR) at 1316Z at 28.2N, 67.0W with 130 kt max flight-level wind encountered (ATS, micro). “An Air Force reconnaissance aircraft departed Bermuda at 08/1030Z and gave a fix on the center of Hurricane Easy at 08/1316Z at 28.2N, 67W. The maximum winds, 130 kt, were found in the NE quadrant” (ATS).

#### September 9:

HWM analyzes a hurricane of at most 990 mb centered near 30.7N, 64.0W. HWM also analyzes hurricane Fox to be located near 37.8N, 57.9W, or about 520 nmi NE of Easy. HURDAT lists Hurricane Easy with a 95 kt intensity at 30.8N, 64.4W. The MWR tracks of centers of cyclones shows a 12Z position near 30.8N, 65.1W with a 966 mb pressure and the MWR post-season track map shows a 12Z position near 30.6N, 63.6W. Microfilm at 00Z analyzes the centers of Easy and Fox to be located only about 440 nmi from each other. Microfilm at 12Z analyzes a low (Easy) of at most 990 mb centered

near 30.5N, 63.7W. The microfilm analysis also shows that Easy and Fox are located within the same 1005 mb contour, but the two cyclones are analyzed with separate 1002 mb closed isobars, and both cyclones are analyzed to be of at most 990 mb. Ship highlights: 35 kt SW and 998 mb at 00Z at 27.0N, 66.5W (COA); 45 kt S and 1002 mb at 00Z at 27.6N, 66.2W (COA); 50 kt S at 00Z at 26.5N, 65.0W (COA); 35 kt NE and 992 mb at 15Z at 31.6N, 63.6W (micro); 45 kt NNW and 994 mb at 18Z at 31.5N, 63.8W (micro). Ten other gales and eight other low pressures. Land/station highlights: 35 kt NNE and 1000 mb at 1530Z at Bermuda (micro). One other gale of 35 kt and 21 other low pressures between 1000-1005 mb at Bermuda. Aircraft highlights: Air Force center fix (loran) at 0051Z at 29.4N, 66.4W with 700 mb height in the eye of 8,935 ft (micro, ATS); Air Force center fix at 1605Z at 31.0N, 63.1W with 80-100 ft waves (ATS, micro); Air Force center fix at 1815Z (no position given) with 967 mb pressure [probably central pressure, but not certain] and 140 kt max flight level winds encountered (micro). "It curved sharply and passed a short distance southeast of Bermuda on the 9<sup>th</sup>" (MWR). "At 08/2330Z another Air Force reconnaissance aircraft departed Bermuda for hurricane Easy and reported the center at 09/0120Z at 29.5N, 66.4W. No winds were reported. This reported showed that Easy had indeed slowed and recurved toward the northeast. Hurricane Fox at that time [09/0030Z] was estimated to be about 31.6N, 59.4W with the hurricane centers now about 390 miles apart. Analysis of the 09/1230Z surface chart gave a fairly good [position estimate] on both hurricanes. Hurricane Easy showed a speed of advance of about 10 kt on a NE course taking it south of Bermuda at 30.6N, 64.8W. At 09/1045Z an Air Force reconnaissance plane departed Tampa, FL for Hurricane Easy. The aircraft fix on Hurricane Easy at 09/1605Z was 31N, 63.1W. [On the 09/1830Z surface chart, Easy was placed] at 31.8N, 62.2W..." (ATS).

#### September 10:

HWM analyzes a hurricane of at most 995 mb centered near 35.1N, 58.6W. HURDAT lists this as an 85 kt hurricane at 35.0N, 58.5W. The MWR tracks of centers of cyclones shows a 12Z position near 35.2N, 56.5W with a 967 mb pressure and the MWR post-season track map shows a 12Z position near 36.2N, 56.2W. Microfilm analyzes a low of at most 996 mb centered near 35.4N, 56.9W. Ship highlights: 60 kt NE and 1000 mb at 00Z at 34.4N, 61.2W (COA); 55 kt SE and 1009 mb at 12Z at 35.0N, 55.1W (COA); 55 kt S and 1008 mb at 18Z at 35.0N, 54.2W (COA). 12 other gales of 35-55 kt and one other low pressure. Aircraft highlights: Air Force center fix at 2053Z at either 37.2N, 54.8W or 37.6N, 56.4W [not sure which is correct] with 120 kt max flight level winds encountered (ATS, micro). "Hurricane Easy was accelerating and by 10/1830Z was at 36.5N, 56.7W (had assumed a speed of advance of about 20 kt). A fix on the center of Easy was received from the Air Force reconnaissance plane at 10/2053Z at 37.2N, 54.8W. The maximum winds of 120 kt were reported on the south side of the hurricane" (ATS).

#### September 11:

HWM analyzes a tropical storm of at most 995 mb centered near 39.7N, 52.7W with a dissipating cold front plotted from 44N, 46W to 45N, 36W and another dissipating cold front plotted from 40N, 58W to 41N, 65W. HURDAT lists this as a 70 kt hurricane at 38.6N, 52.6W. The MWR tracks of centers of cyclones shows a 12Z position near

40.0N, 51.4W with a 984 mb pressure and the MWR post-season track map shows a 12Z position near 40.3N, 52.6W. Microfilm analyzes a tropical storm of at most 993 mb centered near 40.4N, 53.1W. Ship highlights: 55 kt N and 995 mb at 06Z at 40.3N, 55.6W (COA); 40 kt N and 1005 mb at 12Z at 40.8N, 55.3W (COA). 12 other gales between 35-45 kt and three other low pressures between 1001-1005 mb. "The 11/0630Z surface chart indicated Easy was beginning to take on extra-tropical characteristics as it moved northeastward following the path of the now defunct Fox. At 11/1830Z with the highest winds at 60 miles from the center on the west side reported as 35 kt; 5 kt 70 miles to the north and 20 and 25 kt in the southern and eastern sector and with 10 to 20 degree temperature discontinuities across the storm, Easy was declared extratropical" (ATS).

#### September 12:

HWM analyzes a tropical storm of at most 1000 mb centered near 39.3N, 47.1W with a west end of a W-E stationary front plotted about 220 nmi ENE of the cyclone. HURDAT lists this as a 65 kt extratropical cyclone at 39.0N, 46.9W. The MWR tracks of centers of cyclones shows a 12Z position near 40.2N, 47.3W with a 990 mb pressure. Microfilm at 18Z analyzes a closed low of at most 999 mb centered near 39.0N, 45.7W. Ship highlights: 55 kt SSW and 999 mb at 00Z at 39.1N, 48.4W (COA); 50 kt SSW and 989 mb at 06Z at 39.0N, 49.0W (COA); 40 kt WSW and 997 mb at 18Z at 38.5N, 46.9W (micro). Nine other gales between 35-45 kt and two other low pressures between 1003-1005 mb. "[Easy] continued northeastward and was well off Newfoundland by the 12<sup>th</sup>. This great hurricane did not strike any land area, but a few ships were involved more or less and suffered damage to their superstructures. There was no loss of life" (MWR).

#### September 13:

HWM analyzes a closed low of at most 1000 mb centered near 41.6N, 39.4W with the west end of a W-E warm front plotted about 250 nmi ENE of the cyclone. HURDAT lists this as a 50 kt tropical storm at 42.0N, 39.3W. The MWR tracks of centers of cyclones shows a 12Z position near 42.2N, 38.1W with a 997 mb pressure. Ship highlights: 45 kt NE and 1004 mb at 06Z at 42.9N, 41.7W (COA); 45 kt SW and 1004 mb at 06Z at 38.4N, 41.5W (COA); 50 kt N and 1007 mb at 12Z at 41.0N, 44.0W (COA); 50 kt S at 18Z at 42.2N, 35.0W (COA). Three other gales between 35-45 kt.

#### September 14:

HWM analyzes a closed low of at most 990 mb centered near 46.4N, 22.8W with a warm front extending from the low southeastward to 39N, 9W and a cold front extending from the low southwestward to 42N, 30W. HURDAT no longer lists this system. The MWR tracks of centers of cyclones shows a 12Z position near 48.0N, 23.0W with a 990 mb pressure. Ship highlights: 25 kt S and 998 mb at 00Z at 44.1N, 27.2W (COA); 50 kt SW and 981 mb at 06Z at 43.3N, 27.5W (COA); 35 kt SE and 989 mb at 12Z at 46.9N, 21.7W (COA, HWM); 60 kt NE and 991 mb at 14Z at 48.0N, 20.0W (COA); 50 kt SW and 990 mb at 18Z at 46.7N, 17.5W (COA). At least ten other gales and 12 other low pressures.

#### September 15:

HWM analyzes a closed low of at most 1005 mb centered near 52.7N, 2.5W with an occluded front extending from the low to a triple point at 47.5N, 0.1E. A dissipating stationary front extends eastward from the triple point and a cold front extends southwestward from the triple point. HURDAT no longer lists this system.

HURDAT previously started this cyclone at 18Z on 2 September at 14.0N, 37.0W as a 40 kt tropical storm. August 30<sup>th</sup> through September 1<sup>st</sup> were searched for data between 40W and the African coast. On 30 and 31 August, there is not enough data to indicate the presence of a closed circulation although there are a couple of observations of west winds far from where the cyclone likely was if it existed. On 1 September, there were more observations with westerly wind components relatively far away as well, but at 06Z on 1 September, a ship recorded 25 kt NE with 1008 mb around 13.7N, 31.7W, and at 18Z that day, a ship recorded 35 kt NE with 1010 mb at 16N, 36.9W. It could not be determined whether this was the same ship, but the ship would have had to travel at a speed of 25 kt to cover that distance in 12 hours. Regardless, this information is enough to start this cyclone on the 1<sup>st</sup>, especially because of observations found on 3 September that indicate the definite presence of at least a strong tropical storm. The location of the observations found on 1 September are consistent with observations on the 3<sup>rd</sup> from a tropical cyclone moving with a forward speed of about 13 kt. Genesis is analyzed to have occurred at 06Z on 1 September (36 hours earlier than in HURDAT originally) at 12.5N, 31.7W (5 degrees east of the original HURDAT genesis location) as a 30 kt tropical depression. The cyclone is analyzed to have become a tropical storm by 12Z on the 1<sup>st</sup> (30 hours earlier than in HURDAT originally). A 40 kt intensity is analyzed at 18Z on the 1<sup>st</sup> at the time as the 35 kt ship observation was recorded, which was about 150 nmi NW of the analyzed position at that time. On the 2<sup>nd</sup>, there is no data near the cyclone, but on the 3<sup>rd</sup> at 07Z, a ship recorded 35 kt NE with 1000 mb around 16.5N, 43.7W. A peripheral pressure of 1000 mb yields a wind speed of at least 47 kt according to the southern pressure-wind relationship, and the HURDAT intensity of 55 kt at 06Z on the 3<sup>rd</sup> is unchanged. No change is made to the time of when Easy became a hurricane (12Z on the 3<sup>rd</sup>). It should be mentioned that a major change is made to the HURDAT position at 18Z on 2 September. The position is shifted about 2.1 degrees NW of the previous position to 15.3N, 38.6W (from 14.0N, 37.0W originally). That was the only major track change during the tropical portion of the lifetime of Easy, and all track changes from the 3<sup>rd</sup> through the 12<sup>th</sup> are minor track changes. Analyzed positions from 18Z on the 2<sup>nd</sup> to 18Z on the 5<sup>th</sup> are all west of the previous HURDAT positions, but from the 6<sup>th</sup> at 06Z on the 7<sup>th</sup> at 06Z, the analyzed position are slightly east of the previous HURDAT positions. Late on the 7<sup>th</sup> and early on the 8<sup>th</sup>, Easy turned toward north and began to recurve with a furthest west position of 27.1N, 67.6W at 06Z on 8 September. Back on September 4<sup>th</sup>, Easy was moving towards the west-northwest, and on the 4<sup>th</sup> at 1750Z, aircraft reconnaissance intercepted the cyclone at the very edge of its range near 20.3N, 49.0W. The lowest pressure encountered was 989 mb and the strongest flight-level winds encountered were 58 kt, but the information available suggests that the flight crew was uncertain of the location of the true center of the cyclone, and that the 989 mb was not measured at a location of a minimum in wind speed or near a wind shift. Furthermore, ship data suggests that the position of Easy was about 150 nmi south of the reported aircraft fix. The 989 mb reading is therefore not treated as a central pressure. A

peripheral pressure of 989 mb yields a wind speed of at least 65 kt according to the southern pressure-wind relationship. The first reliable aircraft center fix occurred on the 5<sup>th</sup> at 1627Z at 21.0N, 55.7W. No central pressure was reported and maximum flight-level winds of 120 kt were encountered at an unknown elevation. On the 6<sup>th</sup>, aircraft reconnaissance reported central pressures of 967 mb 1406Z and 957 mb 2006Z, and these values are added to HURDAT at 12Z and 18Z respectively on the 6<sup>th</sup>. A central pressure of 967 mb yields 93 kt according to the southern pressure-wind relationship and 95 kt for the intensifying subset. The RMW reported was much larger than climatology, the speed to the cyclone was 13 kt, and the maximum flight-level winds encountered were 110 kt at an unknown elevation. A central pressure of 957 mb yields 106 kt according to the intensifying subset of the southern pressure wind relationship. The RMW was a little larger than climatology, the speed of Easy of 11 kt, and the maximum flight-level winds encountered were 125 kt around 500 ft. Analyzed intensities from 12Z on the 6<sup>th</sup> through 00Z on the 7<sup>th</sup> are 85, 95, and 105 kt (down from 110, 120, and 130 kt originally- all major downward adjustments). On 4 September, at the time aircraft measured a peripheral pressure of 989 mb, an intensity of 80 kt is analyzed for 18Z on the 4<sup>th</sup> (down from 90 kt originally). An 85 kt intensity is analyzed from 00Z on the 5<sup>th</sup> through 12Z on the 6<sup>th</sup>. Easy is analyzed to have become a major hurricane 36 hours later than originally (a major change). On the 7<sup>th</sup> of September at 1442Z, a Navy low-level penetration attempt was unsuccessful. Maximum flight-level winds of 140 kt were encountered (presumably below 1,000 ft) along with a lowest pressure encountered of 968 mb about an estimated 18 nmi from the center. The eye was not visible on radar to the flight crew, so the 18 nmi value is an estimate. Two runs of the Schloemer equation were performed- one assuming the plane reached the RMW, and the other assuming that the plane came within 1 nmi of the RMW. The equation yields central pressure values of 942 and 940 mb respectively. Just five hours later, at 1925Z on the 7<sup>th</sup>, a 700 mb height in the eye of 8,935 ft was reported, indicating a central pressure in the range of 933-950 mb. One hour later, at 2022Z on the 7<sup>th</sup>, an Air Force aircraft reported a central pressure of 937 mb, and this value is added to HURDAT at 18Z on the 7<sup>th</sup>. A central pressure of 937 mb yields 126 and 123 kt respectively according to the intensifying subsets of the southern and north of 25N pressure-wind relationship. The RMW and the speed of the cyclone were near average. During this flight, aircraft estimated 110 kt surface winds visually and encountered 140 kt flight-level winds at an unknown altitude. An intensity of 125 kt is chosen for 18Z on 7 September (down from 140 kt originally). Major downward intensity adjustments of 20 to 25 kt are analyzed at all times from 00Z on the 6<sup>th</sup> to 12Z on the 7<sup>th</sup>. After the 937 mb aircraft central pressure late on the 7<sup>th</sup>, there were no more central pressure observations for this cyclone. On the 8<sup>th</sup>, Easy began a turn toward the northeast. At 06Z, a ship reported 120 kt with 983 mb, and at 12Z, another ship reported 120 kt with 986 mb. At 1316Z, aircraft reconnaissance recorded a maximum flight-level wind encountered of 130 kt. On the 9<sup>th</sup> at 0051Z, an Air Force aircraft recorded a 700 mb height in the eye of 8,935 ft, indicating a central pressure in the range of 942-959 mb. This central pressure range suggests wind speeds in the range of 96-113 kt according to the north of 25N pressure-wind relationship and 92-108 kt for its weakening subset. A 110 kt intensity is chosen for 00Z on the 9<sup>th</sup> (down from 115 kt originally). HURDAT previously listed Easy with a peak intensity of 140 kt from 12Z on the 7<sup>th</sup> to 00Z on the 8<sup>th</sup>. The revised peak intensity is 130 kt from 00Z on the 8<sup>th</sup> to 06Z on the 8<sup>th</sup>. A peak

intensity of 130 kt was chosen because after the 937 mb central pressure was recorded, there was no definitive information to indicate that weakening had taken place until 0051Z on the 9<sup>th</sup> (29 hours after the 937 mb central pressure). Therefore, it is possible that Easy continued to strengthen for a short time after the 937 mb central pressure was recorded before weakening commenced. Since it is unknown whether the actual intensity was closer to 125 kt or 130 kt at 00 and 06Z on the 8<sup>th</sup>, it is better to edge closer to the original HURDAT intensities (140 and 135 kt at 00 and 06Z respectively). Easy made its closest approach to Bermuda on the 9<sup>th</sup> - it passed roughly 100 nmi SE of Bermuda on a northeast course. Hourly observations are available from Bermuda. The lowest hourly pressure recorded was 1000 mb. The barometer was steady around 1000 mb there from 0830Z to 1530Z on the 9<sup>th</sup>. The highest hourly wind was 35 kt recorded at 1430 and 1530Z. Later on the 9<sup>th</sup>, at 1605Z, aircraft reconnaissance reported 80 to 100 ft waves. At 1815Z on the 9<sup>th</sup>, aircraft reconnaissance reported a minimum pressure of 967 mb, and it is not known whether this reading is a central pressure. A central pressure of less than or equal to 967 mb yields a wind speed of at least 88 kt according to the north of 25N pressure-wind relationship and 84 kt for its weakening subset. Maximum flight-level winds of 140 kt were encountered. On the 10<sup>th</sup> at 2053Z, aircraft encountered maximum flight-level winds of 120 kt, and that was the final reconnaissance flight associated with Hurricane Easy. No changes are made to the HURDAT intensity from 06Z on the 9<sup>th</sup> through 06Z on the 12<sup>th</sup>. On the 11<sup>th</sup>, Easy turned eastward for a day along 39.5N, from about 52.5W to 47W, and on the 12<sup>th</sup> around 12Z, it made a turn toward the ENE. Easy is analyzed to have become extratropical by 18Z on the 11<sup>th</sup> (18 hours earlier than originally). HURDAT previously showed a final position at 18Z on 13 September at 45.8N, 37.4W as a 45 kt extratropical cyclone. At 18Z on the 13<sup>th</sup>, the revised position is 43.8N, 37.0W (a major track change) with a 60 kt intensity. The cyclone was not dissipated or absorbed until after 18Z on the 14<sup>th</sup>, so HURDAT is revised to extend this cyclone for 24 more hours. The final position at 18Z on the 14<sup>th</sup> is analyzed to be 47.5N, 17.1W with a 60 kt intensity. Thereafter, Easy was absorbed into another extratropical low to its north.

#### 1951 Storm 7 (Fox) – (originally Storm 6)

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35785 09/02/1951 M=10 6 SNBR= 790 FOX XING=0
35785 09/02/1951 M=10 7 SNBR= 790 FOX XING=0
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35790 09/02* 0 0 0 0* 0 0 0 0* 0 0 0 0*130 200 25 0*
35790 09/02* 0 0 0 0* 0 0 0 0* 0 0 0 0*126 203 30 0*
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35795 09/03*118 235 25 0*116 248 30 0*115 260 30 0*115 275 30 0*
35795 09/03*127 218 40 0*128 233 45 0*130 247 50 0*132 260 50 0*
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35800 09/04*118 290 35 0*124 305 40 0*130 320 45 0*137 333 55 0*
35800 09/04*134 273 55 0*136 290 55 0*142 310 55 0*149 328 60 0*
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35805 09/05*144 346 60 0*152 362 70 0*160 378 75 0*165 390 75 0*
35805 09/05*156 345 65 0*163 362 70 0*168 378 75 0*173 393 75 0*
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35810 09/06*171 401 80 0*176 414 85 0*182 430 90 0*192 455 90 0*
35810 09/06*178 407 80 0*183 421 85 0*189 437 90 0*196 456 90 0*

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35815	09/07*203	482	95	0*210	495	95	0*217	507	100	0*230	531	100	0*	
35815	09/07*203	473	95	0*211	490	95	0*220	507	100	0*231	524	100	0*	
	***			***	***		***			***	***			
35820	09/08*244	552	100	0*252	564	95	0*264	575	95	0*292	588	95	0*	
35820	09/08*243	538	100	0*255	552	95	0*272	566	95	0*296	579	95	0*	
	***	***		***	***		***	***		***	***			
35825	09/09*324	600	90	0*353	598	90	0*380	580	85	0*400	546	85	0*	
35825	09/09*322	587	90	0*351	591	90	0*378	582	85	0*403	546	80	0*	
	***	***		***	***		***	***		***		**		
35830	09/10*420	505	75	0*445	439	75	0*470	370	70	0E496	299	65	0*	
35830	09/10E423	505	75	0E445	439	75	0E472	368	75	0E500	298	75	0*	
	****			*			****	***	**	***	***	**		
35835	09/11E524	228	60	0E555	211	55	0E590	232	45	0*	0	0	0	0*
35835	09/11E535	240	65	0E575	212	55	0*	0	0	0*	0	0	0	0*
	***	***	**	***	***		****	***	**					
35840	HR													

Major track changes and major intensity changes are analyzed for this hurricane. A major change is made to the timing of when this cyclone became a tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

#### September 1:

HWM analyzes a closed low of at most 1010 mb centered over Africa near 14.0N, 14.9W. HURDAT does not yet list this system. No gales or low pressures.

#### September 2:

HWM analyzes a closed low of at most 1010 mb centered near 13.5N, 18.8W. HURDAT firsts lists this system at 18Z as a 25 kt tropical depression at 13.0N, 20.0W. No gales or low pressures.

#### September 3:

HWM analyzes a closed low of at most 1010 mb centered near 12.4N, 25.7W. HURDAT lists this as a 30 kt tropical depression at 11.5N, 26.0W. Ship highlights: 25 kt SE and 1002 mb at 06Z at 13.9N, 22.2W (COA); 20 kt N and 1003 mb at 18Z at 14.4N, 26.6W (COA).

#### September 4:

HWM analyzes a closed low of at most 1010 mb centered near 13.4N, 32.1W. HURDAT lists this as a 45 kt tropical storm at 13.0N, 32.0W. Ship highlights: 45 kt SSE and 1009 mb at 00Z at 13.4N, 25.4W (COA).

#### September 5:

HWM analyzes a tropical storm of at most 1005 mb centered near 15.6N, 38.4W. HURDAT lists this as a 75 kt hurricane at 16.0N, 37.8W. The MWR post-season track map shows a 12Z position near 16.6N, 37.6W. Ship highlights: 40 kt S and 999 mb at

07Z at 16.7N, 35.7W (ATS). “This hurricane was first suspected when the steamship Janecke Naess encountered 45-knot south winds at 15N, 35W on September 5. This wind report indicated that a small hurricane center was located a short distance northwest of the ship’s position” (MWR). “On [the 05/1230Z surface chart] the disturbance that was to become Fox appeared. The ship British Premier at 13.5N, 40.2W reported 1008.4 mb, scattered clouds and a NNE 15 kt wind. The Juthay at 9.8N, 38W reported 1015.6 mb with a SE 15 kt wind. These reports showed very clearly the position of the wave from which the tropical storm had formed. The storm center for Fox was of course based on the ship Janeckenaess at 05/1230Z. At this time, the centers of [Easy and Fox] were computed to be 990 miles apart separated by a weakening north-south ridge” (ATS).

#### September 6:

HWM analyzes a tropical storm of at most 1005 mb centered near 17.8N, 42.0W. HURDAT lists this as a 90 kt hurricane at 18.2N, 43.0W. The MWR post-season track map shows a 12Z position near the HURDAT position. Ship highlights: 35 kt NE and 1007 mb at 18Z at 21.4N, 46.4W (COA).

#### September 7:

HWM analyzes a hurricane of at most 1000 mb centered near 22.0N, 50.3W. HWM analyzes Hurricane Easy to be located near 23.7N, 65.8W, or about 860 nmi west of Fox. HURDAT lists Fox with a 100 kt intensity at 21.7N, 50.7W. The MWR post-season track map shows a 12Z position near 23.3N, 52.3W. Ship highlights: 60 kt E and 1002 mb at 00Z at 21.5N, 46.2W (COA, ATS); 35 kt SE and 1012 mb at 06Z at 21.5N, 46.2W (COA). One other gale of 35 kt. Aircraft highlights: Air Force center fix (DR, penetration) at 1737Z at 23.1N, 52.4W with estimated visual surface winds of hurricane force, maximum measured flight-level winds of 82 kt, and estimated maximum storm intensity of 100 kt (ATS, micro). “The report of the ship Tectus with overcast sky, a minus 4.5 mb falling then rising and a 60 kt E wind indicated hurricane Fox was at about 20N, 46.4W [at 07/0030Z]. This position indicated Hurricane Fox was still on its WNW course and that it had slight increased its speed of advance to about 23 kt. Air Force flying at 10,120 feet altitude gave the center of Fox at 07/1737Z as 23.1N, 52.4W. The eye was described as being oblong 20 by 30 miles. The average wind was reported as 82 kt with the maximum winds of 100 kt from the ESE. Winds of force 12 or greater were reported from west through north to south and southeast” (ATS).

#### September 8:

HWM analyzes a hurricane of at most 995 mb centered near 26.6N, 57.1W. HWM analyzes Hurricane Easy to be located near 28.2N, 67.8W, or about 580 nmi WNW of Fox. HURDAT lists Hurricane Fox with a 95 kt intensity at 26.4N, 57.5W. The MWR tracks of centers of cyclones shows a 12Z position near 26.3N, 56.7W with a 976 mb pressure and the MWR post-season track map shows a 12Z position near 29.3N, 57.7W. Microfilm at 00Z analyzes a hurricane of at most 984 mb centered near 24.0N, 53.9W and at 12Z the microfilm analysis position is not useful because the position is plotted at the location of an 18Z aircraft fix (29.4N, 58.0W). Ship highlights: 70 kt NE and 992 mb at 00Z at 24.5N, 54.5W (COA, micro); 978 mb (min p encountered by ship) at 03Z near ~24.8N, 54.1W (micro); 65 kt SE and 1009 mb at 18Z at 31.4N, 56.7W (micro). Four

other gales between 35-50 kt. Aircraft highlights: Air Force center fix at 1750Z at 29.5N, 58.0W (ATS). "It later proved to be a small, fast moving hurricane which moved on a northwestward course and passed some 350 miles east of Bermuda on September 8<sup>th</sup>. Thereafter it turned northeastward and continued its rapid movement over the Atlantic" (MWR). The proximity of Hurricane Fox [to Hurricane Easy on the morning of the 8<sup>th</sup>] (the centers at this time were about 540 miles apart) and its greater speed of advance (about 20 kt), however, were considered to be a factor... important in the slowing of Hurricane Easy. The situation seemed to indicate that the Fujiwhara effect was indeed taking place. At 08/1344Z an Air Force plane departed Bermuda to reconnoiter Hurricane Fox. At 08/1750Z the plane gave the center position of Fox as 29.5N, 58W" (ATS).

#### September 9:

HWM analyzes a hurricane of at most 990 mb centered near 37.8N, 57.9W with the southwest end of a SW-NE stationary front located about 250 nmi north-northeast of the cyclone and a second frontal boundary located further north and north-northwest. HWM also analyzes Hurricane Easy to be located near 30.7N, 64.0W, or about 520 nmi SW of Fox. HURDAT lists Hurricane Fox with an 85 kt intensity at 38.0N, 58.0W. The MWR tracks of centers of cyclones shows a 12Z position near 36.5N, 58.6W with a 982 mb pressure and the MWR post-season track map shows a 12Z position near 36.2N, 58.7W. Microfilm at 00Z analyzes the centers of Fox and Easy to be located only about 440 nmi from each other. Microfilm at 12Z analyzes a tropical storm (Fox) of at most 990 mb centered near 36.2N, 58.4W. The microfilm analysis also shows that Fox and Easy are located within the same 1005 mb contour, but the two cyclones are analyzed with separate 1002 mb closed isobars, and both cyclones are analyzed to be of at most 990 mb. Ship highlights: 75 kt ESE at 01Z at 33.6N, 58.2W (micro); 50 kt S and 985 mb at 33.5N, 57.4W (micro); 70 kt and 989 mb at 04Z at 33.7N, 58.2W (micro); 55 kt SW and 1006 mb at 12Z at 33.4N, 58.0W (micro); 50 kt S and 1002 mb at 37.9N, 53.5W (micro). 11 other gales between 35-55 kt and 14 other low pressures between 991-1005 mb. "Hurricane Fox [around ~01Z on the 9<sup>th</sup>] was estimated to be about 32.6N, 59.4W with the hurricane centers now about 390 miles apart. Analysis of the 09/1230 surface chart [positioned Hurricane Fox] at 37N, 57W, thereby indicated a slight increase in speed of advance to about 30 kt. Strong southerly convergent flow over Fox at all levels pointed toward a large acceleration in the speed of advance as well as eminent dissipation. The 09/1830Z surface chart... [and] ship reports indicated the center of Fox to be about 40N, 55W and taking on extratropical characteristics with as much as a 20 degree temperature difference across the hurricane. The highest reported wind was south 50 kt and this latest position showed that the speed of advance had increased to nearly 50 kt" (ATS).

#### September 10:

HWM analyzes a tropical storm of at most 980 mb centered near 48.0N, 36.3W. A separate large, broad, weaker extratropical low of at most 990 mb is centered in the general vicinity of 56-60N, 30-38W. A dissipating occluded front is plotted from 61N, 28W to 60N, 22W to 58N, 19W to 56N, 18W to 50N, 20W to 46N, 23W. A small, elongated, weak low of at most 1015 mb is plotted near 48N, 57W with a dissipating stationary front extending eastward from this low to 46N, 46W. HURDAT lists this as a

70 kt hurricane at 47.0N, 37.0W. The MWR tracks of centers of cyclones shows a 12Z position near 47.6N, 38.1W with a 990 mb pressure. The MWR post-season track map last shows a position at 00Z near 40.5N, 54.3W. Microfilm at 00Z analyzes a low of at most 987 mb centered near 42.8N, 50.4W and the last microfilm position before Fox goes off the map is at 06Z near 44.4N, 45.8W. Ship highlights: 50 kt SSE and 993 mb at 00Z at 42.5N, 49.0W (micro); 60 kt S and 997 mb at 04Z at 43.0N, 45.0W (COA); 70 kt SSW and 989 mb at 08Z at 43.0N, 45.0W (COA); 80 kt W and 1006 mb at 18Z at 43.2N, 33.4W (COA); 70 kt SSW and 989 mb at 18Z at 48.0N, 27.0W (COA). 27 other gales between 35-60 kt and 40 other low pressures between 987-1005 mb. "It passed well to the east of Newfoundland on the 10<sup>th</sup>" (MWR). "By 10/0630Z, Fox at 43.8N, 45.8W was definitely extratropical having been considered to have lost the last of its tropical characteristics about 10/0200Z" (ATS).

#### September 11:

HWM indicates that Fox was absorbed by the low to its north before 12Z on the 11<sup>th</sup>. HWM analyzes a single low of at most 965 mb centered near 59N, 23.7W. HURDAT last lists Fox at 12Z as a 45 kt extratropical storm at 59.0N, 23.2W. The MWR tracks of centers of cyclones shows a 12Z position for Fox near 58.8N, 25.0W with a 963 mb pressure. Ship highlights (through 06Z only): 50 kt NW and 973 mb at 00Z at 53.7N, 25.5W (COA); 30 kt SE and 968 mb at 00Z at 56.0N, 24.0W (COA); 50 kt SE and 973 mb at 06Z at 59.3N, 19.1W (COA); 45 kt S and 967 mb at 57.6N, 18.9W (COA). Six other gales between 35-50 kt and 14 other low pressures between 973-999 mb.

The African easterly wave that produced Fox emerged off of Africa late on 1 September or early on the 2<sup>nd</sup>. HURDAT starts this system as a 25 kt tropical depression at 18Z on the 2<sup>nd</sup> at 13.0N, 20.0W, and no change is made to the timing of genesis. Fox moved on a broad, curving path throughout its lifetime. It reached 20.6N, 54.4W by the 5<sup>th</sup> of September, and by the 8<sup>th</sup>, Fox was located very close to and east of Hurricane Easy. The strong southerly winds of the east side of Easy caused Fox to accelerate very quickly north. Fox recurved early on the 9<sup>th</sup> around 60W. On the 3<sup>rd</sup> through the 5<sup>th</sup>, the track is revised north of the previous HURDAT track. These adjustments were made based on ship observations such as the 1002 mb observation at 06Z on the 3<sup>rd</sup>, a 1003 mb ship observation at 18Z on the 3<sup>rd</sup>, and a 45 kt wind observation at 00Z on the 4<sup>th</sup>. Another important ship observation of 40 kt S with 999 mb occurred at 07Z on the 5<sup>th</sup>, and a position about a degree north of the previous HURDAT position continued to be analyzed on the 5<sup>th</sup>. For intensity, the 1002 mb peripheral pressure at 06Z on the 3<sup>rd</sup> suggests a wind speed of at least 43 kt according to the Brown et al. southern pressure-wind relationship, and at 00Z on the 4<sup>th</sup>, a ship recorded 45 kt with 1009 mb. An intensity of 45 kt is chosen for 06Z on the 3<sup>rd</sup> (up from 30 kt originally) and 55 kt is chosen for 00Z on the 4<sup>th</sup> (up from 35 kt originally- a major change). This cyclone is analyzed to have become a tropical storm at 00Z on the 3<sup>rd</sup> (24 hours earlier than originally- a major change). The HURDAT intensity of 70 kt at 06Z on the 5<sup>th</sup> is unchanged (the ship observation of 999 mb with 40 kt at 07Z on the 5<sup>th</sup> is 45 nmi ENE of the analyzed interpolated position at 07Z). Fox is analyzed to have become a hurricane at 00Z on the 5<sup>th</sup> (six hours earlier than in HURDAT originally). The revised positions on

the 6<sup>th</sup> and 7<sup>th</sup> are all within one degree of the previous HURDAT positions. No intensity changes are made to HURDAT from 06Z on the 5<sup>th</sup> to 12Z on the 9<sup>th</sup> (which is after recurvature). This analysis was highlighted by several observations. First, at 00Z on the 7<sup>th</sup>, a ship recorded a 60 kt wind with a pressure of 1002 mb 95 nmi NE of the analyzed position. There were only two aircraft center fixes for Fox- one on the 7<sup>th</sup> and one on the 8<sup>th</sup>, but no aircraft central pressures were obtained. Aircraft reconnaissance on the 7<sup>th</sup> confirmed that Fox was a compact and intense hurricane, as ship observations suggested. At 1737Z on the 7<sup>th</sup>, aircraft reconnaissance visually estimated 70 kt surface winds, encountered maximum flight-level winds of 82 kt, but also estimated the maximum intensity of the storm was 100 kt. At 00Z on the 8<sup>th</sup>, a ship recorded 70 kt with 992 mb 40 nmi from the analyzed position, and at 03Z on the 8<sup>th</sup>, a ship encountered its minimum pressure of 978 mb, but there is no information to indicate whether this was an eye reading, so a central pressure cannot be assumed here. A central pressure of less than or equal to 978 mb yields wind speeds of at least 80, 75, 81, and 78 kt according the southern, north of 25N, southern and intensifying, and north of 25N and intensifying subsets of the pressure wind relationship. Fox was moving with a forward speed of 18 kt, and the RMW reported by aircraft 9 hours earlier is near climatology. Several runs of the Schloemer equation were conducted with observations from the 7<sup>th</sup> and 8<sup>th</sup> of September, but only a few of the variables needed for the equation are known with sufficient accuracy. The range of central pressure obtained show that there is too much uncertainty to make any changes to the HURDAT intensity on those days. The peak intensity of 100 kt in HURDAT from 12Z on the 7<sup>th</sup> to 00Z on the 8<sup>th</sup> is maintained. On the 9<sup>th</sup>, Fox accelerated northeastward. Early on the 9<sup>th</sup>, a couple of ships reported hurricane force winds of 70-75 kt and pressures of 985 and 989 mb. Fox is analyzed to have become extratropical by 00Z on the 10<sup>th</sup> (18 hour earlier than in HURDAT originally) at 42.0N, 50.5W with a 75 kt intensity. The cyclone continued moving northeastward on the 10<sup>th</sup> and early on the 11<sup>th</sup> to an analyzed position of 57.5N, 20.2W at 06Z on the 11<sup>th</sup> (55.5N, 21.1W originally- a major track change). The intensities in HURDAT from 12Z on the 10<sup>th</sup> to 00Z on the 11<sup>th</sup> are revised upward by 5 to 10 kt based upon at least three hurricane force wind observations reported by ships on the 10<sup>th</sup>. The last point listed in HURDAT previously was at 12Z on the 11<sup>th</sup>, but observations show that Fox had clearly been absorbed into a very large and powerful extratropical before 12Z, and the last 6 hourly point is removed from HURDAT.

Additional quotes for Fox:

“It will be noted that this hurricane’s entire life was coexistent with the great Hurricane Easy. When the two were nearest Bermuda on the 8<sup>th</sup>, they exerted the usual counterclockwise torque on each other, which probably prevented Easy from striking the island. The strongest winds reported by aircraft from Fox were 115 to 120 mph. A few ships were involved to some extent but no damage reports have been received” (MWR).

1951 Storm 8 (George) – (originally Storm 7)

35845 09/20/1951 M= 2 7 SNBR= 791 GEORGE XING=0  
 35845 09/19/1951 M= 4 8 SNBR= 791 GEORGE XING=0

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**          *  *
(The 19th is new to HURDAT.)
35850 09/19* 0 0 0 0* 0 0 0 0* 0 0 0 0*194 932 30 0*

35850 09/20* 0 0 0 0*198 930 35 0*206 947 45 0*208 952 50 0*
35850 09/20*195 934 40 0*197 937 40 0*202 942 45 0*208 952 50 999*
      *** *** **      *** *** **      *** ***
      *** ***

35855 09/21*209 957 50 0*210 962 50 0*212 967 45 0*215 975 35 0*
35855 09/21*210 958 50 0*212 964 50 0*215 971 50 0*218 978 35 0*
      *** ***      *** ***      *** *** **      *** ***

(The 22nd is new to HURDAT.)
35855 09/22*223 986 25 0* 0 0 0 0* 0 0 0 0* 0 0 0 0*

35860 TS

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Minor track and minor intensity changes are analyzed for Tropical Storm George. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

#### September 19:

HWM analyzes a dissipating stationary front depicted running through a sharp trough and through a spot low plotted near 20.7N, 93.3W. The front runs from 29N, 78W to 29N, 86W to 27N, 90W through the low near 21N, 93W to 17N, 95W to 16N, 97W to 17N, 98W to 20N, 101W. HURDAT does not yet list a system on this day. Although the MWR tracks of centers of cyclones shows a cyclone at 12Z near 20.2N, 92.1W with a 1002 mb pressure, this is not the same cyclone shown by MWR on the 21<sup>st</sup> that strikes Mexico. No gales or low pressures. Aircraft highlights: 19 kt E max flight-level wind encountered and 1007 mb lowest pressure encountered in trough along 93W (micro). “On the morning of the 19<sup>th</sup>, a decision was made to reconnoiter the Gulf of Campeche. The Navy hurricane reconnaissance aircraft dispatched to the area reported a weak trough located along 93W with a minimum pressure of 1007 mb. The maximum winds encountered were from the east and southeast, 19 kt. Very little precipitation was reported for the entire area. A streamline analysis combining the winds observed on this flight and the gradient winds reported by a few of the Mexican stations along the Gulf of Campeche was performed. A weak vortex was developed and centered at 19.8N, 93.9W” (ATS)

#### September 20:

HWM analyzes a closed low of at most 1005 mb centered near 20.8N, 95.0W. HURDAT lists this as a 45 kt tropical storm at 20.6N, 94.7W. Although the MWR tracks of centers of cyclones shows a cyclone at 12Z near 20.3N, 91.0W with a 1005 mb pressure, this is not the same cyclone shown by MWR on the 21<sup>st</sup> that strikes Mexico. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 18Z analyzed a closed low of at most 999 mb centered near 21.0N, 95.5W. Ship highlights: 45 kt E and 1007 mb at 00Z at 20.3N, 93.5W (COA) [ship may have biases- check wind direction, wind speed with time series]. Aircraft highlights: center fix at 1830Z at 20.5N, 95.4W with 999 mb central pressure and 55 kt maximum flight-level winds encountered at 800 ft (ATS, micro). Four total reported flight-level gales between 35-55 kt and four

low pressures between 999-1004 mb between 1800-1845Z between 20.5-20.8N, 94.3-95.4W (micro, ATS). “A tropical storm of less than hurricane force developed in the Gulf of Campeche on September 20...” (MWR). “[On] September 20<sup>th</sup>, a Navy hurricane reconnaissance aircraft located the circulation at 1830Z at 20.5N, 95.4W. The aerologist reported maximum winds of 55 kt from the south, minimum pressure of 999 mb. The diameter of the eye was 20 miles, with the northern semicircle completely open. Heaviest precipitation was encountered in the southeast quadrant with very little to the southwest. Using the streamline analysis performed on the first fix, the second fix gave the center a WNW movement at 4 kt” (ATS). “The strongest wind reported [for the lifetime of the storm] was about 60 mph (by aircraft) during the afternoon of the 20<sup>th</sup>” (MWR).

#### September 21:

HWM analyzes a closed low of at most 1005 mb centered near 21.5N, 95.1W. HURDAT lists this as a 45 kt tropical storm at 21.2N, 96.7W. The MWR tracks of centers of cyclones shows a 12Z position near 21.9N, 97.0W with a 1003 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a closed low of at most 1008 mb centered near 21.7N, 97.4W. Aircraft highlights: Estimated position of center by aircraft at 1025Z at 21.7N, 96.7W with 40 kt maximum flight-level winds encountered with report of “unable to locate closed circulation” (micro); 55 kt W (max flight-level wind encountered) at 15Z at 21.8N, 97.3W and 1006 mb (lowest pressure encountered) at 1515Z at 21.6N, 97.3W (center may have already been inland) (micro, ATS). One other flight-level gale. “[It] moved into Mexico a short distance south of Tampico on the 21<sup>st</sup>. No damage has been reported in connection with this storm” (MWR). “On 21 September, a Navy reconnaissance aircraft encountered an abrupt wind shift from east to west of 40 to 50 kt at 21/1500Z at 21.8N, 97.3W. Due to the proximity to the Mexican coast, the aircraft did not reconnoiter further to the west where radar showed heavy weather over land. Possibly because of the inability to reconnoiter further west, no closed circulation was found. The 21/1230Z surface chart showed that the center would cross the coast about 30 miles south of Tampico at about 21/1400Z. The storm rapidly dissipated after it crossed the coastline” (ATS).

#### September 22:

HWM analyzes a broad closed low of at most 1010 mb centered over the southwestern Gulf of Mexico. HURDAT no longer lists George on this day. The MWR tracks of centers of cyclones last shows a position at 00Z near 22.6N, 98.6W. Microfilm at 00Z analyzes a tropical storm of at most 1008 mb centered near 22.9N, 98.8W. No gales or low pressures.

George originated from a frontal boundary that extended into the Gulf of Mexico and Bay of Campeche on 18 September. On the 19<sup>th</sup>, the front began to dissipate and lift out to the north, but it left behind a circulation in the Bay of Campeche that is analyzed to have become a tropical cyclone by 18Z on 19 September (12 hours earlier than the original HURDAT genesis time). Ships and Mexican station observations at 18Z on the 19<sup>th</sup> indicate a closed circulation near 19.4N, 93.2W, and this is the analyzed genesis location.

A 30 kt intensity is analyzed for 18Z on the 19<sup>th</sup>. An aircraft reconnaissance flight on the 19<sup>th</sup> around 18Z-21Z did not find a closed circulation, but reported a sharp trough along 93W with minimum pressure encountered 1007 mb and maximum wind encountered 19 kt, but the cyclone is started due to the closed circulation indicated by the surface observations. The cyclone is analyzed to have reached tropical storm strength by 00Z on the 20<sup>th</sup> (six hours earlier than in HURDAT originally), and this is based on a 45 kt ship observation at 00Z, although an observation from this ship at 06Z on the 20<sup>th</sup> indicates that the storm may not have yet reached a 45 kt intensity, and the wind speed reported at 00Z may have been slightly too high. A 40 kt intensity is analyzed at both 00Z and 06Z on the 20<sup>th</sup> (up from 35 kt at 06Z). From 18Z on the 19<sup>th</sup> to 06Z on the 20<sup>th</sup>, George moved rather slowly toward the west-northwest. But it accelerated somewhat on the 20<sup>th</sup>. At 06Z on the 20<sup>th</sup>, the position is adjusted slightly to the west of the previous HURDAT position, and at 12Z, the position is adjusted slightly to the southeast. The only reliable aircraft reconnaissance center fix for George occurred at 1830Z on the 20<sup>th</sup> during which a 999 mb central pressure was measured. A central pressure of 999 mb is added to HURDAT at 18Z on the 20<sup>th</sup>, and this pressure yields a wind speed of 49 kt according to the Brown et al. southern pressure-wind relationship. The 50 kt intensity in HURDAT at 18Z on the 20<sup>th</sup> is unchanged. On the 21<sup>st</sup>, George continued moving west-northwestward and approached landfall in Mexico. At 15Z on the 21<sup>st</sup>, aircraft reconnaissance flew as close as they could to the center of system while remaining over water, but the storm had already moved inland by that time. The flight crew reported that the worst weather was over land to the west. The lowest pressure encountered over water was 1006 mb and the highest flight-level wind encountered was 55 kt. George is analyzed to have made landfall at 14Z on 21 September at 21.6N, 97.4W as a 50 kt tropical storm. The intensity in HURDAT at 12Z on the 21<sup>st</sup> is increased from 45 to 50 kt, and the revised position at that time is 21.5N, 97.1W (originally 21.2N, 96.7W). HURDAT previously showed a final position for George at 18Z on the 21<sup>st</sup> barely inland between a barrier island and the mainland. The new revised 18Z position is three-tenths of a degree west-northwest of the previous HURDAT position, and fully inland with a 35 kt intensity (unchanged). One point is added to HURDAT at 00Z on the 22<sup>nd</sup> as a 25 kt tropical depression at 22.3N, 98.6W- observations indicate that the circulation was likely still closed at that time. The depression dissipated over Mexico after 00Z on the 22<sup>nd</sup>.

#### 1951 Storm 9 (How) – (originally Storm 8)

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35865 09/28/1951 M=11 8 SNBR= 792 HOW          XING=1
35865 09/29/1951 M=10 9 SNBR= 792 HOW          XING=1
      **          ** *
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(The 28th is removed from HURDAT.)

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35870 09/28* 0 0 0 0*187 848 25 0*190 850 25 0*196 853 25 0*
35875 09/29*203 857 25 0*213 863 25 0*222 868 25 0*228 871 25 0*
35875 09/29*202 858 25 0*211 866 25 0*219 872 25 0*227 873 25 0*
      *** **          *** **          *** **          *** **
35880 09/30*233 873 25 0*238 874 25 0*243 875 25 0*249 876 30 0*
35880 09/30*233 873 25 0*239 874 30 0*245 875 30 0*250 876 35 0*
      ***          *** **          *** **
35885 10/01*254 877 30 0*258 875 30 0*261 868 35 0*263 860 40 0*
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35885	10/01*	255	877	35	0*258	876	35	0*261	868	40	1003*	263	860	40	0*
		***		**		***	**			**	****				
35890	10/02*	264	848	45	0*266	833	55	0*268	817	60	0*276	802	60	0*	
35890	10/02*	264	848	45	0*266	833	55	0*268	817	55	0*276	801	55	0*	
										**		***	**		
35895	10/03*	290	788	65	0*306	776	75	0*320	767	80	0*326	762	85	0*	
35895	10/03*	288	787	65	0*301	773	70	0*314	765	75	982*	321	761	80	979*
		***	***			***	***	**	***	***	**	***	***	**	***
35900	10/04*	332	758	90	0*339	752	95	0*346	745	95	0*351	738	95	0*	
35900	10/04*	328	757	80	0*336	752	80	0*343	746	80	0*349	740	80	975*	
		***	***	**		***	**	***	***	**	***	***	**	***	
35905	10/05*	357	730	90	0*364	722	90	0*371	713	90	0*377	702	85	0*	
35905	10/05*	354	734	80	0*361	726	80	0*369	716	85	972*	377	704	85	0*
		***	***	**		***	***	**	***	***	**	***	***		
35910	10/06*	383	690	80	0*389	678	75	0*395	657	75	0*403	609	70	0*	
35910	10/06*	384	692	85	0*391	676	85	0E397	654	80	0E403	612	75	963*	
		***	***	**		***	***	**	****	***	**	*	***	**	***
35915	10/07E	412	553	65	0E419	507	60	0E426	460	60	0E436	409	55	0*	
35915	10/07E	412	567	75	0E423	510	75	0E435	455	75	0E447	398	75	0*	
		***	**			***	***	**	***	***	**	***	***	**	
35920	10/08E	452	359	50	0E483	312	45	0E533	268	45	0*	0	0	0	0*
35920	10/08E	464	340	75	0E493	293	75	0E523	263	75	0E563	230	75	0*	
		***	***	**		***	***	**	***	***	**	****	***	**	

35925 HR

#### U.S. Landfall:

10/02/1951 10Z 26.7N, 82.3W 55 kt

Minor track changes and major intensity changes are analyzed for this hurricane. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Dunn and Miller, Tannehill, and Caribbean station observations.

#### September 28:

HWM indicates the presence of a trough in the western Caribbean and analyzes a spot low near 19.5N, 85.0W and a cold front from 30N, 94W to 32N, 85W dipping southward. HURDAT lists this as a 25 kt tropical depression at 19.0N, 85.0W. No gales or low pressures.

#### September 29:

HWM analyzes a closed low of at most 1010 mb centered near 22N, 88W and a WSW-ENE cold front extending from 22N, 99W to 23N, 95W to 25N, 92W to 27N, 89W to 29N, 83W to 30N, 76W. HURDAT lists this as a 25 kt tropical depression at 22.2N, 86.8W. The MWR tracks of centers of cyclones shows a 12Z position near 19.8N, 86.8W with a 1010 mb pressure. No gales or low pressures. "An easterly wave moved into the Gulf of Mexico through the Yucatan Channel the last two days of September..." (MWR).

## September 30:

HWM analyzes an elongated, closed low of at most 1010 mb centered in the general vicinity of 23.5N, 87.5W with a dissipating cold front extending from the low southwestward to 19N, 95W and a warm front extending from the low east-northeastward to beyond 28N, 72W. HURDAT lists this as a 25 kt tropical depression at 24.3N, 87.5W. The MWR tracks of centers of cyclones shows a 12Z position near 24.9N, 87.0W with a 1009 mb pressure and the MWR post-season track map shows a 12Z position just north of the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 24.7N, 87.2W with the west end of a WSW-ENE frontal boundary located about 240 nmi north of the cyclone. Ship highlights: 35 kt SE and 1015 mb at 15Z at 25.4N, 85.1W (COA); 35 kt SSW and 1008 mb at 21Z at 24.9N, 86.6W (micro). Aircraft highlights: center fix at 2230Z at 25.5N, 87.7W with 35 kt max winds (ATS). "From ship reports in the area, a closed circulation was drawn on the 30/1230Z surface chart in the Gulf of Mexico at 25N, 87W. Ship reports showed winds of 20 kt, clouds and shower activity. In view of the above situation, the decision was made to reconnoiter aircraft. At 30/2230Z, the aerologist reported an elliptical eye with a major east-west axis of 70 miles in diameter of which the apparent center was located at 25.5N, 87.7W. Maximum winds reported were 35 kt in the eastern semicircle" (ATS).

## October 1:

HWM analyzes a closed low of at most 1005 mb centered near 25.6N, 86.1W with a stationary front plotted from 26N, 79W to 30N, 73W to 30N, 67W. HURDAT lists this as a 35 kt tropical storm at 26.1N, 86.8W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1006 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a broad, closed low of at most 1005 mb centered near 25.9N, 86.4W with the west end of a W-E frontal boundary located about 170 nmi NNE of the cyclone. Ship highlights: 40 kt SSE and 1008 mb at 12Z at 25.0N, 85.3W (COA); 25 kt S and 1005 mb at 12Z at 25.3N, 86.2W (COA); 20 kt SW and 1004 mb at 18Z at 26.3N, 85.5W (COA). Three other low pressures between 1004-1005 mb. Aircraft highlights: center fix in the morning at 26.2N, 86.7W with 1003 mb central pressure and 35 kt max winds (micro). "On October 1, reconnaissance planes located a center of circulation near 26.0N, 87.5W attended by squally winds of about 40 mph" (MWR). "On the 1<sup>st</sup> of October, the aerologist failed to find a closed circulation. The aerologist reported a flat low pressure with squalls and rapidly shifting winds. Heavy overcast and continuous rain extended out 200 miles from the west coast of Florida. Rapidly shifting winds were reported at 26.4N, 86.4W. Although a closed circulation wasn't found by the reconnaissance plane, surface and ship reports indicate that a closed circulation was present" (ATS).

## October 2:

HWM analyzes a tropical storm of at most 995 mb centered near 26.2N, 82.5W with a warm front plotted from 28N, 76W to 31N, 71W to 32N, 67W to 32N, 64W. HURDAT lists this as a 60 kt tropical storm at 26.8N, 81.7W, or very near Fort Myers, FL. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1000 mb pressure and the MWR post-season track map shows a 12Z position near

26.8N, 82.3W. Microfilm analyzes a closed low of at most 999 mb centered near 26.8N, 82.1W with a frontal or trough-like feature extending from the low to 29N, 80W to 30N, 77W to 29N, 74W. Ship highlights: 30 kt S and 1001 mb at 00Z at 25.1N, 84.6W (COA); 40 kt SSW and 1006 mb at 00Z at 25.1N, 84.4W (COA); 40 kt SW and 999 mb at 18Z at 26.7N, 79.1W (micro); 45 kt NNE and 993 mb at 21Z at 28.5N, 78.9W (micro). Five other gales of 35 kt and 64 other low pressures between 994-1005 mb. Land highlights: 12 kt SW and 996 mb at 1230Z at Clewiston, FL (micro); 35 kt SW and 998 mb at 18Z at West Palm Beach, FL (micro); 48 kt S (max w/1-min/elevated) at Downtown Miami WB office (climo). One other gale of 37 kt at Jacksonville and 18 other low pressures between 997-1004 mb. Aircraft highlights: 997 lowest pressure encountered between 12Z-13Z somewhere in the vicinity of 26.7N, 82.3W (micro). “The center turned sharply eastward and crossed Florida from about Punta Gorda to Vero Beach on October 2. From the 02/1300Z Weather Bureau advisory... “It is moving inland on the west Florida coast [with winds of 50 mph] (stated in the advisory)” (WB advisories). From the October, 1951 Monthly National Climatic Data Summary... “Monthly [rainfall] totals [for October, 1951] in a strip across southern Florida that included Fort Myers equaled or exceeded 10 inches and ranged up to 17.52 inches. This month’s greatest 24-hour precipitation [for the entire U.S.] occurred in this area, exceeding 10 inches at a number of stations. Most of the month’s storm damage occurred in southern Florida during the passage of a tropical disturbance. The storm, attended by heavy rains that ranged from about 8 to 13 inches, crossed Florida on the 2<sup>nd</sup>, the center passing from near Fort Myers to Vero Beach. Squall winds of 50 to 60 mph occurred along the lower east coast and in the Keys. The greatest damage resulted from the heavy rains which flooded early fall crops in the Okeechobee area. Also, a number of cattle were lost by drowning. Losses due to this storm were estimated at about \$2,000,000” (climo). From the National Climatic Data Summary severe storm reports... “Place: Florida, southern portion; Date: [2nd of October]; Time: All day; Property damage: \$400,000; Crop damage: \$1,600,000; Character of storm: Tropical storm; Remarks: No strong winds occurred near the center [on it’s trek over Florida]. Minor damage to small craft, and a few windows and awnings were lost along the coast from Key West to West Palm Beach. Greatest damage was from rains that flooded farms and pasture lands over a broad belt extending from Naples, Fort Myers, and Punta Gorda on the west coast to Stuart, Fort Pierce, and Vero Beach on the east [coast]. Early fall crops flooded out in the rich Okeechobee farming area. Roadways were damaged and several bridges were washed out” (climo). “The strong winds associated with the disturbance while passing over Florida were confined to squalls along the Keys and on the east coast up to Palm Beach far to the southeast of the center; they reached 50 to 60 mph. No loss of life or injuries occurred” (MWR). “The storm crossed the west coast of Florida between Fort Myers and Tampa as shown on the 02/1230Z surface chart. The storm passed over the east coast of Florida into the Atlantic at Vero Beach at 02/1830Z. In the storm’s transit over the Florida Peninsula, maximum winds were reduced from 60 kt to 45 kt” (ATS). “Tropical Cyclone in Florida – Oct. 2 – Southwest coast – Minor – Damage \$2,000,000” (“Minor” is equivalent to winds of less than 74 mph and pressure above 996 mb, Dunn and Miller).

October 3:

HWM analyzes a hurricane of at most 990 mb centered near 31.0N, 75.9W. HURDAT lists this as an 80 kt hurricane at 32.0N, 76.7W. The MWR tracks of centers of cyclones shows a 12Z position near 31.3N, 76.4W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a hurricane of at most 993 mb centered near 31.9N, 76.1W. Ship highlights: 55 kt NE and 1003 mb at 00Z at 30.4N, 79.5W (COA); 15 kt WSW and 994 mb at 00Z at 28.4N, 78.4W (micro); 50 kt NE and 1001 mb at 12Z at 31.8N, 78.4W (COA, micro); 40 kt ENE and 990 mb at 1615Z at 32.6N, 75.8W (micro); 75 kt NE and 994 mb at 1930Z at 33.8N, 76.9W (micro); 60 kt NNW and 996 mb at 21Z at 32.4N, 77.6W (micro). 11 other gales between 35-50 kt and 67 other low pressures between 994-1005 mb. Land/station highlights: 5 kt N and 1002 mb at 00Z at Tampa, FL (climo); 40 kt WSW and 999 mb at 00Z at West End, Bahamas (26.7N, 79.1W) (micro); 50 kt ENE and 998 mb at 2230Z at Diamond Shoals Lightship (35.1N, 75.3W) (micro); 40 kt N and 997 mb at 2330Z at Frying Pan (33.5N, 77.5W); 33 kt NE (max w/1-min) at Cape Hatteras (climo). Three other gales of 35-40 kt and 11 other low pressures between 1003-1005 mb. Aircraft highlights: Navy center fix (loran) at 1324Z at 31.4-31.6N, 76.4W with 982 mb central pressure and 85 kt max winds (ATS, micro); 70 kt S estimated surface winds and 981 mb with hurricane force flight-level winds at 800 ft at 1930Z at 31.9N, 75.5W (micro); Air Force center fix (loran) at 1930Z at 32.1N, 76.0W with 979 mb central pressure and 90 kt max winds (micro). Three other surface gales between 35-70 kt, three other flight-level hurricane force winds of at least 70 kt and eight other low pressures between 988-999 mb. From the 03/2200Z Weather Bureau advisory... “[position- 32.2N, 75.9W; movement NNE 6 to 8 mph; winds well over 100 mph]” (WB advisories). “A Navy hurricane reconnaissance aircraft on the morning of the 3<sup>rd</sup> of October located the storm at 1324Z at 31.4N, 76.4W. The aerologist had reported a poorly defined eye with minimum pressure 982 mb, winds of 55 kt within 40 miles of center in the northern semicircle, and 85 kt within 25 miles southwest of the center were reported” (ATS).

October 4:

HWM analyzes a hurricane of at most 995 mb centered near 34.5N, 74.5W with a warm front extending from 50N, 73W to 45N, 74W to 42N, 75W to 40N, 75W to 39N, 72W to 39N, 55W. HURDAT lists this as a 95 kt hurricane at 34.6N, 74.5W. The MWR tracks of centers of cyclones shows a 12Z position near 35.0N, 73.8W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near the HWM position. Ship highlights: 80 kt N and 996 mb at 00Z at 32.5N, 77.4W (COA); 40 kt SSE and 988 mb at 00Z at 32.2N, 74.7W (micro); 55 kt NW G 65 kt and 995 mb at 09Z at 33.6N, 76.6W (micro); 50 kt NW and 999 mb at 12Z at 33.3N, 76.5W (COA). 32 other gales between 35-70 kt and at least 45 other low pressures between 994-1005 mb. Land/station highlights: 50 kt N and 997 mb at Diamond Shoals Lightship (35.1N, 75.3W) at both 0130Z and 0330Z (micro); 20 kt N and 995 mb at 07Z and 08Z at Cape Hatteras (micro); 50 kt N and 998 mb at 08Z at Frying Pan (33.5N, 77.5W) (micro); 43 kt N (max w/1-min) at both Cape Henry, VA and Atlantic City, NJ (climo). 23 other gales between 35-45 kt, and 46 other low pressures between 996-1005 mb. Aircraft highlights: 85 kt N (at flight-level of 500 ft) and 987 mb at 18Z at 35.3N, 74.3W (micro); center fix at 19Z at 35.2N, 73.7W with 975 mb central pressure and 85 kt max winds (ATS). Four other flight-level hurricane force winds between 65-70 kt and eight other low pressures

between 977-996 mb. “After leaving Florida the storm increased to hurricane force as it moved northeastward in the Atlantic. It passed a short distance offshore from Cape Hatteras on October 4, without damaging winds on land...” (MWR). “On 04/1900Z a low level reconnaissance aircraft located the hurricane at 35.2N, 73.7W. The aerologist reported a poorly defined eye with lowest pressure 975 mb. Maximum winds were 85 kt out to a radius of 40 miles from the center, and 50 kt out to 100 miles from the center. This fix showed that the hurricane had continued to move in a NNE direction at 9 to 11 kt with some intensification” (ATS).

#### October 5:

HWM analyzes a hurricane of at most 995 mb centered near 36.5N, 72.1W with the closest fronts plotted 400 to 500 nmi north of the cyclone. HURDAT lists this as a 90 kt hurricane at 37.1N, 71.3W. The MWR tracks of centers of cyclones shows a 12Z position near 37.1N, 71.0W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Ship highlights: 60 kt NW and 1000 mb at 00Z at 34.7N, 75.1W (COA); 30 kt NW and 995 mb at 00Z at 35.7N, 74.8W (COA); 50 kt NW and 999 mb at 06Z at 35.5N, 74.5W (COA); 50 kt S and 1005 mb at 18Z at 37.1N, 66.5W (COA). 38 other gales between 35-50 kt and 46 other low pressures between 997-1005 mb. Land/station highlights: 55 kt NW and 999 mb at 00Z at Diamond Shoals Lightship (micro). Four other low pressures between 1000-1004 mb. Aircraft highlights: Navy radar center fixes at 0001, 0100, 0400, 0500, 0600, 0700, 0800, 0900, 1000, and 1100Z between 35.2-36.7N, 72.1-73.5W (micro); Navy center fix at 1245Z at 37.0N, 71.3W with 972 mb central pressure and 95 kt max winds (micro); Air Force center fix (loran) at 2029Z at 38.2N, 70.0W with 977 mb lowest pressure encountered, 80 kt maximum visual surface winds, and 700 mb height in the eye of 9,475 ft (micro). At least four other hurricane force flight-level winds between 65-90 kt between 1600-1800Z between 400-600 ft and at least five other low pressures between 979-992 mb. “Due to the hurricane’s proximity to the coast, radar aircraft were used during hours of darkness on the night of the 4-5 October to get hourly fixes. These fixes showed the hurricane had continued on its previous course and speed. On 5 October, two reconnaissance flight were made, and found the hurricane to be continuing on the same course and speed as it had been for the past 24 hours” (ATS).

#### October 6:

HWM analyzes a hurricane of at most 990 mb centered near 40.1N, 65.7W with another weak, small low plotted near 44N, 72W with a stationary front extending from this 2<sup>nd</sup> low eastward to 43N, 65W to 43N, 47W and a cold front extending from the 2<sup>nd</sup> low to 41N, 73W to 39N, 76W to 37N, 80W. HURDAT lists this as a 75 kt hurricane at 39.5N, 65.7W. The MWR tracks of centers of cyclones shows a 12Z position near 39.8N, 65.1W with a 988 mb pressure and the MWR post-season track map shows a 12Z position near 40.1N, 64.6W. Ship highlights: 55 kt S and 999 mb at 00Z at 37.0N, 67.2W (COA); 70 kt S and 999 mb at 00Z at 38.1N, 68.4W (micro); 35 kt N and 987 mb at 06Z at 40.0N, 67.5W (COA); 65 kt WSW and 996 mb at 06Z at 37.5N, 67.6W (COA); 60 kt SW and 979 mb at 09Z at 38.8N, 67.5W (micro); 70 kt S and 988 mb at 12Z at 38.5N, 65.7W (COA); 65 kt NE and 990 mb at 18Z at 40.9N, 62.4W (COA); 70 kt ENE and 996 mb at 18Z at 42.0N, 62.5W (micro); 965 mb (min p encountered by ship) at 2210Z

(micro). 35 other gales between 35-70 kt and 35 other low pressures between 988-1005 mb. Land/station highlights: 20 kt NNE and 1002 mb at 00Z at Nantucket, MA (micro). Aircraft highlights: Navy radar center fixes at 00, 01, 02, 04, 05, 06, 07, 08, 09, 10, and 11Z between 38.4-40.0N, 65.7-69.4W (micro); Navy center fix at 1535Z at 40.1N, 62.6W with 963 mb central pressure and 110 kt maximum flight-level winds encountered 40-60 nmi WNW of center (ATS); Air Force center fix at 1923Z at 40.3N, 60.6W with 972 mb pressure by dropsonde and 85 kt max winds encountered in the southern semicircle only (ATS, micro). One other hurricane force flight-level wind of 75 kt and four other low pressures between 987-999 mb. “[The cyclone] then continued northeastward and east-northeastward and passed several hundred miles south of Nova Scotia and Newfoundland on the 6<sup>th</sup> and 7<sup>th</sup>. The strongest winds reported [for the lifetime of the cyclone] were about 110 mph” (MWR). “Radar aircraft were again employed on the night of 5-6 October to obtain hourly fixes. These radar fixes from 06/0000Z to 06/1100Z showed the hurricane track to be curving from the NE course it had been following to an easterly course and had accelerated to a speed of 18 kt. On the morning of the 6<sup>th</sup>, a Navy hurricane reconnaissance aircraft located the hurricane at 1553Z at 40.1N, 62.6W. The aerologist reported the eye to be poorly defined, but with well defined spiral bands leading into the center. Maximum winds reported were 110 kt 40 to 60 miles WNW of the center, 65 kt out 85 miles, and 45 kt out to 140 miles. The minimum pressure reported was 963 mb. This fix showed the hurricane to be traveling east and that it had accelerated and was now traveling at 30 kt. The Air Force high-level afternoon fix was the last aircraft fix on this hurricane. The center was located at 06/1923Z at 40.3N, 60.6W. The northern semicircle was not observed, but 85 kt was observed in the southern semicircle. The hurricane became extratropical soon after this fix, as it showed extra-tropical characteristics on the 07/0030Z surface chart” (ATS).

#### October 7:

HWM analyzes a closed low of at most 985 mb centered near 42.5N, 44.8W with a dissipating stationary front extending from just northeast of the low eastward and a cold front extending from 200-300 nmi SSW of the low westward. HURDAT lists this as a 60 kt extratropical storm at 42.6N, 46.0W. The MWR tracks of centers of cyclones shows a 12Z position near 42.8N, 46.5W with a 982 mb pressure and the MWR post-season track map shows a 12Z position near 43.4N, 45.9W. Ship highlights: 65 kt SW and 985 mb at 00Z at 39.9N, 55.3W (COA); 70 kt NNW and 996 mb at 00Z at 41.0N, 59.3W (micro); 70 kt SW and 1000 mb at 06Z at 39.5N, 49.0W (micro); 70 kt SW and 968 mb at 17Z at 45.0N, 37.0W (COA); 70 kt NW and 974 mb at 18Z at 44.7N, 41.7W (COA); 70 kt N and 976 mb at 18Z at 45.4N, 41.4W (COA). Four other hurricane force winds, numerous other gales, and 32 other low pressures between 978-999 mb. “The last warning on this hurricane was issued at 07/2200Z” (ATS).

#### October 8:

HWM analyzes a closed low of at most 970 mb centered near 54N, 26W with a cold front extending from 50N, 22W to 45N, 24W to 40N, 28W to 37N, 33W. HWM also analyzes two other lows within the same 990 mb contour as the feature of interest- one of at most 985 mb centered near 59N, 39N, and the other of at most 975 mb centered near 68.5N, 18W. HURDAT lists this as a 45 kt extratropical storm at 53.3N, 26.8W. The MWR

tracks of centers of cyclones shows a 12Z position near 51.3N, 22.7W with a 978 mb pressure. Ship highlights: 45 kt E and 963 mb at 06Z at 50.5N, 28.4W (COA); 70 kt NW and 965 mb at 12Z at 50.5N, 28.5W (COA); 60 kt SSW and 980 mb at 14Z at 52.5N, 19.7W (COA); 60 kt SW and 985 mb at 18Z at 52.4N, 19.8W (COA); 45 kt S and 963 mb at 21Z at 58.9N, 19.4W (COA). 15 other gales of 50-60 kt and numerous other low pressures. "The hurricane was then tracked on an ENE course across the North Atlantic by use of ship reports. Some of the ship reports indicated that it attained speeds of 55 kt. Winds near the center diminished slowly while the area of gale winds became more widespread" (ATS).

Trouching in the western Caribbean Sea became apparent on 27 September, and this may have been an easterly wave that stalled at that location. Although observations on the 27<sup>th</sup> at 12Z indicate a chance that there may have been a closed circulation near 16N, 83W, subsequent observations on the 28<sup>th</sup> at 18Z provide evidence that there was not yet a closed circulation by 18Z on the 28<sup>th</sup>. HURDAT starts this system at 06Z on the 28<sup>th</sup> as a 25 kt tropical depression at 18.7N, 84.8W. Genesis is analyzed to have not occurred until 00Z on the 29<sup>th</sup> (18 hours later than originally) at 20.2N, 85.8W as a 25 kt tropical depression. As the depression moved northward through the Yucatan Channel into the Gulf of Mexico, a track closer to the northeastern tip of the Yucatan Peninsula is analyzed. On the 30<sup>th</sup>, the depression moved northward in the Gulf of Mexico and strengthened to a tropical storm by 18Z (18 hours earlier than in HURDAT originally). Two ship observations of 35 kt are the evidence for this change. By 12Z on 1 October, Tropical Storm How, moving slowly, made a turn toward the ENE around 26N, 87W. On the morning of the 1<sup>st</sup>, aircraft reconnaissance measured a central pressure of 1003 mb, and this pressure is added to HURDAT at 12Z on the 1<sup>st</sup>. A central pressure of 1003 mb yields a wind speed of 38 kt according to the Brown et al. north of 25N pressure-wind relationship. Ships at 12Z on the 1<sup>st</sup> also suggested a central pressure of at most 1003 mb. A ship also measured a 40 kt wind at 12Z. A 40 kt intensity is chosen for 12Z on the 1<sup>st</sup> (up from 35 kt originally). How continued its east-northeastward motion with some acceleration until it made landfall between Fort Myers and Punta Gorda, FL as a 55 kt tropical storm at 10Z on the 2<sup>nd</sup>. Aircraft reconnaissance on the 2<sup>nd</sup> around 12-13Z only flew over the Gulf of Mexico after the center was already inland and measured a lowest pressure of 997 mb. The lowest available pressure measured from a land station in Florida is 996 mb at Clewiston at 1230Z simultaneously with 12 kt winds. The highest available wind measured from a land station in Florida is a 48 kt one-minute max wind recorded at Miami WBO, which reduces to about 42 kt when the anemometer is brought down to 10m. A landfall central pressure of less than 996 mb yields a landfall intensity of greater than 50 kt according to the north of 25N pressure-wind relationship. The HURDAT intensity at the point before landfall (06Z on the 2<sup>nd</sup>) of 55 kt is unchanged. The HURDAT intensities at 12 and 18Z are reduced from 60 to 55 kt. How was over Florida on the 2<sup>nd</sup> from 10Z to 18Z before it emerged into the Atlantic Ocean near Fort Pierce, FL. Rather than keeping the HURDAT intensities which show strengthening while over land, a flat intensity of 55 kt is analyzed for the How's trek over Florida. The largest track change made thus far (from the 29<sup>th</sup> of September through the 2<sup>nd</sup> of October) is half a degree (on the 29<sup>th</sup>). After How emerged into the Atlantic, it made a turn toward the northeast passing about 80 nmi SE of Cape Hatteras around 10Z on the

4<sup>th</sup>. At 12Z on the 3<sup>rd</sup>, the revised position is six-tenths of a degree SSE of the previous HURDAT position due to aircraft reconnaissance information. Observations indicate that intensification commenced as soon as How emerged into the Atlantic. At 21Z on the 2<sup>nd</sup>, a ship recorded 45 kt simultaneously with 993 mb, and at 00Z on the 3<sup>rd</sup>, a ship measured 55 kt winds. At 1324Z on the 3<sup>rd</sup>, a 982 mb central pressure was measured by aircraft reconnaissance, and this is added to HURDAT as a central pressure at 12Z on the 3<sup>rd</sup>. A central pressure of 982 mb yields 70 kt according to the pressure-wind relationship for north of 25N and 73 kt for its intensifying subset. The HURDAT intensity of 80 kt at 12Z on the 3<sup>rd</sup> is reduced to 75 kt. A 979 mb aircraft central pressure was measured at 1930Z, and this value is added to HURDAT at 18Z on the 3<sup>rd</sup>. A central pressure of 979 mb yields wind speeds of 74 and 77 kt according to the north of 25N pressure-wind relationship and its intensifying subset respectively. The RMW was slightly smaller than average. At the same time, a ship recorded a 75 kt wind with a 994 mb pressure. The 85 kt intensity in HURDAT at 18Z on the 3<sup>rd</sup> is lowered to 80 kt. Although there was one ship observation of 80 kt at 00Z on the 4<sup>th</sup>, the analyzed intensity is also 80 kt at 00Z on the 4<sup>th</sup>. This ship observation was observed simultaneously with a 996 mb pressure about 85 nmi west of the analyzed center position. As How passed by North Carolina, some gales occurred on the coast and pressures as low as 995 mb were recorded at Cape Hatteras, so a tropical storm impact is analyzed for North Carolina. How also produced tropical storm impacts in Virginia and New Jersey, where maximum 1-minute winds of 43 kt were recorded at Cape Henry and Atlantic City. How may have produced tropical storm impacts in Maryland and/or Delaware, but these are not analyzed since available observations indicate peak 1-minute winds well-below tropical storm force. Late on the 4<sup>th</sup> and the 5<sup>th</sup>, How continued to move northeastward, and then it turned toward the ENE on the 6<sup>th</sup> around the time it became extratropical near 40N, 65W. All track changes from the 4<sup>th</sup> through the 6<sup>th</sup> are less than half a degree. Regarding the intensity changes, aircraft reconnaissance measured a central pressure of 975 mb at 19Z on the 4<sup>th</sup>, and this value is added to HURDAT at 18Z on the 4<sup>th</sup>. A central pressure of 975 mb yields 79 and 78 kt according to the north of 25N and north of 35N pressure-wind relationships respectively. The 80 kt intensity analyzed the previous day at 18Z is maintained beyond 18Z on the 4<sup>th</sup> (down from 95 kt originally at 18Z on the 4<sup>th</sup>). On the 5<sup>th</sup> at 1245Z, a 972 mb central pressure was measured by aircraft reconnaissance, and this value is added to HURDAT at 12Z on the 5<sup>th</sup>. A central pressure of 972 mb yields 80 kt according to the north of 35N pressure-wind relationship. The RMW was much smaller than the climatological value, and an intensity of 85 kt is chosen for HURDAT at 12Z on the 5<sup>th</sup> (down from 90 kt originally). At 2029Z on the 5<sup>th</sup>, aircraft reconnaissance encountered a minimum pressure of 977 mb (may not be a central pressure), and on the same flight, a 700 mb height in the eye of 9,475 ft was recorded, indicating a central pressure in the range of 959-978 mb. This range yields a wind speed of between 75-91 kt according to the north of 35N pressure-wind relationship. How is analyzed to have become extratropical at 12Z on the 6<sup>th</sup> (12 hours earlier than originally). At 1535Z on the 6<sup>th</sup>, aircraft reconnaissance measured a central pressure of 963 mb, and this value is added to HURDAT at 18Z on the 6<sup>th</sup>. It is believed that the central pressure of How decreased steadily from 972 mb to 963 mb from 1245Z on the 5<sup>th</sup> to 1535Z on the 6<sup>th</sup>. The 85 kt analyzed intensity on the 5<sup>th</sup> at 12Z is held through the 6<sup>th</sup> at 06Z (up from 75 kt originally at 06Z on the 6<sup>th</sup>). Intensities of 80 and 75 kt are analyzed for 12 and 18Z on

the 6<sup>th</sup> (up from 75 and 70 kt respectively). On the 7<sup>th</sup>, the cyclone accelerated toward the ENE, and on the 8<sup>th</sup>, it acquired a northeastward motion. On the 7<sup>th</sup> at 00Z, the analyzed position is 1.6 degrees west of the previous HURDAT position, and this change is justified because the previous HURDAT position was east of a ship with a reliable observation of a southerly wind. From 06Z to 18Z on the 7<sup>th</sup>, a track to the left (north) of the previous HURDAT track is analyzed, and on the 8<sup>th</sup> and 00 and 06Z, the reanalyzed positions are about 1.9 degrees northeast of the previous HURDAT positions (the largest track changes for the entire lifetime of this cyclone), also justified by ship observations. Ship observations of hurricane force winds were observed the entire time on the 7<sup>th</sup> through 12Z on the 8<sup>th</sup>, and the 75 kt intensity analyzed on the 6<sup>th</sup> is maintained through 12Z on the 8<sup>th</sup>. HURDAT previously analyzed 55 kt at 18Z on the 7<sup>th</sup> and 45 kt at 12Z on the 8<sup>th</sup>. Major upward intensity revisions of between 20-30 kt are made to HURDAT at all times from 18Z on the 7<sup>th</sup> to 12Z on the 8<sup>th</sup>. HURDAT previously lists a final point at 12Z on the 8<sup>th</sup>, but available observations show that it was not absorbed by another low pressure system to its north until after 18Z on the 8<sup>th</sup>, so six hours are added to HURDAT. The new final position (at 18Z on 8 October) is analyzed to be 56.3N, 22.5W with a 75 kt intensity.

#### 1951 Storm 10 (Item) – (originally Storm 9)

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35930 10/12/1951 M= 6 9 SNBR= 793 ITEM          XING=0
35930 10/12/1951 M= 6 10 SNBR= 793 ITEM         XING=0
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35935 10/12* 0 0 0 0*143 782 30 0*150 788 30 0*156 795 30 0*
35935 10/12* 0 0 0 0*155 802 30 0*162 806 30 0*169 811 30 0*
      *** ***          *** ***          *** ***

35940 10/13*162 802 35 0*167 810 45 0*173 818 50 0*179 822 60 0*
35940 10/13*174 815 30 0*178 818 35 0*181 821 35 0*185 822 40 0*
      *** *** **      *** *** **      *** *** **      *** **

35945 10/14*185 821 65 0*191 818 70 0*197 815 70 0*201 813 70 0*
35945 10/14*189 822 45 0*195 820 50 0*201 819 50 0*205 818 50 1000*
      *** *** **      *** *** **      *** *** **      *** *** **

35950 10/15*204 812 65 0*207 813 55 0*209 816 55 0*210 820 50 0*
35950 10/15*207 818 55 0*208 819 55 0*209 819 50 0*211 819 50 998*
      *** *** **      *** ***          *** **      *** *** **

35955 10/16*211 823 50 0*211 826 45 0*212 829 40 0*215 832 40 0*
35955 10/16*213 820 45 0*215 820 35 0*217 820 25 1009*220 821 25 0*
      *** *** **      *** *** **      *** *** **      *** *** **

35960 10/17*220 833 35 0*225 834 30 0*230 835 25 0*236 836 25 0*
35960 10/17*223 823 25 0*227 825 25 0*232 827 25 0*236 829 25 0*
      *** **      *** *** **      *** ***          ***

35965 HR
35965 TS
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Major track changes and major intensity changes are analyzed for this cyclone. The peak intensity of this cyclone is changed from hurricane to tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database,

Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book) and U.S. Weather Bureau public advisories.

October 11:

HWM analyzes a spot low near 16.5N, 80W in an open trough with a stationary front extending from 30 nmi east of the low northeastward to 20N, 75W to 25N, 72W. HURDAT does not yet list a system on this day. Microfilm analyzes a spot low near 16.8N, 80.6W in an open trough with a frontal boundary plotted through the trough from 15N, 83W to 20N, 80W to 26N, 76W. No gales or low pressures. "The southern portion of [a] frontal system which extended from the Bahamas down through the western Caribbean lay in a stationary trough [on the 11/0030Z surface chart]" (ATS). ATS also mentions some easterly waves moving through the Caribbean Sea, causing widespread weather over the Caribbean.

October 12:

HWM analyzes a spot low near 15N, 80W in a trough of low pressure in the southwestern Caribbean Sea with a SSW-NNE stationary front extending from 90 nmi north of the low to 19N, 79W to 23N, 78W to 26N, 75W. HURDAT lists this as a 30 kt tropical depression at 15.0N, 78.8W. Microfilm analyzes a sharp trough in the western Caribbean Sea with a spot low plotted near 17.3N, 82W. No gales or low pressures. "A very small hurricane developed in the northwestern Caribbean Sea on October 12 near 18N, 82W" (MWR).

October 13:

HWM analyzes a closed low of at most 1010 mb centered near 16.5N, 81.5W with a dissipating stationary front extending from 18N, 82W to 19N, 81W, becoming a warm front at 22N, 79W, extending to 26N, 77W. HURDAT lists this as a 50 kt tropical storm at 17.3N, 81.8W. The MWR post-season track map shows a 12Z position near 18.2N, 81.8W. Microfilm analyzed a closed low of at most 1011 mb centered near 17.9N, 81.6W. No gales or low pressures.

October 14:

HWM analyzes a closed low of at most 1010 mb centered near 19.4N, 82.1W with a stationary front plotted from 23N, 82W to 26N, 78W, becoming a warm front at 28N, 76W extended eastward to 28N, 72W. HURDAT lists this as a 70 kt hurricane at 19.7N, 81.5W. The MWR tracks of centers of cyclones shows a 12Z position near 20.8N, 79.8W with a 1008 mb pressure and the MWR post-season track map shows a 12Z position near 20.2N, 81.9W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 20.6N, 81.9W and at 18Z, microfilm analyzes a closed low of at most 1002 mb near 20.8N, 81.9W. Land/station highlights: 30-35 kt E and 1009 mb at 21Z at 21.7N, 81.0W (micro). Aircraft highlights: possible Navy center fix at 1421Z at 20.7N, 81.9W with 1008 mb lowest pressure encountered and 65 kt max winds (ATS, micro); 55 kt NE at flight-level of 500 ft and 1010 mb at 15Z at 21.0N, 82.0W (micro); center fix at 2024Z at either 20.4N, 81.9W or 20.9N, 81.9W (I think 20.4N is more correct) with 1000 mb central pressure, 70 kt max winds, and 5,000 ft pressure in the center of 834 mb (micro, ATS). One other flight-level gale of 40 kt. "On the morning of 14 October a

Navy hurricane reconnaissance aircraft investigating the suspicious area reported a well-defined eye at 1421Z at 20.7N, 81.9W, with a minimum pressure of 1008 mb. Maximum winds of 65 kt were reported in the NW quadrant, and 55 kt winds extending 45 miles out from the center in the northern semicircle, and 45 kt winds extending 35 miles to the west of the center. The afternoon reconnaissance into the hurricane penetrated the eye at 2024Z at 20.4N, 81.9W. This gave the hurricane a northward drift of about 2 kt. The aerologist reported an elongated eye oriented north-south 22 miles by 9 miles with minimum pressure of 1000 mb. Maximum winds reported were 70 kt, three miles from the center in the northwest quadrant, and 45 kt in the northeast quadrant extending out to 35 miles. The southern semicircle was not investigated on this flight” (ATS).

October 15:

HWM analyzes a tropical storm of at most 1005 mb centered near 21.1N, 82.2W with a dissipating stationary front plotted from 23N, 81W to 29N, 76W. HURDAT lists this as a 55 kt tropical storm at 20.9N, 81.6W. The MWR tracks of centers of cyclones shows a 12Z position near 21.1N, 81.0W with a 1008 mb pressure and the MWR post-season track map last shows a position at 00Z near 21.2N, 81.8W. Microfilm at 18Z analyzes a tropical storm of at most 999 mb centered near 21.0N, 81.8W. Land/station highlights: 35 kt E and 1009 mb at 00Z at 21.7N, 81.0W (micro). Aircraft highlights: 35 kt reported (possibly well outside the RMW) around 1615Z at 20.9N, 82.9W (micro); center fix around ~2010Z at 21.0N, 81.9W with 998 mb central pressure and max winds of either 45 or 60 kt (micro, ATS). “During the night of 14-15 October the hourly wind and pressure reported from Cuba aided tremendously in watching the hurricane, particularly the hourly reports from Caya Guana (Station 78340) located just south of Cuba at 21.6N, 81.2W. During the night, the pressure remained almost steady, dropping only about 1 mb. The wind remained easterly and steady at about [20 kt]. The pressure and wind reports, therefore, indicated that the hurricane remained quasi-stationary during the night, and probably with no intensification. At 15/2015Z a reconnaissance plane located the hurricane at 21N, 81.9W. This fix showed the hurricane to be quasi-stationary as was expected from the hourly reports of Station 78340 prior to the fix. Maximum winds of 60 kt out to 45 miles were reported in the northeast quadrant. Minimum pressure reported was 998 mb” (ATS). “It moved slowly northward to a position 60 to 80 miles east-southeast of the Isle of Pines where it became stationary, or made a small loop, and slowly dissipated on the 15<sup>th</sup> and 16<sup>th</sup>. Strongest winds reported by aircraft [for the lifetime of the cyclone] were around 80 mph maintained from the 13<sup>th</sup> to 15<sup>th</sup>. No damage resulted from the hurricane. Lowest pressure reported was 997.3 mb” (MWR).

October 16:

HWM analyzes a tropical storm of at most 1010 mb centered near 20.4N, 82.4W. HURDAT lists this as a 40 kt tropical storm at 21.2N, 82.9W. The MWR tracks of centers of cyclones shows a 12Z position near 21.2N, 82.1W with a 1008 mb pressure. Microfilm analyzes a closed low of at most 1011 mb centered in the general vicinity of 20.7N, 81.8W. Aircraft highlights: center fix at either 1300Z or 1415Z at 21.9N, 82.0W with 1009 mb central pressure and 20 kt max winds (micro, ATS). No gales or low pressures on this day. “When the 16/0300Z upper air charts were analyzed, it was observed that the hurricane was hardly noticeable on the 700 mb chart, where it had

previously [late 14<sup>th</sup> through 15<sup>th</sup>] shown up as a low at this level. A differential analysis was performed between the 850 mb and 700 mb and between the 700 mb and 500 mb levels. This analysis showed advection of cold air into the area over the hurricane in both layers. Some dissipation was called for, and no movement was forecast due to the weak meridional winds. A Navy hurricane reconnaissance aircraft on a flight into the hurricane area was unable to find an eye at 16/1415Z. The aerologist reported no signs of a tropical disturbance other than a closed wind field centered at 21.8N, 82W at 1300Z. Maximum winds were 20 kt in the northern semicircle and 15 kt in the southern semicircle. Minimum pressure reported was 1009 mb” (ATS).

October 17:

HWM analyzes a closed low of at most 1010 mb centered near 23.0N, 83.6W. HURDAT lists this as a 25 kt tropical depression at 23.0N, 83.5W. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 23.4N, 82.1W. No gales or low pressures.

The genesis of Item may have been associated with the combination of a front (which extended down to the western Caribbean Sea) noted on 10 October and an ITCZ disturbance emerging out of the deep southwestern Caribbean. HURDAT starts this system at 06Z on 12 October as a 30 kt tropical depression, and no change is made to the timing of genesis. A major track change is made at the first point at 06Z on the 12<sup>th</sup>, and the position is moved over 2 degrees WNW of the previous HURDAT position. The cyclone moved generally northward, reaching a location near 20N, 82W by the 14<sup>th</sup> before the cyclone decelerated. On the 14<sup>th</sup> at 2024Z, aircraft reconnaissance measured a central pressure of 1000 mb, and this value is added to HURDAT at 18Z on the 14<sup>th</sup>. A central pressure of 1000 mb yields a wind speed of 47 kt according to the Brown et al. southern pressure-wind relationship, and 50 kt is chosen for HURDAT at 18Z on the 14<sup>th</sup> (down from 70 kt originally). On the 15<sup>th</sup>, Item moved very slowly northward around 21N, 82W. On the 15<sup>th</sup> at 2005Z, a 998 mb central pressure was recorded by aircraft reconnaissance and is added into HURDAT at 18Z on the 15<sup>th</sup>. A central pressure of 998 mb yields 51 kt according to the southern pressure-wind relationship. The 50 kt intensity in HURDAT at 18Z on the 15<sup>th</sup> is unchanged. The days when Item was strongest were the 14<sup>th</sup> and 15<sup>th</sup>. HURDAT previously shows a peak intensity for Item of 70 kt from 06Z on the 14<sup>th</sup> to 18Z on the 14<sup>th</sup>, but the reanalyzed peak intensity is 55 kt from 00Z on the 15<sup>th</sup> through 06Z on the 15<sup>th</sup>. Major downward intensity adjustments of 20 kt are analyzed at all times from 18Z on the 13<sup>th</sup> to 18Z on the 14<sup>th</sup>. This is the only cyclone so far for which the peak intensity is revised downward from hurricane to tropical storm during the reanalysis from 1944-1951. Aircraft center fixes along with available observations indicate the previous HURDAT positions from late on the 15<sup>th</sup> through the 17<sup>th</sup> are too far west. On the 16<sup>th</sup>, Item is analyzed to have weakened to a tropical depression while passing just east of the Isle of Pines. On the morning of the 16<sup>th</sup>, aircraft reconnaissance located a closed wind circulation with no convection. A 1009 mb central pressure was measured with maximum winds of 20 kt. A central pressure of 1009 mb is added to HURDAT at 12Z on the 16<sup>th</sup>. A 25 kt intensity is analyzed at 12Z on the 16<sup>th</sup> (down from 40 kt originally). It is analyzed that Item weakened to a tropical depression 12 hours earlier than in HURDAT originally. Item is analyzed to have made landfall in Cuba around 06Z on the 17<sup>th</sup> as a 25 kt tropical depression at 22.7N, 82.5W.

Although Item may have dissipated by 12 or 18Z on the 17<sup>th</sup>, there is not quite enough evidence to remove parts of HURDAT, so no changes are made to the timing of dissipation. The only change made at the final point (18Z on the 17<sup>th</sup>) is to move the position seven-tenths of a degree east to 23.6N, 82.9W. Thereafter, Item dissipated.

### 1951 Storm 11 (Jig) – (originally Storm 10)

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35970 10/15/1951 M= 6 10 SNBR= 794 JIG          XING=0          L
35970 10/15/1951 M= 6 11 SNBR= 794 JIG          XING=0          *
      **
35975 10/15*   0   0   0   0*281 756 35   0*294 753 65   0*306 748 70   0*
35975 10/15*   0   0   0   0*277 760 50   0*290 755 65   0*303 749 65   0*
      *** *** **      *** ***      *** ***      *** *** **
35980 10/16*314 742 70   0*319 736 70   0*322 730 60   0*324 723 55   0*
35980 10/16*311 744 65 990*315 739 65   0*317 733 60 1000*320 726 55   0*
      *** *** **      *** *** *** **      *** ***      **** *** ***
35985 10/17*327 716 55   0*331 707 50   0*335 699 50   0*339 698 50   0*
35985 10/17*324 719 55 999*329 710 55   0*334 702 55   0*336 699 55   0*
      *** ***      *** *** *** **      *** *** **      *** *** **
35990 10/18*342 704 50   0*342 713 45   0*340 722 45   0*335 725 40   0*
35990 10/18E338 703 60 0E337 711 60 0E335 720 60 0E332 723 55   0*
      **** *** **      **** *** **      **** *** **      **** *** **
35995 10/19*328 726 40   0*319 723 40   0*310 718 40   0*303 711 40   0*
35995 10/19E322 726 55 0E316 727 50 0E310 721 50 0E304 713 50   0*
      **** **      **** *** **      *   *** **      **** *** **
36000 10/20*298 707 35   0*294 699 30   0*292 693 25   0*290 650 25   0*
36000 10/20E298 707 50 0* 0 0 0 0* 0 0 0 0* 0 0 0 0 0 0 0*
      *   **      *** *** **      *** *** **      *** *** **

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36005 HR

Minor track changes and minor intensity changes are analyzed for this cyclone. A major change is made to add an extratropical phase for the final few days of this cyclone's lifetime. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book) and U.S. Weather Bureau public advisories.

#### October 14:

HWM analyzes a front running through a trough of low pressure with a spot low plotted near 27.5N, 75.5W. This frontal/trough system is oriented from 28N, 65W westward through the spot low and southwestward to 23N, 82W. Item on this day is plotted as a closed low of at most 1010 mb near 19.4N, 82.1W. HURDAT does not yet list a system on this day. Highest wind observation on this day: a few to several 35 kt observations from ships. ATS describes a front over the western Atlantic off the east coast of the US on the 14<sup>th</sup>.

#### October 15:

HWM analyzes a closed low of at most 1010 mb centered near 29.8N, 73.9W with a warm front extending from the low southeastward to 25N, 65W to 24N, 62W and a

dissipating stationary front extending from the low southwestward to 23N, 81W. Item on this day is plotted as a tropical storm of at most 1005 mb near 21.1N, 82.2W. HURDAT lists Jig as a 65 kt hurricane at 29.4N, 75.3W. The MWR tracks of centers of cyclones shows a 12Z position near 29.7N, 75.4W with a 1007 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z does not yet analyze a closed low, but analyzes a sharp trough and frontal feature extending from 30N, 72W to 31N, 75W to 30N, 77W to 24N, 81W. Microfilm at 18Z analyzes a closed low of at most 1011 mb centered in the general vicinity of 30.6N, 74.8W with a front extending from the low east-southeastward to 30N, 71W and another front extending from the low southwestward to 26N, 80W. Ship highlights: 60 kt E and 1012 mb at 12Z at 31.0N, 73.9W (COA, micro); 50 kt E and 1009 mb at 18Z at 30.6N, 75.0W (COA, micro); 60 kt NNE and 1012 mb at 20Z at 31.6N, 74.3W (micro). 14 other gales between 35-45 kt. Aircraft highlights: center fix (loran) at 2240Z at 31.0N, 74.5W with 998 mb lowest pressure encountered and 70 kt maximum flight-level winds encountered (at 500 feet) (micro, ATS). "The last hurricane of the season developed off the south Atlantic coast on October 15 near 30N, 75W. A semicircular area of hurricane force winds of around 75 to 80 mph developed north of the center and persisted for a couple of days as it moved slowly northeastward" (MWR). ATS describes that by 15/0030Z, the density discontinuity had disappeared although "a wind discontinuity remained causing a wind shear line between the strong easterly flow around the high to the north and the weaker easterly flow to the south in the subtropics. On the 15/0630Z surface chart, a ship at 31N, 74.5W reported a NE wind 25 kt with showers. Drawing to this report, the analysis showed a trough in the easterlies extending to the south, and a closed low of 1014 mb giving a tight gradient to the surface isobars in the northeast. A vortex was suspected as having been forced along the shear line by the strong easterly winds to the north overrunning the slower easterly winds to the south. The aerologist on the first aircraft reconnaissance flight into the suspected area reported that no eye could be found, but a large, flat low pressure area existed with a minimum pressure of 998 mb near 31N, 74.5W. A wind shift from SE to NE was found at 31.2N, 75W, about 30 miles to the west of the low pressure area. Maximum winds reported were 70 kt. At the 5,000 ft level, the aircraft was above all clouds except an altostratus shield observed to the south" (ATS).

#### October 16:

HWM analyzes a tropical storm of at most 1005 mb centered near 31.2N, 73.0W with the NW end of a NW-SE dissipating warm front located about 220 nmi ENE of the cyclone. HURDAT lists this as a 60 kt tropical storm at 32.2N, 73.0W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position with the former showing a 1002 mb pressure. Microfilm analyzes a low of at most 1005 mb centered near 31.9N, 72.4W with a trough or front axis extending from 30N, 72W southwestward to 26N, 76W. Ship highlights: 60 kt NE at 03Z at 32.1N, 75.0W (micro); 50 kt NE and 1006 mb at 06Z at 32.5N, 74.4W (micro); 50 kt NE and 1010 mb at 18Z at 32.9N, 73.1W (COA); 35 kt NNE and 1004 mb at 21Z at 33.1N, 72.5W (micro). 21 other gales between 35-50 kt and one other low pressure of 1005 mb. Aircraft highlights: Navy center fix (loran) at 1342Z at either 31.4N, 73.1W or 31.8N, 73.2W with 1000 mb central pressure and 45 kt max winds (ATS, micro); center fix at

2200Z at either 36.1N, 72.1N, or 31.9N, 72.2W with 999 mb central pressure, 38 kt max winds, and 850 mb height of 4,560 ft in the center (ATS, micro). "On the morning of 16 October, a Navy hurricane reconnaissance aircraft located the low pressure area, 1000 mb, at 1342Z at 31.4N, 73.1W. Maximum winds reported at this time were 45 kt 80 miles to the NE of the low pressure area. The winds were north-northeasterly. The aerologist reported that at 4,500 ft, the plane was on top of stratus clouds, and that no storm clouds were visible. The aircraft fixes showed the disturbance to have moved NE at 10 kt. This direction and speed is not considered to be too accurate, especially the speed of movement due to the fact that both fixes were estimated positions of the center of a large flat low pressure area. Because the disturbance moved in an area of heavily traveled shipping lanes, reports were quite numerous and the disturbance could be tracked quite easily. These reports verified the northeasterly movement. An afternoon reconnaissance of the disturbance located an extensive low pressure area at 16/2200Z at 31.6N, 72.1W. Minimum pressure reported was 999 mb. Maximum winds of 38 kt from the NNE were encountered in the NW quadrant. The aerologist reported a strato-cumulus overcast at 2,300 ft with bases at 800 ft. No middle or high clouds were visible in any direction. A widespread area of frequent light to moderate precipitation was reported" (ATS).

October 17:

HWM analyzes a tropical storm of at most 1000 mb centered near 32.7N, 70.4W. HURDAT lists this as a 50 kt tropical storm at 33.5N, 69.9W. The MWR tracks of centers of cyclones shows a 12Z position near 33.1N, 69.8W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a large low of at most 1005 mb centered in the general vicinity of 32.5N, 70W. Ship highlights: 50 kt NE and 1011 mb at 00Z at 33.3N, 73.0W (COA); 50 kt ENE and 1009 mb at 06Z at 33.0N, 68.7W (COA); 45 kt E and 1006 mb at 12Z at 34.9N, 68.9 (COA, micro); 50 kt E and 1011 mb at 12Z at 33.0N, 68.7W (COA); 45 kt E and 1012 mb at 18Z at 33.9N, 68.0W (COA). 18 other gales between 35-50 kt. "On the 17<sup>th</sup> and 18<sup>th</sup> the center described a loop westward and then southwestward between Bermuda and Cape Hatteras and lost force" (MWR). "The 17/1830Z surface chart showed that the disturbance was fast becoming extra-tropical in character. The area of high winds was becoming more widespread" (ATS).

October 18:

HWM analyzes a tropical storm of at most 1000 mb centered near 33.8N, 72.3W. HURDAT lists this as a 45 kt tropical storm at 34.0N, 72.2W. The MWR tracks of centers of cyclones shows a 12Z position near 34.0N, 71.6W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a large low of at most 1005 mb centered in the general vicinity of the HURDAT position. Ship highlights: 40 kt NE and 1003 mb at 00Z at 35.4N, 72.5W (COA, micro); 55 kt E and 1018 mb at 00Z at 38.0N, 69.8W (COA); 65 kt E and 1019 mb at 06Z at 38.3N, 68.2W (COA); 50 kt E and 1009 mb at 12Z at 33.4N, 68.0W (COA); 60 kt E (wind too high) and 1009 mb at 18Z at 33.7N, 66.9W (COA); 35 kt E and 1005 mb at 34.2N, 71.3W (micro). 46 other gales between 35-55 kt and four other low pressures of 1005 mb.

October 19:

HWM analyzes a very large, broad closed low of at most 1000 mb centered near 31.9N, 72.6W. HURDAT lists this as a 40 kt tropical storm at 31.0N, 71.8W. The MWR tracks of centers of cyclones shows a 12Z position near 31.7N, 72W with a 999 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm analyzes a large, closed low of at most 1005 mb centered in the general vicinity of 31.1N, 72.7W, and microfilm analyzes another large, closed low of at most 1005 mb centered near 38N, 54.2W with both lows located within the same 1011 closed isobar. This elongated area of low pressure extends from about 27N, 78W to 41N, 44W. Ship highlights: 60 kt E (wind too high) and 1012 mb at 00Z at 33.8N, 66.0W (COA); 50 kt N at 00Z at 32.5N, 77.3W (COA); 40 kt N and 1011 mb at 06Z at 34.0N, 76.4W (COA); 35 kt NE and 999 mb at 12Z at 31.5N, 72.4W (COA); 40 kt ENE and 1011 mb at 18Z at 32.0N, 72.4W (COA). 24 other gales between 35-50 kt and 11 other low pressures between 1001-1005 mb.

October 20:

HWM analyzes a closed low of at most 1005 mb centered near 28.6N, 70.2W located within a very large area of low pressure below 1010 mb extending from 24N, 74W to northeast, southeast, and northwest of 35N, 60W. HURDAT lists this as a 25 kt tropical depression at 29.2N, 69.3W. The MWR tracks of centers of cyclones shows a 12Z position near 29.9N, 68.7W with a 1000 mb pressure and the MWR post-season track map shows a 12Z position near 29.1N, 69.0W. Microfilm analyzes a closed low of at most 1005 mb centered near 28.5N, 68.9W located within a very large area of low pressure below 1010 mb similar to the HWM analysis. Ship highlights (through 00Z only): 45 kt ENE and 1003 mb at 00Z at 30.4N, 71.9W (COA). Three other gales between 35-40 kt and 3 other low pressures between 1002-1004 mb. "It finally died out several hundred miles southwest of Bermuda on October 20. Several ships were involved with the storm, but no reports of damage have been received" (MWR).

October 21:

HWM no longer shows a closed low on this day associated with what was Jig. HWM shows a different broad low near 41N, 44W with an upper-level cold front [and likely associated deep-layer troughing] extending southwestward from 34N, 48W to 30N, 55W to 28N, 60W to 27N, 65W to 26N, 70W. HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 30.2N, 54.6W with a 1012 mb pressure.

Hurricane Jig appeared to have formed from the same front/trough that was partially responsible for the formation of Tropical Storm Item. An area of enhanced cyclonic turning became apparent on 13 and 14 October near the northwest Bahamas. On the 14<sup>th</sup>, a very strong surface high was located over the mid-Atlantic and northeast coasts of the U.S. A large area of gale force winds of 35-40 kt in the tight pressure gradient region was located between 29-34N, 69-78W on the 14<sup>th</sup>. HURDAT starts this system at 06Z on 15 October as a 35 kt tropical storm at 28.1N, 76.0W. No change is made to the timing of genesis, but this system is started with a 50 kt intensity at 06Z on the 15<sup>th</sup> (up from 35

kt originally) about half a degree southwest of the previous HURDAT position. At 12Z on the 15<sup>th</sup>, a ship likely located near the center recorded 45 kt NE with 1008 mb. Another ship slightly further away recorded 60 kt with 1012 mb. The 65 kt intensity in HURDAT at 12Z on the 15<sup>th</sup> is unchanged; thus no change is made to the timing of Jig becoming a hurricane. Jig moved northeastward from the 15<sup>th</sup> to 17<sup>th</sup> until it reached a location near 34N, 70W. The cyclone is then analyzed to have made a counterclockwise loop (as in HURDAT). It moved southward to a position near 31N, 72W on the 19<sup>th</sup> and then moved southeastward to near 20N, 71W by 00Z on the 20<sup>th</sup>. The largest track change during the entire lifetime of Jig was about seven-tenths of a degree. This magnitude of a change was made at 12Z on the 16<sup>th</sup> due to aircraft reconnaissance center fix information. At 00Z on the 19<sup>th</sup>, ship observations are responsible for the track change made then. Regarding the intensity and structure of Jig, at 2240Z on the 15<sup>th</sup>, aircraft reconnaissance measured a 998 mb central pressure, and this value is added to HURDAT at 00Z on the 16<sup>th</sup>. A central pressure of 998 mb yields a wind speed of 47 kt according to the Brown et al. pressure-wind relationship for systems north of 25N. An eye radius of 6 nmi was reported along with maximum flight-level winds of 70 kt. There were a few 60 kt ship observations within a few hours before and after the aircraft fix. These ship observations are believable, given the very strong pressure gradient to the north of the cyclone. An intensity of 65 kt is chosen for both 18Z on the 15<sup>th</sup> and 00Z on the 16<sup>th</sup> (down from 70 kt originally at both times). On the 16<sup>th</sup>, central pressures of 1000 and 999 mb were measured by aircraft at 1342 and 2200Z respectively. These values are added to HURDAT at 12Z on the 16<sup>th</sup> and 00Z on the 17<sup>th</sup> respectively. A central pressure of 1000 mb yields 44 kt and a central pressure of 999 mb yields 45 kt according to the north of 25N pressure-wind relationship. The HURDAT intensities of 60, 55, and 55 kt from 12Z on the 16<sup>th</sup> through 00Z on the 17<sup>th</sup> are all unchanged because there are many ship observations of 50 kt around those times. Although the pressure-wind relationships were considered for this cyclone, they were not strictly followed as with pure tropical cyclones because Hurricane Jig would have been classified as a subtropical cyclone with the classification system of today from the 15<sup>th</sup> to 17<sup>th</sup> of October. The strongest observed winds for much of the lifetime of Jig were rather far from the center, but there were also times when strong gales were observed close to the center. There is a chance that Jig could have begun as an extratropical cyclone on the 15<sup>th</sup>, but there is clear evidence that it was a subtropical cyclone on the 16<sup>th</sup> and 17<sup>th</sup> and not an extratropical cyclone. Jig is analyzed as tropical (subtropical today) from genesis through the 17<sup>th</sup>. But it is analyzed that Jig became extratropical by 00Z on the 18<sup>th</sup>. Previously, HURDAT showed no extratropical phase for this cyclone. The addition of an extratropical phase for the final 2+ days of this cyclone's life is a major change to HURDAT. Although there are not any fronts apparent by 00Z on the 18<sup>th</sup>, winds of 10 to 15 kt are observed within 100 nmi of the center, and the winds greater than 50 kt are observed to be located more than 250 nmi from the center. An RMW of 250 nmi is too large, even for a subtropical cyclone. This situation is likely similar to the situation of an occluded low, although there were no fronts on the days previous to the 18<sup>th</sup>. The HURDAT intensities between 06Z on the 17<sup>th</sup> through 00Z on the 20<sup>th</sup> are all raised by 5 to 15 kt because of ship observations of higher winds. HURDAT previously shows dissipation after 18Z on the 20<sup>th</sup>, but observations indicate that a closed circulation no longer existed after 00Z on the 20<sup>th</sup>, so the final 18 hours are eliminated from HURDAT.

Interesting quote from ATS:

“It is doubtful that this hurricane could be classed as a truly characteristic tropical hurricane, as it developed frontal and extratropical characteristics at such an early stage. No eye was ever found in this disturbance so it probably never developed to more than the stage of a closed vortex with a low central pressure and high winds to the north of this central pressure. It is believed that the high latitude at which it formed and its late date of occurrence in the hurricane season prevented this disturbance from developing into a more intense hurricane” (ATS).

### 1951 Storm 12 (new to HURDAT)

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35970 12/03/1951 M=10 12 SNBR= 794 NOT NAMED XING=0 L
35970 12/03* 0 0 0 0* 0 0 0 0E390 535 60 0E388 505 65 0*
35975 12/04E386 481 65 0E383 457 65 0E380 440 65 0E377 444 65 0*
35975 12/05E375 449 65 0E373 454 65 0E370 460 65 0E367 468 60 0*
35975 12/06E364 477 60 0E360 484 60 0E355 488 60 0E351 480 60 0*
35975 12/07E348 470 60 0*346 464 60 0*345 460 65 0*344 462 70 0*
35975 12/08*340 463 70 0*333 464 65 0*327 463 60 0*326 457 55 0*
35975 12/09*325 448 55 0*325 437 50 0*325 425 50 0*335 402 50 0*
35975 12/10*350 376 50 0*365 348 55 0*380 320 55 0*388 300 55 0*
35975 12/11*390 288 50 0E390 277 45 0E390 265 40 0E396 254 40 0*
35975 12/12E405 247 35 0E415 240 35 0* 0 0 0 0* 0 0 0 0*
36005 HR

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Information, observations, and analyses from HWM, COADS, NHC microfilm of synoptic weather maps, the MWR tracks of centers of cyclones, David Roth, and Jack Beven indicate that a hurricane, previously undocumented in HURDAT, occurred during December, 1951 in the north-central Atlantic Ocean.

#### December 2:

HWM does not yet analyze a closed low associated with the feature of interest but instead analyzes an E-W cold front from 43N, 61W to 42N, 70W to 44N, 80W. HWM also analyzes a powerful extratropical cyclone centered near 39N, 51W (not the feature of interest)

#### December 3:

HWM analyzes a closed low of at most 1010 mb centered near 39.5N, 53.0W with a cold front extending from the low westward to 37N, 60W to 36N, 66W to 37N, 71W. HWM also analyzes a powerful extratropical cyclone centered near 46N, 41W (not the feature of interest). At 12Z, Roth lists this as a 55 kt extratropical cyclone at 39.0N, 54.0W. Ship highlights: 45 kt NW and 1010 mb at 06Z at 39.8N, 58.7W (COA); 55 kt ENE and 1014 mb at 12Z at 41.5N, 54.7W (COA); 60 kt NW and 1015 mb at 18Z at 40.4N, 54.8W (COA). Nine other gales between 35-45 kt. “This cyclone and its attendant cold front were induced by a 500 hPa trough in the westerlies moving across the western Atlantic Ocean on the 3<sup>rd</sup>” (Roth).

#### December 4:

HWM analyzes a closed low of at most 1010 mb centered near 37.5N, 43.7W with a cold front extending from the low southwestward to 30N, 53W to 29N, 57W. A separate

frontal system extends from 44N, 28W to 40N, 35W to 30N, 40W to 22N, 47W. The MWR tracks of centers of cyclones shows a 12Z position near 38.3N, 49.8W with a 1004 mb pressure. At 12Z, Roth lists this as a 60 kt extratropical cyclone at 38.0N, 43.5W. Ship highlights: 45 kt NE and 1006 mb at 06Z at 39.2N, 50.5W (COA); 50 kt N and 1012 mb at 12Z at 39.6N, 50.5W (COA); 60 kt N and 1012 mb at 18Z at 39.0N, 50.4W (COA). At least 12 other gales between 35-50 kt. "As it moved eastward, a stronger low and its associated shortwave became absorbed by this deep system, which caused the formation of a cold low aloft, with air as chilly as -25C at 500 hPa by the morning of the 4<sup>th</sup>" (Roth).

#### December 5:

HWM analyzes a closed low of at most 1005 mb centered near 37.1N, 45.7W with a warm front extending from the low east-northeastward to 44N, 31W and a cold front extending from the low to 35N, 41W to 32N, 39W to 28N, 41W to 25N, 43W to 22N, 52W. The MWR tracks of centers of cyclones shows a 12Z position near 38.1N, 44.8W with a 1001 mb pressure. At 12Z, Roth lists this as a 60 kt extratropical cyclone at 36.5N, 47.0W. Ship highlights: 60 kt N and 1012 mb at 06Z at 39.0N, 49.8W (COA); 50 kt SSE and 1001 mb at 06Z at 37.0N, 44.0W (COA); 60 kt N and 1013 mb at 12Z at 39.1N, 49.4W (COA); 50 kt NNE and 1005 mb at 18Z at 37.8N, 49.4W (COA). Ten other gales between 35-50 kt and two other low pressures between 1004-1005 mb. "Its core warmed 3C by the 5<sup>th</sup> and began to retrograde as a shortwave ridge blocked any further eastward movement" (Roth)

#### December 6:

HWM analyzes a closed low of at most 990 mb centered near 35.1N, 49.2W. A dissipating occluded front is plotted from 37N, 54W to 41N, 52W to 44N, 48W to 44N, 45W. The MWR tracks of centers of cyclones shows a 12Z position near 36.1N, 47.7W with a 993 mb pressure. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 35.7N, 48.1W. At 12Z, Roth lists this as a 65 kt hurricane at 35.5N, 49.0W. Ship highlights: 40 kt ENE and 1011 mb at 06Z at 39.9N, 47.3W (COA); 30 kt NE and 987 mb at 18Z at 35.0N, 48.2W (COA); 50 kt SE and 1006 mb at 18Z at 38.8N, 46.7W. Five other gales between 35-50 kt and 15 other low pressures between 988-1005 mb. "Its pressure pattern was still rather large on the 6<sup>th</sup>, with extensive gales north of the center, hinting at a subtropical storm at this time, as ships reported winds of 50-60 kt over the preceding 24 hr" (Roth).

#### December 7:

HWM analyzes a closed low of at most 995 mb centered near 35.2N, 45.8W. A separate closed low of at most 1000 mb is plotted centered near 42N, 37W with a dissipating occluded front extending from this second low N-NE-E-SE-S becoming a stationary front. Both lows are plotted within the same 1010 mb isobar. The MWR tracks of centers of cyclones shows a 12Z position near 35.3N, 45.2W with a 997 mb pressure. At 12Z, Roth lists this as a 65 kt hurricane at 34.0N, 46.0W. Ship highlights: 65 kt NNW and 995 mb at 18Z and 65 kt N and 996 mb at 21Z at 35.0N, 48.0W (COA). 14 other gales between 35-45 kt and 30 other low pressures between 995-1005 mb. "By the 7<sup>th</sup>, its occlusion began to dissipate and the 500 hPa temperature warmed another 8C... up to

minus 14C according to an upper-air report from a weather ship near the center” (Roth). “A ship report of 65 kt winds at 18Z on the 7<sup>th</sup> revealed the presence of a hurricane” (Roth).

December 8:

HWM analyzes a closed low of at most 995 mb centered near 32.4N, 45.6W. At 12Z, Roth lists this as a 55 kt tropical storm at 32.0N, 46.0W. Ship highlights: 55 kt NNE and 1001 mb at 00Z at 35.3N, 48.0W (COA); 50 kt NNE and 1007 mb at 06Z at 35.8N, 47.8W (COA); 35 kt E and 997 mb at 06Z at 34.7N, 46.2W (COA); 40 kt NE and 1011 mb at 12Z at 35.8N, 47.5W (COA). 15 other gales between 35-50 kt and 15 other low pressures between 998-1005 mb.

December 9:

HWM analyzes a closed low of at most 995 mb centered near 32.3N, 42.6W. At 12Z, Roth lists this as a 55 kt tropical storm at 32.5N, 42.5W. Ship highlights: 45 kt N and 1013 mb at 00Z at 32.7N, 49.2W (COA); 25 kt SSW and 1004 mb at 06Z at 32.4N, 41.6W (COA). Two other gales of 35 kt and one other low pressure of 1002 mb. “The hurricane dropped southward on the 9<sup>th</sup> due to a warm core ridge building to the northwest, and according to ship reports weakened while executing this maneuver, with no winds about 45 kt noted that day. An approaching trough in the westerlies moved the ridge out to the east, and the tropical storm began to accelerate east-northeastward across the Azores” (Roth).

December 10:

HWM analyzes a closed low of at most 995 mb centered near 37.9N, 32.3W. A cold front is plotted from 50N, 30W to 45N, 32W becoming a dissipating cold front at 42N, 34W, becoming a warm front at 39N, 41W, extending to 41N, 46W. At 12Z, Roth lists this as a 55 kt tropical storm at 38.0N, 32.0W. Ship highlights: 50 kt NW at 12Z at 37.5N, 32.5W (HWM); 35 kt ENE and 991 mb at 18Z at 40.0N, 30.5W (COA). At least two other gales of 35-40 kt and at least 20 other low pressures between 994-1005 mb.

December 11:

HWM analyzes a closed low of at most 995 mb centered near 39.5N, 25.8W with a frontal system located just a few hundred nmi northwest of the low. At 12Z, Roth lists this as a 45 kt tropical storm at 39.0N, 25.5W. Ship highlights: 35 kt E and 999 mb at 00Z at 39.5N, 27.9W (COA); 35 kt ESE and 996 mb at 06Z at 39.5N, 26.9W (COA); 10 kt N and 992 mb at 12Z at 38.9N, 26.7W (COA); 30 kt SE and 1000 mb at 12Z at 39.6N, 25.0W (COA). One other gale of 35 kt and 17 other low pressures between 996-1005 mb.

December 12:

HWM analyzes a closed low of at most 995 mb centered near 42.2N, 26.5W. It is not 100% clear from analyzing the HWM maps that this low is purely the same independent system that is followed from December 3-11. A warm front extends from 100 nmi north of the low northward, and a cold front extends from the low to 41N, 23W to 39N, 22W. At 12Z, Roth lists this as a 50 kt extratropical cyclone at 41.0N, 26.0W. Ship highlights

(through 06Z only): 30 kt SSE and 1010 mb at 00Z at 38.2N, 15.7W (COA); 10 kt N and 1003 mb at 00Z at 39.5N, 25.7W (COA); 15 kt SE and 1001 mb at 06Z at 42.3N, 23.0W (COA). Four other low pressures between 1002-1005 mb. “It reacquired fronts around the center by the 12<sup>th</sup> soon after passing by the Azores, but was again blocked by another shortwave ridge. A new upper cyclone closed off aloft, and was forced southeast by a building warm core ridge northwest of Spain, which commenced another turn to the southeast and a final round of weakening” (Roth).

December 13:

HWM analyzes a closed low of at most 995 mb centered near 43.8N, 17.2W with a S-N dissipating occluded front located north of the low and the north end of a N-S cold front located 100-150 nmi SE of the low. It is not 100% clear from analyzing the HWM maps that this low is purely the same independent system that is followed from December 3-11. At 12Z, Roth lists this as a 60 kt extratropical cyclone at 44.0N, 17.0W.

December 14:

HWM analyzes a closed low of at most 1015 mb centered near 37.5N, 13.0W. It is not 100% clear from analyzing the HWM maps that this low is purely the same independent system that is followed from December 3-11. A dissipating cold front is plotted from 40N, 7W becoming a cold front at 34N, 8W to 30N, 11W to 24N, 20W. At 12Z, Roth lists this as a 20 kt extratropical low at 38.0N, 11.0W.

December 15:

“The low dissipated by the 15<sup>th</sup> as it moved into Morocco” (Roth).

On 2 December, 1951, an area of cyclonic turning began to take place in the general vicinity of 43N, 65W along a cold front oriented E-W from 43N, 61W to 44N, 80W. A small, extratropical cyclone developed along the east end of this cold front by the 3<sup>rd</sup>. At the same time, a powerful extratropical cyclone was located several hundred nmi NE of this cyclone. The cyclone is started as a 60 kt extratropical cyclone at 12Z on 3 December at 39.0N, 53.5W. By 18Z, the intensity increased to 65 kt. From the 3<sup>rd</sup> to the 4<sup>th</sup>, the cyclone moved eastward, but it curved toward the south and moved southwestward from the 4<sup>th</sup> to the 6<sup>th</sup>. The position on the 4<sup>th</sup> is 38.0N, 44.0W and the position on the 6<sup>th</sup> is 35.5N, 49.0W. A 65 kt intensity is analyzed for this extratropical cyclone from 18Z on the 3<sup>rd</sup> to 12Z on the 5<sup>th</sup>. It is analyzed that the cyclone weakened to 60 kt at 18Z on the 5<sup>th</sup>, and the 60 kt intensity is maintained through the 6<sup>th</sup>. On the 6<sup>th</sup>, the cyclone, which had been moving southwestward, made a turn toward the southeast, but moved slowly for the next couple of days. It is analyzed that the cyclone transitioned to a tropical cyclone at 06Z on 7 December at 34.6N, 46.5W with a 60 kt intensity (today, this cyclone would have been classified as a subtropical cyclone for the entire time it is listed as tropical in this analysis, as it likely never became purely tropical). The 60 kt tropical storm increased to hurricane intensity by 12Z on the 7<sup>th</sup> at 34.5N, 46.0W. On the 7<sup>th</sup> at 18Z 65 kt was recorded simultaneously with a pressure of 995 mb. Just 24 hours earlier, a ship recorded a 987 mb pressure with 30 kt winds, but the cyclone was not yet tropical when the 987 mb pressure was recorded. A peripheral pressure of 995 mb yields a wind speed of greater than 52 kt according to the Brown et al. pressure-wind

relationship for north of 25N and greater than 56 kt according to the north of 35N pressure-wind relationship. A 70 kt intensity is chosen for 18Z on the 7<sup>th</sup> and 00Z on the 8<sup>th</sup> (this is the peak analyzed intensity for the hurricane). The cyclone, which had been moving southward, turned toward the east on the 8<sup>th</sup> with a 12Z position of 32.7N, 46.4W on the 8<sup>th</sup>. The hurricane is analyzed to have weakened to a tropical storm at 12Z on the 8<sup>th</sup>. The cyclone moved eastward for a day and then accelerated toward the ENE between the 9<sup>th</sup> and 10<sup>th</sup>. The cyclone is analyzed to have weakened to a 50 kt tropical storm by 06Z on the 9<sup>th</sup>, and it strengthened to a 55 kt tropical storm at 06Z on the 10<sup>th</sup>. The analyzed position for 12Z on the 10<sup>th</sup> is 38.0N, 32.0W. The cyclone continued to move toward the ENE, but it slowed down late on the 10<sup>th</sup> and early on the 11<sup>th</sup>. It is analyzed that the tropical cyclone became extratropical at 06Z on the 11<sup>th</sup> at 39.0N, 27.7W with a 45 kt intensity. Late on the 11<sup>th</sup> and early on the 12<sup>th</sup> the cyclone moved slowly toward the northeast as it slowly spun down. It is analyzed that the cyclone was no longer closed after 06Z on the 12<sup>th</sup> because no east winds could be found north of the center after that time. In fact, it is possible that the cyclone was no longer closed after 06Z on the 11<sup>th</sup> (only a couple of observations of very light winds with a slight easterly component were present north of the center from 06Z on the 11<sup>th</sup> to 06Z on the 12<sup>th</sup>). Although no observations of east winds could be found north of the center after 06Z on the 12<sup>th</sup>, there is also a slightly possibility that the cyclone stayed closed as the same coherent system until 14 December. The analysis points to the scenario the feature of interest merged with a separate extratropical cyclone after 06Z on the 12<sup>th</sup>. The final point at 06Z on the 12<sup>th</sup> is at 41.2N, 24.0W as a 35 kt extratropical storm.

Additional quote from David Roth:

“It is quite possible this storm was briefly subtropical on the 6<sup>th</sup>, but it is likely that the conversion was quick as the temperature differential between the sea surface and 500 hPa was initially 47C...water temperatures in the area were around 23C or 72F. This temperature difference in the lower 20,000 foot layer of the troposphere yielded an upper air profile that was nearly dry adiabatic, which should have initiated convection beginning late on the 4<sup>th</sup> or early on the 5<sup>th</sup> as hinted at by the first temperature rises occurred at 500 hPa. Studies have in the past noted the formation of convection...thunderstorms...when temperature differences reach 40C in the lower half of the troposphere” (Roth).

1951 additional notes

1)

HWM, COADS, and David Roth indicate that an area of low pressure formed from a larger extratropical cyclone or front on 16 January, becoming its own extratropical cyclone on the 16<sup>th</sup> near 34N, 30W. Several gales and a few low pressures were observed during each day of the lifetime of this cyclone. Late on the 17<sup>th</sup>, the frontal features of this new cyclone may have begun to dissipate somewhat, but during the 17<sup>th</sup> and 18<sup>th</sup>, there is not enough evidence that the cyclone was closed or compact enough to be considered a subtropical cyclone. It was absorbed by another extratropical cyclone by

00Z on the 19<sup>th</sup>. Although there is a slight chance that this was a subtropical storm, this system is not added to HURDAT. This suspect is considered to be #5 on this list of additional notes for the year 1951 for systems not added to HURDAT (the system not added in to HURDAT that was 5<sup>th</sup> closest to being added in during 1951).

DAY	LAT	LON	STATUS
Jan 16	34N	30W	Extratropical
Jan 17	33N	34W	Extratropical
Jan 18	35N	37W	Extratropical
Jan 19			Absorbed

2)

HWM, COADS, David Roth, and Jack Beven's list of suspects indicate that a frontal low became non-frontal in the central north Atlantic on 14 February. The low was broad and there was still somewhat of a temperature gradient across the low on the 14<sup>th</sup> and 15<sup>th</sup> even though there were no fronts apparent on those days in association with the low. The low became extratropical again on the 16<sup>th</sup> as the next approaching frontal system absorbed it. There were no observed low pressures with this system. There were four or five gales in the general vicinity of this low during the 13<sup>th</sup>-16<sup>th</sup>, but only two gales were observed to be directly associated with it- both of 35 kt. One was at 06Z on the 13<sup>th</sup> and the other was at 00Z on the 16<sup>th</sup>. Two gales observed on the 15<sup>th</sup> are too far away and are located in a high pressure gradient region about 10 degrees west of the low. These gales are not considered to be directly related to this system. Although this system may have been a subtropical cyclone on the 14<sup>th</sup> and 15<sup>th</sup> with an intensity of 30 or 35 kt, it is treated as a broad low and is not analyzed to have been a subtropical cyclone. Thus, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Feb 13	26N	60W	Extratropical
Feb 14	30N	61W	Broad low
Feb 15	33N	59W	Broad low
Feb 16	33N	55W	Extratropical

3)

HWM, microfilm, and COADS indicate that an extratropical cyclone developed and intensified along a frontal system on 18 February in the north-central Atlantic. The frontal features were largely dissipated by the 19<sup>th</sup>, and a large, powerful occluded low with widespread gales and low pressures was left over with a minimal temperature gradient from the 19<sup>th</sup> through the 22<sup>nd</sup>. On the 23<sup>rd</sup>, the cyclone was no longer closed as an interaction with an approaching extratropical system took place. The closest that this cyclone came to possibly being a subtropical cyclone was around 18Z on the 19<sup>th</sup>, but it is analyzed that this cyclone was too large and occluded to be considered a subtropical

cyclone. Thus, this system is not added to HURDAT. This suspect is considered to be #4 (the 4<sup>th</sup> closest to being added in to HURDAT that was not added in for 1951)

DAY	LAT	LON	STATUS
Feb 18	34N	54W	Extratropical
Feb 19	35N	55W	Extratropical
Feb 20	34N	52W	Extratropical
Feb 21	36N	50W	Extratropical
Feb 22	34N	48W	Extratropical
Feb 23			Dissipated

4)

HWM analyzes a low of at most 1005 mb on 9 March near 11N, 54W. The COADS was obtained to compliment observations on HWM, and no gales or low pressures could be found. Although there may have been a closed circulation, this could not be confirmed by observations. Thus, this suspect is not added to HURDAT.

DAY	LAT	LON	STATUS
Mar 08	11N	55W	Broad low/trough
Mar 09	11N	54W	Broad low/trough
Mar 10	11N	55W	Broad low/trough

5)

HWM and microfilm indicate that an extratropical (or perhaps subtropical) cyclone formed over the north Atlantic on 30 March. Several gales and low pressures were observed with this cyclone. For many of the days of this cyclone's lifetime, there was a minimal temperature gradient across the low, but absolute temperatures were rather cool. On all days, the cyclone was very large, and the strongest winds were far from the center. Although there is a slight chance that this cyclone could have been subtropical on 30-31 March, it is analyzed to have been extratropical throughout its lifetime. Thus, this cyclone is not added to HURDAT.

DAY	LAT	LON	STATUS
Mar 30	34N	53W	Extratropical
Mar 31	33N	48W	Extratropical
Apr 01	37N	45W	Extratropical
Apr 02	41N	46W	Extratropical
Apr 03	41N	45W	Extratropical
Apr 04	38N	44W	Extratropical
Apr 05	36N	43W	Extratropical
Apr 06	36N	40W	Extratropical
Apr 07	36N	37W	Broad low/trough

Apr 08

Dissipated

6)

HWM, microfilm, COADS, the May 1951 MWR tracks of lows, MWR 1951 p. 189, David Roth, and Jack Beven's list of suspects indicate that a tropical depression formed on 17 May during the same time when Hurricane Able was forming to its west. This suspect is analyzed to have been a tropical cyclone from 12Z on 17 May to 12Z on 18 May. It became extratropical at 18Z on the 18<sup>th</sup>. There was one 35 kt ship observation with a pressure of 1008 mb at 00Z on the 18<sup>th</sup>. There were at least four other ship observations of 30 kt during the time when this was a tropical cyclone. There were four ship observations of 1008 mb, and 1008 mb was the lowest pressure recorded from a ship. Since there is only one piece of evidence during the tropical cyclone portion of this cyclone's lifetime, it is not added to HURDAT. This suspect is judged to be #1 for closest to being added in to HURDAT of all the additional notes of 1951.

DAY	LAT	LON	STATUS
May 15	Open wave/trough 30N, 66W to 17N, 73W		
May 16	23N	70W	Spot low
May 17	30N	69W	Tropical Depression
May 18	36N	71W	Tropical Depression
May 19	36N	74W	Extratropical
May 20	Absorbed into Hurricane Able		

7)

HWM, microfilm, and COADS indicate the presence of a strong tropical wave, or possibly even a tropical depression in the western Caribbean Sea on 20 June. This disturbance moved westward into Central America on the 21<sup>st</sup> and 22<sup>nd</sup>. No gales or low pressures are found in association with this system, so this system cannot be added to HURDAT. However, at 12Z on the 21<sup>st</sup>, observations of 30 kt with 1010 mb and 25 kt with 1009 mb were recorded near the center of the disturbance.

DAY	LAT	LON	STATUS
Jun 20	15N	82W	Spot low/wave
Jun 21	16N	87W	Spot low/wave
Jun 22	15N	92W	Spot low/wave

8)

Microfilm indicates that an area of showers, thunderstorms, and winds possibly as high as 30 kt was located in the Bay of Campeche on 24 June. This may have been associated with a tropical wave or disturbance. It might have moved westward into Mexico during

the night of the 24<sup>th</sup>-25<sup>th</sup>. Information from commercial aircraft flights on the 24<sup>th</sup> and 25<sup>th</sup> provided this information in addition to surface observations. Despite this, observations are still sparse and it is difficult to track a disturbance. There are no gales or low pressures, and this suspect is not added to HURDAT.

DAY	LAT	LON	STATUS
Jun 24	21N	95W	Spot low
Jun 25	23N	102W	Dissipating

9)

David Roth suggests that a tropical depression may have formed on 10 July in the eastern Gulf of Mexico. This disturbance moved over Florida, the Atlantic Ocean, and portions of the southeastern U.S. over the next couple of days. HWM, COADS, and microfilm were searched, and no strong winds near gale force were found. No low pressures were found either. This system is not added to HURDAT.

DAY	LAT	LON	STATUS
Jul 10	25N	83W	Tropical depression
Jul 11	26N	82W	Tropical depression
Jul 12	29N	78W	Tropical depression
Jul 13	33N	82W	Dissipating

10)

HWM, microfilm, and COADS suggest that a trough of low pressure in the northern Gulf of Mexico was near the north-central Gulf Coast on 29 July. A closed circulation may have developed and could have been a tropical depression on the 30<sup>th</sup>. It opened up again into a trough on 31<sup>st</sup> as it moved slowly westward and moved inland in western Louisiana. There were no gales or low pressures with this system, and it is not added to HURDAT.

DAY	LAT	LON	STATUS
Jul 29	29N	91W	Broad low/trough
Jul 30	29N	92W	Tropical depression
Jul 31	30N	93W	Broad low/trough

11)

HWM, microfilm, COADS, the 1951 Navy log book (ATS), Ryan Truchelut, David Roth, and Jack Beven's list of suspects indicate that a tropical wave, which first appeared in HWM along 32W on 12 August, moved westward through the tropical Atlantic and was likely a tropical depression on 19 August near or just north of the northern Leeward

Islands. Aircraft reconnaissance on the 19<sup>th</sup> reported wind shifts from southwest to north to east with a minimum pressure encountered 1008 mb and max wind of 23 kt from the SW. Circular cloudiness covering a diameter of 40 miles was reported. This evidence points to a likely tropical depression. HWM, microfilm, and ATS all show a tropical storm symbol on their August 19 maps. The reconnaissance flight on the 20<sup>th</sup> conducted a through search along the wave axis and found no closed circulation. Lowest pressure encountered was 1012 mb and winds were not gale force. For the remainder of this system's lifetime, there is no evidence of a closed circulation. Although a tropical depression was confirmed on the 19<sup>th</sup>, there are no observed gales or low pressures with this system. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Aug 12			Tropical wave along 32W
Aug 13			Tropical wave along 35W
Aug 14			Tropical wave along 38W
Aug 15	11N	41W	Spot low
Aug 16	11N	44W	Spot low
Aug 17	12N	50W	Spot low
Aug 18	13N	57W	Tropical depression
Aug 19	18N	62W	Tropical depression
Aug 20	21N	66W	Spot low/wave
Aug 21	23N	68W	Spot low/wave
Aug 22	25N	68W	Weak low/trough
Aug 23	28N	68W	Weak low/trough
Aug 24	28N	68W	Weak low/trough
Aug 25			Absorbed by front

12)

HWM, microfilm, COADS, the August and September MWR tracks of lows, August and September Local, State, and National Monthly Climatological Data from NCDC, the 1951 Navy log book (ATS), David Roth, and Jack Beven's list of suspects indicate that a tropical cyclone formed from an old frontal boundary on 31 August off the Carolina coast. At 00Z on the 31<sup>st</sup>, it was still extratropical and located near 33.5N, 72W. It became a tropical depression by 12Z on the 31<sup>st</sup> near 33N, 75W with an intensity of about 25 kt. By 18Z on the 31<sup>st</sup>, the intensity had increased to 30 kt and it was moving west-southwestward located near 32.8N, 76.2W. By 06Z on 1 September, the 30 kt tropical depression was located near 32.7N, 78.7W, and by 12Z, it was nearing landfall in southern South Carolina south of Charleston. The likely 12Z position on the 1<sup>st</sup> is 32.3N, 79.6W and 18Z position is well inland near 32.1N, 81.8W. The highest available wind recorded from a coastal station was 25 kt (max w/1-min) recorded at Charleston on the 1<sup>st</sup>. The lowest pressure recorded from a coastal station was 1004 mb at Charleston on the 1<sup>st</sup>. A central pressure of less than or possibly equal to 1004 mb yields a wind speed of at least 36 kt according to the Brown et al. north of 25N pressure-wind relationship. Environmental pressures were a little lower than typical, so it may have only been a 30 kt

tropical depression. The highest available wind for the entire system is 30 kt recorded at Frying Pan (33.5N, 77.5W) at 18Z on 31 August (the elevation of the anemometer at Frying Pan was not investigated). Since there is only one piece of evidence (the 1004 mb recorded at Charleston) and since there were no gales recorded for the entire lifetime of this system, it is not added to HURDAT. It should be noted that there is a chance that this could have been a 35 kt tropical storm at landfall. No coastal station information could be found for any locations between Charleston, SC and Savannah, GA. This is the #2 suspect for closest to being added in to HURDAT of all the additional notes of 1951.

DAY	LAT	LON	STATUS
Aug 29	36N	70W	Extratropical
Aug 30	35N	72W	Extratropical
Aug 31	33N	75W	Tropical depression
Sep 01	32.3N	79.6W	Tropical depression
Sep 02	31N	83W	Tropical depression
Sep 03			Dissipated

13)

HWM, COADS, and Jack Beven's list of suspects indicate that a tropical wave emerged off of Africa late on the 16<sup>th</sup>. A low formed and moved northward east of the Cape Verde Islands near the African coast. It was likely a tropical depression from 18 to 20 September. On the 19<sup>th</sup> at 06Z, a ship recorded 30 kt SSW with 1006 mb at 17.2N, 18.0W (COA). There were several more observations of 25-30 kt and pressures of 1007-1008 mb on the 19<sup>th</sup> and 20<sup>th</sup> associated with this system. On the 19<sup>th</sup> and 20<sup>th</sup>, there were a total of three 30 kt ship observations and five 25 kt ship observations. There was one 1006 mb ob, one 1007 mb ob, and six 1008 mb observations during those two days. Since there are no gales or low pressures, this system is not added to HURDAT. It is possible that this depression was ready to strengthen to a tropical storm, but its path over cooler waters by the 20<sup>th</sup> likely prevented this.

DAY	LAT	LON	STATUS
Sep 16	Tropical wave over Africa along 16W		
Sep 17	16N	18W	Spot low
Sep 18	17N	19W	Tropical depression
Sep 19	19N	19W	Tropical depression
Sep 20	23N	18W	Tropical depression
Sep 21	28N	15W	Weak low/trough
Sep 22	Weak trough near Canary Islands		
Sep 23	Absorbed by front		

14)

HWM, COADS, and Ryan Truchelut indicate that a large, well-defined cyclonic circulation existed in the eastern Atlantic on 16 October near 11N, 23W. The low traveled slowly westward through the tropical Atlantic. There were no gales observed, but there were two low pressures of 1005 mb observed for the entire lifetime of this system. On the 17<sup>th</sup>, there were two separate observations of 1005 mb. One of these 1005 mb observations was from one of the Cape Verde Islands (reported with winds of either 20 or 30 kt) where a 24-hour pressure fall of 5.2 mb was observed from the 16<sup>th</sup> to the 17<sup>th</sup>. A closed circulation may have existed from the 16<sup>th</sup> through the 19<sup>th</sup>, and there may be enough evidence that there was a closed circulation on the 19<sup>th</sup> at 12Z when a ship at 9.0N, 32.9W recorded a WNW wind. During the 16<sup>th</sup> through the 18<sup>th</sup>, there were a few relevant observations south of the center with westerly wind components, but most were either SSW winds, or rather far from the center. It may have been a tropical cyclone on the 17<sup>th</sup> during the time when the two low pressures of 1005 mb were recorded. There were a few 25 kt observations during that time, and maybe one 30 kt observation (it is difficult to tell whether the observation in HWM on the 17<sup>th</sup> at 14.8N, 23.8W is 25 or 35 mph- Cape Verde Island ob referred to above). From the 20<sup>th</sup> to the 24<sup>th</sup>, there were very few observations in the central tropical Atlantic so the location and status of this potential system is highly uncertain during those days. It is possible that it was the same system as the weak low or trough that was observed from the 25<sup>th</sup> to the 29<sup>th</sup> at the locations listed below. Even though there are two pieces of evidence, this system is not added to HURDAT because there were no observed gales and it is not absolutely conclusive that a closed circulation existed during the time of the 1005 mb observations. This is the #3 suspect for closest to being added in to HURDAT of all the additional notes of 1951.

DAY	LAT	LON	STATUS
Oct 16	12N	20W	Broad low/wave
Oct 17	13N	23W	Broad low/wave
Oct 18	13N	27W	Broad low/wave
Oct 19	13N	31W	Broad low/wave
Oct 20	13N	35W	Broad low/wave
Oct 21	14N	38W	Broad low/wave
Oct 22	14N	40W	Broad low/wave
Oct 23	14N	42W	Broad low/wave
Oct 24	14N	45W	Broad low/wave
Oct 25	14N	50W	Broad low/wave
Oct 26	20N	49W	Broad low/wave
Oct 27	27N	48W	Broad low/trough
Oct 28	28N	48W	Broad low/trough
Oct 29	30N	48W	Broad low/trough
Oct 30			Dissipated

15)

HWM and COADS suggest that a low or trough appeared in the eastern tropical Atlantic on 30 October. It moved generally westward through the 4<sup>th</sup> of November until dissipation. On the 30<sup>th</sup>, winds as high as 30 kt and pressures as low as 1007 mb were recorded. However, there are no available gales or low pressures for the lifetime of this disturbance. Thus, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Oct 30	12N	23W	Broad low/trough
Oct 31	12N	27W	Broad low/trough
Nov 1	12N	32W	Broad low/trough
Nov 2	13N	37W	Broad low/trough
Nov 3	15N	42W	Broad low/trough
Nov 4	16N	48W	Broad low/trough

16)

HWM, microfilm and COADS indicate the presence of a broad low that meandered in the central Atlantic for a few days beginning on 31 October. By 18Z on the 3<sup>rd</sup> of November and 00Z on the 4<sup>th</sup>, observations from microfilm and COADS confirm a closed circulation. A tropical cyclone likely passed southwest of Bermuda on a northwest course between 18Z on the 3<sup>rd</sup> and 06Z on the 4<sup>th</sup>. A cold front approaching from the west absorbed the cyclone by 12Z on the 4<sup>th</sup>. A few 30 kt winds and pressures as low as 1008 mb were recorded from Bermuda and from ships late on the 3<sup>rd</sup> and early on the 4<sup>th</sup>. This could have been a tropical storm, but there are no gales or low pressures that can be directly tied to this system for its entire lifetime. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Oct 31	26N	58W	Broad low/trough
Nov 1	25N	56W	Broad low/trough
Nov 2	24N	59W	Broad low/trough
Nov 3	29N	64W	Tropical Depression
Nov 4	37N	65W	Extratropical/absorbed by frontal system

17)

HWM, microfilm, and COADS indicate that a broad low formed along the tail end of a front located in the western Atlantic just east of the Bahamas on 11 November. The low may not have been completely separated from the front until the front moved well east of the area by 14 November. The low stayed broad and somewhat elongated. Winds of only about 20 to occasionally 25 kt accompanied the low as it moved slowly northward and northeastward before it was absorbed by the next approaching frontal system on the 17<sup>th</sup>. There were no observed gales or low pressures associated with the broad low or

trough, and it might not have even been a tropical depression. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Nov 11	25N	73W	Broad low/trough
Nov 12	25N	73W	Broad low/trough
Nov 13	27N	70W	Broad low/trough
Nov 14	29N	71W	Broad low/trough
Nov 15	30N	65W	Broad low/trough
Nov 16	34N	63W	Broad low/trough
Nov 17			Absorbed into approaching frontal system

## 1952

## 1952 Storm 1

35250 02/02/1952 M= 4 1 SNBR= 779 NOT NAMED XING=1  
 35250 02/03/1952 M= 3 1 SNBR= 779 NOT NAMED XING=1  
 \*\* \*

(The 2nd is removed from HURDAT.)

35255 02/02\* 0 0 0 0\*175 872 30 0\*202 874 35 0\*220 855 35 0\*  
 35260 02/03\*240 826 35 0\*262 804 45 0\*285 784 45 0\*307 770 45 0\*  
 35260 02/03\*240 826 40 0\*265 804 50 0\*289 786 55 0\*310 773 60 0\*  
 \*\* \*\*\* \*\* \*\*\* \*\*  
 35265 02/04E329 756 45 0E357 737 50 0E388 718 50 0E416 699 50 0\*  
 35265 02/04\*331 758 60 0E354 743 60 0E384 720 60 0E414 697 55 0\*  
 \*\*\*\* \*\* \*\* \*\*\* \*\* \*\*  
 35270 02/05E444 680 45 0E474 672 40 0\* 0 0 0 0\* 0 0 0 0\*  
 35270 02/05E438 684 50 0E465 674 45 0\* 0 0 0 0\* 0 0 0 0\*  
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35275 TS

## US Landfall:

02/03/1952 04Z 25.4N, 81.1W 55 kt

Minor track changes and minor intensity changes are analyzed for this February tropical storm. Evidence for these alterations comes from the Historical Weather Map series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Hector, and Dunn and Miller.

## February 1:

HWM does not analyze any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures.

## February 2:

HWM analyzes a spot low near 21.5N, 86.0W. HWM also analyzes a closed low of at most 1010 mb centered near 29N, 92W with a cold front running through it extending south-southwestward to 22N, 95W. HURDAT lists a 35 kt tropical storm at 20.2N, 87.4W. The MWR tracks of centers of cyclones shows a 12Z position near 19.5N, 85.2W with a 1013 mb pressure. No gales or low pressures. "1952- February 2-3: Low intensity hurricane which originated from an extensive low pressure area near Gulf of Honduras. On the 2<sup>nd</sup>, we found the area to be very close to Cozumel after which the storm recurved passing through the Yucatan Channel. It was moving NE with a fast translational velocity" (Hector). From USWB- communication (possibly between New Orleans office and Miami office)... "02/2205Z: Your estimate of closed low in Caribbean [is] completely unfounded on basis of our reports. There [is] a closed low centered over western Mississippi at 1830Z with [a] warm front [extending] into [a] sharp trough along [a] Burwood/Isle of Pines/Manzanillo/ line and [a] cold front extending from [the] low to just south of Vera Cruz. Tropical storms do not form in February" (KMIA WBAS).

## February 3:

HWM analyzes a closed low of at most 1000 mb centered near 29.3N, 78.8W located in the warm sector of an extratropical low of at most 1000 mb centered near 35N, 90W. HURDAT lists this as a 45 kt tropical storm at 28.5N, 78.4W. The MWR tracks of centers of cyclones shows a 12Z position near 28.5N, 78.9W with a 1003 mb pressure. Microfilm first analyzes a closed low at 00Z of at most 1005 mb centered near 24.1N, 82.5W located along a warm frontal boundary which extends from an extratropical low centered near 31N, 88W. At 06Z, microfilm analyzes a closed low of at most 1002 mb centered near 26.3N, 80.5W with some sort of boundary running through or extending from the low. At 12Z, microfilm analyzes a closed low of at most 1005 mb centered near 29.8N, 77.9W with fronts extending from the low. At 18Z, microfilm analyzes a closed low of at most 993 mb centered near 30.5N, 77.3W with a front extending from this low to 28N, 79W to 30N, 81W to 31N, 82W to 31N, 84W. Ship highlights: 35 kt SE and 1008 mb at 06Z at 27.4N, 80.0W (COA); 35 kt ESE and 1007 mb at 12Z at 30.4N, 77.4W (HWM, micro, COA); 45 kt SSE and 995 mb at 18Z at 31.3N, 76.9W (COA); 50 kt SE and 991 mb at 18Z at 31.0N, 77.0W (micro). Six other gales between 35-50 kt and four other low pressures between 994-1002 mb. Land/station highlights: 1004 mb (min p) at Key West, Boca Chica, and Miami WBAS (climo); 59 kt SE (max w/1-min/elevated) G 73 kt at Miami WBO (climo); 39 kt SSE (max w/1-min) at West Palm Beach (climo); 35-40 kt SSE and 1003 mb at 06Z at West Palm Beach (micro); 50 kt SE (elevated) and 1002 mb at 06Z at Carysfort Light (25.2N, 80.2W) (micro); 1002 mb (min p) at West Palm Beach (climo). Three other low pressures between 1004-1005 mb. "Incipient tropical disturbance passed short distance west of city" (Key West Local Monthly Climatological Data). From the February 1952 National Climatic Data Summary Severe Storm Reports... "Place: Florida, southern portion; Date: 2-3; Property damage (exclusive of crops): Minor; Character of storm: Wind and rain; Remarks: Tropical storm crossed extreme southern Florida during night of February 2-3, attended by winds up to 60 mph in gusts and rainfall that totaled from 2 to 3 inches. Wind and rain caused considerable damage in growing vegetable crops in Everglades and lower East Coast districts" (National climo). "Tropical Cyclones in Florida- Feb 2-3 - S Fla. - Minor - Miami wind 68 mph, gusts 84 mph" ("Minor" is equivalent to winds of less than 74 mph and pressure above 996 mb, Dunn and Miller). "[Late] on the 3<sup>rd</sup>, it was located near the southern portion of Charleston Harbor en route towards Cape Hatteras. There, it produced considerable damages to navigation and coastal areas equal to 3,000,000 pesos" (Hector). From 03/22Z WB Advisory... "A cyclonic storm of about hurricane force has developed off the south Atlantic coast and at 5 pm EST/2200Z it was centered near latitude 31N, longitude 77W, or about 250 miles east of the Georgia coast. It is moving north-northeastward about 30 mph and should pass the Cape Hatteras area late tonight attended by dangerous gales..." (WB advisories).

## February 4:

HWM analyzes a closed low of at most 995 mb centered near 38.3N, 72.5W with the WNW end of a WNW-ESE warm front located about 120 nmi east of the low, and the front previously associated with the extratropical low is oriented E-W and plotted about 180 nmi north of the cyclone. HURDAT lists this as a 50 kt extratropical cyclone at

38.8N, 71.8W. The MWR tracks of centers of cyclones shows a 12Z position near 39.1N, 73.0W with a 995 mb pressure. Microfilm at 00Z analyzes a hurricane of at most 993 mb centered near 33.1N, 75.8W with no fronts analyzed except an E-W front is located about 200 nmi north of the cyclone. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near 39.4N, 73.0W with the east end of a front extending from 100 nmi west of the low westward. Microfilm at 18Z analyzes a closed low of at most 990 mb centered near 41.1N, 69.4W with an east end of a front located 150 nmi west of the cyclone. Ship highlights: 45 kt SSE and 1000 mb at 00Z at 33.7N, 75.5W (COA); 45 kt WSW and 997 mb at 12Z at 37.2N, 72.2W (COA, HWM); 60 kt SE and 1005 mb at 12Z at 39.1N, 70.7W (COA); 35 kt WSW and 993 mb at 18Z at 40.0N, 69.7W (COA). 17 other gales between 35-45 kt and 32 other low pressures between 992-1005 mb. Land/station highlights: 21 kt ENE and 1004 mb at 18Z at Portland, ME (climo); 15 kt NW and 991 mb at Nantucket, MA (micro).

February 5:

HWM analyzes a tiny closed low of at most 990 mb [might be the feature of interest] near 49.9N, 65.0W. HWM analyzes another closed low of at most 990 mb centered near 53.5N, 74W. Both lows are located within a single 995 mb isobar, and there are numerous fronts plotted all around these lows. HURDAT last lists this at 06Z as a 40 kt extratropical cyclone at 47.4N, 67.2W. The MWR tracks of centers of cyclones shows a 12Z position near the HWM position with a 993 mb pressure. Microfilm last shows a closed low at 00Z of at most 993 mb centered near 43.9N, 68.2W. The east end of an E-W front is located 130 nmi SSW of the low. Ship highlights: 20 kt NNE and 993 mb at 00Z at 43.0N, 69.9W (COA). Land/station highlights: 35 kt SE and 996 mb at 00Z at Yarmouth, Nova Scotia (43.8N, 66.1W) (micro); 35 kt E and 996 mb at 00Z at Eastport, ME (micro); 20 kt N and 995 mb at 00Z at Portland, ME (climo); 47 kt E (max w/1-min) at Eastport (climo).

February 6:

The MWR tracks of centers of cyclones shows a 12Z position near 55.1N, 56.3W with a 988 mb pressure.

Although The MWR tracks of centers of cyclones and Hector (1975) suggest that this cyclone formed on 2 February, as in HURDAT, sufficient observational evidence indicates that there was no closed circulation present yet on the 2<sup>nd</sup>, and this day is removed from HURDAT. HURDAT previously started this system at 06Z on 2 February as a 30 kt tropical depression not far from Cozumel, Mexico. HURDAT previously listed the cyclone as strengthening to a tropical storm by 12Z, and by 18Z, it was located in HURDAT near the western tip of Cuba. Observations indicate that the circulation was closed by 00Z on the 3<sup>rd</sup> near 24.0N, 82.6W, and the first 18 hours are removed from HURDAT. The cyclone is analyzed to have made landfall in southern Florida close to Cape Sable on 3 February at 04Z at 25.4N, 81.1W as a 55 kt tropical storm. The highest official 1-minute wind of 59 kt (elevated) was recorded at the Miami Weather Bureau Office at about 06Z on the 3<sup>rd</sup>. This value reduces to 51 kt at 10 m. The lowest pressure recorded over southern Florida was 1002 mb at West Palm Beach, but observations suggest that the central pressure was likely a little less than 1000 mb. Observations over

southern Florida are helpful in determining the 06Z position and intensity, especially the observations from Miami and West Palm Beach. The analyzed intensity at the 04Z landfall and 06Z is 55 kt (up from 45 kt originally). A 40 kt intensity is chosen for 00Z on the 4<sup>th</sup> (up from 35 kt originally). The storm was over Florida from 04Z to 07Z on the 3<sup>rd</sup> of February and exited the east coast of Florida near West Palm Beach on a northeastward course at a rapid pace. By 18Z on the 3<sup>rd</sup>, observations indicate that the cyclone was centered near 30.7N, 77.5W (half a degree west of the original HURDAT position at that time). At 18Z, a ship recorded 55 kt with a 991 mb pressure. A 991 mb peripheral pressure suggests winds of at least 58 kt according to the Brown et al. southern pressure-wind relationship, and 60 kt is chosen for HURDAT at 18Z on the 3<sup>rd</sup> (up from 45 kt originally). HURDAT originally listed this cyclone as having become extratropical at 00Z on the 4<sup>th</sup> at 32.9N, 75.6W. However, observations at 00Z on the 4<sup>th</sup> indicate that there is no temperature gradient across the low, and the structure appears the same as on the previous day, which is that of a tropical cyclone. By 12Z on the 4<sup>th</sup>, observations show a large temperature gradient across the low, so extratropical transition is analyzed to have occurred by 06Z (six hours later than in HURDAT originally) with the cyclone located near 35.4N, 74.3W and a 60 kt intensity (originally 35.7N, 73.7W and 50 kt). At 12Z on the 4<sup>th</sup> it was centered east of Delmarva and New Jersey, and by 18Z, it was located just east of Nantucket, MA. The highest wind observed during the lifetime of this cyclone was 60 kt from a ship at 12Z on the 4<sup>th</sup>. The peak analyzed intensity for this cyclone is 60 kt from 18Z on the 3<sup>rd</sup> through 12Z on the 4<sup>th</sup> (part of this time includes the tropical portion of the lifetime of the cyclone). Previously, HURDAT listed a peak intensity of 50 kt on the 4<sup>th</sup> from 06Z to 18Z. By 00Z on the 5<sup>th</sup>, the extratropical cyclone was located over the Gulf of Maine between Portland and Halifax, and it moved inland into Maine shortly after that time. The highest 1-minute wind recorded in Maine was 47 kt E at Eastport, and a 50 kt intensity is analyzed for 00Z on the 5<sup>th</sup> (up from 45 kt originally). HURDAT last lists this at 06Z on the 5<sup>th</sup> over Canada close to Caribou, Maine, and no change is made to the timing of dissipation as the cyclone was being absorbed by a system to its west.

It should be noted that the north winds on the west side of the cyclone were very weak for the entire duration of its lifetime. Nevertheless, these north winds and a closed circulation were present throughout, and the analysis indicates that this was a substantial tropical cyclone. Although this cyclone occurred during the month of February, there is not enough observational evidence that it was not a tropical cyclone from 00Z on the 3<sup>rd</sup> through 00Z on the 4<sup>th</sup> to remove the cyclone from HURDAT.

### 1952 Storm 2 (Able)

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35280 08/18/1952 M=16 2 SNBR= 780 ABLE          XING=1 SSS=1
35280 08/18/1952 M=17 2 SNBR= 780 ABLE          XING=1 SSS=2
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35285 08/18* 0 0 0 0*146 190 25 0*144 196 25 0*143 198 25 0*
35285 08/18* 0 0 0 0*146 190 25 0*144 196 25 0*143 205 25 0*
          ***

35290 08/19*141 209 25 0*139 215 25 0*137 226 25 0*134 236 25 0*
35290 08/19*141 215 25 0*139 226 25 0*137 237 25 0*134 251 25 0*

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Major track changes and major intensity changes are analyzed for this hurricane which made landfall near Beaufort, SC. A major change is made to the time this cyclone first became a hurricane. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Ross (1952), Sherman and Carino (1952), and Dunn and Miller.

August 18:

HWM analyzes a closed low of at most 1010 mb centered near 14.7N, 18.8W. HURDAT lists this as a 25 kt tropical depression at 14.4N, 19.6W. No gales or low pressures. "The occurrence of hurricane Able was anticipated as much as ten days before a definite tropical disturbance was evident on the weather map. The Hurricane Warning Central, Miami, received a report from a Pan-American Airways plane on 15 August which stated that an apparent closed circulation was observed at 14.0N, 34.0W at about 1000Z. There were at that time no surface weather reports from that vicinity to substantiate that plane report, nor was there enough information on subsequent maps to follow any disturbance that might be traveling across the ocean. Nevertheless, this report on 15 August had all components of the Hurricane Warning Central ready for the outbreak of storm Able" (ATS).

August 19:

HWM analyzes a closed low of at most 1010 mb centered near 13.4N, 23.0W. HURDAT lists this as a 25 kt tropical depression at 13.7N, 22.6W. No gales or low pressures.

August 20:

HWM analyzes a closed low of at most 1010 mb centered near 12.8N, 27.2W. HURDAT lists this as a 25 kt tropical depression at 12.8N, 27.2W. No gales or low pressures.

August 21:

HWM analyzes a closed low of at most 1010 mb centered near 12.5N, 32.1W. HURDAT lists this as a 25 kt tropical depression at 12.3N, 32.1W. No gales or low pressures.

August 22:

HWM analyzes a closed low of at most 1010 mb centered near 12.7N, 36.7W. HURDAT lists this as a 25 kt tropical depression at 12.3N, 36.5W. No gales or low pressures.

August 23:

HWM analyzes a closed low of at most 1010 mb centered near 13.8N, 42.5W. HURDAT lists this as a 25 kt tropical depression at 13.7N, 43.1W. No gales or low pressures.

August 24:

HWM analyzes a closed low of at most 1010 mb centered near 15.6N, 49.2W. HURDAT lists this as a 30 kt tropical depression at 15.8N, 49.1W. No gales or low pressures. "At 2100Z on 24 August, the time cross-section streamline analysis showed a line of divergence passing through Martinique and a backing wind from the NNE to NNW. This

indicated the approach of a cyclonic circulation with a center to the northeast of the station” (ATS).

#### August 25:

HWM analyzes a closed low of at most 1010 mb centered near 17.5N, 56.0W. HURDAT lists this as a 45 kt tropical storm at 18.4N, 57.1W. The MWR post-season track map shows a 12Z position near 19.3N, 58.4W. ATS at 12Z analyzes a closed low of at most 1008 mb centered near 19.1N, 58.7W. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 19.6N, 58.9W. Aircraft highlights: 30-40 kt SE (surface wind estimate by commercial aircraft) at 10Z in the general vicinity of 16N, 54 to 55W (ATS); center fix at 2130Z at 20.0N, 59.0W with 1006 mb central pressure and 40 kt SE max flight-level winds encountered at 20.5N, 58.3W (ATS, micro). “A report was received from an Iberia Airline plane stating that an apparent closed circulation was encountered near 16.0N, 54.0W to 55.0W at 1000Z, and upon deviating to the north a trough line was crossed at about 56.0W. The surface wind in the NE quadrant was estimated to be 30 to 40 kt from the SE. The 1230Z surface map, however, showed indications of a disturbance 260 nmi NW of the plane report. The first Navy reconnaissance flight into the storm substantiated the indications of the surface map. The Navy flight departed San Juan at 1750Z and found a diffuse eye centered near 20.0N, 59.0W at 2130Z. Maximum winds of 40 kt were experienced in the NE quadrant. The lowest pressure was 1006 mb” (ATS). “The first hurricane of the 1952 season was discovered as a slowly developing wave about 600 miles east of Puerto Rico on August 25. During the next several days, aircraft reported it to be a crescent-shaped, partially developed, squally wave, with winds of hurricane force on the northeastern side, but open in the southern semicircle, where winds were only 25 kt” (MWR). “Storm Able originated from a development on a wave in the easterlies. When discovered on August 25, organization of the storm circulation was incomplete. The Miami Weather Bureau Office issued its first advisory for storm Able on August 25, 1952. Navy aerial reconnaissance had reported squally conditions with a poorly defined center located at 20N, 59W” (Ross 1952).

#### August 26:

HWM analyzes a tropical storm of at most 1005 mb centered near 20.4N, 62.3W. HURDAT lists this as a 50 kt tropical storm at 20.6N, 61.4W. The MWR tracks of centers of cyclones shows a 12Z position near 21.0N, 61.7W with a 1011 mb pressure, and the MWR post-season track map shows a 12Z position near 21.3N, 61.9W. ATS at 00Z analyses a tropical storm of at most 1008 mb centered near 20.5N, 60.5W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 20.5N, 62.0W. Ship highlights: 35-40 kt WNW and 1010 mb at 06Z at 18.4N, 63.8W (micro); 35-40 kt E-ESE and 1011 mb at 12Z at 21.6N, 60.6W (HWM, micro); 35-40 kt ESE and 1013 mb at 18Z at 21.5N, 60.3W (micro). Aircraft highlights: center fix at 1408Z at 21.0N, 62.0W with 1007 mb pressure (possibly central pressure) and 50 kt max (flight-level?) winds reported (micro); center fix at 1910Z at 20.2 [or 21.2?]N, 62.5W with 1008 mb pressure (possibly central pressure) and 50 kt (flight-level?) winds reported (micro); 50 kt ENE (at flight-level of 10,700 ft) at 2307Z at 25.8N, 64.8W (micro). “Able continued on the west to west-northwest course and slowly intensified to hurricane force. Early in the day the first microseismic indications of this storm were recorded at Roosevelt Roads, Puerto

Rico, by an increase in the period of microseisms. This was followed by an increase in amplitude at that station some 18 hours later” (ATS).

August 27:

HWM analyzes a tropical storm of at most 1005 mb centered near 22.1N, 65.5W. HURDAT lists this as a 70 kt hurricane at 21.9N, 64.7W with an 1003 mb central pressure. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, and the former shows a 1002 mb pressure. ATS at 12Z analyzes a hurricane of at most 1002 mb centered near 21.8N, 64.3W. Microfilm at 12Z analyzes a tropical storm of at most 1005 mb centered near the HURDAT position. Aircraft highlights: Navy center fix at ~1230Z at 22.0N, 64.6W with 1003 mb central pressure and 80 kt max flight-level wind encountered 105 nmi NNE of center (micro, ATS); Air Force center fixes at 1945Z at 22.3N, 65.2W with 998 mb central pressure (micro, ATS) and 2010Z at 22.2N, 66.2W (micro). “The morning Navy reconnaissance flight reported a maximum wind of 80 kt 105 nmi NNE of the center and a diffuse eye with a minimum pressure of 1003 mb. The most severe weather and the roughest seas were observed in the NE quadrant. The storm was about 220 nmi NNE of San Juan. The Air Force reconnaissance in the afternoon found a minimum pressure of 998 mb, indicating continued deepening of the storm” (ATS). “The first winds of hurricane force, observed by aerial reconnaissance, were reported in squalls located in the northern semi-circle of the storm on August 27” (Ross).

August 28:

HWM analyzes a tropical storm of at most 1005 mb centered near 24.6N, 69.4W. HURDAT lists this as a 75 kt hurricane at 24.7N, 69.8W. The MWR tracks of centers of cyclones shows a 12Z position near 23.4N, 67.9W with a 1002 mb pressure, and the MWR post-season track map shows a 12Z position near 24.4N, 70.0W. ATS at 18Z analyzes a tropical cyclone of at most 1002 mb near 24.7N, 70.0W. Microfilm at 12Z analyzes a tropical storm of at most 1002 mb centered near the HURDAT and HWM positions. Ship highlights: 35 kt E and 1011 mb at 03Z at 25.3N, 69.0W (micro); 40-45 kt SE and 1010 mb at 1930Z at 27.0N, 70.1W (micro); 35 kt ESE and 1015 mb at 21Z at 28.6N, 70.2W (COA). A few other gales around 18Z (micro). Aircraft highlights: center fix (loran) at 1940Z at 25.0N, 70.7W with 1003 mb lowest pressure reported and 50 kt max (flight-level?) wind reported (micro). “The storm changed to a northwest movement and the speed increased from 10 to 16 kt. The winds, however had decreased to 50-55 kt. The streamline analysis indicated that Able was due north of Turks Island at 1830Z. Post analysis showed it to be 225 nmi NNE of Turks Island. During this date, the amplitude of the microseisms began to increase at Guantanamo Bay, Cuba” (ATS).

August 29:

HWM analyzes a tropical storm of at most 1005 mb centered near 27.7N, 75.3W. HURDAT lists this as an 80 kt hurricane at 27.8N, 74.7W. The MWR tracks of centers of cyclones shows a 12Z position near 28.0N, 75.0W with a 999 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 27.7N, 75.7W. Microfilm at 12Z analyzes a tropical storm of at most 999 mb centered near the HWM

position. Ship highlights: 40 kt E and 1015 mb at 00Z at 27.1N, 70.5W (micro); 35 kt SW and 1008 mb at 06Z at 26.1N, 73.3W (COA, micro); 35 kt N and 1008 mb at 12Z at 27.8N, 77.0W (COA, micro); 40 kt SSE and 1012 mb at 15Z at 26.7N, 73.5W (micro). At least three other gales between 35-40 kt. Aircraft highlights: Navy center fixes at 1434 and 1445Z at 27.8N, 75.8W and 27.9N, 75.9W 999 mb central pressure and 80 kt max flight-level winds encountered (micro); center fix at 1646Z at 28.2N, 76.2W with 998 mb central pressure and 70 kt max flight-level winds encountered (micro); Air Force center fix (loran) at 1830Z at 27.7N, 76.2W with 998 mb central pressure (micro); center fix at 2237Z at 28.9N, 77.5W (ATS). “This state of development continued as it moved on a northwest course for about 2,000 miles until the 29<sup>th</sup>, when the first evidence of a more completed organization was observed” (MWR). “Development was slow and until August 29<sup>th</sup>, the southern semi-circle of the storm remained open with observed winds not over 25 kt” (Ross). “At 0600Z, when the microseismic amplitude at Guantanamo Bay had reached the maximum value, the microseismic amplitudes at Jacksonville and Miami begun to increase slowly. At 1830Z, Able was 220 nmi east of Cape Canaveral, FL and was moving WNW at 16 to 18 kt” (ATS). “On 29 August, the microseismic amplitude at Guantanamo Bay had registered a sharp increase [from 0000-0600Z]. At this time, the storm was moving away from Guantanamo. An increase in microseismic amplitude at a station away from which a storm is moving indicates the intensification of that storm, provided the microseisms at that station are caused only by the storm” (ATS).

#### August 30:

HWM analyzes a hurricane of at most 1005 mb centered near 29.6N, 79.6W. HURDAT lists this as an 85 kt hurricane at 29.8N, 79.7W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, and the former shows a 999 mb pressure. ATS at 00Z analyzes a tropical cyclone of at most 1005 mb centered near 28.5N, 77.3W. Microfilm analyzes a low of at most 990 mb centered near the HWM position. Ship highlights: 55 kt ESE and 1008 mb at 00Z at 30.0N, 76.1W (COA, micro); 45 kt WSW and 1004 mb at 06Z at 28.2N, 78.7W (micro); 45 kt S and 1006 mb at 12Z at 29.6N, 78.4W (COA); 45 kt WSW and 1010 mb at 18Z at 29.3N, 80.0W (COA). At least 12 other gales between 35-50 kt. Aircraft highlights: Navy radar center fixes at 0815 and 0852Z at 29.0N, 79.6-79.8W (micro); center fix at 1227Z at 29.6N, 79.4W with 992 mb central pressure and 75 kt maximum (flight-level?) winds (micro, ATS); center fix at 2012Z at 31.7N, 80.0W with 983 mb central pressure and 110 kt maximum flight-level winds (ATS). Other center fixes: Gainesville, FL land-based radar center fixes at 1430 and 1500Z at 29.6-29.7N, 79.3-79.4W (micro). “Navy Radar Reconnaissance was ordered for the night of 29-30 August. Two planes afforded continuous coverage throughout the night. The fixes obtained by the radar planes showed that the storm had slowed and assumed a more northwesterly course. However, the fixes obtained by the second plane (commencing at 0815Z on 30 August) were consistently 40 to 60 nmi west to southwest of the five fixes obtained by the first plane earlier in the evening. These fixes were the first indications of the ‘false’ or secondary eye that characterized the circulation of Able for nearly 12 hours” (ATS). “When it reached the vicinity of 30N, 80W, it turned northward, skirted the Georgia coast, and...” (MWR). “On August 30, 1952, storm Able slowed down in its forward movement. Intensification with the formation of a definite eye took place and indications of recurvature were noted.

The storm at this point was located about 130 miles ESE of Jacksonville, FL. An interesting feature of storm Able, after recurvature took place, was the report of an apparent double eye structure. In a post-flight summary August 30, Navy reconnaissance reported a principal eye of 38 miles diameter and a secondary eye located just a few miles to the southwest of the principle eye” (Ross). “A Navy reconnaissance plane from Miami definitely established the existence of the secondary eye during the morning reconnaissance of this date. By actual penetration the secondary eye was found to exist 35 to 40 miles WSW of the real eye. The morning reconnaissance fix when used with the night radar positions revealed that the storm was now moving in a northwest direction at a speed of 12 to 14 kt and the secondary eye was remaining in the SW quadrant and was paralleling the course of the real eye. The process of general intensification of the storm, the favorable location of the southwest quadrant over the Gulf Stream and the absence of an established strong circulation pattern in the southwest quadrant [previously] evidently induced the formation of the secondary eye. An unusual amount of lightning was observed in this quadrant by the morning penetration flight. As late as 2012Z on 30 August, the presence of the secondary eye in the SW quadrant was verified by Navy reconnaissance. This flight positioned the storm about 60 nmi ESE of Savannah, Georgia, observed a pressure of 983 mb and encountered winds of 110 kt. This reconnaissance, which was the last daytime flight into Able, was the last to observe a secondary eye” (ATS).

August 31:

HWM analyzes a tropical storm of at most 1005 mb centered near 34.1N, 81.4W. HURDAT lists this as a 45 kt tropical storm at 34.4N, 81.0W. The MWR tracks of centers of cyclones shows a 12Z position near 34.5N, 80.7W with a 997 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 00Z analyzes a tropical cyclone of at most 1002 mb centered near 31.8N, 80.4W. Microfilm at 12Z analyzes a low of at most 1002 mb centered near 34.1N, 80.8W. Ship highlights: 40 kt SW and 1005 mb at 06Z at 31.6N, 80.4W (micro); 35 kt S and 1015 mb at 18Z at 32.0N, 78.6W (COA, micro). One other gale of 35 kt. Land/station highlights: lull inside RMW [or calm?] for ten minutes from 0320-0330Z at Beaufort, SC (Ross); 985 mb (min p- uncorrected) at Beaufort (Ross); ~75-80 kt WSW (max w) sometime after 0330Z at Beaufort (ATS, Ross); 55 kt SE (measured max w/1-min) G 68 kt (estimated) at Charleston, SC (climo); 17 kt NW and 999 mb at 12Z at Columbia, SC (climo); 35 kt ESE and 1008 mb at 12Z at Florence, SC (micro); 1002 mb (min p) at Charlotte, NC (climo). One other gale of 35 kt (at Columbia, SC) and at least four other low pressures between 998-1005 mb. Aircraft highlights: radar center fix at 0345Z 10 nmi north of Parris Island (32.4N, 80.7W) (ATS, micro). “...moved inland over South Carolina near Beaufort between 10 and 11 pm, August 30. It was the indirect cause of two deaths in South Carolina, and one death in Pennsylvania, and property damage in the Atlantic States was estimated at \$2,750,000” (MWR). “Again, on August 31 a post-flight summary verified the existence of a secondary eye in the same relative position. This same summary reported maximum winds of 110 kt, the highest winds encountered during the existence of the storm” (Ross). “Continuous coverage of the storm by radar was again accomplished by Navy planes during the night of 30-31 August until about 0345Z when the storm moved inland. The radar planes maintained excellent radar coverage but

found no further traces of a secondary eye. It had no doubt been absorbed into the main circulation of the storm. The radar plane observed a circular eye about 28 nmi in diameter, which became reduced to about 15 nmi at 0152Z, 31 August. Three precipitation bands encircled the eye at distances of 20, 25, and 30 nmi from the center. The eye of Hurricane Able moved inland at Beaufort, SC. The highest winds at that coastal town were 90 mph, occurring just after the passage of the eye. The Hurricane Warning Central, Miami, issued its last warning and advisory at 1600Z this date, when Able was in the vicinity of Charlotte, NC” (ATS). “On August 31, 1952 Navy reconnaissance reported the northwest edge of the storm’s eye over the coastline at 0255Z. By 0345Z, the eye of the storm had moved inland. The following is quoted from the preliminary report on storm Able by Mr. Grady Norton: ‘Beaufort was in the western edge of the calm center with unofficial pressure of 985 mb and strongest wind 80 to 90 mph from WSW after the lull, which lasted about 10 minutes from 10:20 to 10:30 pm (0320 to 0330Z). The strongest wind would be expected on the right on eastern side of the eye, but this was over the marsh and swamplands between Beaufort and Charleston where no measurements were obtainable. At Charleston, about 50 miles to the east of the center, the wind reached 63 mph, while at Savannah, about 30 miles west, the highest gusts were only 35 mph. Damage was estimated at about \$2,200,000 in South Carolina, divided roughly \$500,000 to property, \$200,000 to communications, and \$1,500,000 to crops. The crop damage was mostly to open cotton blown on the ground and damaged. Most of it was salvaged but beating by wind and rain in dirt lowered grade and price. In North Carolina, damage was given as minor, or light. Highest winds over a widespread area of the state ranged around 40 mph and did little damage. A small tornado occurred in connection with the passage of the weakened hurricane in Stokes County and damaged a number of farm buildings. Torrential rains caused flooding of lowlands, and a number of highways were flooded for a short time, and a few small bridges and embankments were washed out. The total actual damage [in North Carolina] probably did not exceed \$50,000. Two persons lost their lives in the hurricane in South Carolina. One man was killed when he tried to remove a live wire that had fallen on his automobile, while another was killed when his car was wrecked in the blinding rain when it struck a tree that had fallen on the highway.’ The storm center was located just to the northeast of Columbia, SC at 1230Z on August 31” (Ross). “In eastern South Carolina, from 10:30 pm on the 30<sup>th</sup> to about noon on the 31<sup>st</sup>, a tropical storm which entered the coast near Beaufort moved northward causing damage from rain and wind mostly in the eastern part of the state as follows: \$500,000 to property; \$200,000 to communications, and about \$1,500,000 to crops, mostly cotton by lowering grades from beating down. There were two fatalities directly attributable to the storm but no injuries were otherwise reported” (South Carolina Monthly Climatological Data Summary). “Center of tropical storm passed a short distance east of station moving north at 7:00 am on the 31<sup>st</sup>” (Columbia, SC Local Monthly Climatological Data). “The tropical storm which passed west of the station on August 31<sup>st</sup> gave a peak gust of wind of 53 mph” (Florence, SC Local Monthly Climatological Data). “This tropical storm center gave Charlotte its lowest pressure of the month when the center passed east of the station just after noon of the 31<sup>st</sup>” (Charlotte, NC Local Monthly Climatological Data). “The remnant of the hurricane of August 31 passed to the west of the station as it continued on its northward course” (Greensboro, NC Local Monthly Climatological Data). “Tropical cyclones in the South

Atlantic States- Carolinas and Georgia – Aug. 30-31 – All sections – minimal – Damage \$3,000,000 S.C.” (“Minimal” is equivalent to winds of 74-100 mph and pressure 983 to 996 mb- Dunn and Miller)

#### September 1:

HWM analyzes a tropical storm of at most 1005 mb centered near 39.9N, 77.3W. A NNE-SSW cold front is plotted several hundred nmi west of the low and the SSE end of a NNW-SSE warm front is located a couple hundred nmi ENE of the cyclone. HURDAT lists this as a 35 kt tropical storm at 39.3N, 77.1W. The MWR tracks of centers of cyclones last shows a position at 00Z near 37.0N, 79.9W. The MWR post-season track map shows a 12Z position near 39.0N, 77.1W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 39.7N, 77.1W. Land/station highlights: 39 kt SE (max w/1-min) at Richmond, VA (climo); 49 kt SE (max w/1-min) at Washington, DC (climo); 12 kt SSW and 1004 mb at 12Z at Washington, DC (climo); 49 kt W (max w/1-min) at Baltimore, MD (climo); 36 kt E (max w/1-min) at Philadelphia, PA (climo); 59 kt SE (max w/1-min) at Atlantic City, NJ (climo); 60 kt SE (max w/1-min) at New York City, NY (climo); 35 kt SSE (max w/1-min) at Blue Hill, MA (climo). One other gale of 35 kt at Reading, PA. “[Around 1230Z on 1 September] the center had moved to Frederick, MD. The storm in the Washington, DC area was attended by winds 35 to 40 mph with occasional gusts up to 50 mph. The peak gust reported at Washington National Airport was 60 mph. A small tornado did considerable damage to dwellings at Franconia, VA, in Fairfax County. A tornado, which may have been the same one also struck with destructive force at Potomac, MD. Rainfall was heavy, ranging from 2 to over 3 inches. Property damage done in the area was estimated to be in excess of \$500,000, caused primarily by flooding and the destructive force of the tornado. Falling trees and branches disrupted power and telephone facilities. There were no reports of personal injuries” (Ross).

#### September 2:

HWM analyzes a closed low of at most 1005 mb centered near 44.5N, 70.3W. A larger, more powerful extratropical cyclone of at most 995 mb is centered near 57.5N, 76.5W and fronts extends southward from this low to the vicinity of Able. HURDAT lists this as a 25 kt tropical depression at 43.7N, 70.4W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 44.4N, 69.9W with an approaching NNE-SSW cold front located about 375 nmi west and northwest of the cyclone. Land/station highlights: 25 kt NNE and 1004 mb at 00Z at Albany, NY (micro); 30 kt W (max w/1-min) at Hartford, CT (climo); 10 kt S and 1003 mb at 12Z at Portland, ME (micro, climo); 24 kt S (max w/1-min) at Eastport, ME (climo); 6 kt E and 1004 mb at 18Z at Caribou, ME (micro). At least seven other low pressures between 1003-1005 mb. “After leaving the Washington area, the storm moved up into the New England states and was centered just to the northwest of Portland, ME at 1230Z, September 2. It was in this area that the storm finally lost its closed circulation and dissipated. Pennsylvania, New York, and the New England states experienced winds of 30 to 40 mph, with gusts to 50 mph with the passage of the storm” (Ross). “Able continued on a NNE course and remained an identifiable storm until 3 September. It continued weakening throughout its passage over land; however, strong winds and precipitation remained with the storm until it reached

the Canadian border. Able finally disappeared on 3 September in New Brunswick, Canada” (ATS).

### September 3:

HWM analyzes a closed low of at most 995 mb centered near 59N, 67W, but this low is likely a combination of a separate extratropical system (which had been approaching from the west) and the remnants of Able. HURDAT no longer lists a system on this day. Microfilm at 00Z no longer analyzes a closed low associated with Able but analyzes an approaching extratropical cyclone centered near 48N, 75W at 00Z. Ship highlights: missing wind speed SSW and 1003 mb at 06Z at 47.9N, 63.2W (COA). Land/station highlights: 7 kt NW and 1004 mb at 00Z at Caribou, ME (climo, micro); 10 kt SSW and 1004 mb at 00Z at Moncton, New Brunswick, Canada (46.2N, 64.8W) (micro).

Able formed from a tropical wave which emerged off the African coast late on 17 August or early on 18 August. HURDAT starts this system soon after it emerged off of Africa at 06Z on 18 August as a 25 kt tropical depression at 14.6N, 19.0W. HURDAT keeps this system at tropical depression intensity through 12Z the 24<sup>th</sup>, with a previous HURDAT position of 15.8N, 49.1W on the 24<sup>th</sup>. There is no concrete evidence that there was in fact a closed circulation present from the 18<sup>th</sup> through the 23<sup>rd</sup>. From the 20<sup>th</sup> to the 23<sup>rd</sup>, there are no observations within 400 nmi of the system. There is also not enough evidence that there was not a closed circulation, so a tropical depression is maintained. No changes are made to the timing of genesis, and no intensity changes are analyzed from the 18<sup>th</sup> through the 24<sup>th</sup>. On the 19<sup>th</sup>, a couple of observations in the vicinity of the system suggest that the position was likely a degree further west. The next observation to aid in the position analysis is a 10 kt SSE wind on 24 August at 12Z on HWM at 16.8N, 53.6W. This observation, if accurate, indicates that the system that was to become Able was centered west of that ship. A position of 17.0N, 54.8W is analyzed for 12Z on the 24<sup>th</sup> (originally 15.8N, 49.1W- a major track change). Major westward track adjustments are assessed at all times from 06Z on the 20<sup>th</sup> through 00Z on the 25<sup>th</sup>. Westward track adjustments of 5 to 7 degrees longitude are made from 18Z on the 21<sup>st</sup> through 12Z on the 24<sup>th</sup>. The first aircraft reconnaissance flight reached the system at 2130Z on the 24<sup>th</sup> and measured a 1006 mb central pressure with 40 kt maximum flight-level winds. The 1006 mb central pressure in HURDAT at 00Z on the 26<sup>th</sup> is retained. A central pressure of 1006 mb yields 35 kt according to the Brown et al. southern pressure-wind relationship and 35 kt is chosen at 18Z on the 25<sup>th</sup> and 00Z on the 26<sup>th</sup> (down from 45 and 50 kt respectively). No change is made to the timing of when the system became a tropical storm (18Z on the 24<sup>th</sup>) because there is no evidence to do so. A 35 kt intensity is chosen for 18Z on the 24<sup>th</sup> through 00Z on the 26<sup>th</sup>. That fix late on the 25<sup>th</sup> along with other observations indicates that the HURDAT position was less than one degree too far to the ESE. From August 26<sup>th</sup> through 29<sup>th</sup>, Able moved west-northwestward from north of the northernmost Leeward Islands to north of the Bahamas. All track changes from the 26<sup>th</sup> through the 29<sup>th</sup> are less than one degree changes, and all analyzed positions are within two-tenths of a degree of interpolated aircraft reconnaissance fixes, which are plentiful those days. On the 26<sup>th</sup>, aircraft reconnaissance measured central pressures of 1007 and 1008 mb on the morning and afternoon flights respectively, and these values are added to HURDAT at 12 and 18Z on the 26<sup>th</sup>. There were a few 35 to 40 kt ship observations on

the 26<sup>th</sup>, so intensities of 40 kt are analyzed from 06Z through 18Z on the 26<sup>th</sup> (down from 50, 50, and 55 kt respectively). On the 27<sup>th</sup> at 12Z, aircraft reconnaissance measured a central pressure of 1003 mb and at 1945Z, a 998 mb central pressure was measured by an Air Force reconnaissance plane. The 1003 and 998 mb pressures in HURDAT at 12 and 18Z respectively are retained. These pressures yield 41 and 51 kt respectively according to the southern pressure-wind relationship. Intensities of 45 and 50 kt are chosen for 12 and 18Z on the 27<sup>th</sup> (down from 70 kt originally- major intensity changes at both times). On the 28<sup>th</sup> at 1940Z, aircraft reconnaissance measured a central pressure of 1003 mb, and this value is added to HURDAT at 18Z on the 28<sup>th</sup>. A central pressure of 1003 mb yields 41 and 38 kt according to the southern and north of 25N pressure-wind relationship respectively. The 50 kt intensity chosen for 18Z on the 27<sup>th</sup> is maintained through the 28<sup>th</sup> and into the 29<sup>th</sup> (75 kt originally at all times on the 28<sup>th</sup> and early on the 29<sup>th</sup>- major downward intensity adjustments). Aircraft central pressures of 999 and 998 mb were observed on the 29<sup>th</sup> between 1434Z and 1830Z. A central pressure of 999 mb is added to HURDAT at 12Z on the 29<sup>th</sup> and 998 mb is added at 18Z. A central pressure of 998 mb yields 47 kt according to the north of 25N pressure-wind relationship. Visual observations indicate the RMW was smaller than the climatological value, and 55 kt is the analyzed intensity at both 12 and 18Z on the 29<sup>th</sup> (down from 80 kt originally at both times). Early on the 30<sup>th</sup>, Able was moving west-northwestward in the direction of Jacksonville, or the Georgia coast, but the cyclone made a north-northwestward turn late on the 30<sup>th</sup>. On the 30<sup>th</sup>, surveillance by aircraft radar, land-based radar located in Gainesville, FL, and aircraft penetrations allowed for a relatively accurate track and intensity analysis on this day as Able moved closer to the US coastline. On the 30<sup>th</sup> at 00Z, the position is adjusted seven-tenths of a degree south of the previous HURDAT position, which is in agreement with aircraft fixes at 1830Z on the 29<sup>th</sup> and 0815Z on the 30<sup>th</sup>. The 12Z and 18Z positions on the 30<sup>th</sup> are very close to previous HURDAT positions. At 00Z on the 30<sup>th</sup>, a ship observed 55 kt winds, and a 60 kt intensity is chosen for HURDAT (down from 80 kt originally). Aircraft reconnaissance measured central pressures of 992 and 983 mb on the 30<sup>th</sup> at 1227 and 2012Z respectively, and these central pressures are added to HURDAT at 12 and 18Z respectively on the 30<sup>th</sup>. A central pressure 992 mb yields 59 kt according to the intensifying subset on the north of 25N pressure-wind relationship and 983 mb equals 72 kt according to the same subset. Intensities of 65 and 75 kt are chosen for 12 and 18Z on the 30<sup>th</sup> (down from 85 kt at both times). Able is analyzed to have become a hurricane 66 hours later than in HURDAT originally- a major change. Major downward intensity adjustments of 20 to 25 kt are analyzed at all times from the 27<sup>th</sup> at 12Z through the 30<sup>th</sup> at 12Z. In addition to observations that indicate these adjustments are necessary, written commentary indicates that the cyclone was weak and not fully developed until soon before landfall (which occurred on the 31<sup>st</sup> of August).

Hurricane Able made landfall near Beaufort, SC on 31 August at 03Z at 32.3N, 80.6W. The city of Beaufort was located inside the left RMW of Baker as it made landfall. Beaufort experienced a lull for ten minutes from 0320-0330Z. Highest observed winds at Beaufort were ~75-80 kt after the lull. Lowest observed pressure at Beaufort was 985 mb. There was a comment that this pressure observation was an unofficial observation, but sources indicate that the wind was a measured wind and was not a gust. There is

evidence that the eye of Able was contracting prior to landfall. HURDAT previously listed a 90 kt intensity at 00Z on the 31<sup>st</sup>. Observations indicate that the central pressure at landfall was likely in the ballpark of 980 mb, which yields 76 kt according to the intensifying subset of the north of 25N pressure-wind relationship. In a quote from Ross (1952), which quotes Grady Norton in what is likely either a personal communication or a post-season summary article that is unavailable, Norton believes that the strongest winds at landfall were not measured since the right RMW made landfall over a swampy marsh area between Beaufort and Charleston that was very sparsely populated. An 85 kt intensity is chosen for 00Z on the 31<sup>st</sup> (down from 90 kt originally) and landfall. In addition to the evidence just mentioned for decreasing the landfall intensity, this cyclone is not listed in the Ho et al. study (this study lists U.S. Landfalling hurricanes with central pressures below 983 mb). A category 2 impact is analyzed for South Carolina. No hurricane impact is analyzed for Georgia (the highest gusts at Savannah failed to reach tropical storm force). Although track adjustments of one-tenth of a degree were made at 00 and 06Z, the landfall point is nearly identical to the interpolated previous landfall point. Later on the 31<sup>st</sup>, Able passed just east of Columbia, SC and turned northward into central North Carolina. Able passed just west of Washington, D.C. a little before 12Z on 1 September. Then the cyclone moved over extreme eastern Pennsylvania, northwestern New Jersey, southeastern New York, Connecticut, Massachusetts, New Hampshire, and Maine, where it was located by 12Z on the 2<sup>nd</sup>. Runs of the Kaplan and DeMaria Inland Decay Model yield 65, 45, and 35 kt for 06, 12, and 18Z respectively on 31 August. The highest observed winds within 2 hr of the synoptic times are 40, 35, and 31 kt at 06, 12, and 18Z respectively. Revised intensities in HURDAT are 65, 45, and 40 kt (originally 70 kt at 06Z and no change at 12 and 18Z on the 31<sup>st</sup>). On 1 September, Able was still a tropical storm. The cyclone reintensified as a tropical storm, and tropical storm force winds (1-min avg) were reported from numerous official Weather Bureau stations including Richmond, VA (39 kt); Washington, D.C. (49 kt); Baltimore, MD (49 kt); Reading, PA (35 kt); Philadelphia, PA (36 kt); Atlantic City, NJ (59 kt); New York City, NY (60 kt); and Blue Hill, MA (35 kt). Analyzed intensities on the 1<sup>st</sup> are 40, 45, 50, and 60 kt (originally 40, 35, 35, and 30 kt) at 00, 06, 12, and 18Z respectively (a major 30-kt upward intensity adjustment at 18Z on 1 September). After 1 September, no more gales were recorded in association with Able. The highest winds recorded early on the 2<sup>nd</sup> were 30 kt in Connecticut. Intensities of 45 and 30 kt are chosen for 00 and 06Z on the 2<sup>nd</sup> respectively (up from 30 and 25 kt originally). Able is analyzed to have weakened to a tropical depression 12 hours later than shown in HURDAT originally. The following states are analyzed to have received tropical storm impacts from Able: North Carolina, Virginia, Maryland, Pennsylvania, New Jersey, New York, Connecticut, and Massachusetts. There is a chance that tropical impacts could have also occurred in portions of Georgia, Rhode Island, Vermont, New Hampshire, and Maine, but tropical storm impacts are not analyzed for those states. The last point listed in HURDAT, at 18Z on 2 September, is as a 25 kt tropical depression just inland over southeastern Maine. Although the HURDAT position at 12Z was barely adjusted, available observations indicate that Able was located more than one degree northeast of the previous HURDAT position at 18Z (still over Maine but approaching the border of New Brunswick, Canada). Observations indicate that Able was still a tropical depression through at least 00Z on the 3<sup>rd</sup>, and maybe after 06Z on the 3<sup>rd</sup> as well. Observations show that Able was absorbed

by an extratropical low before 12Z on the 3<sup>rd</sup>. Dissipation is analyzed to have occurred 12 hours later. The final point is now shown to be at 06Z on 3 September as a 20 kt tropical depression at 48.5N, 63.5W.

Additional quotes:

MWR: “[Able] moved into South Carolina late on August 30, and advanced northward over the Atlantic Plain to die out over New England on September 2. Property and crop damage in the states affected has been estimated at \$2,750,000, a very low damage figure. This hurricane was small and not unusually severe, but it had a small area of winds near 100 mph when it moved inland near Beaufort, SC. The strongest winds occurred over a swampy area between Beaufort and Charleston, where there were few inhabitants and little property exposed” (MWR).

Ross: “Storm Able, although never really developing into a large storm over the ocean maintained its circulation and identity as a tropical storm over a long land trajectory. Two important features can account for this. First, since the trajectory remained east of the Appalachian Mountains, the storm’s circulation was not distorted appreciably by the terrain. Secondly, and of perhaps greater importance, the general circulation over the eastern seaboard, prior to and during the time storm was inland, was characterized by southerly flow bringing warm moist tropical air into the area. The dew point temperatures ranged in the 70s as far north as New York City. The tropical maritime area supplied the energy required by the storm to maintain itself” (Ross).

ATS:

“Able (Aug 24- Sep 3): Number of warnings [advisories] issued: 24; Number of reconnaissance flights: 14 in total- 8 by Navy WoaRon 2, 4 by Air Force, 2 by Navy radar (Faetulant); maximum velocity reported: 110 kt; minimum pressure reported: 983 mb; number of days Able was hurricane force: 4; originated: Atlantic

Able: First suspected: 8/15 1000Z – A PAA plane reported a closed circulation at 14N, 34W. First recon fix on closed circulation: 8/25 2130Z, 20N, 59W, 1006 mb, 40 kt. First advisory: 8/26 0200Z” (ATS).

Malkin and Galway (1953): “Three tornadoes occurred in connection with Hurricane Able [1952] as it moved northward during the night and early morning of August 31-September 1, 1952. The first occurred the evening of the 31<sup>st</sup> in Stokes County, NC. The other two struck the morning of the 1<sup>st</sup> at Franconia, VA at 0330 GMT and Potomac, MD at 0400 GMT. Potomac is 11 miles northwest of Washington, D.C., and Franconia is 10 miles west-southwest of Washington. The tornado at Potomac could have been the same one which struck Franconia, for it moved toward the north-northwest. Details are available only for the Franconia tornado. Its path was surveyed on September 1 by a group of several meteorologists who agreed unanimously that there was positive evidence of a tornado having occurred” (Malkin and Galway). From a footnote in the Malkin and Galway paper... “According to the intensity limits now in general use, Able, at the time of the Franconia tornado, should be classed as a tropical storm rather than a hurricane, the

maximum surface wind being over Beaufort 6, but under Beaufort 12" (Malkin and Galway).

### 1952 Storm 3 (new to HURDAT)

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35370 08/27/1952 M= 2 3 SNBR= 781 NOT NAMED XING=1
35420 08/27* 0 0 0 0* 0 0 0 0* 0 0 0 0*322 776 50 0*
35420 08/28*333 782 50 0*344 795 40 0*357 810 30 0*375 823 20 0*
35275 TS
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#### US Landfall:

08/28/1952 02Z 33.7N 78.7W 50 kt

HWM, microfilm, COADS, the MWR tracks of lows, climatological data summaries from NCDC, and Jack Beven's list of suspects indicate that a tropical storm, previously undocumented in HURDAT, made landfall near the South Carolina/North Carolina border with a 50 kt intensity on 28 August, 1952.

#### August 26:

HWM analyzes a warm front lying through an open trough plotted from 33N, 65W to 32N, 70W to 29N, 73W to 26N, 75W becoming a stationary front at 24N, 79W and continuing westward. HURDAT did not previously list this system. Microfilm at 12Z analyzes a NE-SW front lying through a trough from 32N, 67W to 29N, 73W to 27N, 79W.

#### August 27:

HWM analyzes a closed low of at most 1010 mb centered near 29.7N, 76.2W with a stationary front running right through the low extending from 23N, 82W to 25N, 78W to the low, becoming a warm front at 32N, 76W, extending to 34N, 74W to 35N, 71W becoming a stationary front at 34N, 66W and extending eastward. The MWR tracks of centers of cyclones shows a 12Z position near 30.9N, 76.8W with a 1002 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near the HWM position with a front extending from the low east-northeastward to 32N, 71W and another front extending from the low south-southwestward to 25N, 79W turning westward to beyond 24N, 83W. Ship highlights: 60 kt NNW and 1003 mb at 18Z at 32.2N, 78.2W (COA); 35 kt NNE and 1003 mb at 18Z at 32.4N, 77.9W (COA); 40 kt E and 1009 mb at 18Z at 33.2N, 76.9W (COA). Four other gales and one other low pressure.

#### August 28:

HWM analyzes a closed low of at most 1015 mb centered inland near 34.8N, 81.3W. A dissipating stationary front is analyzed running through the low and the front becomes a stationary front just NE of the low extending eastward. The MWR tracks of centers of cyclones shows a 00Z position near 33.4N, 78.1W and a 12Z position inland near 35.3N, 80.4W with a 1008 mb pressure. Microfilm at 00Z analyzes a closed low of at most 1002 mb centered near 33.3N, 78.3W with no fronts analyzed. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 35.4N, 81.0W. Ship highlights: 35 kt S and 1007 mb at 00Z at 32.9N, 77.5W (COA); 35 kt ESE and 1013 mb at 06Z at 33.9N,

76.7W (COA). Land/station highlights: 45 kt SE and 1004 mb at 00Z at 33.5N, 77.5W (micro); 30 kt NNE and 1003 mb at Myrtle Beach, SC at 00Z (micro); 31 kt NE (max w/1-min) at Wilmington, NC (climo); 30 kt ESE and 1002 mb at 06Z at Charlotte, NC (micro). From the North Carolina Monthly Climatological Data Summary... "Outstanding features of the month's weather were the two tropical storms which passed across the state during the last four days [of the month]. The first was a small storm which moved inland near the North Carolina-South Carolina line on the 28<sup>th</sup>, and passed rapidly northwestward across North Carolina" (climo). "The fine, sunny weather of the 24<sup>th</sup>-26<sup>th</sup> was cut short by the rapid growth of a tropical storm off the coast of Florida. This storm moved into the coast of the North Carolina-South Carolina line on the evening of the 27<sup>th</sup>, sped across Piedmont North Carolina, and died out in the hills of Kentucky and West Virginia. Neither of the storms during the final week of August brought any general destructive winds to North Carolina. Most of the damage results from the tropical storms of late August was caused by washouts of highway bridges..." (August, 1952 North Carolina Monthly Climatological Data Summary). From the South Carolina Monthly Climatological Data Summary... "A high proportion of the total rain in the eastern portion of South Carolina fell during the last week when two storms, one an extratropical one and the other a tropical storm, entered the section from the Atlantic Ocean" (climo). "A low pressure area which originated off the coast of Florida moved into the coast of South Carolina on the 27<sup>th</sup> and caused rainy weather with normal temperatures through the 28<sup>th</sup>" (August, 1952 South Carolina Monthly Climatological Data Summary).

#### August 29:

HWM no longer analyzes a closed low, but analyzes a cold front extending from 50N, 68W southwestward to 45N, 78W becoming a stationary front at 42N, 84W extending to 41N, 91W. Microfilm last analyzes a closed low at 00Z of at most 1014 mb centered near 39.6N, 85.0W.

On 26 August, synoptic weather maps analyze a front running through a trough just north of the Bahamas. However, 12Z temperatures were all warm on both sides of the front. An area of some cyclonic turning was located near 29N, 72.5W on the 26<sup>th</sup>, but there was not yet a closed circulation present. Winds on the 26<sup>th</sup> and into the 27<sup>th</sup> were mainly unidirectional on each side of the front in most locations. By 12Z on the 27<sup>th</sup>, distinct pressure falls were noted and the first gale was observed in the vicinity of 31-32N, 76-78W. There is not yet enough evidence to close off a circulation at 12Z on the 27<sup>th</sup>. At 18Z on the 27<sup>th</sup>, there are numerous gale and low pressure observations surrounded by high environmental pressure on all sides. Although there are no observations of west winds south of a likely center position of a tropical cyclone, this system is started at 18Z on 27 August as a 50 kt tropical storm at 32.2N, 77.6W. Although the highest observed wind was 60 kt, there were two other 35 kt observations very close to this ship reporting 60 kt, so a 50 kt intensity is analyzed (it should be noted that the ship reported 15 kt winds at subsequent times which fit in and looked correct). The lowest observed pressure so far was 1003 mb. A closed circulation likely existed by this time because of the large pressure gradient that existed. The winds around the low were no longer unidirectional. By 00Z on 28 August, observations south of the center confirm the closed, symmetric

wind circulation. There was no temperature gradient across the cyclone, and gales coincided with low pressures near the center. At 00Z, Myrtle Beach recorded 30 kt winds with a 1003 mb pressure and a station recorded 45 kt with 1003 mb also. The position of the 50 kt tropical storm at 00Z on the 28<sup>th</sup> is 33.3N, 78.2W. The cyclone made landfall at 02Z on 28 August as a 50 kt tropical storm between Myrtle Beach and the North Carolina-South Carolina border at 33.7N, 78.7W. There are no available observations of gale force winds from any coastal station. The highest wind at Wilmington was 31 kt (1-min) and the highest available 6-hourly wind at Myrtle Beach was 30 kt at 00Z on the 28<sup>th</sup> (micro). There is no station observation information available from the NCDC climatological data summaries for any locations on the coast between Charleston, SC and Wilmington, NC. It was stated that this storm was small. A tropical storm impact is analyzed for South Carolina and North Carolina. At 06Z on the 28<sup>th</sup>, Charlotte, NC recorded 30 kt with 1002 mb and the analyzed position is 34.4N, 79.5W as a 40 kt tropical storm. It is analyzed that the tropical storm weakened to a tropical depression by 12Z on the 28<sup>th</sup> at 34.9N, 81.0W. The cyclone continued inland and reached the mountains of West Virginia and Kentucky by 18Z. The final position is listed at 18Z on the 28<sup>th</sup> as a 20 kt tropical depression at 38.1N, 82.3W.

#### 1952 Storm 4 (Baker) – (originally Storm 3)

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35370 08/31/1952 M=10 3 SNBR= 781 BAKER      XING=0
35370 08/30/1952 M=12 4 SNBR= 781 BAKER      XING=0
      **          ** *
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(The 30th is new to HURDAT.)

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35420 08/30* 0 0 0 0* 0 0 0 0* 0 0 0 0*140 515 40 0*
35375 08/31* 0 0 0 0*167 584 60 0*173 587 60 0*178 590 60 0*
35375 08/31*147 527 45 0*154 539 50 0*161 551 55 0*168 563 60 0*
      *** *** **      *** *** **      *** *** **      *** ***
35380 09/01*182 593 65 0*186 595 70 1003*190 598 75 0*199 603 80 1003*
35380 09/01*175 575 60 0*182 587 60 1003*191 597 60 0*201 605 65 996*
      *** *** **      *** *** **      *** *** **      *** *** **
35385 09/02*210 610 85 0*219 619 90 0*228 630 95 0*237 642 95 0*
35385 09/02*211 612 65 0*220 621 70 0*228 630 70 993*237 642 65 0*
      *** *** **      *** *** **      *** *** **      *** **
35390 09/03*245 653 100 0*252 664 100 0*259 674 100 993*268 684 105 0*
35390 09/03*245 653 65 0*252 663 65 0*259 671 65 993*265 680 65 993*
      ***      *** ***      *** ***      *** ***      *** *** ***
35395 09/04*277 694 105 0*287 702 105 0*297 707 105 0*307 711 105 0*
35395 09/04*274 690 65 0*284 698 70 0*295 704 70 0*307 707 70 983*
      *** *** ***      *** *** ***      *** *** ***      *** *** ***
35400 09/05*316 713 105 0*324 712 105 0*330 710 105 0*335 706 100 0*
35400 09/05*316 709 70 0*322 711 70 0*327 712 70 0*331 710 70 983*
      *** ***      *** *** ***      *** *** ***      *** *** ***
35405 09/06*339 702 100 0*343 699 100 0*348 696 95 981*358 686 95 0*
35405 09/06*334 707 75 0*337 704 75 0*343 697 75 981*351 690 80 978*
      *** *** ***      *** *** ***      *** *** **      *** *** **
35410 09/07*369 671 90 0*380 657 85 0*390 640 80 0*404 611 75 969*
35410 09/07*362 679 90 0*376 660 95 0*389 635 95 0*404 601 95 969*
      *** ***      *** *** **      *** *** **      *** **
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35415	09/08*425	574	70	0*456	517	65	0E478	493	60	0E500	477	55	0*
35415	09/08E425	564	90	0E454	523	85	0E480	489	80	0E500	473	75	0*
	*	***	**	****	***	**	***	***	**	***	***	**	
35420	09/09E520	470	50	0E539	465	50	0E558	459	45	0E576	458	45	0*
35420	09/09E518	470	75	0E538	460	75	0E558	450	70	0E570	440	55	0*
	***	**		***	***	**	***	**		***	***	**	

(The 10th is new to HURDAT.)

35420	09/10E577	430	45	0*	0	0	0	0*	0	0	0	0	0*
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35425 HR

Major track and major intensity adjustments are made to this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Carino (1953).

#### August 30:

HWM does not analyze any features of interest on this day. HURDAT does not yet list a system on this day. Ship highlights: E wind and 1004 mb at 18Z at 14.5N, 50.3W (COA).

#### August 31:

HWM analyzes a spot low near 16.3N, 55.3W. HURDAT lists this as a 60 kt tropical storm at 17.3N, 58.7W. The MWR post-season track map shows a 12Z position near 17.8N, 58.6W. ATS at 18Z analyzes a closed low of at most 1011 mb centered near 19.1N, 58.7W. No gales or low pressures. "Martinique, French West Indies, gave the first indication of the presence of Hurricane Baker, which was forming in the general area that had been the breeding grounds of Able. The Time-Cross-Section streamline analysis showed a neutral point passing Martinique at 1700Z on 31 August, which indicated the presence of a vortex northeast of that station. Post analysis of the 1830Z map placed the vortex about 375 nmi NNE of Martinique. The actual cyclonic circulation of the storm did not affect Martinique" (ATS).

#### September 1:

HWM analyzes a tropical storm of at most 1010 mb centered near 18.2N, 58.7W. HURDAT lists this as a 75 kt hurricane at 19.0N, 59.8W. The MWR post-season track map shows a 12Z position near 18.9N, 60.2W. ATS at 12Z analyzes a tropical cyclone of at most 1005 mb centered near 20.5N, 60.4W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 19.6N, 60.5W. Ship highlights: 35 kt E and 1017 mb at 03Z at 18.7N, 58.7W (ATS); 35 kt E and 1012 mb at 06Z at 18.6N, 58.6W (micro); 45 kt S and 1001 mb at 17Z at 19.7N, 60.0W (ATS, micro); 50 kt ESE and 1002 mb at 18Z at 20.7N, 60.2W (COA). Two other gales of 50 kt. Aircraft highlights: possible Navy center fix at 1828Z at either 19.8N, 61.0W or 21.0N, 61.0W with 1003 mb (likely peripheral) lowest pressure encountered and 80 kt maximum flight-level winds encountered (micro); 1003 mb at 20.0N, 61.2W (micro); 80 kt (flight-level) at 2000Z at 22.0N, 60.0W (micro). "The Norwegian S. S. *Fridtjof Nansen* located at 18.8N, 58.8W in the early morning of September 1 sent a special report as follows: 'Wind easterly force 7 to 8 in squalls, sea 5 increasing, barometer 30.02 inches at 0300Z, 29.90 at 0400Z. Fear tropical storm and have altered course to 70 degrees 8 kt at 0400Z, after which

barometer steady at 29.90 inches.’ This report was the first indication of the development of the second hurricane of the season. Reconnaissance aircraft dispatched to search later on the 1<sup>st</sup>, found that the storm had developed winds of hurricane force on its northern and eastern sides and was increasing and moving on a northwesterly course” (MWR). “Ship reports and the first Navy reconnaissance, which staged from San Juan, definitely established the existence of a hurricane near 21.0N, 61.0W. The issuing of... advisories by the Fleet Weather Central, Miami, and the Weather Bureau Office, San Juan, began at 2015Z. The initial movement of the storm was WNW to NW at 10 to 12 kt” (ATS).

#### September 2:

HWM analyzes a hurricane of at most 995 mb centered near 23.3N, 63.4W. HURDAT lists this as a 95 kt hurricane at 22.8N, 63.0W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, and the former shows a 993 mb pressure. ATS at 06Z analyzes a tropical cyclone of at most 1002 mb centered near 22.3N, 62.5W. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near the HURDAT position. Aircraft highlights: Navy center fix at 1215Z at 22.8N, 63.0W with 993 mb central pressure and 130 kt maximum flight-level winds (ATS, micro); center fix at 1905Z at 24.2N, 64.8W with 996 mb (probably central pressure) and 100 kt max wind estimate (micro); 996 mb at 24.2N, 64.8W (micro); 100 kt E at 24.8N, 64.6W (micro). “A Navy reconnaissance flight, entering the eye of Baker at 1215Z, reported maximum winds of 130 kt showing that the hurricane’s intensity has increased considerably” (ATS).

#### September 3:

HWM analyzes a hurricane of at most 1000 mb centered near 25.5N, 67.0W. HURDAT lists this as a 100 kt hurricane at 25.9N, 67.4W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, and the former shows a 993 mb pressure. ATS at 12Z analyzes a tropical cyclone of at most 999 mb centered near 25.7N, 66.6W. Microfilm at 12Z analyzes a closed low of at most 990 mb centered near the HURDAT position. Aircraft highlights: Navy center fix at 1430Z at 26.1N, 67.4W with 993 mb central pressure (ATS, micro); Air Force center fix (loran) at 2017Z at 26.5N, 68.4W with 993 mb central pressure (micro); 90-130 kt estimated maximum wind range on this day from Navy and AF (ATS). “At 1030Z, Baker was about 340 nmi NE of Turks Island and was still moving NW at a speed of about 12 kt. Reconnaissance flights into the storm by both Navy and Air Force planes encountered hurricane-force winds which varied between 90 and 130 kt. The Navy flight found the eye still poorly defined although the minimum pressure was 993 mb and the hurricane itself was fully formed. Recurvature of Baker commenced late this day when the hurricane was about 640 nmi east of Miami, FL, and about 500 nmi NNW of San Juan, PR” (ATS).

#### September 4:

HWM analyzes a hurricane of at most 1000 mb centered near 29.4N, 70.7W. A NE-SW stationary front is plotted from 37N, 67W becoming a dissipating front at 33N, 73W, becoming a cold front at 30N, 78W becoming a warm front at 28N, 83W extending to beyond 27N, 85W. HURDAT lists this as a 105 kt hurricane at 29.7N, 70.7W. The

MWR tracks of centers of cyclones shows a 12Z position near 29.0N, 71.3W with a 990 mb pressure, and the MWR post-season track map shows a 12Z position near the HWM and HURDAT positions. ATS at 18Z analyzes a tropical cyclone of at most 1002 mb centered near 30.4N, 70.6W with the SW end of a NE-SW cold front located NNE of the cyclone near 35N, 68W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 29.9N, 70.4W with a frontal analysis similar to the HWM analysis. Ship highlights: 35 kt SE and 1012 mb at 15Z at 31.5N, 68.2W (micro); 35 kt ENE and 1011 mb at 18Z at 33.2N, 70.3W (micro); 40 kt SE and 1015 mb at 18Z at 31.4N, 67.7W (micro). Aircraft highlights: Air Force center fix (loran) at 1822Z at 30.8N, 70.6W with 983 mb central pressure and estimated surface winds of 100 kt (micro); Air Force center fix (loran) at 2117Z at 30.9N, 70.7W with a 700 mb height in the center of 9,778 ft (micro); 60 kt (surface estimate) at 2130Z at 31.5N, 69.9W (micro).

#### September 5:

HWM analyzes a hurricane of at most 995 mb centered near 32.7N, 71.3W with the west end of a W-E warm front located 300 nmi NE of the hurricane and the east end of a E-W cold front located 225 nmi SW of the hurricane. HURDAT lists this as a 105 kt hurricane at 33.0N, 71.0W. The MWR tracks of centers of cyclones shows a 12Z position near 33.1N, 71.8W with a 990 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 999 mb centered near 32.3N, 70.9W. Microfilm at 12Z analyzes a tropical storm of at most 987 mb centered near the HURDAT position with the ENE end of a ENE-WSW front located a short distance SW of the cyclone. Ship highlights: 40 kt NNE and 1010 mb at 00Z at 33.0N, 70.5W (micro); 45 kt SE and 1013 mb at 18Z at 33.7N, 68.4W (COA, micro); 35 kt SW and 1004 mb at 21Z at 31.8N, 69.7W (COA). Four other gales between 35-40 kt and one other low pressure of 1004 mb. Aircraft highlights: Navy center fix (loran) at 1618Z at 33.0N, 71.2W with 983 mb central pressure and 90 kt max winds (micro); 90 kt and 996 mb at 1700Z at 33.5N, 71.8W (micro); Air Force center fix (loran) at 2005Z at 33.1N, 70.9W with 988 mb central pressure, 62 kt highest measured flight-level winds, but maximum winds for storm not determined (micro). "The course continued northwestward during the next several days, until it reached the vicinity of 32N, 71W on September 5" (MWR). "At 0030Z, it was located near 31.5N, 70.7W. The Microseismic Research Project supplied valuable information during the early portion of the recurvature and especially during the evening of 5 September when there was no night [aircraft] radar coverage... The micro-ratio technique, developed by Mr. Gilmore at Miami, was applied successfully during the night of 5 September using the readings of Cherry Point [NC] and Bermuda. The fixes thus obtained greatly aided the Fleet Weather Central in the tracking and forecasting of the movement of Baker" (ATS).

#### September 6:

HWM analyzes a hurricane of at most 995 mb centered near 34.1N, 70.1W with the WNW end of a WNW-ESE warm front located 340 nmi NNE of the hurricane and the ENE end of a ENE-WSW cold front located 190 nmi SSW of the hurricane. HURDAT lists this as a 95 kt hurricane at 34.8N, 69.6W. The MWR tracks of centers of cyclones shows a 12Z position near 34.4N, 69.7W with a 987 mb pressure, and the MWR post-season track map shows a 12Z position at about the same location. ATS at 00Z analyzes

a tropical cyclone of at most 1002 mb centered near 33.2N, 70.5W with the WSW end of a WSW-ENE stationary front located several hundred miles ENE of the cyclone and the ENE end of a ENE-WSW cold front located a few hundred miles SSW of the cyclone. Microfilm at 12Z analyzes a hurricane of at most 996 mb centered about 30 nmi S of the HURDAT position. Ship highlights: 40 kt S and 1001 mb at 00Z at 32.1N, 69.4W (COA); 50 kt SSE at 03Z at 32.3N, 69.5W (COA); 55 kt SW and 1002 mb at 09Z at 32.2N, 69.5W (COA, micro); 45 kt SW and 1005 mb at 12Z at 31.7N, 69.2W (COA, micro). Three other gales between 35-40 kt. Aircraft highlights: Navy radar center fix at 0104Z at 33.4N, 70.8W (micro); radar center fixes at 0546, 0600, and 0640Z at 33.7N, 70.6-70.7W (micro); Navy center fix (loran) at 1154Z at 34.3N, 69.7W with 981 mb central pressure and 110-120 kt maximum winds encountered (ATS, micro); Air Force center fix (loran) at 2030Z at 35.5N, 68.7W with 978 mb central pressure and 80 kt maximum winds encountered (ATS, micro); 80 kt SE at 35.0N, 68.3W (micro). "Here it began curving along a course which carried the center about midway between Cape Hatteras and Bermuda on the 6<sup>th</sup> and then northeastward over the Atlantic. In the period September 2-6 winds were estimated at 100-115 mph with gusts to 140 mph." (MWR). "Continuous radar coverage during the night had shown the hurricane drifting northeastward at about 5 kt. The morning Navy reconnaissance encountered a clearly-defined eye of 20 nmi diameter and winds of 120 kt with gusts to 130 kt in the northern semi-circle. The lowest pressure was 981 mb and 65-kt winds existed in the SE semicircle. The hurricane was showing no signs of becoming extratropical and joining the front that divided the Bermuda High Cell. The slow advance of the hurricane continued until the afternoon at which time a reconnaissance fix by the Air Force plane from Bermuda showed evidences of its slow acceleration" (ATS).

#### September 7:

HWM analyzes a hurricane of at most 990 mb centered near 39.3N, 64.4W. A cold front is undergoing frontogenesis extending from 37N, 62W to 34N, 62W to 29N, 67W. A warm front extends from 44N, 58W to 42N, 54W to 37N, 52W to 34N, 50W. A 3<sup>rd</sup> front extends from 46N, 57W southwestward to 43N, 65W becoming a cold front at 40N, 69W, extending to 38N, 75W to 38N, 80W. HURDAT lists this as an 80 kt hurricane at 39.0N, 64.0W. The MWR tracks of centers of cyclones shows a 12Z position near 39.6N, 63.7W with a 985 mb pressure, and the MWR post-season track map shows a 12Z position near 38.4N, 63.9W. ATS at 12Z analyzes a tropical cyclone of at most 999 mb centered near 39.3N, 62.8W with a boundary extending from the cyclone northeastward. Microfilm analyzes a tropical storm of at most 987 mb centered near 39.5N, 62.3W with a NE-SW frontal boundary plotted a couple hundred nmi NW of the cyclone. Ship highlights: 45 kt N and 999 mb at 12Z at 40.5N, 64.0W (COA, micro); 60 kt N and 1001 mb at 18Z at 41.3N, 62.1W (micro); 40 kt E and 979 mb at 23Z at 42.8N, 56.5W (micro). 19 other gales between 35-55 kt and ten other low pressures between 989-1005 mb. Aircraft highlights: radar center fixes at 0130, 0230, and 0300Z between 36.1-36.9N, 66.8-68.2W (micro); 65 kt at 1450Z at 38.8N, 63.2W (micro); Navy center fix (loran) at 1526Z with 969 mb central pressure and maximum winds of either 100 or 140 kt (ATS, micro); Air Force center fix (loran) at 2110Z at 40.3N, 58.4W with 100 kt surface winds and 136 kt flight-level winds [at 10,000 feet?] (ATS, micro). "The last Navy reconnaissance into this hurricane was staged from the Naval Air Station, New York,

during the morning. This flight found a small eye, 3 nmi in diameter, at 39.5N, 61.1W or about 320 nmi SSE of Halifax, Nova Scotia. The maximum winds were above 100 kt and gusting to 140 to 150 kt in the southern semicircle of the storm. The minimum pressure was 969 mb. The last reconnaissance flight into Baker was flown by the Air Force during the afternoon. The position of the hurricane was fixed at 40.3N, 58.4W. The eye was confused and surface winds were reported to be still about 100 kt. The last [advisory] on Baker issued by the Miami Hurricane Warning Central was at 1600Z. This advisory described Baker as moving northeastward at a speed of 26 kt" (ATS). "This hurricane remained at sea and did not give strong winds at any land point. It moved out over the Atlantic several hundred miles south of Newfoundland on September 7 and 8, and passed beyond aircraft range. A total of 25 advisories were broadcast enabling shipping to avoid the hurricane or maneuver to miss the strongest part, and no reports of marine damage have been received" (MWR).

#### September 8:

HWM analyzes a closed low of at most 990 mb centered near 47.9N, 47.9W with a cold front extending from 70 nmi south of the low southwestward to 44N, 48W to 39N, 54W to 36N, 61W. A N-S warm front extends from 49N, 43W to 47N, 42W to 44N, 43W to 38N, 45W to 36N, 45W. A SSW-NNE warm front extends from 52N, 46W north-northeastward, becoming a stationary front at 56N, 40W, extending to 61N, 31W. HURDAT lists this as a 60 kt extratropical cyclone at 47.8N, 49.3W. The MWR tracks of centers of cyclones shows a 12Z position near 48.1N, 50.3W, and the MWR post-season track map shows a 12Z position near 44.4N, 49.8W. Microfilm at 06Z analyzes a closed low of at most 987 mb centered near 43.3N, 54.7W and at 12Z, the low is starting to go off the map, but microfilm analyzes a closed low of at most 993 mb centered near 43.5N, 48.0W. Ship highlights: 50 kt N and 1004 mb at 00Z at 42.7N, 59.5W (COA, micro); 50 kt SE and 987 mb at 18Z at 49.7N, 45.4W (COA); 70 kt NNE and 989 mb at 23Z at 52.0N, 48.0W (COA). 12 other gales between 35-60 kt and six other low pressures between 992-1005 mb.

#### September 9:

HWM analyzes a closed low of at most 990 mb centered near 56.0N, 45.5W with a cold front extending from the low to 57N, 44W to 56N, 39W to 54N, 35W to 49N, 33W and a warm front extending from the low north-northeastward to 63N, 40W. HURDAT lists this as a 45 kt extratropical cyclone at 55.8N, 45.9W. The MWR tracks of centers of cyclones shows a 12Z position near 55.0N, 43.5W. Ship highlights: 45 kt SSW and 982 mb at 00Z at 50.5N, 44.5W (COA); 70 kt N and 992 mb at 03Z at 52.0N, 48.0W (COA); 70 kt N and 997 mb at 07Z at 52.0N, 48.0W (COA); 60 kt NW and 995 mb at 12Z at 54.5N, 47.5W (COA); 60 kt NW and 1007 mb at 15Z at 52.0N, 48.0W (COA); 50 kt NW and 1003 mb at 18Z at 53.5N, 47.5W (COA); 25 kt E and 988 mb at 23Z at 58.0N, 41.0W (COA). 19 other gales between 35-60 kt and 18 other low pressures between 985-1005 mb. "Baker continued on a northeast course until 0030Z on 9 September then came to a NNW movement. The Fleet Weather Central, Washington, DC, continued the issuance of [advisories] for the information of shipping in the North Atlantic. At 1830Z on 9 September at 55.8N, 47.0W Baker lost its identity as a hurricane and ceased to be regarded as a menace to shipping due to its far northern position and rapid filling" (ATS).

September 10:

HWM analyzes the extratropical remnant of Baker [not sure whether absorbed by this date] in the vicinity of 62N, 40W. HURDAT no longer lists a system on this day. Ship highlights (through 05Z only): 30 kt SE and 987 mb at 00Z at 57.5N, 40.5W (COA); 35 kt S and 1007 mb at 00Z at 56.0N, 31.9W (COA); 25 kt SE and 986 mb at 02Z at 58.0N, 40.0W (COA). Two other gales of 35 kt and one other low pressure of 994 mb.

Baker may have originated from a tropical wave which emerged off of Africa on 23 August. Baker also may have formed from an interaction between a tropical wave and the ITCZ. At 18Z on 30 August, a ship reported an east wind with a pressure of 1004 mb at 14.5N, 50.3W. This cyclone is started as a 40 kt tropical storm at 18Z on the 30<sup>th</sup>. HURDAT originally starts this system at 06Z on the 31<sup>st</sup> as a 60 kt tropical storm at 16.7N, 58.4W. The 23<sup>rd</sup> through the 29<sup>th</sup> were searched for data from the African coast to 60W longitude, but no gales or low pressures were found, and there is not enough evidence of a closed circulation to begin this cyclone more than 12 hours earlier than shown in HURDAT. There is no data near the cyclone on the 31<sup>st</sup>, but the position estimate of the cyclone on 1 September is more accurate due to more ship observations as well as an aircraft fix. The analyzed positions at 18Z on the 30<sup>th</sup> and 06Z on the 1<sup>st</sup> were interpolated to obtain the positions on the 31<sup>st</sup> and at 00Z on the 1<sup>st</sup>. Major eastward track adjustments are made from 06Z to 18Z on the 31<sup>st</sup>. The largest track change (06Z on the 31<sup>st</sup>) places the position about five degrees ESE of the original HURDAT position at that time. Baker passed northeast of the northernmost Leeward Islands on the 1<sup>st</sup> and 2<sup>nd</sup>, and it traveled northwestward to its recurvature point about halfway between Bermuda and Cape Hatteras by the 5<sup>th</sup> of September. The east-southeastward track adjustments made from 06Z on 31 August through 06Z on 1 September are no longer necessary by 12Z on 1 September. All track changes from 12Z on the 1<sup>st</sup> through the 5<sup>th</sup> were six-tenths of a degree or less. The first available gale observation associated with Baker occurred at 03Z on the 1<sup>st</sup> (a ship observation of 35 kt). At 17Z on the 1<sup>st</sup>, a ship recorded 45 kt along with a 1001 mb pressure, and two ships observed 50 kt winds at 18Z. At 1828Z on the 1<sup>st</sup>, aircraft reconnaissance had some trouble finding the center, although it was well established that a closed circulation existed. A lowest pressure of 1003 mb was encountered on this flight. Since the aircraft messages displayed some uncertainty regarding the location of the true center, and since ship observations suggested the central pressure was likely significantly lower than that value, the 1003 mb central pressure in HURDAT at 18Z is removed. On the 2<sup>nd</sup> at 1215Z, aircraft reconnaissance measured a central pressure of 993 mb, and this value is added to HURDAT at 12Z on the 2<sup>nd</sup>. A central pressure of 993 mb yields 59 kt according to the Brown et al. southern pressure-wind relationship. The RMW at this time was about half of the climatological value. A 70 kt intensity is chosen for HURDAT at 12Z on the 2<sup>nd</sup> (down from 90 kt originally- a major change). The 40 intensity, which is chosen for 18Z on the 30<sup>th</sup>, is brought up to 50 kt by 06Z on the 31<sup>st</sup> (down from 60 kt originally), 60 kt at 18Z on the 31<sup>st</sup> (no change), and 65 kt at 18Z on the 1<sup>st</sup> (down from 80 kt originally). Baker is analyzed to have become a hurricane 18 hours later than originally. The 1003 mb pressure listed in HURDAT at 06Z on the 1<sup>st</sup> is removed. Although there is no evidence that this value is incorrect, there is also no evidence that the value is correct. There is also no evidence to

decrease the wind speeds shown in the original HURDAT more than that has been done. Despite these circumstances, the wind speed and the pressure in HURDAT at 06Z cannot both remain unaltered, because we cannot show a hurricane with a 1003 mb central pressure. Therefore, the 1003 mb pressure is removed from HURDAT at 06Z on the 1<sup>st</sup>. Later on the 2<sup>nd</sup>, a 996 mb central pressure was reported by aircraft, and this value is added to HURDAT at 18Z on the 2<sup>nd</sup>. A central pressure of 996 mb yields 54 and 50 kt respectively according to the southern and north of 25N pressure-wind relationships, and 65 kt is chosen for HURDAT at 18Z on the 2<sup>nd</sup> (down from 95 kt originally). On the 3<sup>rd</sup>, central pressures of 993 mb were recorded by aircraft reconnaissance at 1430 and 2017Z. The 993 mb central pressure in HURDAT at 12Z on the 3<sup>rd</sup> is retained and a 993 mb central pressure is added to HURDAT at 18Z. These central pressure values both yield 55 kt according to the pressure-wind relationship for north of 25N. A 65 kt intensity is chosen for HURDAT at all times on the 3<sup>rd</sup> (down from 100 kt originally from 00-12Z and down from 105 kt at 18Z- all major downward intensity adjustments). Central pressures of 983 mb were recorded by aircraft reconnaissance on the 4<sup>th</sup> at 1822Z and again on the 5<sup>th</sup> at 1618Z, and 983 mb central pressures are added to HURDAT at 18Z both days. The 983 mb central pressure on the 4<sup>th</sup> yields 69 kt north of 25N and 72 kt if the intensifying subset is used. The RMW was reported to be nearly twice the climatological value. The 983 mb central pressure on the 5<sup>th</sup> yields 69 kt north of 25N, and the RMW was significantly smaller than the climatological value. However, the forward speed to the storm, which was 11 kt on the 4<sup>th</sup>, had slowed to 6 kt by the 5<sup>th</sup>. A 70 kt intensity is analyzed from 06Z on the 4<sup>th</sup> through 18Z on the 5<sup>th</sup> (down from 105 kt from the 4<sup>th</sup>/06Z through the 5<sup>th</sup>/12Z and down from 100 kt at the 5<sup>th</sup>/18Z- all major downward intensity adjustments). After Baker recurved on the 5<sup>th</sup>, it moved in a direction between NE and ENE until the 8<sup>th</sup>, and then made a north-northeastward turn. The cyclone passed roughly 100 nmi SE of the outer Newfoundland banks on the 8<sup>th</sup> just after becoming extratropical. From 00Z on the 6<sup>th</sup> through 06Z on the 7<sup>th</sup>, the positions are adjusted slightly south and west, and at 12 and 18Z on the 7<sup>th</sup>, the positions are moved slightly south and east of the previous HURDAT positions. These adjustments are mostly in good agreement with interpolated aircraft reconnaissance fixes, but ship observations are weighted for some of the track changes as well. On the 6<sup>th</sup>, aircraft central pressures of 981 and 978 mb were measured at 1154 and 2030Z respectively. The 981 mb central pressure in HURDAT 12Z on the 6<sup>th</sup> is retained, and a 978 mb central pressure is added to HURDAT at 18Z on the 6<sup>th</sup>. The 981 mb central pressure equals 71 kt north of 25N and 72 kt north of 35 kt. The RMW was about half of the climatological value. The 978 mb central pressure yields 75 kt according to both the north of 25N and north of 35N pressure-wind relationships. Intensities of 75 and 80 kt are chosen for 12 and 18Z on the 6<sup>th</sup> (down from 95 kt originally at both times). Major downward intensity revisions of 20 to 40 kt are implemented at all times from 00Z on 2 September to 12Z on 6 September. On the 7<sup>th</sup> at 1526Z, aircraft measured a central pressure of 969 mb at 39.5N, 61.1W with a 3 nmi diameter eye. The 969 mb central pressure in HURDAT at 18Z on 7<sup>th</sup> is retained. A central pressure of 969 mb yields a wind speed of 83 kt according to the north of 35N pressure wind relationship. The system was intensifying, the RMW was 2 nmi compared with a 33 nmi climatological RMW, and the cyclone had been accelerating and was now moving at about 27 kt. A 95 kt intensity is chosen from 06Z to 18Z on the 7<sup>th</sup> (up from 75 kt at 18Z on the 7<sup>th</sup>- a major intensity change) and this

is the analyzed peak intensity for Hurricane Baker. HURDAT previously showed a peak intensity of 105 kt from 18Z on the 3<sup>rd</sup> to 12Z on the 5<sup>th</sup>. The last aircraft fix for Baker occurred at 2110Z on the 7<sup>th</sup>, and this fix estimated surface winds of 100 kt and measured flight-level winds of 136 kt (altitude not certain). However, on the flight, it was reported that there were “no clouds above 5,000 ft.” Available observations indicate that Baker was extratropical by 00Z on the 8<sup>th</sup> (12 hours earlier than in HURDAT originally). Some minor eastward track adjustments are made on the 9<sup>th</sup> as the cyclone moved north-northeastward with a position at 18Z on the 9<sup>th</sup> of 57.0N, 44.3W (originally 57.6N, 45.8W). Ship observations of strong winds require major upward intensity adjustments on the 8<sup>th</sup> and 9<sup>th</sup>. Major upward intensity revisions of 20 to 25 kt are analyzed at all times from 18Z on the 7<sup>th</sup> through 12Z on the 9<sup>th</sup>. Numerous ship observations of 60 kt to hurricane force were observed from 19Z on the 8<sup>th</sup> through 15Z on the 9<sup>th</sup>. The winds dropped below 50 kt by 00Z on the 10<sup>th</sup>. The last position shown in HURDAT is at 18Z on the 9<sup>th</sup>, but available observations indicate that Baker was not absorbed or dissipated until after 06Z on the 10<sup>th</sup>, so 12 hours are added to HURDAT. By 00Z on the 10<sup>th</sup>, the cyclone was located near the southern tip of Greenland, and it was moving northeastward until dissipation after 06Z on the 10<sup>th</sup>.

#### 1952 Storm 5 (new to HURDAT)

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35370 09/08/1952 M= 7 5 SNBR= 781 NOT NAMED XING=0
35420 09/08*420 230 35 0*418 250 40 0*416 270 45 0*411 281 45 0*
35420 09/09*406 285 50 0*403 276 50 0*400 265 50 0*398 260 45 0*
35410 09/10*395 258 40 0*393 254 35 0*390 250 35 0*386 244 30 0*
35410 09/11*385 237 30 0*387 230 30 0E387 223 30 0E383 203 35 0*
35410 09/12E375 168 35 0E373 139 35 0E372 112 35 0E370 090 35 0*
35410 09/13E372 078 35 0E390 058 35 0E410 038 35 0E417 020 35 0*
35410 09/14E423 002 35 0E4323591 35 0E4403584 35 0* 0 0 0 0*
35275 TS

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HWM and COADS indicate that a tropical storm, previously undocumented in HURDAT occurred over the northeastern Atlantic Ocean from 8 to 14 September, 1952.

#### September 7:

HWM analyzes an elongated closed low of at most 1010 mb centered in the general vicinity of 42.5N, 25.5W with a warm front extending from the low northward and a cold front extending from the low southward and then south-southwestward. HURDAT did not previously list this system. No gales or low pressures.

#### September 8:

HWM analyzes a closed low of at most 1010 mb centered near 41.4N, 27.1W with a dissipating warm front extending from the low northwestward and then northward and a cold front extending from 60 nmi east of the low southeastward, and then southward, becoming a dissipating cold front. Ship highlights: 35 kt W and 1005 mb at 14Z at 40.0N, 28.0W (COA). Six other low pressures between 1003-1005 mb.

#### September 9:

HWM analyzes a closed low of at most 1005 mb centered near 40.0N, 27.6W. A dissipating cold front extends from 42N, 28W to 43N, 27W to 43N, 23W to 40N, 19W to

35N, 19W. Ship highlights: 30 kt SSE and 999 mb at 00Z at 40.4N, 28.0W (COA); 40 kt S and 1003 mb at 00Z at 39.8N, 26.5W (COA); 40 kt WSW and 1008 mb at 12Z at 39.6N, 24.4W (COA, HWM). One other gale of 35 kt and three other low pressures of 999-1005 mb. Land/station highlights: 20 kt WSW and 1003 mb at 12Z at 38.7N, 27.2W (HWM).

September 10:

HWM analyzes a closed low of at most 1010 mb centered near 39.6N, 23.8W. No gales or low pressures.

September 11:

HWM analyzes a closed low of at most 1010 mb centered near 38.8N, 20.4W. The northeast end of a ENE-WSW cold front is located about 180 nmi SSW of the HWM analyzed position. No gales or low pressures.

September 12:

HWM analyzes a closed low of at most 1010 mb centered near 37.8N, 14.7W with a cold front extending from the low southwestward. No gales or low pressures.

September 13:

HWM analyzes a closed low of at most 1010 mb centered over Spain near 40.7N, 4.0W with a cold front extending from the low southward to 35N, 5W and then southwestward to 20N, 13W to 29N, 19W. Land/station highlights: 30 kt WSW at 12Z at Madrid, Spain (HWM).

September 14:

HWM analyzes a closed low of at most 1015 mb centered near 44.0N, 1.0E with a cold front extending from the low to 44N, 4E to 41N, 6E to 37N, 5E to 36N, 3E. No gales or low pressures directly related to circulation.

On 7 September, a frontal wave stalled out near 25W between 35-50N. A low pressure area formed, and this low quickly lost its frontal characteristics as it attained a closed circulation. Temperatures were warm all around the low. This cyclone is begun at 00Z on the 8<sup>th</sup> as a 35 kt tropical storm. At 12Z on the 8<sup>th</sup>, the position is 41.6N, 27.0W with a 45 kt analyzed intensity. The cyclone moved slowly southwestward to 40.6N, 28.5W by 00Z on the 9<sup>th</sup>, and its intensity had increased to 50 kt by that time. The cyclone moved slowly southeastward on the 9<sup>th</sup> and 10<sup>th</sup>, reaching a position of 39.0N, 25.0W by 12Z on the 10<sup>th</sup>. A peak intensity of 50 kt is analyzed from 00Z to 12Z on the 9<sup>th</sup>. The storm weakened to a tropical depression by 18Z on the 10<sup>th</sup> at 38.5N, 24.4W. The tropical depression is analyzed to have become extratropical by 12Z on the 11<sup>th</sup> at 39.0N, 22.3W. After the cyclone become extratropical, it accelerated eastward and moved into the Iberian Peninsula around 20Z on 12 September near 37.1N, 8.9W as a 35 kt extratropical cyclone. By 12Z on the 13<sup>th</sup>, it was located near Madrid, Spain with a 35 kt intensity, and it dissipated after 12Z on the 14<sup>th</sup> into an elongated area of low pressure with a final position of 44.0N, 1.6E.

## 1952 Storm 6 (Charlie) – (originally Storm 4)

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35430 09/22/1952 M=10 4 SNBR= 782 CHARLIE XING=0
35430 09/23/1952 M= 9 6 SNBR= 782 CHARLIE XING=0
      **          ** *

(The 22nd is removed from HURDAT.)
35435 09/22* 0 0 0 0*144 622 25 0*151 649 25 0*154 659 30 0*
35440 09/23*160 668 30 0*168 676 35 0*177 684 35 0*185 691 35 0*
35440 09/23*160 668 30 0*168 676 35 0*175 685 35 0*183 693 35 0*
      *** ***          *** ***

35445 09/24*193 698 35 0*202 706 40 0*212 714 45 0*222 722 55 0*
35445 09/24*193 699 30 0*203 706 30 0*213 713 30 0*223 720 40 0*
      *** **          *** **          *** **          *** **

35450 09/25*233 730 60 0*245 738 70 0*256 747 85 0*265 751 90 993*
35450 09/25*235 728 45 0*245 734 50 0*255 740 55 0*265 746 65 993*
      *** *** **          *** **          *** *** **          *** **

35455 09/26*273 750 100 0*282 748 105 0*291 741 105 0*303 724 105 0*
35455 09/26*272 749 75 0*279 748 85 0*290 743 95 969*303 731 105 0*
      *** *** ***          *** ***          *** *** ***          *** ***

35460 09/27*317 706 105 0*326 695 100 0*336 681 100 0*352 657 95 0*
35460 09/27*315 716 105 0*325 702 100 0*338 686 100 958*351 659 95 0*
      *** ***          *** ***          *** ***          *** *** ***

35465 09/28*369 632 95 0*384 608 90 0*395 586 85 0*400 569 85 0*
35465 09/28*367 630 95 0*384 608 90 0*395 587 85 0E399 571 85 0*
      *** ***          ***          ***          ***          **** ***

35470 09/29*403 555 80 0*407 541 75 0*408 527 70 0E405 510 65 0*
35470 09/29E403 555 75 0E406 541 70 0E406 529 65 0E404 515 60 0*
      *          **          ****          *** **          **** *** **

35475 09/30E402 494 60 0E398 482 55 0E395 470 50 0E392 455 50 0*
35475 09/30E399 501 55 0E397 486 50 0E395 472 45 0E395 460 40 0*
      *** *** **          *** *** **          *** **          *** *** **

35480 10/01E397 440 45 0E406 425 45 0E422 411 40 0* 0 0 0 0*
35480 10/01E400 447 35 0* 0 0 0 0* 0 0 0 0*
      *** *** **          **** *** **          **** *** **

35485 HR

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Minor track changes and major intensity adjustments are made to this hurricane. A major change is made to the time of extratropical transition. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Long (1952).

## September 19:

ATS at 00Z analyzes a closed low of at most 1011 mb centered near 12.5N, 56.3W located along a wave axis which extends from 21N, 54W to 15N, 56W to the low to 10N, 56W to 7N, 56W. "Hurricane Charlie began causing concern to the Hurricane Warning Service early on 19 September when a strong easterly wave approaching the Lesser Antilles was detected on the 0030Z surface map" (ATS).

## September 20:

“On the basis of the widespread precipitation ahead of this wave, the area of lower pressure (near 1011 mb) east of Barbados, and the west and south winds reported by ships near the southern extremity of the wave, the entire area just east of the Antilles was investigated on 20 September by a Navy reconnaissance plane which staged from Trinidad about 0800Z, 20 September. The easterly wave was now moving into the Caribbean where its progress could be followed by reports from the islands and by the analysis of the time cross-section” (ATS).

September 21:

HURDAT does not yet list a system on this day. No gales or low pressures.

September 22:

HWM analyzes a closed low of at most 1010 mb centered near 15.5N, 64.7W. HURDAT lists this as a 25 kt tropical depression at 15.1N, 64.9W. ATS at 18Z analyzes a tropical wave axis along 67W from 20N to 10N. Microfilm does not show any features of interest on this day. No gales or low pressures. “An easterly wave moved into the eastern end of the Caribbean Sea on September 22” (MWR). “This wave continued across the Caribbean at a speed of 8 to 9 kt, slightly slower than the normal speed of advance of an easterly wave in the Caribbean. At 1630Z on 22 September, this easterly wave, now clearly unstable, passed San Juan” (ATS).

September 23:

HWM analyzes a closed low of at most 1010 mb centered near 16.8N, 68.9W and another closed low of at most 1010 mb centered near 12.7N, 70W. HURDAT lists this as a 35 kt tropical storm at 17.7N, 68.4W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 17.4N, 68.8W. No gales or low pressures. “It showed some signs of developing a center just south of Mona Passage on September 23. Just prior to this, the wave caused heavy flooding rains on Puerto Rico September 22-23, which caused four deaths and damage estimated at \$1,000,000, but no strong winds were reported. The incipient center noted on the 23<sup>rd</sup> moved northwestward over the Dominican Republic during the day and lost its identity” (MWR).

September 24:

HWM analyzes a closed low of at most 1010 mb centered near 20.3N, 72.0W with a NE-SW stationary front located about 620 nmi NW of the cyclone. HURDAT lists this as a 45 kt tropical storm at 21.2N, 71.4W. The MWR post-season track map shows a 12Z position near 21.8N, 71.1W. ATS at 12Z analyzes a closed low of at most 1011 mb centered near 23.3N, 71.7W with a frontal system located several hundred miles northwest of the cyclone. Microfilm at 12Z shows a spot low or perhaps weak closed low of at most 1011 mb centered near 22.5N, 71.5W with a front located 400 nmi NW of the cyclone, but at 18Z, microfilm analyzes a hurricane of at most 1008 mb. Ship highlights: 35 kt SE at 18Z at 22.9N, 70.3W (micro). “But on the 24<sup>th</sup>, there were signs of a reforming center near Turks Island, with strongest winds about 20 to 30 kt” (MWR). “Post analysis placed the vortex at 1230Z, 24 September, about 120 nmi north of Turks Island” (ATS).

**September 25:**

HWM analyzes a tropical storm of at most 1010 mb centered near 24.8N, 74.5W with a dissipating stationary front located 310 nmi WNW of the cyclone. HURDAT lists this as an 85 kt hurricane at 25.6N, 74.7W. The MWR tracks of centers of cyclones shows a 12Z position near the HWM position with a 1005 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical storm of at most 1005 mb centered near 25.7N, 73.8W with a warm front located northwest of the cyclone. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 25N, 74.8W with a NE-SW frontal boundary located 250 nmi WNW of the cyclone, but at 18Z, microfilm analyzes a closed low of at most 1002 mb with the front a little closer to the cyclone than at 12Z. Ship highlights: center fix at 1530Z at 26.3N, 73.8W with estimated maximum winds encountered of 52 kt (micro); 45 kt SSE and 1005 mb at 21Z at 27.1N, 74.1W (micro). Six other gales between 35-40 kt and two other low pressures between 1002-1005 mb. Aircraft highlights: Navy center fix at 1700Z at 26.2N, 74.5W with 993 mb central pressure and 90 kt maximum flight-level winds encountered (ATS, micro). "An airplane dispatched to reconnoiter the area east of the Bahama Islands on the 25<sup>th</sup> found the hurricane with winds 80 to 90 kt near 26N, 74.5W moving north-northwestward" (MWR). "A Navy reconnaissance plane departed Jacksonville early in the day and found a hurricane at 26.2N, 74.5W. The eye was well-defined, circular and 10 nmi in diameter and the minimum pressure was 993 mb. Winds of 90 kt with gusts to 100 kt existed in the eastern quadrant out to 35 nmi from the eye. The consensus of the various 'forecasting tools' indicated the possibility of early recurvature. This was based primarily on the eastward movement of the trough which was over the Atlantic Coastal waters at 1500Z on 24 September and the southeastward into low latitudes of the jet stream at 200 mb. Accordingly, the first [advisory] forecast a northwest movement and stated that early recurvature to the NNW and then to the north was expected. As the storm was about 340 nmi from the Florida coast, radar reconnaissance was ordered for the night of 25-26 September" (ATS).

**September 26:**

HWM analyzes a hurricane of at most 1000 mb centered near 29.1N, 74.4W with the WSW end of a WSW-ENE stationary front located 280 nmi NNW of the cyclone and the east end of a E-W stationary front located 310 nmi WSW of the cyclone. HURDAT lists this as a 105 kt hurricane at 29.1N, 74.1W. The MWR tracks of centers of cyclones shows a 12Z position near 29.3N, 74.6W with a 1000 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 999 mb centered near 29.3N, 74.0W with a NE-SW stationary front located a few hundred nmi northwest of the cyclone. Microfilm at 12Z analyzes a hurricane of at most 990 mb centered about 30 nmi north of the HWM position with a dissipating frontal boundary located a couple hundred nmi NW of the cyclone. Ship highlights: 35 kt NE and 995 mb at 00Z at 26.9N, 74.9W (micro); 55 kt NNE at 18Z at 31.0N, 74.0W (micro); 65 kt SSE and 1006 mb at 21Z at 30.9N, 71.0W (micro). Seven other gales between 35-45 kt and four other low pressures between 1000-1004 mb. Aircraft highlights: radar center fixes at 0105, 0210, 0305, and 0400Z between 27.2-27.4N, 75.0-75.1W (micro); Navy center fix at 1323Z at 29.4N, 74.0W with 969 mb

central pressure and 100+ kt winds (ATS, micro); Air Force center fix at 2030Z at 30.8N, 72.6W (micro). “It recurved to the northeast on the 26<sup>th</sup>” (MWR). “Strongest winds in connection with this hurricane were around 120 to 125 mph estimated by aircraft on the 26<sup>th</sup>. Thereafter, it gradually lost force” (MWR). “All-night radar coverage was accomplished by Faetulant and their radar fixes showed Charlie moving NNW for four hours then curving to the NNE. The Navy and Air Force reconnaissance flights found that intensification was continuing. Winds were now slightly in excess of 100 kt, the minimum pressure was 969 mb and the eye was well-defined and 20 nmi in diameter” (ATS).

#### September 27:

HWM analyzes a hurricane of at most 995 mb centered near 33.4N, 69.1W with the SW end of a SW-NE stationary front located 200 nmi NE of the cyclone and the NE end of a NE-SW cold front located 110 nmi SW of the cyclone. Another NE-SW front is plotted about 500 nmi NW of the cyclone. HURDAT lists this as a 100 kt hurricane at 33.6N, 68.1W. The MWR tracks of centers of cyclones shows a 12Z position near 33.4N, 68.6W with a 990 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 993 mb centered near 33.8N, 68.2W. Microfilm at 12Z analyzes a hurricane of at most 990 mb centered near 34.0N, 68.2W with a NE-SW front located 250 nmi NW of the cyclone. Ship highlights: 75 kt NE and 999 mb at 00Z at 32.5N, 72.1W (COA); 65 kt SW and 1005 mb at 00Z at 30.4N, 71.0W (COA, micro); 70 kt SSW and 1004 mb at 06Z at 31.0N, 68.7W (COA, micro); 35 kt SW and 995 mb at 15Z at 33.5N, 66.5W (micro). Eight other gales between 35-60 kt. Aircraft highlights: Navy radar center fix (loran) at 0800Z at 32.9N, 69.8W (micro); 75 kt S (flight-level) and 992 mb at 1150Z at 32.9N, 67.3W (micro); 65 kt ESE (flight-level) and 992 mb at 1254Z at 34.0N, 67.0W (micro); Air Force center fix (loran) at either 1321Z or 1421Z at 34.0N, 68.1W with 958 mb central pressure and 130 kt maximum winds encountered at 34.1N, 68.1W (micro); Air Force center fix (loran) at 2027Z at 35.8N, 64.2W with 982 mb central pressure and 90 kt maximum winds encountered at 35.8N, 63.7W (micro). “It passed some distance to the northwest of Bermuda on the 27<sup>th</sup>” (MWR). “Charlie settled on a northeast movement at a speed of 22 to 24 kt. The microseismic amplitude at Bermuda began a sharp increase early in the day and remained above normal until the storm went out of microseismic range north of Bermuda on the following day. Both reconnaissance flights were made by Air Force planes from Bermuda. They found Charlie well-defined and containing winds in excess of hurricane force. These two flights were the last reconnaissance flights into Charlie. The last advisory was issued by the Hurricane Warning Central, Miami, at 2200Z” (ATS).

#### September 28:

HWM analyzes a hurricane of at most 990 mb centered near 39.7N, 57.8W. The WSW end of a WSW-ENE stationary front is located 150 nmi ENE of the cyclone and another front oriented in a similar fashion is located just 100 nmi north of the former front. Two cold fronts are plotted oriented ENE-WSW with the ENE ends located 310 nmi south and 250 nmi SW of the cyclone respectively. HURDAT lists this as an 85 kt hurricane at 39.5N, 58.6W. The MWR tracks of centers of cyclones shows a 12Z position near

39.8N, 58.8W with a 988 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a somewhat large and elongated closed low of at most 999 mb centered near 40.0N, 58.6W. Ship highlights: 75 kt NE and 985 mb at 06Z at 39.3N, 60.9W (micro); 80 kt SW at 1130Z at 39.5N, 58.0W (micro); either 65 or 85 kt and 979 mb[?] sometime around 14Z-18Z at 38.8N, 59.0W (micro). 12 other gales between 35-50 kt and 13 other low pressures between 992-1005 mb.

#### September 29:

HWM analyzes a hurricane of at most 995 mb centered near 40.3N, 53.0W with the west end of a W-E warm front located 230 nmi ENE of the cyclone and the northeast end of a NE-SW cold front located 260 nmi south of the cyclone. HURDAT lists this as a 70 kt hurricane at 40.8N, 52.7W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 990 mb pressure, and the MWR post-season track map shows a 12Z position near 41.6N, 53.7W. Microfilm at 12Z analyzes a large closed low of at most 1008 mb centered in the general vicinity of the HWM position. Ship highlights: 50 kt NNE and 1004 mb at 00Z at 41.2N, 58.9W (COA, micro); 50 kt NE and 1005 mb at 12Z at 41.3N, 56.5W (COA, micro); 40 kt N and 1001 mb at 18Z at 40.0N, 54.8W (COA, micro). 14 other gales between 35-50 kt and three other low pressures between 1000-1005 mb. "It continued northeastward over the Atlantic and passed 400 miles or more southeast of Newfoundland on September 29 and 30" (MWR). "Warnings on this hurricane continued to be issued by the Fleet Warning Central, Washington, until 2200Z on 29 September. Charlie continued on a northeast course at a speed of 30 to 35 kt until 29 September, then came to an east course and decelerated" (ATS).

#### September 30:

HWM analyzes a closed low of at most 1000 mb centered near 40.1N, 47.7W. The west end of a W-E warm front is located 490 nmi NNE of the cyclone and the NNE end of a NNE-SSW dissipating cold front is plotted 270 nmi SSE of the cyclone extending from 37N, 43W to 32N, 46W to 30N, 48W. HURDAT lists this as a 50 kt extratropical cyclone at 39.5N, 47.0W. The MWR tracks of centers of cyclones shows a 12Z position near 39.8N, 47.3W with a 996 mb pressure, and the MWR post-season track map shows a 12Z position very different from the other sources near 44.3N, 43.4W. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near 39.8N, 47.7W. Ship highlights: 45 kt NW and 1005 mb at 00Z at 38.5N, 53.6W (COA, micro); 15 kt E and 999 mb at 12Z at 40.6N, 47.8W (COA, HWM, micro); 35 kt SW and 1002 mb at 12Z at 37.5N, 46.7W (COA, HWM); 35 kt N and 1016 mb at 18Z at 38.3N, 53.7W (COA); either 20 or 30 kt NW and 997 mb at 18Z at 39.7N, 48.4W (micro). Four other gales between 35-40 kt and 19 other low pressures between 1000-1005 mb. "On 30 September it began decreasing in intensity" (ATS).

#### October 1:

HWM analyzes a closed low of at most 1005 mb centered near 43.8N, 40.9W with an approaching NE-SW cold front located 220 nmi WNW of the cyclone. HURDAT lists this as a 40 kt extratropical cyclone at 42.2N, 41.1W. Ship highlights (through 05Z

only): 20 kt NW and 1001 mb at 00Z at 38.5N, 50.2W (COA); 30 kt NW and 997 mb at 00Z at 40.8N, 45.5W (micro); 5 kt SSE and 1000 mb at 03Z at 42.0N, 43.0W (COA). "It finally became extratropical and lost its intensity on 1 October near 46.0N, 36.8W" (ATS).

October 2:

The HWM analysis indicates the remnant of Charlie was absorbed by a more powerful extratropical low before 12Z on this day. HWM analyzes a closed low of at most 1000 mb centered near 49.8N, 25.6W with a warm front extending from the low southeastward and a cold front extending from the low southwestward. HURDAT no longer lists a system on this day.

Charlie may have originated from a tropical wave that emerged off the African coast on 12 September. On the 19<sup>th</sup>, observations detected the presence of the wave as it began to approach the Lesser Antilles. Aircraft reconnaissance on the 20<sup>th</sup> located the wave axis just east of the islands with no closed circulation present. HURDAT begins this cyclone at 06Z on 22 September at 14.4N, 62.2W as a 25 kt tropical depression. Sufficient observations at 18Z on the 22<sup>nd</sup> indicate that a closed circulation was not yet present, and the 22<sup>nd</sup> of September is removed from HURDAT. ATS and MWR call the system an open wave on the 22<sup>nd</sup> as well. On the 23<sup>rd</sup>, there are very few observations near the HURDAT positions, and the cyclone is maintained on the 23<sup>rd</sup>. Genesis is now shown to have occurred at 00Z on 23 September (18 hours later than originally) as a 30 kt tropical depression. No intensity changes or significant track changes were made on the 23<sup>rd</sup>, and the time that HURDAT shows this system becoming a tropical storm (06Z on the 23<sup>rd</sup>) is unchanged. A ship observation of 30 kt associated with the circulation was recorded at 12Z on the 23<sup>rd</sup>. Charlie is analyzed to have made landfall in the Dominican Republic as a 35 kt tropical storm at 19Z on 23 September on a north-northwestward course. Charlie is analyzed to have weakened to a 30 kt tropical depression by 00Z on the 24<sup>th</sup> (down from 35 kt originally) since it was over land until 02Z on the 24<sup>th</sup>. Observations from Salt Cay and Caicos Island on the 24<sup>th</sup> indicate that the depression was closed, but had not yet strengthened back to a tropical storm by 12Z on the 24<sup>th</sup>, so the 30 kt intensity is held through 12Z on the 24<sup>th</sup> (down from 45 kt originally at 12Z on the 24<sup>th</sup>). Tropical Depression Charlie made landfall on Salt Cay (21.3N, 71.2W) at 11Z on the 24<sup>th</sup>. Next, the center of the depression made landfall on East Caicos Island (21.7N, 71.5W) at 13Z on the 24<sup>th</sup>. The first observed gale occurred at 18Z on the 24<sup>th</sup> from a ship. Data from the 25<sup>th</sup> at 00Z suggests the wind from that ship might be biased slightly high. Nevertheless, a 35 kt wind was recorded by a different ship at 00Z on the 25<sup>th</sup>, so Charlie is analyzed to have become a tropical storm again by 18Z on the 24<sup>th</sup> with a 40 kt intensity (down from 55 kt originally). The largest track change on the 23<sup>rd</sup> and 24<sup>th</sup> was three-tenths of a degree. On the 25<sup>th</sup>, Charlie turned northward and the cyclone recurved around the 26<sup>th</sup> at 00Z near 27N, 75W. The cyclone then accelerated northeastward reaching 39.4N, 58.7W by the 28<sup>th</sup> at 12Z. Charlie did not affect any more land areas subsequent to the Caicos Islands and Hispaniola. All track changes from the 25<sup>th</sup> through the 28<sup>th</sup> are one degree or less. These changes are based primarily on center fix data and to a lesser extent peripheral ship observations. The first center fix occurred on 25 September at 1530Z when a ship passed through the center of Charlie. Maximum winds

encountered were estimated at 60 mph. The first aircraft center fix just a short time later at 17Z reported a central pressure of 993 mb and maximum flight-level winds encountered of 90 kt. The 993 mb central pressure in HURDAT at 18Z on the 25<sup>th</sup> is retained. This value yields winds of 57 kt according to the intensifying subset of the Brown et al. north of 25N pressure-wind relationship, which nicely matches the intensity estimate from the ship. Intensities of 55 and 65 kt are chosen for 12 and 18Z respectively on the 25<sup>th</sup> (down from 85 and 90 kt- major downward intensity revisions). Charlie is analyzed to have become a hurricane 12 hours later than in HURDAT originally. The next day, on the 26<sup>th</sup> at 1323Z, a central pressure of 969 mb was measured by aircraft reconnaissance, and this value is added to HURDAT at 12Z on the 26<sup>th</sup>. A central pressure of 969 mb yields 89 kt according to the intensifying subset of the north of 25N pressure-wind relationship. The RMW was smaller than climatological value, and 95 kt is chosen for 12Z on the 26<sup>th</sup> (down from 105 kt originally). Ship observations of hurricane force winds are observed late on the 26<sup>th</sup> and early on the 27<sup>th</sup>. On the 27<sup>th</sup> at either 1321 or 1421Z, a 958 mb central pressure was observed by aircraft reconnaissance, and this value is added to HURDAT at 12Z on the 27<sup>th</sup>. A central pressure of 958 mb yields 97 and 91 kt according to the north of 25N and north of 35N pressure-wind relationships respectively. The RMW was average and the forward speed of the cyclone was 20 kt. The 100 kt intensity in HURDAT at 12Z on the 27<sup>th</sup> is not changed. A mere six or seven hours after the aircraft measured a central pressure of 958 mb, an apparent 982 mb central pressure was measured by aircraft reconnaissance, but other data indicates that this was incorrectly reported and that the plane was not in the eye. This seems reasonable considering a 24 mb pressure rise in six or seven hours is a stretch given that other synoptic data did not change much and still indicated the presence of a strong hurricane. On the 28<sup>th</sup> at 06Z, a ship reported 75 kt with 985 mb and at 1130Z, a different ship recorded an 80 kt wind. A few hours later, this second ship reported a 979 mb pressure with simultaneous hurricane force winds. Hurricane force winds experienced by this ship veered from SW at 1130Z to NW around 1500Z (the time of the 979 mb observation was simultaneous with the NW hurricane force winds). According to the revised track and the reported positions of the ship, the minimum pressure of the ship (not reported) likely occurred sometime around 13Z. A peripheral pressure of 979 mb yields a wind speed of greater than 74 kt for north of 35N. The 85 kt intensity in HURDAT at 12Z on the 28<sup>th</sup> is unchanged. No changes are made to the HURDAT intensities from 18Z on the 26<sup>th</sup> through the 28<sup>th</sup>. HURDAT previously showed a peak intensity of 105 kt occurring from 06Z on the 26<sup>th</sup> through 00Z on the 27<sup>th</sup>. The peak intensity of 105 kt is retained, but only from 18Z on the 26<sup>th</sup> to 00Z on the 27<sup>th</sup>. Although there is no information to indicate that the storm reached an intensity of 105 kt, it easily could have attained that intensity in between the aircraft fixes on the 26<sup>th</sup> and the 27<sup>th</sup>. On the 28<sup>th</sup> through the 30<sup>th</sup>, Charlie moved generally eastward along the 40<sup>th</sup> parallel as it became extratropical. Charlie is analyzed to have become extratropical by 18Z on the 28<sup>th</sup> (24 hours earlier than originally- a major change). No track changes larger than one degree are analyzed for the remainder of the cyclone's lifetime. Intensities on the 29<sup>th</sup> and 30<sup>th</sup> are lowered slightly by 5 to 10 kt due to sufficient observational coverage by ships that indicates the cyclone was weakening more quickly than indicated in HURDAT. By 00Z on the 1<sup>st</sup>, the circulation was become elongated and ill-defined, and observations indicate that it was no longer closed after 00Z on the 1<sup>st</sup>. Dissipation is analyzed to have

taken place 12 hours prior to the time shown in HURDAT. The new final position at 00Z on 1 October is at 40.0N, 44.6W as a 35 kt extratropical cyclone.

Additional quote:

“With the exception of the flood damage noted in Puerto Rico, no damage has been reported” (MWR).

### 1952 Storm 7 (Dog) – (originally Storm 5)

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35490 09/25/1952 M= 5 5 SNBR= 783 DOG          XING=0
35490 09/24/1952 M= 7 7 SNBR= 783 DOG          XING=0
      **          *  *

(The 24th is new to HURDAT.)
35495 09/24* 0 0 0 0* 0 0 0 0*126 487 30 0*129 495 35 0*

35495 09/25* 0 0 0 0*140 510 50 0*148 516 50 0*152 519 50 0*
35495 09/25*132 502 40 0*137 509 50 0*142 516 50 0*147 521 50 0*
      *** *** **          *** ***          ***          *** ***

35500 09/26*155 523 55 0*159 528 55 0*162 534 60 0*166 540 70 998*
35500 09/26*152 525 55 0*157 529 55 0*162 534 55 0*166 540 55 998*
      *** ***          *** ***          **          **

35505 09/27*170 546 75 0*175 550 70 0*180 554 55 0*187 559 45 0*
35505 09/27*170 546 55 0*175 551 50 0*180 555 45 1002*187 559 45 1001*
      **          *** **          *** ** *****          ****

35510 09/28*193 564 40 0*198 569 40 0*202 573 40 0*207 577 35 0*
35510 09/28*193 563 40 0*199 567 40 0*204 570 40 1001*208 575 35 0*
      ***          *** ***          *** ***          **** *** ***

35515 09/29*213 581 35 0*217 587 35 0* 0 0 0 0* 0 0 0 0*
35515 09/29*211 579 35 0*213 582 35 0*214 585 30 0*215 589 30 1009*
      *** ***          *** ***          *** *** **          *** *** **

(The 30th is new to HURDAT.)
35515 09/30*217 592 30 0*219 594 30 0*221 596 30 1008*222 598 25 0*

35520 HR
35520 TS
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Minor track changes and major intensity changes are analyzed for this cyclone. Dog is reanalyzed to have been only a tropical storm instead of a hurricane. A major change is made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

### September 24:

HWM analyzes a spot low near 10.7N, 52.3W. HURDAT does not yet list a system on this day. ATS at 18Z analyzes a closed low of at most 1011 mb centered near 12.4N, 48.9W. Ship highlights: 30 kt WSW and 1011 mb at 1830Z at 11.3N, 49.4W (ATS). “On 24 September, the ship Mormacowl reported west and southwest winds in the vicinity of 11.0N, 49.0W. Other ships north and west of the Mormacowl’s position showed the northeast winds that usually precede the approach of an easterly wave.

Therefore, it appeared that an unstable easterly wave or possibly a vortex was in existence and was moving toward the Lesser Antilles island chain” (ATS).

September 25:

HWM analyzes a closed low of at most 1010 mb centered near 14.3N, 52.9W. HURDAT lists this as a 50 kt tropical storm at 14.8N, 51.6W. The MWR post-season track map shows a 12Z position near 16.0N, 51.0W. ATS at 12Z analyzes a closed low of at most 1011 mb centered near 13N, 51W. No gales or low pressures. “An easterly wave was discovered over the Atlantic about 700 miles east of the Lesser Antilles on September 25” (MWR). “The Air Force diverted the Gull Hotel flight to investigate this general area. No severe weather or significant circulation was encountered. However, the surface map at 1230Z showed the suspicious area centered about 13.0N, 50.0W...” (ATS).

September 26:

HWM analyzes a tropical storm of at most 1010 mb centered near 15.8N, 53.8W. HURDAT lists this as a 60 kt tropical storm at 16.2N, 53.4W. The MWR post-season track map shows a 12Z position near 16.9N, 53.3W. ATS at 12Z analyzes a tropical cyclone of at most 1005 mb centered near 15.4N, 53.1W. Aircraft highlights: Air Force center fix at 2020Z at 16.6N, 54.2W with 998 mb central pressure, maximum surface wind visually estimated at force 12, maximum flight-level wind measured 68 kt, and estimated maximum storm intensity 100 kt (ATS, micro) [not sure whether the 100 kt was the maximum visual sea-surface estimate or a guess of the maximum storm intensity]. One other surface gale. “It showed signs of intensifying, and on the 26<sup>th</sup> aircraft searching the area encountered squalls of 68 kt over a considerable area in the northern quadrant of the wave around 16 to 18N, 54W. Winds in the northeast quadrant were estimated at 100 mph, but a closed center of circulation could not be found” (MWR). “The Air Force reconnaissance flight discovered Hurricane Dog at 2020Z at 16.6N, 54.2W. The maximum measured winds were 68 kt, but 100-kt winds were estimated in the northern quadrant. The eye was described as well-defined and 70 nmi in diameter. A minimum pressure of 997.6 mb existed in the center. Dog was situated in a portion of the Atlantic where weather reports from ships are always rather scarce. Due to this fact and the distance of the hurricane at this time from any inhabited land area, the Hurricane Warning Central made the decision to issue [advisories] only after reconnaissance flights or after receipt of other significant information” (ATS).

September 27:

HWM analyzes a tropical storm of at most 1005 mb centered near 18.0N, 55.1W. HURDAT lists this as a 55 kt tropical storm at 18.0N, 55.4W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 18.2N, 56.0W. Microfilm at 12Z analyzes a tropical storm of at most 1005 mb centered near 18.3N, 55.8W. Aircraft highlights: Navy center fix at 1340Z (DR, sun lines) at 18.2N, 56.2W with 1002 mb central pressure and 50 kt max winds (ATS, micro); Air Force center fix at 2010Z at 18.9N, 55.6W with 1001 mb central pressure (ATS, micro). “By the 27<sup>th</sup> winds had weakened to 45 kt” (MWR). “Two reconnaissance flights – one Navy and one Air Force

– penetrated the storm but found no hurricane-force winds. The Navy plane encountered 50 kt maximum winds and the Air Force plane reported a maximum of 30 kt. The storm was described as ‘fairly dry’ and the eye was reported as well-defined. Post-analysis showed that Dog was centered near 18.2N, 56.2W or about 350 nmi northeast of Martinique at 1230Z. There was a small irregularity present on this day. The late afternoon Air Force fix was approximately 45 nmi northeast of the morning Navy fix. This small irregularity was felt due to the reintensification of the storm about a new center slightly removed from the position of the previous eye” (ATS).

#### September 28:

HWM analyzes a tropical storm of at most 1010 mb centered near 20.8N, 58.5W with the closest front located 550 nmi NNW of the cyclone. HURDAT lists this as a 40 kt tropical storm at 20.2N, 57.3W. The MWR post-season track map shows a 12Z position near 20.8N, 57.4W. ATS at 18Z analyzes a tropical storm of at most 1008 mb centered near 20.3N, 57.5W. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 20.6N, 57.0W. Aircraft highlights: center fix at 1315Z at 20.6N, 57.1W with 1001 mb central pressure and 35 kt max winds (ATS, micro). “The morning reconnaissance flight into Dog found the storm quite weak with a maximum winds of 35 kt, but still showing a definite closed circulation. At 1830Z, the disturbance was now about 450 nmi NNE of Martinique. At 2200Z, the Hurricane Warning Central issued the last [advisory] on Dog with the statement that issuance of [advisories] would be resumed if further reconnaissance information reveal indications of reintensification” (ATS).

#### September 29:

HWM no longer analyzes any features of interest on this day that can be traced to a remnant of Dog. HURDAT last lists this at 06Z as a 35 kt tropical storm at 21.7N, 58.7W. The MWR post-season track map shows a 12Z position near 22.4N, 59.0W. Microfilm at 12Z analyzes a closed low of at most 1014 mb centered near 22.2N, 59.2W. Aircraft highlights: Air Force center fix (loran) at 1935Z at 21.6N, 59.0W with 1009 mb central pressure and 35 kt max winds (ATS, micro). “The Air Force again diverted their regularly scheduled Gull Hotel flight to reconnoiter the general area of Dog or the remnants thereof. The best remaining indication of a storm center was found near 21.6N, 59.0W or about 440 nmi NNE of Martinique at 1935Z. The maximum winds were 35 kt” (ATS).

#### September 30:

The MWR post-season track map shows a 12Z position near 23.5N, 59.9W. Microfilm at 12Z analyzes a weak, broad closed low of at most 1011 mb between 20-26N, 55-62W. Ship highlights: 10 kt SE and 1000 mb [pressure likely a typo] at 12Z at 22.6N, 59.1W (COA). Aircraft highlights: possible center fix at 1305Z at 21.9N, 59.8W with 1008 mb central pressure and 30 kt max winds (ATS, micro) “It continued losing force as it moved northwestward and finally died out by September 30 near 23N, 60W. While winds of hurricane force in squalls were reported at one time, all evidence indicates that this storm remained a wave and did not develop an organized center of circulation” (MWR). “The last reconnaissance into Dog was made by the Air Force Gull Hotel flight on this date. The remnants of the eye were now very diffuse and no actual closed

circulation could be established. The maximum winds were 30 kt and the lowest pressure was 1008 mb. The last fix on Dog was at 21.9N, 59.8W” (ATS).

There is good evidence Dog formed from a tropical wave that emerged off the African coast on 18 September. HURDAT starts this system at 06Z on 25 September at 14.0N, 51.0W. The COADS data was obtained back to 18 September to the African coast. The data indicates an easterly wave with a circulation not defined well enough to be considered a tropical cyclone for the first two days after leaving the African coast. After that, data becomes more sparse until the 24<sup>th</sup> when ship data indicates a closed circulation. This system is begun on the 24<sup>th</sup> at 12Z (18 hours earlier than in HURDAT originally) as a 35 kt tropical storm. By 06Z on the 25<sup>th</sup> (the first point listed in HURDAT), the HURDAT intensity of 50 kt is not changed and the position is adjusted four-tenths of a degree southward. Some ship data in the northern and eastern outer periphery of the circulation is helpful in locating the position on the 25<sup>th</sup>. Dog continued moving northwestward far from any land areas, and it reached a position of 21.3N, 58.2W by the 29<sup>th</sup> at 06Z. On the 26<sup>th</sup>, although there is no available ship data near the storm, an aircraft reconnaissance plane located the center at 2020Z and measured a central pressure of 998 mb. All track changes from the 26<sup>th</sup> through 06Z on the 29<sup>th</sup> are half a degree or less. The 998 mb central pressure in HURDAT at 18Z on the 26<sup>th</sup> is retained. A central pressure of 998 mb equals 51 kt according the Brown et al. southern pressure-wind relationship. The RMW was 2.5 times the climatological value and the forward speed of the cyclone was 7 kt. Visually estimated surface winds of hurricane force and maximum flight-level winds of 68 kt were recorded. On the 27<sup>th</sup>, aircraft central pressures of 1002 and 1001 mb were measured at 1310 and 2010Z. These values are added to HURDAT at 12 and 18Z respectively. On the 28<sup>th</sup> at 1315Z, a central pressure of 1001 mb was measured, and this value is added to HURDAT at 12Z on the 28<sup>th</sup>. A peak intensity of 55 kt is analyzed from 00Z on the 26<sup>th</sup> through 00Z on the 27<sup>th</sup>. The previous peak intensity in HURDAT was 75 kt at 00Z on the 27<sup>th</sup>. Intensities of 45 kt are analyzed for 12 and 18Z on the 27<sup>th</sup> (down from 55 kt at 12Z), and the 40 kt intensity in HURDAT at 12Z on the 28<sup>th</sup> is not changed. The last point shown in HURDAT previously was at 06Z on the 29<sup>th</sup> at 21.7N, 58.7W as a 35 kt tropical storm. Data from ships and aircraft reconnaissance indicate that there was still a closed circulation on the 29<sup>th</sup> and into the 30<sup>th</sup>. The new analysis shows a weakening of Dog to a tropical depression at 12Z on the 29<sup>th</sup>. Aircraft located the cyclone with a closed circulation and a central pressure of 1009 mb at 1935Z on the 29<sup>th</sup> with a max wind estimate of 35 kt. On the 30<sup>th</sup> at 1305Z aircraft reconnaissance located the system at 21.9N, 59.8W with 30 kt max winds and a 1008 mb central pressure. Central pressures of 1009 and 1008 mb are added to HURDAT at 18Z on the 29<sup>th</sup> and 12Z on the 30<sup>th</sup> respectively. The revised final position is listed at 18Z on 30 September at 22.2N, 59.4W as a 25 kt tropical depression. Thereafter, the depression is analyzed to have degenerated to a remnant low or broad low, which persisted for another couple of days before the low completely dissipated.

Additional quotes:

ATS: "Post-analysis shows that although Dog manifested hurricane-force winds at an early stage, it was never disassociated from the easterly wave on which it originally developed. From the limited information available it appears that Dog was an unstable vortex formation from a strong easterly wave, which did not continue its development to the stable vortex or hurricane stage except for a brief interval of time. All reconnaissance flights reported the southwest quadrant weak" (ATS).

### 1952 Storm 8 (new to HURDAT)

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35525 09/25/1952 M= 4 8 SNBR= 784 NOT NAMED XING=0
35530 09/25* 0 0 0 0* 0 0 0 0*124 227 25 0*127 236 30 0*
35530 09/26*131 245 30 0*135 254 35 0*139 263 35 0*142 270 40 0*
35530 09/27*144 276 40 0*145 281 40 0*145 285 40 0*145 288 35 0*
35530 09/28*145 290 35 0*145 291 30 0*145 292 30 0*145 293 25 0*
35530 TS

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HWM, COADS, and Ryan Truchelut's warm anomaly study indicate that a tropical storm, previously undocumented in HURDAT, occurred in the tropical eastern Atlantic Ocean from 25-28 September.

#### September 25:

HWM analyzes a spot low near 16N, 22W. HURDAT did not previous list this system. No gales or low pressures.

#### September 26:

HWM analyzes a closed low of at most 1010 mb centered near 15N, 26W. Ship highlights: 25 kt SW and 1002 mb at 18Z at 13.7N, 27.0W (COA).

#### September 27:

HWM analyzes a spot low near 16N, 30W. Ship highlights: 15 kt SW and 1003 mb at 00Z at 14.0N, 27.7W (COA); 20 kt NNW and 1000 mb at 06Z at 14.5N, 28.5W (COA); 20 kt N and 1005 mb at 12Z at 14.7N, 29.4W (COA).

#### September 28:

HWM analyzes a spot low near 15.5N, 33W. No gales or low pressures.

#### September 29:

HWM analyzes an elongated trough of low pressure from 22N, 28W to 17N, 31W to 14N, 36W to 13N, 43W. No gales or low pressures.

A tropical wave that emerged off the African coast on 24 September became attained a closed circulation and became a tropical depression by 12Z on the 25<sup>th</sup> at 12.4N, 22.7W with a 25 kt intensity. The depression moved west-northwestward and became a tropical storm by 06Z on the 26<sup>th</sup> with an analyzed position of 13.5N, 25.4W. By 12Z on the 27<sup>th</sup>, the cyclone was located near 14.5N, 28.5W. There were no observations of gales recorded with this cyclone, but there were four low pressure observations between 1000-1005 mb, all from the same ship. This ship is not analyzed to have contained a low pressure bias. Comparison with other ships reveals that the pressure on this ship may

only have been biased 1 mb too low, if any. The four low pressure observations occurred between 18Z on the 26<sup>th</sup> and 12Z on the 27<sup>th</sup>. There were two 30 kt winds recorded from a different ship between 00Z on the 27<sup>th</sup> and 12Z on the 27<sup>th</sup>. The lowest pressure of 1000 mb was recorded by the first ship at 06Z on 27 September. A peripheral pressure of 1000 mb yields a wind speed of at least 47 kt according to the Brown et al. southern pressure-wind relationship. A peak intensity of 40 kt is analyzed from 18Z on the 26<sup>th</sup> through 12Z on the 27<sup>th</sup>. The tropical storm is analyzed to have weakened to a tropical depression at 06Z on the 28<sup>th</sup> at 14.5N, 29.1W. Observations become very sparse on the 28<sup>th</sup>, and after that time, the cyclone can no longer be tracked. After 18Z on 28 September, the depression is analyzed to have degenerated into an open wave. The final position at 18Z on the 28<sup>th</sup> is 14.5N, 29.3W as a 25 kt tropical depression.

### 1952 Storm 9 (Easy) – (originally Storm 6)

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35525 10/06/1952 M= 6 6 SNBR= 784 EASY XING=0
35525 10/06/1952 M= 6 9 SNBR= 784 EASY XING=0
      *

35530 10/06* 0 0 0 0* 0 0 0 0*152 510 30 0*153 510 30 0*
35535 10/07*155 510 35 0*157 510 35 0*160 510 40 0*163 510 45 995*
35535 10/07*154 509 35 0*157 508 40 0*162 507 45 0*167 506 50 995*
      *** **
      *** **

35540 10/08*167 510 50 0*171 510 60 0*175 510 65 0*181 509 80 968*
35540 10/08*171 505 60 0*174 505 70 0*177 505 80 0*180 504 85 968*
      *** **
      *** **

35545 10/09*187 505 95 0*187 502 80 0*187 498 60 0*180 492 40 1001*
35545 10/09*181 501 85 0*181 498 75 0*180 495 60 0*177 494 40 1001*
      *** **
      *** **

35550 10/10*172 492 40 0*164 494 40 0*156 499 35 0*151 503 35 0*
35550 10/10*170 495 40 0*163 497 40 0*157 501 35 0*154 505 35 0*
      *** **
      *** **

35555 10/11*147 510 35 0*141 519 35 0*140 530 35 0* 0 0 0 0*
35555 10/11*152 510 35 0*149 519 30 0*145 530 30 0* 0 0 0 0*
      *** **
      *** **

35560 HR

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Minor track and intensity alterations are analyzed for this hurricane. Evidence for these changes comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and U.S. Weather Bureau public advisories.

#### October 6:

HWM analyzes a tropical storm of at most 1010 mb centered near 15.1N, 51.1W. HURDAT lists this as a 30 kt tropical depression at 15.2N, 51.0W. ATS at 18Z analyzes a broad closed low of at most 1011 mb centered in the general vicinity of 16.5N, 48.5W with a wave axis running through the low from 21N, 47W to 8N, 51W. Ship highlights: 25 kt E and 1010 mb at 18Z at 17.0N, 48.5W (COA); 75 kt ENE (wind appears either too high, a typo, or incorrect) and 1012 mb at 1830Z at 19.3N, 52.3W (ATS).

**October 7:**

HWM analyzes a tropical storm of at most 1005 mb centered near 16.4N, 51.0W. HURDAT lists this as a 40 kt tropical storm at 16.0N, 51.0W. The MWR post-season track map shows a 12Z position near 16.3N, 50.6W. ATS at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 16.2N, 50.5W. Ship highlights: 35 kt E at 06Z at 15.5N, 49.9W (COA); 30 kt NE and 1005 mb at 18Z at 18.2N, 51.6W (COA). Aircraft highlights: Air Force center fix at 1720Z at 16.8N, 50.5W with 995 mb central pressure and 40 kt max winds (ATS). “It was located by reconnaissance aircraft on October 7 with maximum winds of only about 40 kt” (MWR). “The Gull Hotel flight arrived in the suspicious area in the early afternoon. A definite disturbance was encountered and a low-level penetration of a well-defined eye of 25 nmi diameter was made at 1720Z. The disturbance was centered about 16.8N, 50.5W. The maximum observed winds were 40 kt and the minimum pressure was 995 mb. Advisory number one on Tropical Storm Easy was issued at 1930Z by the Fleet Weather Central, Miami, and the Weather Bureau Office, San Juan, respectively. As in the early stages of Storm Dog, it was decided that further warnings and advisories on Easy would not be issued until after the reconnaissance flight of the following day unless other significant information was received earlier. This was predictable at this time due to the remoteness of the storm from land areas or busy shipping lanes” (ATS).

**October 8:**

HWM analyzes a hurricane of at most 1000 mb centered near 17.8N, 50.7W. HURDAT lists this as a 65 kt hurricane at 17.5N, 51.0W. The MWR post-season track map shows a 12Z position near 18.0N, 51.0W. ATS at 06Z analyzes a tropical cyclone of at most 999 mb centered near 17.3N, 50.4W. Ship highlights: 30 kt E and 1006 mb at 00Z at 18.7N, 50.2W (COA); 30 kt SE and 1007 mb at 0630Z at 19.4N, 49.4W (ATS). Aircraft highlights: Air Force center fix at 1626Z at 17.8N, 50.4W with 968 mb central pressure, 83 kt maximum measured flight-level winds, and 95 kt maximum estimated winds (ATS, micro). “But on the 8<sup>th</sup>, the plane encountered winds of 95 kt near the center” (MWR). “The Air Force plane diverted from the Gull Hotel flight to make the Duck Echo flight into Easy. This flight found a hurricane with measured winds of 83 kt gusting to 100 kt. At 1626Z, the center was fixed near 17.8N, 50.4W. The eye was 25 nmi in diameter and the minimum pressure was 968 mb. This fix showed a northerly drift of the storm of only 60 nmi in the past 24 hr” (ATS).

**October 9:**

HWM analyzes a tropical storm of at most 1005 mb centered near 17.7N, 49.6W. HURDAT lists this as a 60 kt tropical storm at 18.7N, 49.8W. The MWR post-season track map shows a 12Z position near 18.9N, 50.5W. ATS at 06Z analyzes a tropical cyclone of at most 996 mb centered near 18.1N, 49.8W and at 18Z, ATS analyzes a tropical cyclone of at most 999 mb centered near 17.5N, 49.5W. Ship highlights: 30 kt NE and 1008 mb at 18Z at 17.7N, 51.4W (COA). Aircraft highlights: Air Force center fix at 1727Z 60 nautical miles due east of the previous day’s fix with 1001 mb central pressure and 42 kt maximum winds (ATS). “The flight on October 9 found that winds had dropped to 42 kt and thereafter it died out” (MWR). “The Air Force reconnaissance flight arrived in the storm at 1727Z and revealed that Easy was now 60 nmi due east of

the position fixed by the plane the previous day. Furthermore, Easy had diminished greatly in intensity and was apparently filling. The reconnaissance plane stated positively that no winds over 42 kt existed in the storm area. The minimum pressure had risen to 1001 mb” (ATS).

October 10:

HWM analyzes a tropical storm of at most 1010 mb centered near 15.7N, 50.2W. HURDAT lists this as a 35 kt tropical storm at 15.6N, 49.9W. No gales or low pressures. “Easy continued weakening and continued moving southward until late on 10 October. Then the easterly flow initiated the westward movement of the storm” (ATS).

October 11:

HWM analyzes a closed low of at most 1010 mb centered near 14.1N, 53.1W. HURDAT lists this as a 35 kt tropical storm at 14.0N, 53.0W. ATS at 18Z analyzes a tropical cyclone of at most 1008 mb centered near 15.7N, 53.9W. No gales or low pressures. “A recognizable circulation persisted at the surface until 1830Z on 11 October” (ATS).

October 12:

HWM analyzes a spot low near 12.3N, 54.7W. HURDAT no longer lists a system on this day. No gales or low pressures. “Easy lost its identity as a circulation after 11 October but progressed westward in the form of a strong easterly wave, which crossed the Lesser Antilles on 13 October. This easterly wave, or the remnants of Easy, disappeared during the passage over the Caribbean Sea. After the formation of Fox on 20-21 October, it was noted that the remnants of Easy, traveling westward at a speed of 8 to 10 kt, would have been in the area of the formation of Fox at the time it was discovered. All attempts to establish such a relationship between Easy and Fox failed, however, due to the disappearance of the remnants of Easy both on the surface maps and on the time cross-section. This disappearance may have been an actuality or may have been the result of the scarcity of reports in the easter areas of the Caribbean. Whichever was the case, this most interesting relationship could not be positively established, and the two storms, Easy and Fox, had to be considered as separate and individual phenomena” (ATS).

HURDAT begins this cyclone on 6 October at 12Z as a 30 kt tropical depression at 15.2N, 51.0W. Data obtained back to 5 October does not indicate a closed circulation. No changes are made to the timing of genesis or the intensities and positions on the 6<sup>th</sup>. Easy moved very little for the next few days and aircraft center fixes substantiate the loop in the track shown in HURDAT. However, the fixes and well as available ship observations indicate the loop was tighter than shown in the original HURDAT. Despite that, all track changes are eight-tenths of a degree or less. The three aircraft fixes reported central pressures of 995, 968, and 1001 mb- one per day for three consecutive days. These central pressures are retained in HURDAT. The 995 mb central pressure yields 56 kt according to the southern pressure-wind relationship. The RMW is slightly larger than the climatological value and the speed is slow. Maximum winds of 40 kt were encountered on the flight. A 50 kt intensity is chosen for 18Z on the 7<sup>th</sup> (up from 45 kt originally). The 968 mb central pressure on the 8<sup>th</sup> yields 93 kt according to the intensifying subset of the southern pressure-wind relationship. The RMW and speed of



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35610 10/28*282 721 30 0*296 696 30 0*317 690 25 0* 0 0 0 0*
35610 10/28E288 728 35 0E300 717 30 0E314 704 25 0* 0 0 0 0*
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35615 HR

Major track changes and major intensity changes are analyzed for Hurricane Fox, which made a Cuban landfall as a major hurricane. A major change is made to add in an extratropical phase. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Perez.

#### October 19:

HWM analyzes a spot low near 12.1N, 79.2W located within a trough of low pressure in the southwestern Caribbean Sea. HURDAT does not yet list a system on this day. No gales or low pressures.

#### October 20:

HWM analyzes a spot low near 10.3N, 77.6W located within a trough of low pressure in the southwestern Caribbean Sea. HURDAT lists this as a 25 kt tropical depression at 11.8N, 77.6W. Microfilm first plots a closed low at 18Z of at most 1008 mb centered near 13.9N, 79.9W. No gales or low pressures. "The outbreak of Fox provided another demonstration of the great value of the Microseismic Research Project. The first positive indications of a tropical disturbance came from the microseismic station at Swan Island as early as 1200Z on 20 October. The surface wind at Swan Island, which was NE force 2 (5 kt), at 1230Z, 20 October became NW, force 3 (10 kt), after the [cold] frontal passage" (ATS).

#### October 21:

HWM analyzes a closed low of at most 1010 mb centered near 15.3N, 80.7W with a dissipating stationary front located from 22N, 83W to 19N, 85W, becoming a cold front at 17N, 87W, extending to 16N, 90W to 15N, 93W. HURDAT lists this as a 45 kt tropical storm at 15.0N, 80.7W. ATS at 12Z analyzes a closed low of at most 1005 mb centered near 16N, 81.1W with the south end of a cold front located about 200 nmi north of the cyclone. Microfilm at 12Z analyzes a large, broad closed low of at most 1008 mb centered in the general vicinity of 17N, 81W. Aircraft highlights: possible Navy center fix at 2050Z at 17.4N, 82.2W with 1003 mb lowest pressure encountered (possible central pressure) and 50 kt max wind encountered (ATS, micro). "A Navy reconnaissance flight arrived in the area at 2050Z. The plane encountered a heavy squall line and a wind shift at 17.4N, 82.2W. The max winds were 50 kt and these existed in the southwest portion of the area. The lowest pressure was 1003 mb. On the return flight the plane penetrated the mild cold front ten nmi north of Grand Cayman Island at 2300Z. The strongest wind and lowest pressure reported from that vicinity on 21 October were at station #725, near Cabo Gracias a Dios, Nicaragua at 1230Z" (ATS). "The last hurricane of the 1952 season was the most severe. It developed from a perturbation on the intertropical convergence zone that was first noted in the western Caribbean Sea north of the Canal Zone on October 21" (MWR).

October 22:

HWM analyzes a tropical storm of at most 1000 mb centered near 17.0N, 81.9W with the SW end of a SW-NE stationary front located near 24N, 80W, and the north end of a ENE-WSW dissipating cold front located about 120 nmi south of the cyclone. HURDAT lists this as a 65 kt hurricane at 16.8N, 82.2W. The MWR post-season track map shows a 12Z position near 17.1N, 82.3W. ATS analyzes a tropical cyclone of at most 999 mb centered near 16.9N, 81.7W with the SW end of a SW-NE cold front located 180 nmi NNW of the cyclone. Microfilm at 12Z analyzes a hurricane of at most 993 mb centered near the HWM position with the WSW end of a WSW-ENE front located near 22N, 84W extending to 24N, 80W. Ship highlights: 40 kt WNW and 999 mb at 21Z at 17.0N, 82.6W (micro). Aircraft highlights: Navy center fix at 1745Z at 17.2N, 81.9W with 993 mb central pressure and 80 kt max winds (ATS, micro). Three other flight-level gales between 40-50 kt and two other low pressures between 1001-1004 mb. "It increased to hurricane force on the 22<sup>nd</sup> when it was about 150 miles east of Swan Island" (MWR). "The 0030Z surface map contained a report from a ship about 85 nmi east of Swan Island. This report showed NW wind force 7 (30 kt) and continuous moderate rain. The Navy reconnaissance plane arrived in the suspicious area at 1745Z. This time a hurricane was found. The eye, which was centered near 17.2N, 81.9W, was very poorly defined and contained no definite calm area. The maximum winds of 80 kt existed in the eastern semicircle and the minimum pressure was now 993 mb. [Advisory] Number One was issued at 2000Z, 22 October. At the same time the plane reported hurricane force winds, the microseismic amplitude at Swan Island was increasing. This comparison of reconnaissance and microseismic information is an illustration of the value of microseisms in detecting changes of intensity in storms" (ATS).

October 23:

HWM analyzes a hurricane of at most 1000 mb centered near 17.7N, 81.9W with the southwest end of a SW-NE stationary front located near 24N, 80W. HURDAT lists this as a 95 kt hurricane at 18.4N, 82.2W. The MWR tracks of centers of cyclones shows a 12Z position near 18.5N, 81.0W with a 991 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 12Z analyzes a tropical cyclone of at most 996 mb centered near 18.2N, 82.1W with the SW end of a cold front located at 24N, 80W. Microfilm analyzes a closed low of at most 1002 mb centered near the HURDAT position with the southwest end of a SW-NE front located near 23N, 81W. Ship highlights: 30 kt NW and 1004 mb at 00Z at 17.2N, 82.8W (COA); 35 kt NW and 1007 mb at 00Z at 17.8N, 83.0W (micro); 40 kt NW and 1010 mb at 06Z at 16.0N, 84.2W (micro). Five other gales of 35 kt. Land/station highlights: 40-45 kt SSE and 1000 mb at 21Z at Grand Cayman (micro). One other gale and one other low pressure at Grand Cayman between 15-18Z. Aircraft highlights: Navy center fix at 1410Z at 18.5N, 82.0W with 942 mb central pressure and 100+ kt winds (ATS, micro); 80 kt SSE at flight-level of 600 ft and 995 mb at 15Z at 18.7N, 81.3W (micro); center fix (circumnavigation only) during the afternoon at 19.3N, 82.0W with 80-85 kt maximum winds encountered in outer periphery (ATS). "Two Navy reconnaissance flights were scheduled for this date. The morning flight fixed the center of the hurricane about 75 nmi SE of Grand Cayman at 1410Z. The eye was now well-defined and circular. The

minimum pressure was 942 mb. Severe continuous and continuous heavy rain were encountered as long as 10 minutes prior to and after penetration. This morning flight returned to the Marina Corps Air Station, Miami, and the pilot and aerologist were interviewed personally by the Officer in Charge, Fleet Weather Central. The pilot and aerologist, both experienced in hurricane and typhoon flying, stated that Fox was the worst storm they had experienced. They advised that subsequent reconnaissance flights not attempt penetration but reconnoiter the storm by circumnavigation. The afternoon reconnaissance heeded this advice and circumnavigated the hurricane on the 45 and 70-knot isovels [isotachs?]. The maximum winds encountered on circumnavigation were 80 to 85 kt. The estimated position of the center at 19.5N, 82.0W showed that the storm was still moving northward at a rather slow speed” (ATS).

October 24:

HWM analyzes a hurricane of at most 1000 mb centered near 20.9N, 81.5W with the southwest end of a SW-NE stationary front located near 26N, 76W. HURDAT lists this as a 125 kt hurricane at 20.8N, 81.5W. The MWR tracks of centers of cyclones shows a 12Z position near 21.1N, 80.5W with a 993 mb pressure, and the MWR-post season track map shows a 12Z position near 21.1N, 81.6W. ATS at 18Z analyzes a tropical cyclone of at most 1002 mb centered near 22.3N, 80.8W with the SW end of a cold front located at 25N, 78W. Microfilm at 12Z analyzes a closed low of at most 993 mb centered near the HWM and HURDAT positions with the southwest end of a SW-NE front located 140 nmi NNW of the hurricane extending from 23N, 82W to 25N, 79W to 27N, 75W. Ship highlights: 35 kt NW and 1011 mb at 00Z at 17.7N, 84.1W (COA, micro). Land/station highlights: 45 kt SSE and 1001 mb at 00Z at Grand Cayman (micro); either 934 or 940 mb (min p) at 1630Z at Cayo Guano del Este (21.6N, 81.1W) (MWR, Perez); 155 kt (peak gust at 25 meters) around ~1630Z at Cayo Guano del Este (MWR, Perez); gusts of 85 kt reported from several stations in Cienfuegos province (Perez); 981 mb (min p) at Abreu, Cienfuegos, Cuba (22.3N, 80.6W) (Perez). Five other gales between 35-80 kt and five other low pressures between 986-1005 mb. Boca Chica land-based radar center fixes at 2030, 2230, and 2330Z between 22.3-22.6N, 80.6-80.9W (micro). Aircraft highlights: radar center fixes at 0400, 0500, 0600, 0700, 0800, 0900, and 0950Z between 19.6-20.3N, 81.4-82.0W (micro); Navy center fix at 1534Z at 21.8N, 80.9W with 940 mb central pressure and 130 kt max flight-level winds encountered (ATS, micro). “All night coverage by Navy radar aircraft was provided on 23-24 October by Faetulant. Very good fixes were obtained throughout the night and the plot of these fixes substantiated the commencement of a slow recurvature to the NNE. The last radar report at 1000Z fixed the eye 170 nmi SSE of Havana, Cuba. The Navy morning reconnaissance flight again decided on a low-level penetration and found the storm at 21.9N, 80.9W, about 25 nmi south of Cuba, at 1534Z. The eye was circular, well-defined and 18 nmi in diameter. Winds of 130 kt were encountered 20 nmi SW of the eye, with extremely heavy precipitation. This morning reconnaissance revealed that the storm already had accelerated. The 1830Z surface map shows the situation shortly after the eye went inland near Cienfuegos, Cuba. Cuba suffered considerable damage as a result of the passage of Fox. Extensive damage to the principal industries – sugar and bananas – and to shipping near the coast was reported. About 100 people were injured and property damage was well above \$3,000,000. No loss of life was reported” (ATS). “It moved northward with

increasing intensity and crossed Cuba on the 24<sup>th</sup> as a very severe small hurricane. The passage over Cuba was through the rural sugar cane plantation section, and it was reported that 36 of Cuba's 161 sugar mills were in the storm area and suffered damage in addition to the heavy damage to the cane crops. The largest community struck was the inland town of Aguada de Pasajeros (25,000 population) where about 600 homes were destroyed, and a thousand or more damaged. No lives were lost. Strongest winds reported 180 mph and lowest pressure 933.6 mb at Cayo Guano del Este" (MWR). "This was by far the most severe hurricane of the season when it reached the south Cuban coast 30 or 40 miles west of Cienfuegos. Lowest pressure was 933.6 mb and maximum wind gusts reached 170 and 180 mph at the official weather station on Cayo Guano del Este just off the south Cuban coast. Aircraft flying into the hurricane [south of Cuba] reported torrential rain driven with such force by the wind that the paint was stripped from the nose and all leading surfaces of the plane, and turbulence was the most severe the crew had ever experienced. Fortunately, no very large communities were hit in Cuba, but the rural areas affected were severely damaged" (MWR). Perez indicates a Category 4 landfall for Cuba with 936 mb central pressure (from a 940 mb observation) and estimated 120 kt max sustained winds. "Maxima intensidad cerca de Cayo Guano del Este. Grandes danos" (Perez).

October 25:

HWM analyzes a hurricane of at most 1005 mb centered near 23.7N, 79.5W with the southwest end of a SW-NE stationary front located 170 nmi NNE of the cyclone. HURDAT lists this as an 85 kt hurricane at 24.1N, 79.6W. The MWR tracks of centers of cyclones shows a 12Z position near the HWM position with a 993 mb pressure, and the MWR post-season track map shows a 12Z position near the HWM and HURDAT positions. ATS at 12Z analyzes a tropical cyclone of at most 1005 mb centered near 23.8N, 79.3W. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near the positions of all the above sources. Ship highlights: 35 kt NE and 1014 mb at 18Z at 28.3N, 79.8W (COA, micro). Land/station highlights: 35 kt SE and 1006 mb at 00Z at 22.5N, 79.4W (micro); 25 kt ESE and 1004 mb at 21Z at Nassau (25.1N, 77.4W) (micro, ATS), 15 kt SW and 1003 mb at 21Z at Andros Island (24.2N, 77.7W) (micro). One other low pressure of 1003 mb at Andros Island. Boca Chica land-based radar center fixes at 0030, 0130, 0230, 0430, 0530, 0630, and 0830Z between 22.7-23.7N, 79.7-80.6W (micro). Aircraft highlights: radar center fixes at 0250, 0346, 0408, 0500, 0600, 0700, 0800, and 0900Z between 23.2-23.7N, 79.4-79.8W (micro); Navy center fix [probably bad] at 1305Z at 23.7N, 79.3W with 995 mb lowest pressure encountered and 100 kt max flight-level winds encountered at 500 ft (ATS, micro); Navy center fix at 2005Z at 24.7N, 77.8W with 991 mb central pressure and 40 kt winds reported (ATS, micro). "Hurricane Fox lost much of its violence in crossing Cuba, but retained winds of 100 mph or better as it moved on an erratic course through the Bahama Islands" (MWR). "Moving at a speed of 10 kt, the hurricane was over water again on the 0030Z surface analysis. Navy radar coverage was again provided throughout the night. On the radar the storm had a diffuse eye with precipitation bands existing only in the northern quadrant. The passage over land evidently had affected the size and intensity of the storm. At the surface the circulation of Fox extended over southern Florida... however the winds were quite light. Two Navy reconnaissance flights were made from Miami on 25 October.

The morning flight located the eye about 140 nmi SE of Miami. The SW quadrant appeared quite weak and clear, however, winds in excess of 100 kt were found in the NE quadrant. The afternoon flight penetrated the storm at 2005Z and centered the well-defined, circular eye just east of Andros Island. The lowest pressure was 991 mb. Fox had crossed the center of Andros Island, Bahamas, between the two reconnaissance fixes. It was now on an ENE course and passing very close to Nassau. Nassau, being only 30 nmi from the northern edge of the eye at the closest point, experienced maximum winds of only 25 kt! It was apparent that Fox had not recovered from its passage over Cuba and that its eventual complete dissipation was a matter of time” (ATS).

October 26:

HWM analyzes a hurricane of at most 1005 mb centered near 24.6N, 75.0W with the WSW end of a WSW-ENE stationary front located 80 nmi northeast of the cyclone extending from 26N, 74W to 28N, 67W to 29N, 61W. A W-E cold front is also plotted from 31N, 77W to 31N, 65W. HURDAT lists this as a 100 kt hurricane at 24.6N, 75.9W. The MWR tracks of centers of cyclones shows a 12Z position near 25.2N, 76.0W with a 1005 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 18Z analyzes a tropical cyclone of at most 1005 mb centered near 24.6N, 75.3W. Microfilm at 12Z analyzed a closed low of at most 1002 mb centered near the HURDAT position with a W-E frontal boundary located about 240 nmi north of the cyclone. Ship highlights: 35 kt NE and 1014 mb at 18Z at 27.9N, 74.2W. A few other gales of 35 kt possibly related to the circulation far away from the center. Land/station highlights: 25 kt E and 1002 mb at 01Z at Nassau (micro); 95 kt SE (estimated) and 1000 mb at 0745Z at Eleuthera (25.1N, 76.2W) (micro); 83 (kt or mph?) S at either 15 or 16Z Cat Island (24.3N, 75.4W) (ATS, micro); 50 kt SW at 2120Z at San Salvador (24.0N, 74.5W). 14 other gales between 35-85 kt and 14 other low pressures between 1000-1005 mb. Aircraft highlights: Air Force center fix [probably bad] at 1425Z at 24.8N, 76.3W with 994 mb lowest pressure encountered and 50 kt max winds (ATS, micro); 95 kt WSW flight-level max at 1630Z (micro); Air Force center fix at 2118Z at 24.4N, 74.8W with 994 mb central pressure and 65 kt max winds (ATS, micro). Two other gales of 35-60 kt and two other low pressures of 995-998 mb. “In the Bahamas, winds of 100 mph or a little higher attended the erratic course. The station at Cat Island reported 110 mph for the strongest wind, and about 100 mph was reached on Watling and Eleuthera Islands, and a few other. In the southern part of Eleuthera Island crops suffered severe damage from wind and heavy rain. It is estimated that 30% of the tomato crop was destroyed” (MWR). Regarding the track... “The erratic swing to east and east-southeast was not indicated by meteorological conditions, and even more unusual was its swing back northward to its normal course after reaching the vicinity of Watling Island” (MWR). “During the night, reports of hurricane force winds began to arrive from the eastern-most islands of the Bahamas group. Shortly after midnight (Miami time) a report of 100 kt of wind was received from Eleuthera Island. Fox had to be considered as still a dangerous hurricane until more complete information was received. It was evident that such information had to come from a reconnaissance flight since the reports from the Bahamas and ships in the vicinity on the current maps showed light to moderate winds for the most part. The Air Force at Bermuda was now assuming the primary reconnaissance duty. The morning flight found a well-defined circulation

centered at 24.8N, 76.3W. The maximum winds, however, were 50 kt and these occurred only in squalls. The afternoon reconnaissance located the storm at 24.4N, 74.8W and observed maximum winds of 65 kt in the NE quadrant. The flight aerologists described the active storm area as a crescent-shaped arc 70 nmi from the center in the southern semicircle. At 1100 (Miami time) a report of 83 kt of wind was received from Cat Island. During the afternoon, San Salvador reported increasing winds and a falling barometer. Eleuthera, Cat, and San Salvador Islands, which lie in a NW-SE line, obviously were experiencing successively the passage of squalls in the active storm area described by the afternoon reconnaissance. The Fleet Weather Central held the theory that the storm was weakening and consisted now of a slow-moving small center and a squall line which was moving ahead of the center to the east and which contained the most severe weather and the highest winds" (ATS).

October 27:

HWM analyzes a tropical storm of at most 1005 mb centered near 27.5N, 74.9W with the west end of a W-E warm front located about 140 nmi north of the cyclone extending from 30N, 75W to 30N, 70W to 29N, 65W to 29N, 60W. HURDAT lists this as a 40 kt tropical storm at 26.3N, 74.4W. The MWR tracks of centers of cyclones shows a 12Z position near 25.2N, 73.1W with a 1005 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS at 18Z analyses a closed low of at most 1008 mb centered near 26.4N, 75.4W with a warm front extending from the low east-northeastward and a cold front extending from the low south-southwestward. Microfilm at 12Z analyzes two closed lows along a frontal boundary- one of at most 1011 mb centered near 29.6N, 70.1W, and the other of at most 1008 mb centered near 25.9N, 75.2W. At 18Z, microfilm analyzes the first low of at most 1005 mb centered near 29.5N, 68.3W, and the other low is of at most 1002 mb centered near 27.9N, 74.7W (the 18Z HURDAT position is 27.3N, 73.5W). Ship highlights: 35 kt ENE and 1011 mb at 00Z at 27.0N, 75.5W (COA); 35 kt S and 1012 mb at 00Z at 24.5N, 74.0W (micro); 35 kt NE and 1008 mb at 18Z at 28.0N, 75.7W (COA); 40 kt ENE and 1003 mb (pressure looks too low) at 18Z at 29.7N, 74.4W (COA). Land/station highlights: 35 kt NNE and 0007Z at San Salvador (micro). Aircraft highlights: possible Air Force center fix at 1437Z at 25.9N, 75.2W with 1008 mb lowest pressure encountered and 45 kt max winds (ATS, micro). "After clearing the Bahamas the storm swung back north to resume a more normal course, it was joined by an old polar front and become a wave disturbance of extratropical character" (MWR). "The Air Force provided the morning reconnaissance of 27 October and found a diffuse eye at 25.9N, 75.2W. This position was about 80 nmi NNW of the fix of the previous afternoon. The maximum winds encountered were 45 kt in the SE quadrant and the minimum pressure had risen to 1008 mb. A search of the area of the reconnaissance plane failed to disclose any indication of a closed circulation. The degeneration of Hurricane Fox was now evident. The remnants of the organized storm were drifting slowly north-northwestward toward an area of falling pressure tendencies near a front. Fox was extratropical on the 1830Z surface analysis of 27 October. The frontal wind shifts and temperature discontinuities were becoming more marked and Fox was becoming the westernmost cell of an elongated low which extended eastward to an open wave about 180 nmi SW of Bermuda. After 1830Z, 27 October, the open wave, which had been Fox, began to move northeastward" (ATS).

October 28:

HWM analyzes a closed low of at most 1005 mb centered near 31.0N, 72.5W with a warm front plotted from 35N, 70W southeastward to 32N, 64W to 30N, 60W. HURDAT lists this as a 25 kt tropical depression at 31.7N, 69.0W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes an elongated, but closed low along a frontal boundary of at most 1008 mb centered in the general vicinity of 31.2N, 69.8W. Ship highlights (through 12Z only): 35 kt ENE at 00Z at 29.0N, 76.0W (COA). “It moved northeastward thereafter as a disturbance of no great violence and passed to the northwest of Bermuda on October 28” (MWR). “The last [advisories] on Fox were issued on the morning of 28 October” (ATS).

October 29:

HURDAT no longer lists a system on this day. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 41.3N, 55.2W [not sure if this is the remnant of Fox]. This low is located in the warm sector of a powerful extratropical cyclone of at most 987 mb centered near 46.6N, 64W. “The wave passed 100 nmi north of Bermuda on 29 October” (ATS).

October 30:

“On 30 October the open wave lost its identity as a separate circulation and become imbedded in the much stronger circulation of a deep North Atlantic low” (ATS).

The disturbance that became Hurricane Fox originated in the western Caribbean Sea as many historical hurricanes have in the month of October. HURDAT begins this system on 20 October at 12Z as a 25 kt tropical depression at 11.8N, 77.6W. Observations back on the 19<sup>th</sup> show that a closed circulation did not yet exist on that day. On the 20<sup>th</sup>, observations show a weak circulation beginning to take shape. No change is made to the timing of genesis or to the intensity at genesis, but the position is moved a few tenths of a degree southward to 11.4N, 77.7W. No major track changes are made to this system until the 28<sup>th</sup> during an extratropical phase (discussed later). While the circulation was still weak, it moved northward at a modest speed, but by the 21<sup>st</sup>, it began to slow down when it reached a location near 15.3N, 80.9W. The highest wind recorded from genesis through the 21<sup>st</sup> at 18Z was 25 kt and the lowest pressure recorded during that time was 1008 mb. On the 21<sup>st</sup>, the center of the cyclone passed very close to ship 6583 (COA). The ship was sailing southeastward and passed within a degree (or maybe within one-half degree) west of the center (probably the weaker side). The wind shifted from 15 kt N and 1010 mb at 12Z on the 21<sup>st</sup> to 15 kt SW and 1010 mb at 18Z on the 21<sup>st</sup>. On 21 October at 2050Z, aircraft reconnaissance encountered a lowest pressure of 1003 mb and 50 kt maximum winds. A wind shift was observed at the point of lowest pressure, but ship data indicates that the reported position of this possible aircraft center fix was probably too far north. If the position of the aircraft was reported correctly, then the aircraft pressure appears biased about 3 mb too low. Another scenario is that the aircraft position was in error or the navigation was off. Due to this uncertainty and also that the cyclone looked weak from the ship data, the intensity at 12 and 18Z on the 21<sup>st</sup> is lowered. Intensities of 35 and 45 kt are chosen for 12 and 18Z on the 21<sup>st</sup> (down from 45 and 50 kt originally).

No change is made to the time this cyclone became a tropical storm (12Z on the 21<sup>st</sup>). The 1003 mb pressure in HURDAT at 18Z on the 21<sup>st</sup> is removed. Fox moved slowly north-northwestward, and then it moved slowly northward. It passed west of Grand Cayman on the 23<sup>rd</sup> and moved north-northeastward toward the south-central coast of Cuba. The largest track change during the period from genesis through the 24<sup>th</sup> is about six-tenths of a degree, and these change were made at 18Z on the 21<sup>st</sup> and 00Z on the 22<sup>nd</sup> (the positions were shifted north-northwestward. Some 30 kt winds were observed from ships and Swan Island from late on the 21<sup>st</sup> through 12Z on the 22<sup>nd</sup>. On the 22<sup>nd</sup> at 1745Z, aircraft reconnaissance measured a central pressure of 993 mb. The 993 mb central pressure in HURDAT at 18Z on the 22<sup>nd</sup> is retained. A central pressure of 993 mb yields 59 kt according to the Brown et al. southern pressure-wind relationship. Maximum flight-level winds encountered were 80 kt at 600 ft. Fox was moving with a forward speed at only 4 kt. A 60 kt intensity is chosen for 18Z on the 22<sup>nd</sup> (down from 75 kt originally). The first ship gale was recorded at 21Z on the 22<sup>nd</sup> (40 kt with a 999 mb pressure 40 to 45 nmi from the interpolated analyzed center). On the 23<sup>rd</sup> at 1410Z, a central pressure of 942 mb was recorded by aircraft reconnaissance, and this value is added to HURDAT at 12Z on the 23<sup>rd</sup>. A 942 mb central pressure equals 121 kt according to the intensifying subset of the southern pressure-wind relationship. The RMW was average and the speed was still slow. Intensities of 110 and 115 kt are chosen for 12 and 18Z on the 23<sup>rd</sup> (up to 95 and 100 kt originally). Fox is analyzed to have become a hurricane by 00Z on the 23<sup>rd</sup> (12 hours later than originally). Fox is analyzed to have become a major hurricane by 12Z on the 23<sup>rd</sup> (six hours earlier than originally). Observations from Grand Cayman late on the 23<sup>rd</sup> indicate that this intense hurricane was very small (strong winds did not extend very far outward from the center). On the 24<sup>th</sup> at 1534Z, aircraft reconnaissance measured a central pressure of 940 mb, and this value is added to HURDAT at 12Z on the 24<sup>th</sup>. A central pressure of 940 mb equals 121 kt according to the southern-pressure wind relationship. The RMW was average and the speed had increased to about 9 kt. Hurricane Fox passed near or over Cayo Guano Del Este lighthouse (21.6 to 21.7N, 81.0 to 81.1W) at 1630Z on the 24<sup>th</sup> and it is analyzed to have made landfall in mainland Cuba at 18Z on 24 October. MWR states that the minimum pressure recorded at Cayo Guano Del Este was 933.6 mb, but Perez states that 940 mb was the minimum pressure experienced at 1630Z. Perez estimates a central pressure of 936 mb based on the 940 mb observation. Therefore, Perez believes that the 940 mb observation was not a central pressure observation. The analyzed central pressure should be either 934 or 936 mb, depending on whether the MWR or the Perez information is used. (Maybe the 934 mb was a pressure not adjusted to sea-level) but there is no information on this). The 934 mb central pressure in HURDAT at 18Z on the 24<sup>th</sup> is retained. The highest wind gusts reported at Cayo Guano Del Este are 151 kt (Perez) and 157 kt (MWR). It is not certain whether these winds gusts were measured or estimated. If they were measured, this lighthouse is about 25 m tall, and the anemometer can be assumed to be at a height of 25 m. Regardless, this uncertain wind gust information cannot be used to determine the intensity. The 934 mb central pressure yields intensities of 126 and 129 kt according to the southern pressure-wind relationship and its intensifying subset respectively. HURDAT previously showed landfall with a 130 kt intensity. Perez recommends a 120 kt landfall intensity. A 125 kt intensity is chosen for the 16Z landfall on Cayo Guano Del Este and the 18Z landfall in mainland Cuba.

Therefore, the landfall intensity (which is also the peak intensity for Hurricane Fox) is reduced from 130 to 125 kt. Fox was over Cuba until 02Z on the 25<sup>th</sup>. The center was tracked by radar fixes from the Boca Chica land-based radar while it was over land, and when it emerged back over water, aircraft made radar fixes during the night. A run of the Kaplan and DeMaria Inland Decay Model yields 78 kt for 00Z on the 25<sup>th</sup>, and 80 kt is chosen for the 00Z intensity (down from 100 kt originally). All information indicates that rapid filling occurred as soon as Fox made landfall in Cuba. On the 25<sup>th</sup>, Fox curved from north-northeastward to eastward. It passed over Andros Island from 19Z to 22Z on the 25<sup>th</sup>. On the 25<sup>th</sup> at 2005Z, aircraft reconnaissance apparently measured a central pressure of 991 mb. Even though the analyzed track is a few tenths of a degree of from the center fix, which indicates the center was over land at the time of the center fix, the 991 mb central pressure value is retained in HURDAT at 18Z on the 25<sup>th</sup>. A central pressure of 991 mb yields 62 kt according to the southern pressure-wind relationship and 58 kt north of 25N. A 60 kt intensity is analyzed for 18Z on the 25<sup>th</sup> (down from 90 kt originally- a major change). As Fox continued moving eastward through the Bahamas, Eleuthera experienced strong winds and pressures down to 1000 mb during the pre-dawn hours of the 26<sup>th</sup>. All winds reported from Eleuthera were estimated after 04Z and should not be considered official winds. At 1425Z on the 26<sup>th</sup>, aircraft apparently fixed the center and measured a central pressure of 994 mb. However, other data indicates that this fix was in error and a 994 mb central pressure is not added to HURDAT. Cat Island reported hurricane force winds at 15 or 16Z on the 26<sup>th</sup>. At 1630Z, aircraft reconnaissance reported 95 kt flight-level winds. At 1930Z, San Salvador recorded winds of 45 to 50 kt, and a rather interesting wind shift of nearly 180 degrees was observed there. At about the same time, at 2118Z on the 26<sup>th</sup>, a central pressure of 994 mb was recorded by aircraft reconnaissance, and this value is added to HURDAT at 00Z on the 27<sup>th</sup>. A central pressure of 994 mb yields 58 and 53 kt according to the southern and north of 25N pressure-wind relationships. The center fix by aircraft reconnaissance was eight-tenths of a degree north of San Salvador. A position halfway between San Salvador and aircraft fix is analyzed for that time. Analyzed intensities on the 26<sup>th</sup> are 65, 75, 75, and 70 kt (down from 95, 95, 100, and 95 kt- all major changes). A 55 kt intensity is analyzed from 00Z on the 27<sup>th</sup> (down from 80 kt originally). Fox is analyzed to have weakened to a tropical storm at 00Z on the 27<sup>th</sup> (12 hours earlier than originally). It is difficult to track the cyclone on the 27<sup>th</sup> after it left the Bahamas. Observations indicate that the circulation of Fox became elongated as frontal features began to take shape. On the 27<sup>th</sup> at 18Z, ship data indicates that Fox was still a rather distinct cyclone about eight-tenths of a degree west of the previous HURDAT position. It is analyzed that Fox became extratropical at 18Z on the 27<sup>th</sup>. This is a new addition to HURDAT, as HURDAT did not previously show an extratropical phase. The only major track change is made at 06Z on the 28<sup>th</sup>. The position is moved 2.1 degrees west of the previous HURDAT position, and this is indicated by a few ship observations. No change is made to the timing of dissipation, which occurred at 12Z on the 28<sup>th</sup> at 31.4N, 70.4W as a 25 kt extratropical cyclone.

Additional quote:

“The excellent warning service is given credit for the fact that no lives were lost. Commander Millas of the National Observatory at Havana gave the Miami Hurricane

Central the best possible cooperation, and the special surface and upper air observations furnished from Cuban stations made the excellent warnings possible. This was another of those very small but very severe hurricanes from the western Caribbean for which October is famous" (MWR).

#### 1952 Storm 11 (new to HURDAT)

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35565 11/24/1952 M= 7 11 SNBR= 785 NOT NAMED XING=0 L
35570 11/24* 0 0 0 0* 0 0 0 0* 0 0 0 0E225 600 30 0*
35570 11/25E232 585 35 0E241 570 40 0E252 560 45 0E258 557 45 0*
35570 11/26E264 557 45 0E270 559 45 0*276 563 45 0*282 568 45 0*
35570 11/27*288 580 50 0*292 593 50 0*293 603 50 0*290 613 50 0*
35570 11/28*284 623 50 0*278 626 50 0*272 627 50 0*269 627 50 0*
35570 11/29*266 624 45 0*263 613 45 0*262 602 40 0*267 588 40 0*
35570 11/30*272 574 35 0*270 570 35 0*267 568 35 0E264 563 35 0*
35570 TS

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HWM, microfilm, the MWR tracks of lows COADS, Jack Beven's list of suspects, and David Roth's list of potential systems indicates that a tropical storm, previously undocumented to HURDAT, occurred during late November in the central Atlantic Ocean.

#### November 23:

HWM analyzes an elongated, closed low of at most 1010 mb centered near 21.8N, 61.3W with a stationary front extending from the low east-northeastward to 25N, 50W. The MWR tracks of centers of cyclones shows a 12Z position near 22.1N, 65.1W with a 1010 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 21.0N, 65.0W. No gales or low pressures.

#### November 24:

HWM analyzes an elongated, closed low of at most 1010 mb between 19-24N, 55-64W with a warm front extending from the low eastward to 24N, 46W and a stationary front extending from the low southwestward to 18N, 66W. The MWR tracks of centers of cyclones shows a 12Z position near 21.8N, 60.7W with a 1008 mb pressure. Roth at 12Z lists this as a 25 kt extratropical cyclone at 22.5N, 58.0W. Microfilm at 12Z does not analyze a closed low. No gales or low pressures.

#### November 25:

HWM analyzes a closed low of at most 1005 mb centered near 24.5N, 55.7W with a warm front extending from the low eastward to 25N, 46W and a cold front extending from the low southwestward to 18N, 65W. The MWR tracks of centers of cyclones shows a 12Z position near 25.5N, 57.1W with a 1000 mb pressure. Roth at 12Z lists this as a 35 kt extratropical cyclone at 24.5N, 56.5W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 24.4N, 56.1W. Ship highlights: 35 kt NE and 1002 mb at 12Z at 26.0N, 56.7W (micro); 35 kt ENE and 1006 mb at 12Z at 26.7N, 54.5W (COA, HWM, micro); 35 kt NE and 999 mb at 18Z at 26.2N, 55.7W (micro); 35 kt ENE and 1002 mb at 18Z at 27.0N, 53.7W (COA, micro).

## November 26:

HWM analyzes a closed low of at most 995 mb centered near 26.8N, 58.0W. An occluded front extends from 29N, 58W to a triple point at 29N, 55W. A stationary front extends from the triple point eastward to 27N, 44W, and a dissipating cold front extends from the triple point to 27N, 54W to 25N, 54W to 22N, 55W becoming a cold front at 21N, 56W extending southwestward to 17N, 65W. The MWR tracks of centers of cyclones shows a 12Z position near 27.6N, 57.7W with a 995 mb pressure. Roth at 12Z lists this as a 40 kt extratropical cyclone at 28.0N, 56.0W. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near 27.8N, 56.0W. Ship highlights: 30 kt W and 1003 mb at 00Z at 24.6N, 56.5W (COA); 20 kt N and 998 mb at 12Z at 28.0N, 57.2W (COA); 30 kt S and 999 mb at 12Z at 27.7N, 55.4W (HWM, micro); 30 kt S and 1002 mb at 18Z at 26.6N, 55.8W (COA, micro). Six other low pressures.

## November 27:

HWM analyzes a closed low of at most 1000 mb centered near 28.6N, 59.6W. The WNW end of a WNW-ESE dissipating stationary front is located 120 nmi ENE of the cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 29.1N, 59.1W with a 1004 mb pressure. Roth at 12Z lists this as a 50 kt extratropical cyclone at 28.5N, 60.5W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 28.6N, 59.2W. Ship highlights: 40 kt N and 1001 mb at 06Z at 29.3N, 61.3W (COA); 40 kt NNE and 1003 mb at 12Z at 30.0N, 62.0W (COA); 50 kt NE and 1006 mb at 18Z at 30.7N, 63.2W (COA). Three other low pressures.

## November 28:

HWM analyzes a closed low of at most 1000 mb centered near 26.2N, 61.9W. The west end of a W-E warm front is located more than 300 nmi east of the cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 27.8N, 62.6W with a 997 mb pressure. Roth at 12Z lists this as a 50 kt subtropical storm at 26.5N, 62.0W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 27.0N, 61.3W. Ship highlights: 40 kt NE and 1011 mb at 00Z at 31.5N, 64.8W (COA); 30 kt NE and 1001 mb at 00Z at 27.5N, 64.0W (COA); 40 kt ENE and 1000 mb at 12Z at 28.1N, 62.0W (COA, HWM, micro); 35 kt NNE and 1004 mb at 18Z at 27.8N, 63.6W (COA).

## November 29:

HWM analyzes a closed low of at most 1005 mb centered near 25.3N, 59.3W. A warm front is plotted from 32N, 57W to 29N, 52W becoming a dissipating stationary front at 27N, 50W extending to 23N, 43W. Also, a cold front is approaching from the northwest as is located 400 nmi NW of the cyclone. The MWR tracks of centers of cyclones shows a 12Z position near 28.8N, 61.9W with a 1002 mb pressure. Roth at 12Z lists this as a 45 kt subtropical storm at 26.5N, 59.0W. Microfilm analyzes a closed low of at most 1011 mb centered in the general vicinity of 25.7N, 61.2W with a cold front approaching from the northwest. Ship highlights: 20 kt SW and 1006 mb at 18Z at 27.3N, 58.4W (COA).

## November 30:

HWM analyzes a closed low of at most 1010 mb centered near 25.3N, 56.6W. A cold front approaching from the northwest is now located about 110 nmi NW of the cyclone.

The MWR tracks of centers of cyclones shows a 12Z position near 25.8N, 58.4W with a 1005 mb pressure. Roth at 12Z lists this as a 45 kt extratropical cyclone at 34.0N, 50.0W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 26.1N, 56.2W with fronts encroaching on the cyclone from the NNE and SW, each located about 120 nmi from the cyclone. Ship highlights: 30 kt SSW and 1007 mb at 06Z at 25.1N, 55.9W (COA).

December 1:

The MWR tracks of centers of cyclones last shows a position at 00Z near 26.8N, 55.7W.

On 23 November, the tail end of a front was located a few hundred nmi north of the Virgin Islands. A large, broad, extratropical low formed along this front on 24 October. This cyclone is started at 18Z on 24 November as a 30 kt extratropical low at 22.5N, 60.5W. The low intensified to a 45 kt extratropical cyclone by 12Z on the 25<sup>th</sup> as it moved northeastward to a position of 25.2N, 55.8W. The cyclone moved northward and transitioned to a tropical cyclone at 12Z on the 26<sup>th</sup> at 27.6N, 56.3W. Although no gales were observed on the 26<sup>th</sup>, gales were observed on every other day from the 25<sup>th</sup> through the 28<sup>th</sup>. On the 26<sup>th</sup>, a 998 mb pressure was recorded with winds of 20 kt by a ship at 12Z. A peripheral pressure of 998 mb suggests winds of at least 47 kt according to the Brown et al. north of 25N pressure-wind relationship, and a 45 kt intensity is analyzed at all times on the 26<sup>th</sup>. Then the tropical storm moved west-northwestward to 29.3N, 60.3W by 12Z on the 27<sup>th</sup>. On the 27<sup>th</sup>, winds as high as 50 kt and pressures as low as 1001 mb were recorded by ships. The analyzed intensity of the tropical storm is 50 kt at all times on the 27<sup>th</sup>. The cyclone moved southwestward to 27.2N, 62.7W by 12Z on the 28<sup>th</sup>. Winds as high as 40 kt and pressures as low as 1001 mb were recorded on the 28<sup>th</sup>. A peak intensity of 50 kt is analyzed from 00Z on the 27<sup>th</sup> through 18Z on the 28<sup>th</sup>. Then, the cyclone made a southeastward turn, reaching a point of 26.2N, 60.2W by the 29<sup>th</sup> at 12Z. The tropical storm did not move much on the 30<sup>th</sup> as a cold front approached from the northwest. No gales or low pressures were observed on the 29<sup>th</sup> or 30<sup>th</sup> for the remainder of the lifetime of the cyclone. The cyclone is analyzed to have weakened to a 35 kt tropical storm by 00Z on the 30<sup>th</sup>. The cyclone was absorbed and dissipated by a cold front early on 1 December. The final point before the cyclone was absorbed is 18Z on 30 November at 26.4N, 56.0W as a 35 kt tropical storm. The circulation of this cyclone was large throughout its lifetime and likely would have been considered to be a subtropical storm using the classification system of today.

1952 additional notes

1)

HWM, microfilm, and the MWR tracks of lows indicate that a weak, non-frontal low existed in the west-central Atlantic Ocean from 24-26 April. No gales or low pressures were found, even after obtaining the COADS data. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Apr 24	23N	64W	Broad low/trough
Apr 25	28N	68W	Broad low/trough
Apr 26	33N	69W	Broad low/trough
Apr 27			Absorbed by frontal system

2)

Hector (1975) indicates that a “low pressure system formed SE of Swan Island with a central pressure of 1005 mb [on the 11<sup>th</sup>]. On the 12<sup>th</sup>, it was located NE of Grand Cayman Island where it had weakened and its central pressure had risen to 1009 mb” (Hector). There are no other sources that indicate a disturbance of any kind, and there are no gales, low pressures, or observations that would indicate a closed circulation in the area. Thus, this is not added to HURDAT.

DAY	LAT	LON	STATUS
May 11	16N	82W	Weak low
May 12	20N	80W	Weak low

3)

David Roth’s list of potential suspects and Ryan Truchelut’s (FSU grad student) warm anomaly study indicate that an extratropical low pressure system developed over the northern Bahamas on 1 July. By the 3<sup>rd</sup>, these sources indicate the system was no longer extratropical and it had a closed circulation. It crossed the Florida peninsula on the 3<sup>rd</sup> from east to west before emerging into the Gulf of Mexico. A search through observations over Florida from the climatological summaries and microfilm reveals that there were no gales recorded on land. No gales or low pressures were recorded during the entire tropical portion of the lifetime of this system. Thus, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Jul 01			Open trough
Jul 02	28N	78W	Extratropical
Jul 03	26N	83W	Tropical Depression
Jul 04	24N	88W	Tropical Depression
Jul 05			Dissipated

4)

HWM, microfilm, COADS, climatological data summaries from NCDC, and Truchelut’s warm anomaly study indicate that a sharp trough or easterly wave containing squally weather moved across the western half of the Gulf of Mexico on 15-16 July and moved

inland over Texas and Mexico on the 17<sup>th</sup>. Aircraft reconnaissance flights on the 15<sup>th</sup> and 16<sup>th</sup> find an elongated, squally trough over the western Gulf of Mexico with lowest pressure 1005 mb on the 15<sup>th</sup> and 1004 mb on the 14<sup>th</sup>. The land-based radar in Freeport, TX also does not show a tropical cyclone on its scope but does show squall lines containing heavy rain according to human observers there. Highest 1-minute winds recorded at Corpus Christi and Galveston were 35 and 37 kt respectively. The lowest pressure recorded from a land station in Texas was 1007 mb. Six-hourly observations from Texas coastal cities reveal that no tropical cyclone made landfall on the Texas coast. There were no wind shifts or pressure drops suggesting the passage of a tropical cyclone. The strongest winds were behind the wave axis and were recorded well after the lowest pressures.

DAY	LAT	LON	STATUS
Jul 15			Open wave/trough along 92W from 32N-18N
Jul 16			Open wave/trough along 95W from 32N-20N
Jul 17			Open wave/trough along 99W from 31N-20W
Jul 18			Open wave/trough along 103W

5)

HWM shows a small, weak low in the northeastern Atlantic Ocean on 27 July. On the 27<sup>th</sup>, the low was closed with temperatures in the 70s surrounding it. No gales or low pressures were observed in association with the low for the entire duration of its lifetime. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Jul 27	38N	36W	Tropical Depression
Jul 28	41N	33W	Broad low/trough
Jul 29			Dissipated

6)

HWM, COADS, and Ryan Truchelut's study indicate that a tropical wave emerged off of Africa on 12 August and traveled westward across the tropical Atlantic Ocean during the next several days. COADS data suggests that it may have attained a closed circulation by the 14<sup>th</sup>, and Truchelut's data indicates a possible closed circulation on the 15<sup>th</sup>. No gales or low pressures are found with this system from the 12<sup>th</sup> through the 18<sup>th</sup>, which is all of the days that were searched. Thus, this system is not added to HURDAT. Note that points listed below from 15 to 18 August are somewhat uncertain due to lack of data.

DAY	LAT	LON	STATUS
Aug 12	5-24N	18W	Tropical wave
Aug 13	14N	23W	Broad low/wave
Aug 14	13N	28W	Tropical depression

Aug 15	14N	32W	Tropical depression
Aug 16	15N	35W	Broad low/wave
Aug 17	15N	38W	Broad low/wave
Aug 18	17N	40W	Broad low/wave

7)

HWM, microfilm, and Shernan and Carino (1952) indicate that a broad area of elongated low pressure or a trough was present in the Gulf of Mexico on 28 August. On the 28<sup>th</sup> at 12Z, a 35 kt east wind was observed with a 1013 mb pressure at 28.7N, 93.7W but other observations very close to this ship reported lower winds. One low pressure of 1005 mb was observed at 12Z on the 28<sup>th</sup> plotted on microfilm much further south in the central Gulf of Mexico. The trough split into two areas of slightly low pressure on the 29<sup>th</sup>. One moved inland on the Gulf coast and one continued southward. Neither of these are analyzed to have become tropical cyclones, and neither system is added to HURDAT.

DAY	LAT	LON	STATUS
Aug 28	26N	93W	Broad low/trough
Split into 2 broad lows/areas of troughiness			
Aug 29 area 1:	30N	86W	Broad low/trough
Aug 29 area 2:	24N	93W	Broad low/trough
Aug 30 area 1:	35N	87W	Broad low/trough
Aug 30 area 2:	24N	93W	Broad low/trough
Aug 31 area 1:			Dissipated
Aug 31 area 2:			Dissipated

8)

Lott (1952) describes a severe flooding rain event that occurred in Texas on September 9<sup>th</sup> and 10<sup>th</sup>. Lott suggests that one of the key ingredients that produced this flood was a tropical wave that moved westward into Texas from the Gulf of Mexico. HWM, microfilm, and COADS indicate that some squally weather was present in the western Gulf of Mexico during the time that would be consistent with a wave moving into northern Mexico and/or southern Texas late on the 9<sup>th</sup>. Ryan Truchelut's study indicates a tropical wave with warm signature anomalies near 20N, 73W on 2 September, and this anomaly is tracked westward to the Bay of Campeche by 7 September. It is possible this was the precursor to the rain event in Texas. HWM on the 3<sup>rd</sup> indicates a tropical wave or spot low near 17N, 80W. On the 8<sup>th</sup>, HWM analyzes two areas of interest- one near 25N, 94W, and the other near 21N, 88W. Even after obtaining all data, it is difficult to track a coherent vortex, and data indicates this was an open wave. Although the system produced pressure falls of about 3 mb over the Gulf of Mexico, Texas, and Mexico, there were no gales or low pressures observed with this system, either over the ocean or over Texas. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 08	23N	89W	Broad low/trough
Sep 09	25N	94W	Broad low/trough
Sep 10	32N, 97W to 22N 99W		Open trough
Sep 11			Dissipated

9)

HWM, the MWR tracks of lows, COADS, and Jack Beven's list of suspects indicate that a low formed along a dissipating frontal boundary near 28N, 78W on 10 September. Later on the 10<sup>th</sup>, the low occluded and drifted west-northwestward. Some gales of 35-45 kt were reported on the 10<sup>th</sup> through 00Z on the 11<sup>th</sup>. On the 11<sup>th</sup>, observations indicate that this low was still occluded as it moved closer to the coastline near the Florida/Georgia border. By the time the low reached the coast just after 12Z, the circulation was very weak. No gales were reported from any land stations. Although several gales were reported on the 10<sup>th</sup> through 00Z on the 11<sup>th</sup>, it is analyzed that this system never became a tropical cyclone. During the time when the gales were recorded, it was frontal and then occluded. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 10	28N	78W	Extratropical
Sep 11	30N	80W	Weak low
Sep 12			Dissipated

10)

Analyses and a few observations in HWM and on microfilm suggest that a broad area of low pressure or a pressure trough existed in the Gulf of Mexico from 10-13 September. At 18Z on the 12<sup>th</sup>, microfilm interesting analyzes a closed low near Vera Cruz. Pressures of 1004 and 1003 mb are observed, but the winds are light and environmental pressures are low. It is more likely that this remained a NNE-SSW open trough the Gulf of Mexico rather than an organized area of low pressure. There are no observed gales in this area associated with this trough from the 10<sup>th</sup> through the 13<sup>th</sup>, and a closed circulation is difficult to confirm from available observations. This system is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 10	24N	93W	Broad low/trough
Sep 11	21N	93W	Broad low/trough
Sep 12	19N	94W	Broad low/trough
Sep 13	31N 91W to 15N 98W		Open trough
Sep 14			Dissipated

11)

HWM and COADS data indicate a compact, closed low with winds of at least 30 kt and temperatures in the 70s centered near 44N, 32W on 14 September. This low probably formed along a frontal boundary associated with an eastward-moving mid-latitude cyclone, but there is the possibility that this could have been an early recurving tropical cyclone. The COADS data from 12<sup>th</sup> and 13<sup>th</sup> were obtained for a wide area of the Atlantic, but no data was found to indicate a disturbance on the 12<sup>th</sup> or 13<sup>th</sup>. The former scenario is used in this case- that this low was developing along a frontal boundary which already existed, although observations show that there was not a temperature gradient across the low. On the 14<sup>th</sup>, only one gale could be found at 18Z, but this gale is too far away from the center of the cyclone and lies in a region with a high synoptic pressure gradient. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 14	44N	32W	Extratropical
Sep 15	45N	32W	Extratropical
Sep 16			Absorbed by a frontal wave which later became additional note #12

12)

HWM, COADS, David Roth's list of potential systems, and Jack Beven's list of suspects indicate that a frontal wave in the North Atlantic Ocean became an extratropical cyclone on the 17<sup>th</sup> with an intensity of about 35 kt. This extratropical cyclone is analyzed to have transitioned to a tropical cyclone by the 19<sup>th</sup> through at least the 21<sup>st</sup>. By the 22<sup>nd</sup>, the tropical cyclone was very weak and by the 23<sup>rd</sup> it was dissipated. There are three observed gales of 35 kt after the cyclone lost its extratropical characteristics, but two of them are too far away from the center to be considered representative of the circulation. Since only one gale is observed near the center of circulation, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 17	49N	34W	Extratropical
Sep 18	43N	30W	Extratropical
Sep 19	39N	33W	Tropical depression
Sep 20	39N	35W	Tropical depression
Sep 21	41N	36W	Tropical depression
Sep 22	46N	37W	Tropical depression
Sep 23			Dissipated

13)

Microfilm shows a ship observation of 40 kt with 1009 mb at 0330Z on 25 September at 21.5N, 96.5W. The ship's lowest pressure of 1007.5 mb occurred on the 24<sup>th</sup> at 2000Z. All available data including COADS on the 24<sup>th</sup> and 25<sup>th</sup> does not reveal any other gales or low pressures. The data also does not reveal any signs of a significant disturbance. Since there is only one piece of evidence and since there are no other signs of a disturbance, a system cannot be added to HURDAT.

DAY	LAT	LON	STATUS
Sep 25 00Z	21N	96W	Squall

14)

HWM, microfilm, the MWR tracks of lows, and climatological data summaries indicate that an extratropical cyclone, which formed over the Gulf of Mexico on the 19<sup>th</sup>, moved eastward and passed over Florida on the 20<sup>th</sup> and 21<sup>st</sup> before moving off into the Atlantic on the 22<sup>nd</sup>. Gales were reported from several official Weather Bureau stations including Downtown Miami, Miami Airport, Tampa, Daytona Beach, and Jacksonville. Miami WBO recorded 52 kt (max w/1-min/elevated) (45 kt at 10 m), and Jacksonville recorded 49 kt (max w/1-min/elevated) (47 kt at 10 m). Since all data sources indicate that this system was extratropical, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Oct 19	26N	86W	Extratropical
Oct 20	27N	83W	Extratropical
Oct 21	27N	78W	Extratropical
Oct 22	27N	74W	Extratropical
Oct 23			Open trough/front

15)

Observations mainly from HWM and also from COADS and microfilm indicate that a disturbance in the southwestern Caribbean Sea on 29 October moved west-northwestward. It appears to have attained a closed circulation by the 31<sup>st</sup> near 13N, 83W. Observations on microfilm maps outline the system fairly well from 2 November at 06Z through 3 November at 00Z as it moves over the Yucatan Peninsula; observations from HWM alone to locate the position on the 2<sup>nd</sup> are not sufficient compared to observations on microfilm maps over land. The one gale observed with this system- 40 kt- is found in COADS from a ship 350 nmi north of the center. The highest available wind observation directly associated with this system is 30 kt and the lowest observed pressure was 1007 mb. This system was likely at least a tropical depression and could have been a tropical storm. Since the only piece of evidence is a gale located too far away, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
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Oct 29	13N	76W	Weak low
Oct 30	13N	79W	Weak low
Oct 31	14N	83W	Tropical depression
Nov 01	16N	85W	Tropical depression
Nov 02	18N	89W	Tropical depression
Nov 03	19N	93W	Remnant low
Nov 04			Dissipated

16)

Jack Beven's list of suspects, David Roth's list of potential systems, and HWM indicate that an extratropical cyclone over the northeastern Atlantic lost its frontal characteristics late on 4 November with temperatures surrounding the cyclone of near 70 degrees. It could have been a tropical cyclone on the 4<sup>th</sup> and 5<sup>th</sup> before being absorbed on the 6<sup>th</sup>. The only gale directly associated with this system occurred at 00Z on the 4<sup>th</sup>. Since there is only one piece of evidence, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Nov 03	34N	36W	Extratropical
Nov 04	32N	34W	Extratropical
Nov 05	34N	35W	Tropical depression
Nov 06			Absorbed

17)

HWM, microfilm, the MWR tracks of lows, and Jack Beven's list of suspects indicate that a non-frontal, but broad, closed low was moving slowly northward in the subtropical central Atlantic Ocean on 3 and 4 November. There were observed pressures below 1005 mb closer to the center, but these were all accompanied by light winds. Stronger winds associated with the circulation were located several hundred miles away. Although available observations indicate this system was not a tropical cyclone, but instead a very broad low on the 3<sup>rd</sup> and 4<sup>th</sup>, observations were somewhat sparse on those days. It was absorbed by a front early on the 5<sup>th</sup>. A powerful extratropical cyclone rapidly developed that day from the combination of the broad low and the front, and it accelerated north-northeastward. At 18Z on the 5<sup>th</sup>, a ship near the center reported 75 kt WNW with a 967 mb pressure at about 41.5N, 54.4W. Since data suggests that this system was never a tropical cyclone, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Nov 03	26N	62W	Broad low
Nov 04	28N	62W	Broad low
Nov 05	39N	56W	Extratropical
Nov 06	50N	57W	Extratropical
Nov 07	57N	59W	Extratropical

Nov 08	62N	57W	Extratropical
Nov 09	67N	55W	Extratropical
Nov 10	Dissipated		

18)

David Roth and HWM show a disturbance in the southwestern Caribbean in December that may have been a tropical depression or storm. The highest observed wind is 30 kt. There are no gales or low pressures with this system. This, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Dec 05	12N	78W	Weak low/trough
Dec 06	13N	78W	Weak low/trough
Dec 07	14N	79W	Weak low/trough
Dec 08	14N	80W	Weak low/trough
Dec 09			Dissipated

19)

HWM, microfilm, the MWR tracks of lows, and Jack Beven's list of suspects indicate that an extratropical cyclone moves from just off the southeast coast of the US northward and then eastward. This cyclone was extratropical for its entire lifetime, and this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Dec 05	33N	76W	Extratropical
Dec 06	44N	70W	Extratropical
Dec 07	41N	58W	Extratropical
Dec 08	42N	52W	Extratropical
Dec 09	41N	48W	Extratropical
Dec 10	41N	50W	Extratropical
Dec 11	37N	52W	Extratropical
Dec 12	37N	52W	Extratropical
Dec 13	38N	50W	Extratropical
Dec 14	37N	43W	Extratropical

**1953**

## 1953 Storm 1 (Alice)

## U.S. Landfall:

6/6/1953 - 17Z - 30.3N, 85.9W - 40 kt

Minor track changes and major intensity changes are analyzed for Alice. A major change is made to the timing of when Alice first attained tropical storm strength. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories and Dunn and Miller (1960).

## May 24:

HWM analyzes a closed low of at most 1010 mb centered near 15.7N, 82.6W. HURDAT does not yet list a system on this day. No gales or low pressures. “[An easterly] wave proceeded westward appearing at... Havana (24/0630Z)...” (ATS).

## May 25:

HWM analyzes a very broad closed low of at most 1010 mb between 11-20N, 76-87W with a spot low plotted near 15.3N, 80.1W. HURDAT first lists this at 18Z as a 35 kt tropical storm at 14.4N, 81.8W. Microfilm at 12Z analyzes a spot low near 18.5N, 82.7W. No gales or low pressures. “The first storm of the season developed rather earlier than usual and did not attain hurricane strength. During the latter part of May, a large cold low aloft drifted northward from the vicinity of Panama. On May 25, when this low was centered east of the Nicaraguan coast, a weak warm-core surface center formed” (MWR). “...Swan Island (25/0930Z). Swan Island, supported by other synoptic reports in the vicinity, showed that this easterly wave had been carrying a small vortex through an area of sparse reports along 19N, and at 25/1830Z it was detected near 18.7N, 84.3W” (ATS). “The time cross section showed a second easterly wave passing Martinique and Trinidad at 25/1230Z and 1830Z respectively” (ATS).

## May 26:

HWM analyzes a closed low of at most 1005 mb centered near 15.1N, 83.5W. HURDAT lists this as a 35 kt tropical storm at 16.2N, 83.1W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 15.5N, 83.0W. Land/station highlights: 10 kt N and 1005 mb at 00Z at 15.1N, 83.3W (micro); 5 kt W and 1004 mb at 12Z at 15.1N, 83.3W (HWM, micro); 15 kt NE and 1004 mb at 18Z at 14.3N, 87.1W (micro). “Moving with the larger cyclonic circulation aloft, the surface low made a counterclockwise loop over the Cape Gracias area during the 26<sup>th</sup> to 28<sup>th</sup> and lost force” (MWR). “Surface reports at 26/0630Z placed the circulation near 16.8N, 87.0W, accompanied by winds of 20 kt and moving SW at 15 kt. It then moved inland over Honduras and its identity was lost. A general area of low pressure persisted near 14.0N, 83.0W, fluctuating with the

ITCZ, and occasionally deepening to a possible 1002 mb. The western Caribbean was therefore an area of suspicion prior to the formation of Tropical Storm Alice” (ATS). “[The second wave] at 26/0630Z passed San Juan, with precipitation spreading in advance of the wave; however, passage at Curacao was only lightly reflected at 26/1830Z” (ATS).

May 27:

HWM analyzes a trough in the western Caribbean with a spot low plotted near 13.0N, 78.5W. HURDAT lists this as a 35 kt tropical storm at 14.3N 84.8W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 14.3N, 85.4W. Land/station highlights: 15 kt SE and 1003 mb at 00Z at 15.1N, 83.3W (micro); 20 kt SE and 1003 mb at 00Z at 14.0N, 83.4W (micro); 10 kt NNW and 1003 mb at 18Z at 14.3N, 87.1W (micro). “Surface reports tracked [the second] wave at a fairly constant speed of 10 kt, and pilot reports from the area confirmed that there was a general spreading and intensification of precipitation to the north, and then to the west of the wave axis as it moved westward” (ATS).

May 28:

HWM analyzes a spot low near 12.8N, 80.9W. HURDAT lists this as a 40 kt tropical storm at 13.1N, 83.5W. The MWR post-season track map shows a 12Z position near 14.2N, 83.3W. ATS shows a 1230Z map time position near 17.1N, 76.9W. Microfilm at 12Z analyzes a spot low near 13.6N, 81.4W. Ship highlights: 10 kt ESE and 1005 mb at 00Z at 13.5N, 80.7W (micro). Land/station highlights: 10 kt ENE and 1005 mb at 15.1N, 83.3W (micro). Regarding the second wave described in ATS... “Light continuous rain began at Guantanamo Bay [around 28/0030Z], when the wave was still 200 nmi to the east. This forerunning precipitation reached Kingston [Jamaica], six hours later at 28/0630Z. The surface charts at 28/1230Z and 28/1830Z showed Jamaica to be under the influence of a disturbance passing to the south on a westward course. It is believed that the easterly wave spilled at about 75W, and the resulting small vortex was the beginning of Tropical Storm Alice” (ATS).

May 29:

HWM analyzes a closed low of at most 1005 mb centered near 16.4N, 82.2W. HURDAT lists this as a 40 kt tropical storm at 17.3N, 81.9W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 17.7N, 82.6W. Microfilm at 12Z analyzes a tropical cyclone of at most 1005 mb centered near 16.9N, 82.3W. Station highlight: 10 kt ESE and 1005 mb at 00Z at 15.1N, 83.3W (micro). “The 700 mb chart reflected the circulation [of Alice] by 29/0300Z near 18N, 80W, at which time the post analysis track placed the surface center near 17.2N, 80.5W, entering the envelope of already low pressure previously mentioned as being in the Western Caribbean. The 29/1230Z surface reports... showed it passing to the northeast of Swan Island with a central pressure of 1006 mb, and winds Beaufort Force 2 to 4 (5 to 15 kt)” (ATS).

May 30:

HWM analyzes a closed low of at most 1005 mb centered near 19.9N, 85.3W. HURDAT lists this as a 45 kt tropical storm at 20.9N, 83.0W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 20.0N, 83.8W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 20.9N, 83.4W. Ship highlights: 15 kt SSW and 1004 mb at 06Z at 19.5N, 82.9W (COA); 20 kt SW and 1004 mb at 18Z at 19.0N, 83.5W (COA). Three other low pressures of 1004 mb. Land/station highlights: 10 kt SSE and 1005 mb at 00Z at Grand Cayman (micro). Aircraft highlights: center fix at 1750Z at 20.5N, 84.2W with 1000 mb (possible central) pressure and 40 kt max winds (micro, ATS). “At 30/1230Z, the 3,000 foot winds at Swan Island, Grand Cayman, and Cape San Antonio, Cuba, showed the vortex enclosed with 30 kt [winds] at that level. The surface disturbance was then under a low at 300 mb. [A Navy reconnaissance plane] located the low pressure center at 20.5N, 84.2W at 1750Z with the central pressure at [1000] mb accompanied by 15 kt winds near the center” (ATS).

May 31:

HWM analyzes a closed low of at most 1005 mb centered near 21.1N, 83.9W. HURDAT lists this as a 45 kt tropical storm at 22.0N, 83.6W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 0030Z map time position near 21.0N, 84.4W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 21.6N, 83.7W. Ship highlights: 25 kt ENE and 1003 mb at 12Z at 22.9N, 84.0W (COA, micro); 35 kt SW and 1004 mb at 12Z at 20.7N, 83.0W (COA). Four other low pressures between 1004-1005 mb. Land/station highlights: 10 kt ESE and 1003 mb at 00Z at Isle of Pines (21.5N, 82.8W) (micro); 20 kt ENE and 1005 mb at 00Z at 22.5N, 83.3W (micro). Four other low pressures between 1004-1005 mb. Aircraft highlights: center fixes at 1710Z at 21.8N, 85.0W and at 1730Z near 21.9N, 84.9W with 1003 mb central pressure and 42 kt maximum winds encountered (ATS, micro). “A plane located a definite circulation near 21.8N, 85.0W at 31/1710Z with a low pressure of 1003 mb. This flight, as well as the previous one [on the 30<sup>th</sup>?] encountered winds of 40 kt, but in both cases they were found in the Florida Straits rather than near the surface low center. As the center passed closed to the westward of Cape San Antonio winds of no greater than force 3 [10 kt] were reported” (ATS).

June 1:

HWM analyzes a closed low of at most 1005 mb centered near 23.2N, 85.3W. HURDAT lists this as a 55 kt tropical storm at 24.0N, 84.7W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 0030Z map time position near 22.6N, 85.2W. Microfilm at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 24.3N, 84.7W. Ship highlights: 35 kt NE and 1007 mb at 00Z at 24.6N, 86.2W (COA); 20 kt S and 1002 mb at 12Z at 23.6N, 84.4W (COA, micro); 35 kt E and 1007 mb at 18Z at 25.2N, 84.6W (micro). One other gale of 35 kt and three other low pressures of 1003-1005 mb. Aircraft highlights: center fix at 1417Z at 24.2N, 84.9W (micro); Navy center fix (loran) at either 1530 or 1605Z at 24.3N, 85.6W with 997 mb central pressure and 55 kt maximum winds encountered (micro); center fix at 2345Z at 24.0N, 84.7W with 996 mb central pressure (micro). “Emerging from the loop, the storm deepened as it moved northward and then on June 1-2 described another loop north of the

western end of Cuba in another counterclockwise movement with the upper level circulation. During this second loop, aircraft estimated maximum winds of about 55 kt on June 1..." (MWR). "The first [advisory] on Tropical Storm Alice was released at 01/1530Z. A fix on an eye, amply justifying the [advisory] was obtained by a flight at 01/1605Z, placing the center at 24.3N, 85.6W, with a central pressure of 997 mb, and maximum winds of 55 kt" (ATS).

June 2:

HWM analyzes a closed low of at most 1005 mb centered near 23.2N, 84.6W. HURDAT lists this as a 45 kt tropical storm at 23.0N, 84.7W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 23.3N, 84.9W. Microfilm at 12Z analyzes a tropical cyclone of at most 999 mb centered near 23.0N, 84.4W. Ship highlights: 35 kt NE and 1006 mb at 00Z at 25.5N, 85.4W (COA); 20 kt S and 1000 mb at 14Z at 23.7N, 83.2W (micro); 35 kt SSW and 1005 mb at 1830Z[?] at 24.2N, 82.0W (micro). Three other gales of 35 kt and 15 other low pressures of 1003-1005 mb. Land/station highlights: 25 kt WSW and 1004 mb at 12Z at 21.8N, 84.8W (HWM, micro). Aircraft highlights: center fixes at 0148 and 0240Z between 24.1-24.2N, 84.5W (micro); 40 kt E and 1000 mb at 14Z at 23.3N, 84.3W (ATS); possible Navy center fix at 2050Z at 23.1N, 84.4W with 999 mb (possible central pressure) and 28 kt maximum winds encountered (micro, ATS). "But on the 2<sup>nd</sup> and 3<sup>rd</sup> the wind force dropped to 35-40 kt" (MWR). "Flight No. 6 was a night flight and the plane maintained position between the Florida coast and the storm area. This flight reported that an 'apparent' eye, 40 nmi long, was located... Flight No. 7, made the next morning, searched the area of the night radar fixes and found no closed circulation. The southernmost report from this flight, however, was only 23.3N, 84.3W. At that position at 02/1400Z he reported a pressure of 1000 mb, and wind east at 40 kt. This was the lowest pressure and highest wind reported by that flight. Flight No. 8 found the storm at the position indicated by the 02/2050Z fix. This flight reported 'Definite closed circulation exists. Max west winds were 25 kt just north of Cape San Antonio. Eye completely clear. Lowest pressure 999 mbs. Max winds 28 kt'" (ATS).

June 3:

HWM analyzes a closed low of at most 1005 mb centered near 23.2N, 83.3W with a dissipating stationary front plotted from 34N, 93W to 29N, 90W to 27N, 85W, becoming a cold front near 27N, 80W, extending to 30N, 69W. HURDAT lists this as a 35 kt tropical storm at 23.4N, 83.0W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows an 1830Z map time position near 23.2N, 82.8W. Microfilm at 12Z analyzes a tropical cyclone of at most 1002 mb centered near the HURDAT and HWM positions. Ship highlights: 25 kt E and 1002 mb at 00Z at 24.5N, 83.1W (COA); 20 kt SW and 1000 mb at 06Z at 23.0N, 83.6W (COA). Six other low pressures between 1003-1005 mb. Land/station highlights: 20 kt S and 1002 mb at 00Z at 22.7N, 83.3W (micro); 30 kt SE and 1003 mb at 18Z at Havana, Cuba (micro). "This storm gave heavy flooding rains in western Cuba and unconfirmed press reports indicate there were several deaths from drowning" (MWR). "The effect of a high pressure cell to block northward movement... believed to be responsible for the erratic

movement of Alice from 01/1500Z to 04/0300Z. In coordination with the Weather Bureau, it was decided to discontinue [advisories] after 03/0400Z” (ATS).

June 4:

HWM analyzes a closed low of at most 1005 mb centered near 24.2N, 84.4W. HURDAT lists this as a 50 kt tropical storm at 24.5N, 83.7W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows an 1830Z map time position near 25.0N, 84.0W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 24.3N, 84.3W with the west end of a WSW-ENE frontal boundary located several hundred nmi NE of the cyclone. Ship highlights: 15 kt WSW and 1003 mb at 00Z at 23.1N, 83.1W (COA); 35 kt E and 1005 mb at 06Z at 25.3N, 82.8W (COA); 20 kt SSE and 1005 mb at 12Z at 24.6N, 83.5W (COA, HWM). “Northward movement was resumed on June 4...” (MWR). “By 04/0030Z, with... the storm beginning to occupy a position under the western edge of the ridge, which had strengthened to the east, [Alice] commenced a northwesterly movement at approximately 11 kt. Aware of the possible danger to Gulf coastal installations should it intensify, a close watch was kept on this depression as it moved northward” (ATS).

June 5:

HWM analyzes a spot low near 27.2N, 84.9W. HURDAT lists this as a 60 kt tropical storm at 27.3N, 85.5W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 27.6N, 85.3W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 27.2N, 86.4W. Ship highlights: 40 kt NE and 1005 mb at 00Z at 26.3N, 85.6W (COA); 25 kt S and 1002 mb at 06Z at 26.5N, 85.6W (COA); 45 kt S and 1009 mb at 06Z at 25.1N, 84.8W (COA); possible 65 kt ship ob at 1805Z at 28.8N, 84.3W (micro). Five other low pressures of 1005 mb. Aircraft highlights: Navy center fix at 2245Z at 28.6N, 85.8W with 994 mb central pressure and 65 kt maximum flight-level winds encountered 60 nmi NE of center (micro, ATS). “Maximum development was reached on the 5<sup>th</sup> when aircraft estimated highest winds to be 60 to 65 kt in brief squalls northeast of the center near 29N, 83 to 85W. Central pressure at this time was 997 mb” (MWR). “[A reconnaissance] flight reported a well-defined eye at 28.6N, 85.8W at 05/2245Z. Maximum winds found near the center of the circulation were 40 kt from 160 degrees, however one report was made of 65 kt near an isovellie wind maxima located approximately 60 nmi northeast of the low pressure center” (ATS).

June 6:

HWM analyzes a closed low of at most 1005 mb centered near 28.6N, 87.0W. HURDAT lists this as a 40 kt tropical storm at 29.6N, 85.8W. The MWR post-season track map shows a 12Z position near 29.6N, 86.0W. ATS shows an 1830Z map time position of 30.4N, 86.0W. Microfilm at 12Z analyzes a tropical cyclone of at most 1005 mb centered near 29.7N, 86.3W. Land/station highlights: 35 kt E (max wind/1-minute) at Apalachicola, FL (29.7N, 85.0W) (climo); 1005 mb (min p) at Panama City, FL (30.2N, 85.7W) (ATS). “[Advisories] were resumed on Alice at 06/0025Z. A Navy [radar night] flight showed the storm slowing in speed with a continued NW movement changing to northerly. A flight from Jacksonville on 6 June was unable to find a surface center,

however average winds encountered at 11,000 ft from 29.5N, 86.9W to 28.8N, 84.9W were 290 degrees at 60 kt. Alice lost intensity quickly as the northern edge of its circulation moved over land. The center was estimated to have moved inland at about 06/1800Z by the flight aerologist on the last flight. The post-analysis of the 06/1830Z surface chart proved this quite accurate. Strongest surface winds, although decreasing, continued to be to the east of the center. Highest winds reported by a land station were force 6 [25 kt] at Panama City, FL, as the storm passed 80 nmi to the west. Lowest pressure (1005.1 mb) was also noted at that station” (ATS). “During the night of the 5<sup>th</sup>, the storm again lost force and when it moved inland a short distance west of Panama City, FL about noon of the 6<sup>th</sup>, strongest winds were around 35 to 40 kt. There was no damage of consequence in Florida” (MWR, climo). “Tropical Cyclones in Florida – June 6 – NW FL – Minor” (“Minor” – winds less than 74 mph, pressure greater than 996 mb-Dunn and Miller).

June 7:

HWM analyzes a spot low near 30.7N, 86.1W with a W-E frontal boundary located 300 nmi north of the cyclone. HURDAT no longer lists a system on this day. The MWR post-season track map last shows a position at 00Z near 31.0N, 86.0W. ATS shows an 1830Z map time position near 31.5N, 85.7W. Microfilm at 12Z does not analyze a closed low, but at 18Z analyzes a closed low of at most 1014 mb centered near 30.7N, 84.8W. “The circulation continued inland with decreasing intensity. The weather and winds associated with it remained in the northeast quadrant” (ATS).

June 8:

ATS shows an 1830Z map time position near 32.3N, 84.2W. Microfilm at 12Z analyzes a spot low near 32.4N, 83.9W. “It maintained a central pressure of approximately 1011 mb until 08/0030Z after which time it filled rapidly and was last identifiable as a small closed low of 1016 mb on the 08/1830Z surface chart” (ATS).

HURDAT previously started this system as a 35 kt tropical storm at 18Z on 25 May at 14.4N, 81.8W. Although the timing of genesis is not changed, the cyclone is begun as a 25 kt tropical depression. The depression is analyzed to have moved inland over Honduras and Nicaragua from 06Z on the 26<sup>th</sup> until 12Z on the 28<sup>th</sup> when, after performing a loop, the center moved back into the Caribbean Sea. On the 26<sup>th</sup>, when the cyclone first moved inland into Central America, a pressure of 1004 mb with 5 was recorded from a costal station near the Nicaragua/Honduras border. Although a pressure of less than 1004 mb would suggest winds of greater than 37 kt according to the Brown et al. southern pressure-wind relationships, observations indicate that there was a large area of low environmental pressure over the region, and no observations higher than 10 to 20 kt were observed on that day. All track changes during that time were eight-tenths of a degree or less. After re-emerging over the Caribbean Sea, the depression is analyzed to have moved northward reaching a position of 18.2N, 82.2W by 18Z on the 29<sup>th</sup>, which is the time that the cyclone is analyzed to have strengthened to a tropical storm (four days later than in HURDAT originally). The revised intensity at 18Z on the 29<sup>th</sup> is 35 kt (down from 45 kt originally). It needs to be mentioned that there is some uncertainty as to whether a tropical cyclone actually existed along the indicated track between the 25<sup>th</sup>

and the 28<sup>th</sup>. It is possible that the area of low pressure that moved into Central America on the 26<sup>th</sup> continued westward into the East Pacific. If that is the case, then the cyclone located on the 29<sup>th</sup> near 17N, 82W is not the same cyclone and would have originated from the westward moving tropical wave mentioned in ATS. There are not many observations to support the easterly wave scenario, but available observations indicate that the previous HURDAT scenario could be correct. Therefore, the genesis location and track for the first few days with the loop over Central America is maintained. From the 29<sup>th</sup> to the 31<sup>st</sup>, Alice moved slowly north-northwestward toward the western tip of Cuba. A track about a half degree to the left of the previous HURDAT track is analyzed during that time. ATS mentions that Alice was located underneath a low at the 300 mb level on the 30<sup>th</sup>, and this may have persisted for several more days, hinting that Alice may have been more subtropical in structure. An aircraft central fix at 1750Z on 30 May reported a central pressure of 1000 mb, and this pressure is added to HURDAT at 18Z on the 30<sup>th</sup>. A central pressure of 1000 mb yields 47 kt according to the Brown et al. southern pressure-wind relationship, and 40 kt is chosen (down from 45 kt originally) due to a slow forward motion of the cyclone combined with the fact that no gales had been reported from any ships or surface stations yet and aircraft reconnaissance also reported max winds of 40 kt on that flight. The first gale reported by a ship occurred at 12Z on the 31<sup>st</sup> when 35 kt with a 1004 mb pressure was recorded. The tropical storm is analyzed to have moved over the western tip of Cuba between 12-18Z on the 31<sup>st</sup> at a 45 kt tropical storm (no change to HURDAT intensity at 12Z on the 31<sup>st</sup>). At 1710Z, just after the center re-emerged over water, aircraft reconnaissance reported a central pressure of 1003 mb, and this value is added to HURDAT at 18Z on the 31<sup>st</sup>. A central pressure of 1003 mb yields 41 kt south of 25N, and due to the slow speed, 40 kt is chosen for the 18Z intensity on the 31<sup>st</sup> (down from 50 kt originally). Five center fixes between 1417Z on 1 June and 0240Z on 2 June show that the cyclone moved north-northwestward until 18Z on the 1<sup>st</sup> reaching a point of 24.3N, 85.5W, and then it moved south-southeastward over the same track from where it came through 12Z the 2<sup>nd</sup> before it turned east-northeastward just north of the western Cuban coast. These are minor track changes to HURDAT. Central pressures of 997 and 996 mb are measured by aircraft on the 1<sup>st</sup> of June at ~1605Z and 2345Z respectively, and these values are added to HURDAT at 18Z on the 1<sup>st</sup> and 00Z on the 2<sup>nd</sup> respectively. A central pressure of 996 mb yields 54 kt according to the southern pressure-wind relationship. The 50 kt intensity listed in HURDAT at 00Z on the 2<sup>nd</sup> is maintained. A 999 mb central pressure is measured by aircraft reconnaissance at 2050Z on the 2<sup>nd</sup>, and this value is added to HURDAT at 18Z on the 2<sup>nd</sup>. A central pressure of 999 mb yields 49 kt according to the southern pressure-wind relationship. The 40 kt intensity listed in HURDAT is not changed because the storm was nearly stationary and there are no other observations to indicate a stronger storm. Around 00Z on 4 June, the cyclone turned toward the north-northwest near 24N, 83W. No flights were performed on the 3<sup>rd</sup> and the 4<sup>th</sup>, and the storm was relatively weak on those days, but on the 5<sup>th</sup> at 2245Z, a Navy fix, which located the tropical cyclone near 28.6N, 85.8W, reported a central pressure of 994 mb. This not only indicated that Alice was moving toward the Gulf Coast, but also showed that some strengthening had occurred. The 997 mb central pressure previously listed in HURDAT at 00Z on the 6<sup>th</sup> is replaced by a 994 mb central pressure value. A central pressure of 994 mb yields 53 kt according to the north of 25N pressure-wind relationship. A 55 kt intensity is chosen for

00Z on the 6<sup>th</sup>. Previously, HURDAT showed a peak lifetime intensity of 60 kt from 00Z on the 5<sup>th</sup> to 00Z on the 6<sup>th</sup>. The revised peak intensity is maintained at 60 kt, but only from 12-18Z on the 5<sup>th</sup>. A ship reported a possible 65 kt wind at 18Z on the 5<sup>th</sup> about a degree northeast of the center. The same afternoon, a reconnaissance aircraft reported 65 kt winds encountered 60 nmi NE of the center. Therefore, Alice may have been a hurricane. These reports are enough to keep the 60 kt peak intensity, but not enough evidence to increase Alice to hurricane strength. The ship report is uncertain and the aircraft report may have been of flight-level winds. Either way, when Alice made landfall at 17Z on the 6<sup>th</sup> just west of Panama City, FL, the highest winds observed from any land station were reported to have been about 35 to 40 kt. The analyzed landfall intensity at 17Z on the 6<sup>th</sup> is 40 kt and this is also the 18Z intensity. The intensities at 12 and 18Z on the 6<sup>th</sup> are increased by 5 kt from the previous HURDAT intensities. HURDAT previously showed dissipation after 18Z on the 6<sup>th</sup> as soon as Alice reached the coastline. Dissipation is analyzed to have occurred 12 hours later after the storm weakened to a depression and moved into extreme southeastern Alabama as a tropical depression. The revised final point is at 06Z on 7 June at 31.1N, 85.5W as a 20 kt tropical depression before dissipation occurred.

Additional quotes:

“Tropical Storm Alice was a small storm and its erratic track reflects the large variability of synoptic weather patterns over the Gulf. Winds were not of hurricane force, but did sink a 65-foot trawler 100 miles northeast of the Yucatan Peninsula. Principle damage was from the torrential rains which caused drowning of six people in Cuba and drenched the Florida Peninsula for a week. 7.16 inches of rain was reported in Havana in a 24-hour period” (ATS).

1953 Storm 2 (new to HURDAT)

HWM, COADS, the MWR tracks of lows, NHC microfilm, Jack Beven’s list of suspects, and Ryan Truchelut’s warm anomaly study indicate that a tropical storm, previously undocumented in HURDAT, existed a couple hundred miles off the east coast of the United States from 11 to 16 July.

July 11:

HWM analyzes a trough axis plotted from 27N, 82W to 20N, 83W to 14N, 82W. HURDAT did not previously list this system. The MWR tracks of centers of cyclones first shows a position at 18Z near 25.1N, 82.0W. Microfilm at 12Z does not analyze a closed low.

July 12:

HWM analyzes a closed low of at most 1005 mb centered near 28.2N, 79.8W with a warm front extending north-northeastward from the low and a cold front extending westward from the low. The MWR tracks of centers of cyclones shows a 12Z position near 28.7N, 79.6W with a 1006 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 28.9N, 79.2W with a front running through the low.

July 13:

HWM analyzes a closed low of at most 1010 mb centered near 29.5N, 77.6W with a warm front extending northeastward from the low and a cold front extending southward from the low. The MWR tracks of centers of cyclones shows a 12Z position near 30.1N, 78.0W with a 1008 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 29.6N, 77.4W with a front extending northeastward from the low and another front extending southward from the low. Ship highlights: 35 kt S and 1010 mb at 18Z at 30.2N, 73.5W (micro); 30 kt E and 1005 mb at 30.7N, 74.6W (COA); 25 kt ESE and ~1005 mb at 18Z at 30.9N, 74.8W (COA).

July 14:

HWM analyzes a closed low of at most 1010 mb centered near 33.2N, 74.8W with a warm front extending northeastward from the low and a cold front extending southward from the low. The MWR tracks of centers of cyclones shows a 12Z position near 33.1N, 74.1W with a 1006 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 33.8N, 73.0W. The SW end of a front is located about 150 nmi NW of the cyclone.

July 15:

HWM analyzes a closed low of at most 1010 mb centered near 38.2N, 71.4W with several fronts analyzed intersecting the low and near the low. The MWR tracks of centers of cyclones shows a 12Z position near 38.1N, 71.2W with a 1010 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1014 mb centered near 38.1N, 71.0W with the south end of a SSW-NNE front located 80 nmi north of the cyclone. Ship highlights: 35 kt NE and 1012 mb at 00Z at 37.0N, 74.7W (micro); 40 kt N and 1014 mb at 06Z at 37.7N, 74.8W (COA); 40 kt S and 1010 mb at 18Z at 39.8N, 68.7W (COA). A few other gales.

July 16:

HWM analyzes a closed low of at most 1010 mb centered near 43.9N, 60.9W with a NNE-SSW cold front running through the low. The MWR tracks of centers of cyclones shows a 12Z position near 44.2N, 62.2W with a 1008 mb pressure. The microfilm analysis suggests that the low may have been absorbed before 12Z.

A tropical disturbance started to become better defined near the southwest coast of Florida on 11 July. At the same time, an E-W frontal boundary was located over northern Florida. However, the origins of the disturbance were purely tropical. A tropical depression is analyzed to have formed at 18Z on 11 October over south Florida. It moved northeastward and emerged into the Atlantic early on the 12<sup>th</sup>. On the 12<sup>th</sup> and the 13<sup>th</sup>, the tropical cyclone was heavily involved with the environment of the front located to the north of it, and the circulation was asymmetric, although temperatures were warm all around the low. The low strengthened and the wind structure improved by late on the 13<sup>th</sup> and the 14<sup>th</sup>. It is analyzed that the depression became a tropical storm just after emerging off of Florida at 12Z on the 12<sup>th</sup> at 27.7N, 80.1W. At 18Z on 13 July, one ship recorded 35 kt with 1010 mb, and two other ships recorded 1005 mb pressures, one with

30 kt and the other with 25 kt. At 18Z on the 13<sup>th</sup>, it is analyzed that the intensity increased to 40 kt with a position near 30.2N, 75.2. The cyclone continued moving north-northeastward. On the 14<sup>th</sup>, the structure is that of a tropical cyclone with warm temperatures surrounding it. Although there are no highlight observations on the 14<sup>th</sup>, there are numerous 25 to 30 kt winds and pressures below 1010 mb. At 00Z on the 15<sup>th</sup>, with the storm centered near 35.6N, 73.3W, another 35 kt gale was recorded about 120 nmi NNW of the center, but by this time, extratropical transition was underway. The system was not fully extratropical until 06Z on the 5<sup>th</sup>, so the last highlight is analyzed to have occurred during the tropical stage. At least four pieces of evidence exist while this cyclone is tropical – one gale and two low pressures at 18Z on the 13<sup>th</sup>, and one gale at 00Z on the 15<sup>th</sup>. When the cyclone became extratropical at 06Z on the 15<sup>th</sup>, the intensity increased to 45 kt and the position at 06Z on the 15<sup>th</sup> is analyzed at 36.9N, 72.5W. The cyclone continued north-northeastward with a 45 kt intensity before dissipating after 00Z on the 16<sup>th</sup> with a final position at that time of 41.4N, 68.6W.

#### 1953 Storm 3 (Barbara) – (originally Storm 2)

U.S. Landfall (barrier island):

8/14/1953 – 02Z – 34.9N, 76.3W – 80 kt – 975 mb – 1015 mb OCI – 150 nmi ROCI

U.S. Landfall (mainland NC):

8/14/1953 – 05Z - 35.4N, 76.1W – 75 kt – 978 mb – 1015 mb OCI – 150 nmi ROCI

U.S. Landfall (barrier island- approach from the intercoastal waters):

8/14/1953 – 09Z - 36.1N, 75.7W – 75 kt – 978 mb – 1015 mb OCI – 150 nmi ROCI

Minor track changes and major alterations to the intensity are analyzed for Hurricane Barbara. A major change is made to the timing of when Barbara first attained hurricane intensity. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, James and Thomas (1953), Dunn and Miller (1960), Jarrell et al. (1992), and Barnes (2001).

August 8:

“The charts at 700 and 500 mb show good continuity of the wave which crossed San Juan, Puerto Rico about 1500Z, August 8” (James and Thomas).

August 9:

“The earliest indications of the formation of Hurricane Barbara were from synoptic reports in the vicinity of the Greater Antilles and the Bahamas. At 09/1830Z the surface charts commenced indicating a persistent cyclonic tendency in the winds just north of eastern Cuba” (ATS).

August 10:

ATS shows a 1230Z map time position near 20.9N, 73.8W. No gales or low pressures. “At 10/1230Z there was a small 1014 mb low in the area of 20-22N, 73-75W” (ATS). “The 700-mb chart for 1500Z, August 10 showed the first definite indication of a closed circulation over eastern Cuba” (James and Thomas).

August 11:

HWM analyzes a spot low associated with a trough near 24.2N, 73.3W. HURDAT lists this as a 45 kt tropical storm at 24.1N, 74.5W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position with the former showing a 1013 mb pressure. ATS shows a 1230Z map time position near 24.8N, 74.0W. Microfilm first analyzes a closed low at 18Z of at most 1014 mb near 26.0N, 74.8W. No gales or low pressures. “The low fluctuated considerably, but at 11/0030Z the center of circulation was near 22N, 73.5W and further identified itself on the 11/1230Z surface chart near 25N, 74W. Reported winds were force 2-4 (5-15 kt)” (ATS). “This low [at 700 mb] deepened slightly and moved northward to a position just east of Eleuthera Island in the Bahamas at 1500Z, August 11 with the closed circulation extending to the 500 mb level. It wasn’t until the afternoon of the 11<sup>th</sup> that a definite low could be noted on the surface chart” (James and Thomas). “The 11/1830Z surface chart showed the circulation near 26N, 74W attended by winds of force 6 (25 kt)” (ATS).

August 12:

HWM analyzes a hurricane of at most 1010 mb centered near 29.0N, 74.6W. HURDAT lists this as a 65 kt hurricane at 29.2N 75.9W. The MWR tracks of centers of cyclones shows a 12Z position near 28.8N, 75.6W with a 1005 mb pressure, and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near the HURDAT position. Microfilm at 12Z analyzes a tropical cyclone of at most 1005 mb centered near the HURDAT position. Ship highlights: 50 kt SE at 06Z at 28.7N, 74.5W (micro); 35 kt at 1230Z (ATS); 50 kt S and 1014 mb at 18Z at 29.3N, 74.0W (COA). Two other gales of 35 kt. Aircraft highlights: 75 kt E (at flight-level of 500 ft) and 1009 mb at 1400Z at 29.5N, 75.7W (micro); center fix (loran) at 1420Z at 29.4N, 75.9W with a 1005 mb central pressure and 60 kt maximum winds (micro, ATS); 80 kt S (at flight-level of 500 ft) and 1005 mb at 2130Z at 30.1N, 75.0W (micro); center fix (loran) at 29.8-29.9N, 75.9W at 2250Z with 1002 mb central pressure and 80 kt maximum flight-level winds encountered (micro, ATS). “The second storm [of the season] developed during the night of August 11 northeast of the Bahama Islands from a weak easterly wave that had moved westward over the Atlantic during several days preceding. On the morning of the 12<sup>th</sup>, reconnaissance aircraft located the center in the formative stages near 29N, 76W; it was moving northward. Strongest winds were about 75 mph on the northeast side at this time, but the southwest quadrant was weak and open” (MWR). “At 12/1420Z, [aircraft reconnaissance] reported a poorly defined eye at 29.4N, 75.9W. Winds were 60 kt with gusts to 75 kt within 50 nmi of the center in the NE quadrant. The first [advisory] on Barbara was issued at 12/1500Z. The original intensification of Barbara came about rather rapidly, passing through the tropical storm stage in less than 24 hours. Ships at distances of approximately 60 nmi from the center reported no winds higher than force 6 (25 kt) as late as 12/0630Z. By 12/1230Z one ship

reported force 8 (35 kt). In view of these reports and the result of the first aircraft reconnaissance flight it appears unlikely that hurricane wind velocities had been long in existence. Following the 12/1420Z aircraft fix, Barbara continued to move north-northwesterly as it had for about 18 hours previously. As Barbara was a potential threat to the East Coast of the United States, maximum reconnaissance was planned. A second Navy flight on the 12<sup>th</sup> fixed the eye at 29.8N, 75.9W at 12/2250Z with maximum winds of 80 kt near the center” (ATS).

#### August 13:

HWM analyzes a closed low of at most 1005 mb centered near 30.5N, 75.4W. HURDAT lists this as a 90 kt hurricane at 32.5N, 76.3W. The MWR tracks of centers of cyclones shows a 12Z position near 31.8N, 76.2W with a 995 mb pressure and the MWR post-season track maps shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near the HURDAT position. Microfilm at 12Z analyzes a tropical cyclone of at most 996 mb centered near the HURDAT position. Ship highlights: 50 kt E and 1004 mb at 06Z at 32.1N, 75.6W (COA); 50 kt SE and 1004 mb at 12Z at 32.7N, 75.6W (COA). 27 other gales between 35-45 kt and one other low pressure of 1005 mb. Land/station highlights: 49 kt N (max wind/1-min) at Wilmington, NC (climo); 25 kt NNE and 1001 mb at 21Z at Cherry Point, NC (micro); 40 kt E and 1002 mb at 23Z at Hatteras, NC (micro); 30 kt N and 1000 mb at 23Z at New Bern, NC (micro). One other gale of 35 kt and two other low pressures of 1005 mb. Aircraft highlights: radar center fixes at 0200, 0300, 0400, 0430, and 0600Z between 29.9-31.3N, 76.2-78.5W (micro); center fix (loran) at 1327Z at 32.4N, 76.5W with 995 mb central pressure and 100 kt maximum flight-level gusts (micro); 65 kt ESE (at flight-level of 500 ft) and 1000 mb at 1430Z at 33.5N, 75.9W (micro); center fix at 1945Z at 33.6N, 76.6W with 987 mb central pressure and 80 kt max winds (ATS, micro). “During the 12<sup>th</sup> and 13<sup>th</sup>, winds increased slowly in force and completed a circular organization; the strongest winds, estimated at slightly over 100 mph, were observed by aircraft about 120 miles south of Cape Hatteras” (MWR). “Two Navy flights from Jacksonville on August 13 fixed the eye of Barbara and indicated the course to be veering to the northward. These flights were in agreement as to winds, weather and general configuration of the storm. However, minimum surface pressure at 1945Z was found to be 987 mb, a decrease of 12 mb from that observed approximately six hours earlier. The position of the center of the storm was at this time about 70 nmi south of Cape Lookout and coastal stations had already begun to feel the effects of the circulation” (ATS).

#### August 14:

HWM analyzes a closed low of at most 995 mb centered near 37.4N, 75.6W. HURDAT lists this as a 65 kt hurricane at 37.0N, 75.0W. The MWR tracks of centers of cyclones shows a 12Z position near 37.0N, 75.6W with a 993 mb pressure and the MWR post-season track map shows a 12Z position near 36.8N, 75.6W. ATS shows a 0030Z map time position near 34.8N, 76.7W and a 1230Z map time position near 37.0N, 75.6W. Microfilm at 12Z analyzed a closed low of at most 993 mb centered near the MWR positions with a NE-SW front located a few hundred nmi northwest of the cyclone. Ship highlights: 45 kt SE and 1004 mb at 08Z at 36.5N, 74.6W (micro); 65 kt E and 999 mb at 12Z at 38.0N, 74.4W (COA); 55 kt S and 996 mb at 15Z at 36.7N, 74.6W (COA); 70 kt

SE and 992 mb at 18Z at 37.9N, 74.4W. 30 other gales of 35-60 kt and six other low pressures of 998-1005 mb. Land highlights: 35 kt NNW and 994 mb at 01Z at Cherry Pt., NC (J & T); 989 mb (min p) at Morehead City, NC (J & T); [land-based radar?] center fix at 0230Z at 34.9N, 76.4W (J & T); 67 kt SE (max wind/1-min) at Hatteras, NC (highest gust at Hatteras was 78 kt E) (climo); center fix at 0330Z at Ocracoke, NC (J & T); 989 mb (min p) at Belhaven, NC (J & T); 991 mb (min p) at Hatteras, NC (climo); 55 kt NE and 1000 mb at 06Z at Elizabeth City, NC (micro); estimated center fix at 08Z at 35.9N, 75.8W (J & T); 988 mb (min p) at Coinjock, NC (J & T); 55 kt NE (max wind/1-min) at Norfolk, VA (climo); 995 mb (min p) at Norfolk (climo). Aircraft highlights: possible Air Force center fix (loran) at 2030Z at 38.0N, 74.1W with 993 mb lowest pressure encountered (40 nmi S of center) and 100 kt estimated winds (micro, ATS). “The center passed over the North Carolina Capes section during the night of August 13 attended by winds of 90 to 100 mph and lowest pressure about 29.15 inches. One death and approximately \$1,000,000 in property damages were reported” (MWR). “As the center of Barbara moved inland between Cherry Point and Hatteras shortly before 14/0030Z, an eccentricity in the pressure envelope developed. This consisted of an elongation of the pressure pattern to the southeast and caused a marked distortion of the wind field in that sector. The storm was over land until approximately 14/1000Z, departing the coast approximately 15 nmi south of Cape Henry. Following this time, it intensified again attaining maximum winds of 100 kt at approximately 14/1900Z. As the storm pursued its short trajectory over land the distortion persisted. When the center moved out over water it became more pronounced, as shown by the 14/2030Z reconnaissance fix, which found a circular opening and a pressure of 993 mb 40 nmi south of the center. This synoptic situation, which presented serious forecasting problems was alleviated by the system rapidly becoming extratropical” (ATS). “Hurricane Barbara... struck the coast of North Carolina between Morehead City and Ocracoke on August 13. After spinning northward along the Outer Banks, the storm turned to the northeast and moved out to sea near the Virginia line. Barbara was a category-one hurricane and damages were not severe. The storm’s highest winds were reported as gusts to 90 mph at Cape Hatteras and Nags Head. Several locations along the coast reported rainfall exceeding six inches, but winds and rains on the mainland were very light. Damage estimates exceeded \$1 million, but most of this was attributed to crop damage. The only death associated with Barbara occurred at Wrightsville Beach, where a man was swept from a pier and drowned” (Barnes). “Barbara crossed the North Carolina coastline between Morehead City and Ocracoke about 2200 EST [0300Z], August 13 [14], and after sweeping the entire Capes section of North Carolina passed out to sea again about 0600 EST [1100Z] August 14. The lowest pressure recorded on land was 29.19 inches (988 mb) at Coinjock, NC near where the storm re-entered the Atlantic; both Morehead City and Belhaven reported 29.20 inches (989 mb). The strongest winds reported from land stations were gusts of 90 mph at Hatteras and Nags Head, NC. Gusts to 78 mph were reported from Cherry Point before a power failure rendered some instruments useless. Radar fixed the center of the storm 23 miles east of Cherry Point at 2130 EST [0230Z] August 13 [14]; an amateur radio operator at Ocracoke reported being in the eye one hour later; and at about 0300 EST [0800Z], August 14 the eye passed about 10 miles west of Nags Head. The only known casualty of the storm occurred at Wrightsville Beach near Wilmington, NC where a man was swept from a pier and

drowned. Two marines were injured at the Cherry Point base. Damage from the storm was light to moderate in the North Carolina-Virginia Capes area. Preliminary press reports indicated around a million dollars in damage to crops and property, crop damage in some areas reaching 25 percent. Elizabeth City, Nags Head, New Bern, Kitty Hawk, and Cherry Point suffered some damage to buildings. A report from Nags Head mentioned that numerous trees were uprooted, some being large ones that survived the great September 14, 1944 hurricane unharmed” (James and Thomas). “Then it began to curve slowly to the north-northeast, re-entering the Atlantic the morning of the 14<sup>th</sup>” (James and Thomas). From the August, 1953 National Climatological Data Summary storm reports... “Location: New Hanover, Pender, Onslow, Jones, Carteret, Craven, Pamlico, Beaufort, Hyde, Dare, Tyrrell, Washington, Martin, Bertie, Chowan, Perquimans, Gates, Hertford, Pasquotank, Camden, and Currituck Counties, NC; Date: 13<sup>th</sup>; Time: Day and night; Deaths: 1; Injuries: 7; Property damage (exclusive of crops): \$100,000; Crop damage: \$1,000,000; Character of storm: hurricane; Remarks: Crop damage is from estimates just received from county agents’ reports. Actually, most crop damage due to corn blown down in fields, and amount of loss depends on the weather between now and harvest time. Most property damage to beach cottages and warehouse roofs; much of it due to vulnerable construction. Location: Virginia, eastern portion; Date: 13-14<sup>th</sup>; Character of storm: hurricane; Remarks: Boats loosened from moorings; signs blown over; utility lines down; roofs damaged. Most crop damage to corn which partially recovered. Location: Delaware and eastern Maryland; Date: 14<sup>th</sup>; Time: am – pm; Character of storm: hurricane; Remarks: Numerous boats loosened from moorings; signs blown over; utility lines down; roofs damaged. Most crop damage to corn which partially recovered. Location: New Jersey coastal area; Date: 14<sup>th</sup>; Time: late am – early pm; Property damage (exclusive of crops): \$5,000; Crop damage: \$1,000; Character of storm: wind and rain; Remarks: Offshore hurricane caused little damage, although winds reached gale force along south and central coast, and 24-hour rainfall exceeded 8 inches in some areas” (climo). “Tropical Cyclones in the South Atlantic States- Carolinas and Georgia – Aug. 13-14 – N.C. Capes – Minimal – Damage \$1,000,000” (“Minimal” has maximum winds of 74 to 100 mph and central pressure 983 to 996 mb - (Dunn and Miller). “Barbara – NC, 1 – 987 mb” (Jarrell et al. 1992).

#### August 15:

HWM analyzes a hurricane of at most 995 mb centered near 41.7N, 66.5W. HURDAT lists this as a 75 kt hurricane at 41.5N, 68.0W. The MWR tracks of centers of cyclones shows a 12Z position near 42.4N, 66.7W with a 984 mb pressure, and the MWR post-season track map shows a 12Z position near 41.6N, 66.2W. ATS shows a 1230Z map time position near 41.6N, 66.9W. Microfilm at 12Z analyzes a closed low of at most 999 mb centered near 41.5N, 66.0W with a NW-SE frontal feature plotted a few hundred nmi west of the cyclone. Ship highlights: 75 kt E and 1001 mb at 00Z at 39.8N, 73.9W (micro); 60 kt W and 1006 mb at 00Z at 37.3N, 74.0W (COA); 55kt W and 1001 mb at 00Z at 37.3N, 72.6W (COA); 55 kt WSW and 998 mb at 00Z at 37.3N, 72.5W (micro); 40 kt S and 996 mb at 05Z at 39.5N, 69.2W (micro); 55 kt SW and 994 mb at 06Z at 39.2N, 70.0W (COA); 35 kt E and either 986 or 996 mb at 06Z at 40.2N, 70.5W (micro); 40 kt WSW and 1011 mb at 18Z at 39.9N, 63.2W (COA). Land/station highlights: 25 kt NW and 1005 mb at 12Z at Nantucket, MA (HWM); 15 kt ESE and 996 mb at 18Z at

44.6N, 63.6W (micro). “The Navy night radar reconnaissance plane, which departed Norfolk at 15/0157Z, was unable to detect an eye although it passed almost directly over the center. The speed accelerated rapidly, averaging about 25 kt for 12 hours after 14/2200Z and 31 kt for the following 12 hours. It was unquestionably extratropical by 15/1230Z with winds less than hurricane intensity. [Advisories] were discontinued after 15/1600Z” (ATS). “After re-entering the Atlantic, Barbara continued on a northeasterly course, deepening slightly and passing a short distance southeast of Nantucket. The strongest winds in New England were only about 60 mph. There were no casualties there, and damage was minor” (James and Thomas). “After leaving the North Carolina Capes, the center moved northeastward to the Canadian Maritime provinces on the 15<sup>th</sup>” (MWR).

#### August 16:

HWM analyzes a closed low of at most 990 mb centered near 49.0N, 53.8W and a 2<sup>nd</sup> closed low of at most 985 mb centered near 53N, 58.2W. A cold front extends from 150 nmi south of the first low southwestward from 46N, 55W to 42N, 58W to 41N, 61W. A warm front extends from the 2<sup>nd</sup> low eastward from 54N, 58W to 54N, 50W to 53N, 45W to 52N, 40W. HURDAT lists this as a 45 kt extratropical cyclone at 53.5N, 59.4W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 993 mb pressure and the MWR post-season track map last shows a position at 00Z at 44.3N, 60.8W. ATS shows a 1230Z map time position near 49.4N, 56.0W. Microfilm last shows a closed low at 06Z before it goes off the north edge of the map of at most 993 mb centered near 48.3N, 58.4W. Ship highlights: 55 kt SW and 1002 mb at 00Z at 43.1N, 58.2W (COA); 40 kt W and 1010 mb at 06Z at 42.7N, 59.0W (COA); 40 kt ESE and 1003 mb at 18Z at 56.5N, 51.0W (COA).

#### August 17:

HWM analyzes a large extratropical low of at most 980 mb centered near 55.8N, 59.6W [it appears that Barbara had already merged with another extratropical low before this date]. HURDAT no longer lists a system on this day. ATS last shows this at 1230Z with a map time position near the HWM position.

The original HURDAT begins Barbara as a tropical storm right away at 06Z on 11 August. Observations from the southeastern and central Bahamas as well as ships show a weak, closed circulation on the 11<sup>th</sup>. The timing of genesis is not changed, but the cyclone is begun as a 25 kt tropical depression at 06Z (down from 35 kt originally). The cyclone moved northward from the Bahamas on the 11<sup>th</sup> to North Carolina on the 14<sup>th</sup>. All track changes from genesis through landfall in North Carolina are half a degree or less. The first observed gale in association with this cyclone occurred at 06Z on the 12<sup>th</sup>- a 50 kt wind from a ship, and another 50 kt ship observation occurred at 18Z on the 12<sup>th</sup>. The cyclone is analyzed to have strengthened to a tropical storm at 18Z on the 11<sup>th</sup> (12 hours later than in HURDAT originally). Aircraft reconnaissance on the 12<sup>th</sup> measured central pressures of 1005 and 1002 mb at 1420 and 2250Z respectively, and these central pressures are added into HURDAT at 12Z on the 12<sup>th</sup> and 00Z on the 13<sup>th</sup> respectively. A central pressure of 1005 mb equals 34 kt according to the Brown et al. north of 25N pressure-wind relationship, but the RMW was smaller the climatological RMW value

from Vickery et al. A 1002 mb central pressure equals 40 kt according to the same pressure-wind relationship, and the RMW at that point had returned to a size near average. A steady intensity of 50 kt is chosen from 06Z on the 12<sup>th</sup> through 00Z on the 13<sup>th</sup> (down from 80 kt at 00Z on the 13<sup>th</sup> – a major change). On the 13<sup>th</sup> at both 06Z and 12Z, the highest available wind observations from ships are 50 kts concurrent with 1004 mb pressures. Aircraft reconnaissance on the 13<sup>th</sup> measured central pressures of 995 and 987 mb at 1327 and 1945Z respectively, and these values are added to HURDAT at 12 and 18Z respectively on the 13<sup>th</sup>. Central pressures of 995 mb and 987 mb equal 54 kt (north of 25N) and 66 kt (north of 25N and intensifying) respectively, but the RMW was smaller than average for both fixes. Intensities of 60 and 70 kt are chosen for 12 and 18Z on the 13<sup>th</sup> (down from 90 and 95 kt respectively- both major changes). Barbara is analyzed to have strengthened to a hurricane at 18Z on the 13<sup>th</sup> (30 hours later than originally- another major change to HURDAT). Major downward intensity adjustments of 20 to 30 kt are implemented at all times from 18Z on 12 August through 18Z on the 13<sup>th</sup>.

Hurricane Barbara made landfall between Morehead City and Ocracoke, NC at about 02Z on 14 August. The cyclone was already moving north-northeastward at that time, and it is analyzed to have exited North Carolina back into the Atlantic between 09Z and 10Z the same day with oceanfall occurring near 36.2N, 75.7W (north of Kill Devil Hills, NC). Center fixes early on the 14<sup>th</sup> occurred at 0230Z (radar), 0330Z (Ocracoke in center), and possibly at 08Z (possibly radar). The center fixes are consistent with time series' of observations from the land stations and show that the previous HURDAT position at 06Z on the 14<sup>th</sup> was a few tenths of a degree too far to the east-northeast. In fact, the HURDAT track is shifted a couple tenths of a degree to the left of the previous track from 06Z on the 13<sup>th</sup> through 12Z on the 14<sup>th</sup> including the landfall point. The highest observed wind was 67 kt (maximum 1-minute wind) at Cape Hatteras, but it is likely that Cape Hatteras was well outside the RMW as they were to the right of Barbara's path. The lowest observed pressures from land stations were 989 mb from both Morehead City and Belhaven, NC, and 988 mb from Coinjock, NC (a short distance away from the oceanfall point). All three of those observations are analyzed to be peripheral pressures. None of the pressures reported from any stations are believed to have been observed inside the RMW at anytime during Barbara's path over coastal North Carolina. The size of the RMW is also uncertain (at 1945Z on the 13<sup>th</sup>, the RMW was about 19 nmi, and at 2030Z on the 14<sup>th</sup>, the RMW was about 30 nmi). The Schloemer equation was run using the 989 mb peripheral pressure observation from Morehead City, since it occurred at the time of landfall (Morehead City is located 20 nmi from the center at closest approach). If Morehead City is assumed to be at the RMW at the time of its minimum pressure of 989 mb, a central pressure of 974 mb is yielded. It should be noted that several hours later, well after oceanfall, at 2030Z on the 14<sup>th</sup>, aircraft reconnaissance information indicates a 973 mb central pressure with an 80 kt intensity. A central pressure of 975 mb and an intensity of 80 kt are chosen at 00Z on the 14<sup>th</sup> (down from 90 kt originally) and for the North Carolina landfall, maintaining Barbara as a Category 1 for North Carolina. The 987 mb central pressure previously listed in HURDAT at 00Z on the 14<sup>th</sup> is replaced by a 975 mb central pressure. It is possible though that Barbara could have been a Category 2. It is not appropriate to run the Kaplan and DeMaria inland decay model for this case

because Barbara was located over the intercoastal waters most of the time between the initial landfall and oceanfall. As Barbara exited North Carolina, Norfolk, VA recorded a maximum 1-minute wind of 55 kt. It is possible that the extreme southeastern coast of Virginia experienced Category 1 conditions, but after running the Schwerdt et al. model, it was determined that winds of only about 60 kt likely occurred on the Virginia coastline, so a hurricane impact is not analyzed for Virginia. Barbara passed close enough to the Delmarva Peninsula and Atlantic City, New Jersey to cause tropical storm force winds there, but hurricane conditions were not experienced on those coastlines. Shortly after Barbara left North Carolina, at 12Z on the 14<sup>th</sup>, a ship recorded winds of 65 kt (with a 999 mb pressure), and at 18Z, a ship recorded 70 kt (with a pressure of 992 mb) about 28 nmi from the analyzed position at that time. At 2030Z on the 14<sup>th</sup>, aircraft reconnaissance did not penetrate the center but encountered a minimum pressure of 993 mb 40 nmi south of the center. An RMW was reported, and in this case, the Schloemer equation was run with all required parameters well known. A central pressure of 973 mb is yielded, and this value is added into HURDAT at 18Z on the 14<sup>th</sup>. A central pressure of 973 mb yields 80 kt according to the Landsea et al. (2004) north of 35N pressure-wind relationship, and 80 kt is the analyzed intensity for 18Z on the 14<sup>th</sup> (up from 70 kt originally). Analyzed intensities at all times on the 14<sup>th</sup> are 80, 75, 75, and 80 kt (originally 90, 70, 65, and 70 kt). Previously, the peak intensity listed for Barbara was 95 kt at 18Z on the 13<sup>th</sup>. The revised peak intensity is 80 kt at 00Z on the 14<sup>th</sup> and 80 kt again at 18Z on the 14<sup>th</sup>. Barbara continued northeastward and is analyzed to have passed about a degree southeast of Nantucket around 08Z on the 15<sup>th</sup>. The maximum 1-minute wind recorded at Nantucket was 41 kt. The largest track changes during the tropical portion of the lifetime of Barbara are made at 18Z on the 14<sup>th</sup> and 00Z on the 15<sup>th</sup> when the positions are shifted about one degree southwest of the previous positions. Barbara is analyzed to have become extratropical by 12Z on the 15<sup>th</sup> (six hours earlier than originally), and it is analyzed that Barbara weakened to a 60 kt cyclone at that time (down from 75 kt originally at 12Z on the 15<sup>th</sup>). The extratropical cyclone turned northward early on the 16<sup>th</sup>. On the 16<sup>th</sup>, another extratropical cyclone began to form and strengthen to the southeast of extratropical Barbara (covered in James and Thomas, 1953), and these two cyclones eventually merged late on the 16<sup>th</sup>, but dissipation of Barbara is delayed by six hours because available observations indicate that Barbara was not absorbed/dissipated until after 18Z on the 16<sup>th</sup>. The revised final position for Barbara is at 18Z on the 16<sup>th</sup> at 53.5N, 59.0W as a 45 kt extratropical cyclone.

Additional quotes:

“In comparison to earlier tropical storm tracks... Barbara’s track was almost identical to that of the storm of September 10-16, 1933; both had their eastward movement blocked near Newfoundland and were deflected northward” (James and Thomas).

“Hurricane Barbara originated just north of Cuba and headed towards North Carolina, disabling a 398-foot tanker in route. It crossed North Carolina, moved into the Atlantic once more near Norfolk, Virginia, and caused an estimated 50,000 people to leave the 500-mile long coastal strip from Morehead City, North Carolina to Long Island. It deposited 7.29 inches of rain at Atlantic City, 4.86 at Block Island, and moved out to sea,

leaving the United States a death toll of seven and property damage of over a million dollars” (ATS).

#### 1953 Storm 4 – (originally Storm 3)

U.S. Landfall:

9/1/1953 – 08Z – 31.6N, 81.1W – 35 kt

Minor track and minor intensity alterations are implemented for this tropical storm. Major changes are made to the time that tropical storm intensity was first attained and to the dissipation of this cyclone. Changes are also made to tropical storm impacts for the United States. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and the Monthly Climatological Data Summaries from NCDC.

August 28:

HWM does not analyze any features of interest on this day. HURDAT first lists this at 18Z as a 35 kt tropical storm at 21.7N, 82.6W. Microfilm at 12Z analyzes a weak trough in the northwestern Caribbean Sea. No gales or low pressures.

August 29:

HWM suggests a trough in the northwestern Caribbean and analyzes a dissipating stationary front located along the north-central Gulf Coast of the United States. HURDAT lists this as a 45 kt tropical storm at 26.0N, 82.6W with a 985 mb pressure. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1009 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 26.2N, 79.9W. Aircraft highlights: center fix at 2030Z at 26.8N, 79.1W with 1007 mb central pressure (micro). “On the 29<sup>th</sup> of August, while a Navy reconnaissance plane was investigating a circulation at 27N, 79W...” (ATS).

August 30:

HWM analyzes a closed low of at most 1010 mb centered near 27.2N, 78.0W with the west end of a dissipating stationary front extending eastward from the low. HURDAT lists this as a 35 kt tropical storm at 27.4N, 77.5W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 1008 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near the HWM position also containing a frontal boundary extending from the low east-northeastward. Ship highlights: 30 kt NE and 1014 mb at 18Z at 30.1N, 79.7W (COA).

August 31:

HWM analyzes a closed low of at most 1010 mb centered near 29.0N, 79.2W. HURDAT lists this as a 50 kt tropical storm at 29.7N, 78.4W. The MWR tracks of centers of cyclones shows a 12Z position near 30.2N, 78.2W with a 1007 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 29.1N, 78.4W with a

frontal boundary extending east-northeastward from the low. Ship highlights: 30 kt NE and 1017 mb at 06Z at 30.1N, 79.3W (micro); 30 kt SW and 1010 mb at 18Z at 28.7N, 79.0W (micro). Land/station highlights: 15 kt NE and 1013 mb at 18Z at Brunswick, GA (micro). Aircraft highlights: center fix at 1530Z at 30.0N, 79.0W with 1008 mb central pressure and 35 kt max winds (micro). “Navy reconnaissance on the 31<sup>st</sup> found the remnants of this circulation near 29N, 79W, and confirmed the opinion that it was no longer a danger as a possible hurricane” (ATS).

#### September 1:

HWM analyzes a closed low of at most 1015 mb centered near 31.5N, 81.3W. HURDAT lists this as a 25 kt tropical depression at 32.4N, 82.0W. The MWR tracks of centers of cyclones shows a 12Z position near 32.8N, 81.7W. Microfilm at 12Z analyzes a closed low of at most 1014 mb centered near 32.3N, 81.6W. Station highlights: 25 kt ENE and 1013 mb at 00Z at Savannah, GA (micro); 5 kt N and 1010 mb at 06Z at Brunswick, GA (micro); 30 kt S and 1012 mb at 12Z at 32.1N, 80.0W (micro). “A moderate storm of tropical nature moved inland on the lower Georgia coast on the 1<sup>st</sup> and continued westward across the state, causing light rains in most districts...” (climo).

#### September 2:

HWM analyzes a closed low of at most 1015 mb centered near 34.3N, 85.8W. HURDAT lists this as a 25 kt tropical depression at 33.2N, 84.8W. The MWR tracks of centers of cyclones shows a 12Z position near 33.5N, 84.6W. Microfilm at 06Z analyzes a closed low of at most 1014 mb centered near 32.7N, 84.7W but at 12Z does not show a closed low. No gales or low pressures.

#### September 3:

HURDAT last lists this at 06Z as a 20 kt tropical depression at 38.5N, 85.2W. The MWR tracks of centers of cyclones shows a 12Z position near 39.4N, 85.1W. No gales or low pressures.

An area of weak, cyclonic turning formed near the Isle of Pines on 28 August. HURDAT starts this system as a 35 kt tropical storm at 18Z on the 28<sup>th</sup>. No change is made to the timing of genesis, but the cyclone is started as a 25 kt tropical depression (sufficient observational coverage in the area indicates and a very weak, closed circulation). An unrealistic forward speed shown in the original HURDAT track during the first six hours is eliminated (supported by observations), and the revised position at 00Z on the 29<sup>th</sup> is on the south coast of Cuba (originally well north of the north coast of Cuba at that time). Previously, HURDAT lists this cyclone with a 35 kt intensity at the time it crosses Cuba, but it is analyzed that the cyclone was only at tropical depression strength when it passed over Cuba. The cyclone was over Cuba from 00Z-04Z on the 29<sup>th</sup> moving northward across western Cuba. Next, the cyclone turned east-northeastward and passed over south Florida as a 30 kt tropical depression (previously listed with a 45 kt intensity at the point before Florida landfall). There is no basis for the 985 mb central pressure listed in HURDAT at 12Z on the 29<sup>th</sup>, and it is removed since there is very good data that indicates that the cyclone was only a tropical depression at that time. After the cyclone emerged into the Atlantic Ocean, aircraft performed a center fix at 2030Z on the 29<sup>th</sup> just

west of Grand Bahama Island and measured a central pressure of 1007 mb, and this central pressure is added to HURDAT at 18Z on the 29<sup>th</sup>. A central pressure of 1007 mb equals 28 kt according to the Brown et al. north of 25N pressure-wind relationship, and a 30 kt intensity is chosen for 18Z on the 28<sup>th</sup> (down from 35 kt originally). The cyclone reached its furthest east point at 12Z on the 30<sup>th</sup> near 27.5N, 77.5W before making a turn toward the northwest. Ship observations of 30 kt at 18Z on the 30<sup>th</sup> and one 35 kt observation on the 31<sup>st</sup> indicate that the depression likely strengthened to a tropical storm. It is analyzed that the depression became a tropical storm at 18Z on 30 August (two days later than originally- a major change). On 31 August, the cyclone moved northwestward toward the Georgia coastline. At 1530Z on the 31<sup>st</sup>, aircraft reconnaissance measured a central pressure of 1008 mb with maximum winds of 35 kt reported. A 1008 mb central pressure is added to HURDAT at 18Z on the 31<sup>st</sup>. The tropical cyclone is analyzed to have made landfall on the Georgia coast between Brunswick and Savannah at 08Z on 1 September at 31.6N, 81.1W as a 35 kt tropical storm (HURDAT previously listed only tropical depression intensity at the point before landfall). Therefore, a tropical storm impact is eliminated for Florida but added for Georgia for this storm. Previously, HURDAT showed a peak lifetime intensity of 50 kt from 12Z-18Z on the 31<sup>st</sup>. The revised peak lifetime intensity is 35 kt from 18Z on 30 August through landfall at 08Z on 1 September. The cyclone then moved west-northwestward further inland into Georgia and weakened to a tropical depression at 12Z on 1 September (six hours later than originally). HURDAT previously held onto this system as a depression through 06Z on 3 September with a previous final position near the Kentucky/Indiana border, but available observations indicate the dissipation occurred after 18Z on 1 September, so dissipation is analyzed to have occurred 36 hours earlier than in HURDAT originally (a major change). The revised final point is at 18Z on 1 September at 32.5N, 82.8W as a 25 kt tropical depression.

1953 Storm 5 (Carol) – (originally Storm 4)

U.S. Impact:

Tropical Storm impact in MA and ME

Major track changes and major intensity changes are analyzed for Hurricane Carol, which made landfall in Canada as a Category 1 hurricane. Major changes are made to the timing of when Carol attained hurricane and major hurricanes status. This is the first hurricane during the aircraft reconnaissance era for which a hurricane was revised upward in intensity to a Category 5 based on aircraft observations. Finally, another major change was made to remove the hurricane impact listed for Maine. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Jarrell et al. (1992), and Tucker (1995).

August 27:

HWM analyzes a closed low of at most 1010 mb centered near 10.5N, 18.2W along the ITCZ. HURDAT does not yet list a system on this day. No gales or low pressures.

August 28:

HWM analyzes a closed low of at most 1010 mb centered near 15.8N, 20.3W. HURDAT lists this as a 30 kt tropical depression at 15.3N, 21.6W. No gales or low pressures. "The wave from which Carol formed was traced from the coast of Africa, where it was first noted on August 28" (MWR).

August 29:

HWM analyzes a broad, closed low of at most 1010 mb centered between 10-16N, 20-26W. HURDAT lists this as a 30 kt tropical depression at 12.6N, 26.7W. No gales or low pressures. "On the 29<sup>th</sup> it passed the Cape Verde Islands moving westward" (MWR).

August 30:

HWM analyzes a closed low of at most 1010 mb centered near 13.2N, 30.9W. HURDAT lists this as a 30 kt tropical depression 10.7N, 32.1W. No gales or low pressures. "An easterly wave was tracked by the ship reports from near 34-35W at 30/1230Z to 44-45W by 01/0630Z" (ATS).

August 31:

HWM analyzes a closed low of at most 1010 mb centered near 12.5N, 40.3W. HURDAT lists this as a 35 kt tropical storm at 10.6N, 39.6W. No gales or low pressures. "Signs of development began to appear on August 31" (MWR).

September 1:

HWM analyzes a tropical storm of at most 1005 mb centered near 13.6N, 46.0W. HURDAT lists this as a 50 kt tropical storm at 12.5N, 45.6W. Ship highlights: 60-65 kt NNE and 992 mb at 1745Z at 14.3N, 48.5W (ATS); 45 kt SSW and 1004 mb at 1935Z at 14.2N, 48.4W (ATS). "On the 1<sup>st</sup> of September a modified Gull Lima flight penetrated to 16.7N, 54.2W and, at that position, at 01/1745Z, reported a NE surface winds Beaufort force 7 (30 kt), partly cloudy, and a moderate southeasterly swell. Coupled with the fact that the 850 mb height had fallen 110 feet during the last hour [as the aircraft flew closer to what was obviously Carol], as the above position was approached on a course of 150 degrees, the report indicated a disturbance further on out in the Atlantic, probably southeast of this position, but at an unknown distance. The situation was not long in doubt. Three reports received from the S.S. Umatilla are quoted: '...1745Z position 14.3N, 48.5W, wind NNE [force 11 to 12] (60 to 70 kt), swell sea NNE very high, barometer 29.29 in. falling rapidly. 1935Z position 14.2N, 48.4W with SSW [force 9] (40 kt), confused high swell, barometer 29.66 in. rising slowly, temp 76, hurricane center NW of position. 2345Z [position] 14.2N, 48.0W, wind SE [force 6] (25 kt) in squalls up to [force] 8 (35 kt), confused swell, barometer 29.92 in rising, temp 78.' In coordination with the Weather Bureau, [advisory] No. 1 on Hurricane Carol was issued at 01/2230Z with an estimated position (based on the above ship report) of 14.4N, 48.8W, at 01/2200Z, and stated that the next [advisory] would follow Wednesday morning (September 2) after the reconnaissance fix" (ATS). "On September 1, confirmation that

a hurricane had formed was received from the S. S. Umatilla which reported force 11 to 12 NNE winds, very high seas, and rapidly falling pressure at 14.3N, 48.5W” (MWR).

#### September 2:

HWM analyzes a hurricane of at most 995 mb centered near 15.6N, 52.1W. HURDAT lists this as a 75 kt hurricane at 15.0N, 51.0W. ATS shows a 1230 map time position near 15.8N, 52.9W. Aircraft highlights: Air Force center fix at 1311Z at 15.9N, 53.2W with 944 mb central pressure, 80 kt estimated maximum winds, and 700 mb height 7,900 ft (micro, ATS). “An Air Force reconnaissance plane fixed the center at 15.9N, 53.2W at 02/1311Z. Surface winds about the center at that time were 80 kt, sea level pressure 994 mb, and 700-mb height 7,900 ft” (ATS).

#### September 3:

HWM analyzes a hurricane of at most 995 mb centered near 18.7N, 58.2W. HURDAT lists this as a 130 kt hurricane at 18.9N, 58.7W. The MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 19.3N, 58.3W. Microfilm analyzes a tropical cyclone of at most 984 mb centered near 19.2N, 58.4W. Aircraft highlights: Air Force center fix at 1300Z at 19.3N, 58.3W with 120 kt maximum winds (micro, ATS); Navy center fix at 1808Z at 19.8N, 60.4W with 929 mb central pressure and 130 kt maximum winds (micro, ATS). “This storm became the most severe hurricane of the season during the next few days as it moved on a west-northwest course, with aircraft reporting 130+ knot winds and minimum pressure 930 mb (27.45 inches) on September 3 and 4” (MWR). “Another Air Force reconnaissance plane found the center to be at 19.3N, 58.3W at 13/1200Z, with maximum winds of 120 kt. The eye was diffuse, three nmi in diameter at the surface, but well-defined, eight nmi in diameter at 10,000 ft. Another fix was obtained on the 3<sup>rd</sup> by a Navy low-level penetration flight operating from San Juan. At 1808Z, the center was found to be at 19.8N, 60.4W attended by maximum winds of 130 kt in the southeast quadrant. The eye was three nmi in diameter and well-defined, minimum surface pressure 929 mb. The northern semicircle was not explored due to [fear of] extremely severe turbulence. Navigational error [on this fix] was probably not more than five to eight nmi, since an excellent [navigational] landfall had been made after departing the storm. Following 03/1830Z, Carol assumed a course of north-northwest. Aerial reconnaissance was continued and was invaluable in maintaining a track of the storm in an area of sparse ship reports. The Air Force made the flights during the day, while the Navy provided night radar coverage” (ATS).

#### September 4:

HWM analyzes a hurricane of at most 995 mb centered near 23.2N, 62.9W. HURDAT lists this as a 130 kt hurricane at 23.7N, 63.5W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, with the former showing a 992 mb pressure. ATS shows a 1230Z map time position near 23.4N, 63.2W. Microfilm at 12Z analyzes a tropical cyclone of at most 987 mb centered near the HURDAT position. Ship highlights: 60 kt NW and 1001 mb at 18Z at 24.0N, 66.0W (COA); 35 kt SSE and 1012 mb at 18Z at 22.9N, 59.2W (COA). Aircraft highlights: radar center fixes at 0157, 0251, 0352, 0450, 0551, 0651, 0751, and 0851Z

between 21.5-23.1N, 61.5-62.7W (micro); Air Force center fix (loran) at 1328Z at 23.5N, 63.3W with 100 kt estimated surface winds, 110 kt maximum flight-level winds encountered, 950 mb dropsonde surface pressure, and lowest 700 mb height 8,795 feet (micro); Air Force center fix (loran) at 1900Z at 25.2N, 63.8W with 942 mb central pressure, 120 kt maximum flight-level winds encountered, and lowest 700 mb height 8,490 ft (micro, ATS). “On September 4<sup>th</sup>, a Hurricane Hunter B-29 from Kindley AFB flew into the hurricane’s eye and found it to be about 20 miles in diameter with winds blowing around that centre at 120 kt” (Tucker). “On 4 September the Air Force fixed the position at 1900Z at 25.2N, 63.8W” (ATS).

#### September 5:

HWM analyzes a hurricane of at most 995 mb centered near 28.6N, 66.5W. HURDAT lists this as a 105 kt hurricane at 29.2N, 67.1W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position, with the former showing a 993 mb pressure. ATS shows a 1230Z map time position near the HWM position. Microfilm at 12Z analyzes a tropical cyclone of at most 978 mb centered near 28.9N, 66.8W. Ship highlights: 50 kt NNE and 1004 mb at 12Z at 29.3N, 68.7W (HWM, micro); 30 kt WNW and 1002 mb at 1730Z at 27.0N, 69.1W (micro). Five other gales of 35-50 kt and three other low pressures of 1003-1005 mb. Aircraft highlights: radar center fixes at 0130, 0230, 0330, and 0430Z between 26.2-27.5N, 64.1-65.9W (micro, ATS); center fix (loran) at 1235Z at 28.9N, 66.6W with 945 mb central pressure, 90 kt estimated maximum winds and 700 mb height in the eye of 8,530 ft (micro); center fix (loran) at 1817Z at 29.9N, 67.2W with 80 kt maximum winds encountered in the SW quadrant and 700 mb height of 8,640 ft. “No. 4 Warning (that the centre was now expected to pass a short distance to the west, was hoisted at 4 P.M. on Saturday, September 5<sup>th</sup> and Dr. Macky predicted that the fringe winds felt here might be at hurricane force” (Tucker). “That night a Navy radar flight reported the center to be at 26.2N, 64.1W at 05/0130Z and at 26.6N, 64.3W at 05/0230Z. The Navy radar plane subsequently advised that the positions were in error by approximately 70 nmi to the east. When corrected, these agreed quite well with later surface and aerial reconnaissance reports which showed Carol continuing on a north-northwesterly course. Between 2207Z and 2230Z three position on the storm center were reported by an Air Force reconnaissance plane, which showed it to be approximately 90 nmi SW of Bermuda. These were believed to be in error...” (ATS).

#### September 6:

HWM analyzes a closed low of at most 985 mb centered near 33.3N, 70.2W with a NNE-SSW frontal system approaching from the west located about 400 nmi west of the cyclone. HURDAT lists this as an 85 kt hurricane at 33.0N, 69.6W. The MWR tracks of centers of cyclones shows a 12Z position near 33.9N, 69.5W with a 975 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. ATS shows a 1230Z map time position near 33.6N, 69.3W. Microfilm at 12Z analyzes a tropical cyclone of at most 990 mb centered near 33.4N, 69.6W with a NE-SW front approaching from the west located several hundred nmi west of the cyclone. Ship highlights: 50 kt SE and 991 mb at 12Z at 33.4N, 68.7W (COA); ~60 kt NW and 986 mb at 12Z at 33.1N, 71.0W (HWM); 55-60 kt S and 982 mb at 15Z at 33.5N, 68.5W (micro).

18 other gales between 35-50 kt and 11 other low pressures between 996-1005 mb. Aircraft highlights: radar center fix at 0618Z at 32.7N, 68.3W (micro); center fix (loran) at 1147Z at 33.4N, 69.4W with 75 kt max winds and 700 mb height of 9,000 ft (micro); center fix (loran) at 2000Z at 35.8N, 69.9W with 962 mb central pressure and 100 kt estimated maximum winds (micro). “By September 6, when the hurricane passed about midway between Cape Hatteras and Bermuda, there were signs of weakening” (MWR). “In the event, Hurricane ‘Carol’ by-passed the Colony some 200 miles west on Saturday night at 8 pm (~0100Z on the 6<sup>th</sup>). The island escaped with gale-force winds and only slight damage: steady winds of 50-60 mph swept the islands. Surprisingly little rain fell: one tenth of an inch in 24 hours. Some trees were uprooted, salt spray drenched the land, and one hundred telephones went out of action” (Tucker). “Ironically enough, the ‘Queen of Bermuda’ which altered course to avoid the big blow, unfortunately ran slap into it. Wind and sea increased in fury and beset the ‘Queen’ for 8 ½ hours forcing Capt. Leslie Banyard to hove his ship to and ride out the storm. Her forward deck was continuously awash and waves rose as high as the bridge, while occasionally she rolled 28 degrees. When at last she arrived back in port, half a dozen or so passengers were obliged to go to the hospital for X-rays and one seaman had died of a broken skull” (Tucker). “Reconnaissance was continued on the 6<sup>th</sup> with the Air Force making two flights, and the Navy providing radar coverage that night. This latter flight experienced considerable difficulty in finding the center by radar return, indicating that the storm was assuming extratropical characteristics. Meanwhile, the storm accelerated from 14 kt at 06/1000Z to 19 kt at 07/0300Z” (ATS).

#### September 7:

HWM analyzes a hurricane of at most 985 mb centered near 40.9N, 68.1W with a N-S dissipating stationary front located just west of the cyclone. HURDAT lists this as a 70 kt hurricane at 40.3N, 69.3W. The MWR tracks of centers of cyclones shows a 12Z position near 40.9N, 68.7W with a 981 mb pressure and the MWR post-season track map shows a 12Z position near 40.6N, 69.4W. ATS shows a 1230Z map time position near 41.5N, 68.9W. Microfilm at 12Z analyzes a tropical cyclone of at most 984 mb centered near 40.7N, 68.4W with a NNE-SSW frontal system approaching from the west located about 200 nmi west of the cyclone. Ship highlights: 60 kt SSW and 991 mb at 12Z at 40.1N, 66.6W (COA); 50 kt WNW and 986 mb at 12Z at 39.8N, 68.6W (micro); 65 kt SSE and 995 mb at 12Z at 40.7N, 66.2W (micro); 15 kt NNW and 985 mb at 12Z at 40.5N, 69.9W (micro); 60 kt SW and 1002 mb at 18Z at 41.1N, 66.7W (COA); 70 kt SW and 993 mb at 18Z at 42.4N, 66.4W (COA). 20 other gales between 35-55 kt and eight other low pressures between 991-1003 mb. Land/station highlights: 45 kt NNW and 994 mb at 12Z at Nantucket, MA (micro); 47 kt N (max w/1-min) at Nantucket (climo); 30 kt NE and 991 mb at 18Z at Eastport, ME (micro); 40 kt ESE and 1001 mb at 18Z at Halifax, Nova Scotia (micro); 42 kt (max w/1-min) at Eastport (climo). Three other low pressures of 1003 mb. From the September, 1953 National Monthly Climatological Data Summary Storm reports... “Location: Cape Cod area, Mass., and Maine Coast; Date: 7<sup>th</sup>; Time: all day; Property damage (exclusive of crops): \$1,070,000; Character of storm: wind; Remarks: Hurricane Carol traveled northward east of New England, producing heavy seas and gales along southeastern MA and ME shores. A 3,500 ton freighter grounded near Provincetown, MA, later refloated; damage unreported but apparently

minor. Fishing craft wrecked near Gloucester, MA: \$50,000 loss. Power yacht foundered off MA coast: \$20,000 loss. Maine fisheries commissioner estimated state's fisheries loss \$1,000,000 worth of gear, mostly lobster traps in storm" (climo). "Thereafter it slowly lost force, but was still about hurricane strength when it passed over Nova Scotia and New Brunswick on the 7<sup>th</sup>" (MWR). "It then began to accelerate more rapidly, attaining a speed of 25 kt by 07/1600Z, and moved with an easterly component. The center passed about 60 nmi east of Nantucket Island at approximately 07/1100Z with highest winds reported of about 55 kt while a ship as far as 150 nmi to the east of the center reported Beaufort force 12. By this time it was moving north-northeasterly with continued acceleration, and showed further evidence of becoming extratropical. Shortly after 07/1830Z the storm center entered the Bay of Fundy and rapidly became extratropical. Winds of storm velocity continued in the eastern semicircle causing considerable crop damage in Nova Scotia as it moved up the Bay" (ATS). "Carol – ME, 1" (Jarrell et al. 1992).

#### September 8:

HWM analyzes a tropical storm of at most 990 mb centered near 51.9N, 59.3W with the WSW end of a WSW-ENE warm front located 180 nmi NNE of the cyclone and the NNE end of a NNE-SSW cold front located 70 nmi SSW of the cyclone. HURDAT lists this as a 50 kt extratropical cyclone at 51.8N, 60.8W. The MWR tracks of centers of cyclones shows a 12Z position near 52.0N, 60.3W with a 989 mb pressure and the MWR post-season track map last shows a position at 00Z near 46.6N, 65.2W. ATS shows a 1230Z map time position near 51.2N, 60.0W. Microfilm last shows a closed low at 00Z before the cyclone goes off the north edge of the map of at most 987 mb centered near 46.7N, 64.9W with a front near the cyclone. Ship highlights: 30 kt E and 1003 mb at 12Z at 51.9N, 55.1W (COA); 30 kt S and 1000 mb at 18Z at 52.3N, 53.8W (COA); 30 kt SE and 1002 mb at 18Z at 51.8N, 53.3W (COA). Land/station highlights: 25 kt SW and 990 mb at 00Z at Moncton (46.1N, 64.8W) (micro); 35 kt SW and 1004 mb at 06Z at Sydney (46.1N, 60.2W) (micro). Eight other low pressures between 997-1005 mb. "The Hurricane Warning Service discontinued warnings on Carol after 08/0400Z" (ATS).

#### September 9:

HWM analyzes a closed low of at most 995 mb centered near 61.6N, 52.0W with an occluded front extending near or just east of the low to a triple point near 59N, 46W. A warm front extends from the triple point east-northeastward and a cold front extends from the triple point south-southwestward. HURDAT lists this as a 45 kt extratropical cyclone at 61.8N, 52.0W. The MWR tracks of centers of cyclones shows a 12Z position near 62.2N, 54.1W with a 987 mb pressure. Ship highlights (through 06Z only): 30 kt S and 1000 mb at 03Z at 56.5N, 51.0W (COA). Three other low pressures.

#### September 10:

The MWR tracks of centers of cyclones last shows a position at 06Z near 66.9N, 35.7W.

Carol formed from a tropical wave that moved off the coast of Africa on 27 August. HURDAT begins this system as a 25 kt tropical depression on 28 August at 06Z at 16.0N, 20.5W. Observations on the 28<sup>th</sup> indicate the definite presence of at least a strong

tropical wave. Although there is not concrete evidence that it was a tropical depression by the 28<sup>th</sup>, there is also not evidence that it was not closed, so no change is made to the timing of genesis. The previous HURDAT track shows a southwestward motion from 16.0N, 20.5W on the 28h at 06Z to 10.6N, 33.9W on the 30<sup>th</sup> at 18Z. A ship on the 30<sup>th</sup>, which experienced greater than or equal to a 4 mb pressure drop in a 24-hour period, indicates that the circulation is definitely closed by the 30<sup>th</sup> and that the position at 18Z on the 30<sup>th</sup> is near 14.0N, 35.0W instead of 10.6N, 33.9W (a major track change). In addition to the pressure falls, this ship experienced a wind shift of greater than 180 degrees in 12 hours. The highest 6-hourly wind reported from this ship was 20 kt and the lowest 6-hourly pressure was 1011 mb (although one pressure was missing- likely the value when it was closest to the center). The data indicates that the cyclone was still weak on the 30<sup>th</sup>, so the 30 kt intensity shown in HURDAT on the 30<sup>th</sup> is maintained. On August 31<sup>st</sup>, there is absolutely no data, but on 1 September at 1745Z, a ship ran into the cyclone and reported winds of 60-65 kt with a 992 mb pressure and barometer rapidly falling near 14.3N, 48.5W. The revised position at 18Z on 1 September is about 1.5 degrees WNW of the previous HURDAT position. Major north-northwestward track adjustments ranging from 2 to more than 3.5 degrees are analyzed at all times from August 30<sup>th</sup> at 00Z through September 1<sup>st</sup> at 06Z. Carol, which had been moving due west, turned toward the west-northwest on 2 September, and the first aircraft reconnaissance flight occurred on the 2<sup>nd</sup>. At 1311Z on 2 September, the Air Force plane measured a central pressure of 944 mb, and this value is added to HURDAT at 12Z on the 2<sup>nd</sup>. A central pressure of 944 mb equals 119 kt according to the Brown et al. southern pressure-wind relationship for intensifying systems and 120 kt is chosen for 12Z on 2 September (up from 75 kt originally). The ship data on September 1<sup>st</sup> indicates that the intensity of Carol at 18Z on the 1st was at least 70 kt, but it is not known how much higher than 70 kt the intensity was at that time. Therefore, the intensity is decreased by 10 kt per 6 hours backward from the 120 kt chosen for 12Z on the 2<sup>nd</sup>. Revised intensities at 12Z each day from 31 August to 2 September are 40, 80, and 120 kt (up from 35, 50, and 75 kt respectively- major upward revisions on the 1<sup>st</sup> and 2<sup>nd</sup>). Although there is no change to the time Carol became a tropical storm, Carol is analyzed to have become a hurricane by 06Z on 1 September (24 hours earlier than originally). Carol is analyzed to have become a major hurricane by 00Z on 2 September (also 24 hours earlier than originally) (both of these are major changes). On the 3<sup>rd</sup> of September, Carol was passing a few hundred nmi northeast of the northern Leeward Islands. All track changes from the 3<sup>rd</sup> through the 6<sup>th</sup> are seven-tenths of a degree or less. During those four days, the hurricane moved northwestward, passing well west of Bermuda and reaching a point near 35N, 70W by 18Z on the 6<sup>th</sup>. After the 944 mb central pressure was obtained by aircraft reconnaissance on the 2<sup>nd</sup>, a 929 mb central pressure was measured by a Navy aircraft on 3 September at 1808Z. Maximum winds of 130 kt were reported with an eye diameter of 3 nmi. The pressure value obtained by the aircraft was double checked, calibrated, and found to be correct. The central pressure of 929 mb listed in HURDAT at 18Z on 3 September is retained. A central pressure of 929 mb equals 133 kt according to the intensifying subset of the Brown et al. pressure-wind relationship. The estimated RMW of 3 nmi is much smaller than the climatological RMW value of 12 nmi from Vickery et al. for that central pressure and latitude. The forward speed of Carol was about 16 kt. Given this data, a 140 kt intensity is chosen on the 3<sup>rd</sup> for 12 and 18Z (up

from 130 kt originally) making Carol a Category 5 hurricane. 140 kt is the new peak intensity for Carol (previously 130 kt). This is the only tropical cyclone reanalyzed for this thesis (1944-1953) that was increased in intensity to a Category 5 from previously being listed with an intensity below Category 5 strength. The 929 mb central pressure was also the lowest central pressure ever recorded by aircraft in the Atlantic Basin up until that time, breaking the previous record of 937 mb set in Hurricane Easy (1951). The record before that was 938 mb set in the 1947 Fort Lauderdale hurricane. Major upward revisions to the intensity of 20 to 45 kt are analyzed at all times on the 1<sup>st</sup> and 2<sup>nd</sup> of September. Central pressures of 942 and 945 mb were measured at 19Z on the 4<sup>th</sup> and 1235Z on the 5<sup>th</sup> by reconnaissance aircraft, and these values are added to HURDAT at 18Z on the 4<sup>th</sup> and 12Z on the 5<sup>th</sup> respectively. The latter yields a wind speed of 110 kt according to the north of 25N pressure-wind relationship, and 110 kt is chosen for 12Z on the 5<sup>th</sup> (up from 105 kt originally). On the 6<sup>th</sup> at 2000Z, aircraft reconnaissance measured a 962 mb central pressure, and this value is added to HURDAT at 18Z on the 6<sup>th</sup>. A 962 mb central pressure yields 89 kt according to the weakening subset of the north of 25N pressure-wind relationship and 88 kt according to the north of 35N pressure-wind relationship from Landsea et al. (2004). An 85 kt intensity is chosen for 18Z on the 6<sup>th</sup> (up from 80 kt originally) because the RMW at that time was very large (and the forward speed of the cyclone was slightly fast). Carol reached its furthest west point and recurved around 00Z of the 7<sup>th</sup> near 37N, 70.5W. On the 7<sup>th</sup>, the cyclone passed well east of Nantucket, and the maximum wind recorded at Nantucket was 47 kt (1-minute). Ships at 12Z on the 7<sup>th</sup> recorded winds as high as hurricane force and pressures as low as 985 mb. At 18Z on the 7<sup>th</sup>, when Carol was still over water located between Maine and Nova Scotia moving northward, a ship recorded 70 kt with 993 mb about 60 nmi south of the center. Observations indicate that Carol was still tropical at that time. Carol is analyzed to have made two direct Canadian hurricane landfalls (the first of which is a result of a slight eastward track adjustment on the 7<sup>th</sup>). The first landfall occurred at 20Z on 7 September as a 75 kt (up from 65 kt originally at 18Z) Category 1 hurricane at 44.2N, 66.4W (western tip of Nova Scotia), and the second landfall occurred at 22Z on 7 September as a 70 kt hurricane at 45.3N, 65.8W (New Brunswick). Carol was previously listed as a Category 1 hurricane for Maine, but the hurricane impact for Maine is removed. The highest wind that occurred at Eastport, ME was 42 kt (1-min) and this was by far the closest station and also the nearest point on the Maine coast to which the center passed. It is quite possible that hurricane force winds only existed on the right side of Carol, but another important point is that the track has been adjusted a few tenths of a degree further away from Maine compared with the previous track at closest approach. Portland, ME did not even record any tropical storm force winds. Maine and Massachusetts received tropical storm impacts from Carol, and Bermuda also received a tropical storm impact. After Canadian landfall, HURDAT previously listed Carol as having become extratropical by 00Z on the 8<sup>th</sup> with a 60 kt intensity, but it is analyzed that Carol did not become extratropical until 06Z on the 8<sup>th</sup>. No change is made to the timing of dissipation or to the position or intensity at the final point, which is listed at 12Z on 9 September at 61.8N, 52.0W as a 45 kt extratropical cyclone.

Additional quotes:

“Hurricane Carol was full-fledged when it made its appearance out of an area of no reports some 700-800 miles east of the Lesser Antilles. This severe hurricane spent most of its fury at sea. Only light damage was inflicted on Bermuda. Shipping at sea was able to stay out of the storm’s path, except for a Panamanian freighter that went aground near Cape Cod. Some damage was done to New England, but the storm had its worst effect on apple orchards and grain fields of Nova Scotia. One fishing vessel was sunk in the Bay of Fundy and another near Gloucester. Two deaths were reported as being due to this storm” (ATS).

#### 1953 Storm 6 (Dolly) – (originally Storm 5)

Major track changes and major intensity changes are analyzed for Hurricane Dolly. A major change is made to the timing of when hurricane intensity was first attained, and a major change is introduced for the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Tucker (1995).

#### September 5:

From Truchelut’s warm anomaly study... “Hurricane Dolly: Sig anom and closed circulation analyzed as early as 9/5/12Z near 13N 52W” (Truchelut, personal communication, 2010).

#### September 6:

“Pressure 1009 no evidence of CC on 9/6, west wind on 9/6/18z” (Truchelut)

#### September 7:

“The ship L. Lykes at 18.2N, 60.1W [at 07/1830Z] drew attention to that part of the wave which was north of the island chain. This ship reported winds WSW force 5 (20 kt) and rain, suggesting the existence of a low center near 19N, 61W” (ATS). “1005slp in Carib on 9/7/6z. TYPE 2” (Truchelut).

#### September 8:

HWM analyzes a spot low near 19.9N, 67.1W. HURDAT lists this as a 50 kt tropical storm at 20.0N, 66.7W. The MWR tracks of centers of cyclones first shows a position at 18Z near 20.2N, 68.9W. ATS shows a 1230Z map time position near 19.1N, 64.0W. Microfilm analyzes a trough. Ship highlights: 35 kt NE and 1014 mb at 00Z at 21.5N, 64.1W (COA). “An easterly wave moved into the Caribbean Sea on September 8 and caused heavy rainfall in the Virgin Islands and Puerto Rico” (MWR). “A Navy reconnaissance aircraft departed San Juan on 8 September to investigate in the area of 19N, 67W and 17.3N, 65.5W. No evidence of a tropical storm was found in either area. This search, in conjunction with surface reports, showed that neither of the suspected low centers were of immediate danger” (ATS).

#### September 9:

HWM analyzes a hurricane of at most 1005 mb centered near 20.5N, 68.7W. HURDAT lists this as a 65 kt hurricane at 20.7N, 69.4W. The MWR tracks of centers of cyclones shows a 12Z position near 21.3N, 69.0W with a 1003 mb pressure and the MWR post-season track map shows a 12Z position near 21.0N, 69.1W. ATS shows a 1230Z map time position near the HURDAT position. Microfilm at 12Z analyzes a tropical cyclone of at most 1005 mb centered near the HURDAT position. Ship highlights: 45 kt SE and 1011 mb at 00Z at 21.0N, 67.5W (COA); 45 kt ESE and 1008 mb at 18Z at 22.5N, 69.1W (micro); 40 kt SE and 1005 mb at 21Z at 22.3N, 69.0W (micro). Four other gales between 35-45 kt. Aircraft highlights: center fix at 1345Z at 20.6-20.8N, 69.5W with 1005 mb central pressure and 85 kt maximum flight-level winds encountered (micro, ATS). "It was the 9<sup>th</sup> before aircraft located a developing center in the wave near 21N, 69W" (MWR). "During the night [of the 8<sup>th</sup>-9<sup>th</sup>], the area near 23N, 69W was watched closely for indications of intensification. However, ships in the area reported easterly winds of no more than 30 kt. Another reconnaissance plane departed from San Juan at first light on the 9<sup>th</sup>. Enroute to the above area, winds of no higher than 38 kt were reported. These were expected in view of previous ship reports near the area. This plane's subsequent reports of 60 and 85 kt were the first of hurricane force. At 09/1345Z this flight centered an eye at 20.6N, 69.5W with central surface pressure 1005 mb, maximum winds 85 kt in the NE quadrant and heavy precipitation in the eastern semicircle. The eye was about 15 nmi in diameter. Warning number one was issued on Dolly at 09/1445Z. At the time of the first aircraft fix winds of 45 kt extended only to 35 nmi from the center in the NE quadrant and the observer in the aircraft believed that the eye was then in the process of formation. On the 9<sup>th</sup>, a second Navy aircraft from San Juan attempted to observe the storm by radar but was unable to locate an eye. However, it did give indications that both strongest winds and heaviest weather were concentrated in the eastern semicircle of the storm and that Dolly had taken a more northerly course" (ATS).

#### September 10:

HWM analyzes a hurricane of at most 1000 mb centered near 24.0N, 70.2W with a SW-NE stationary front located a few hundred nmi west and northwest of the cyclone. HURDAT lists this as a 100 kt hurricane at 23.7N, 70.5W with a 995 mb central pressure. The MWR tracks of centers of cyclones shows a 12Z position near 24.3N, 71.0W with a 993 mb pressure and the MWR post-season track map shows a 12Z position near 23.8N, 70.9W. ATS shows a 1230Z map time position near the HURDAT position. Microfilm analyzes a tropical cyclone of at most 1002 mb centered near 24.1N, 70.6W with the east end of a front located near 30N, 73W. Ship highlights: 50 kt SE and 1006 mb at 00Z at 22.4N, 68.9W (COA); center fix at 0400Z at 22.9N, 69.9W with 999 mb central pressure and calm winds (micro); 55-60 kt SE and 1012 mb at 18Z at 25.3N, and either 68.3 or 69.3W (micro). Four other gales of 35-50 kt and one other low pressure of 1004 mb. Aircraft highlights: Air Force center fixes at 1316 and 1330Z at 24.0N, 70.7W and 24.1N, 70.7W (micro); Air Force center fix (loran) at 1400Z at 24.3N, 70.8W with 990 mb central pressure, and 80 kt maximum estimated [flight-level?] winds (micro); 65 kt estimated surface winds at 1430Z from the SW in the SE quadrant and at 1500Z from the W in the S quadrant (micro); center fixes at 1430 and 1500Z at 24.4N, 70.9W and 24.5N, 70.9W (micro); 90 kt flight-level winds at 1530Z 50 nmi east of the center (micro); center

fix (loran) at 1645Z at 24.9N, 71.0W with 989 mb central pressure and 90 kt estimated maximum winds (micro); center fix at 1900Z at 25.2N, 71.0W (micro). “The center developed slowly and curved toward a northerly course during the 9<sup>th</sup> and 10<sup>th</sup>, reaching maximum development on the 10<sup>th</sup>, when aircraft estimated top wind speed at near 100 knots” (MWR). “Dolly was reported to have clouds radiating 100 miles from the centre in all directions and winds of 100-120 mph at the centre. At this stage it was considered unlikely to affect Bermuda except with clouds and showers” (Tucker). “During the night of 9 and 10 September, a Navy night radar reconnaissance flight was made. Even though a definite eye was not detected, numerous bands of weather were reported, the interpretation of which proved helpful in determining the storm’s track. Reconnaissance was continued on the 10<sup>th</sup> with an Air Force flight from Bermuda. A good series of fixes was obtained by this flight, which showed the path of Dolly recurving again to the northward after 10/1230Z, and no appreciable change in intensity” (ATS).

#### September 11:

HWM analyzes a hurricane of at most 995 mb centered near 29.0N, 68.9W. A stationary front extends from 34N, 55W to 34N, 68W to 33N, 71W, becoming a dissipating stationary front near 33N, 72W, extending to 30N, 74W to 27N, 75W to 23N, 76W to 20N, 77W. HURDAT lists this as an 85 kt hurricane at 29.0N, 69.0W. The MWR tracks of centers of cyclones shows a 12Z position near 28.3N, 68.9W with a 1000 mb pressure and the MWR post-season track map shows a 12Z position near 28.1N, 69.1W. ATS shows a 1230Z map time position near 28.7N, 69.2W. Microfilm analyzes a low of at most 996 mb centered near 28.3N, 68.4W with the eastern end of a front located near 30N, 72W. Ship highlights: 50 kt SE and 1007 mb at 00Z at 24.8N, 69.0W (COA, micro); 60 kt SE and 993 mb at 06Z at 26.6N, 69.0W (micro); center fix around ~10Z near ~27.7N, 68.5W with maximum winds encountered of 60 kt (micro); 50 kt NE and 998 mb at 1030Z at 27.9N, 68.5W (micro); 50 kt SW and 996 mb at 12Z at 28.5N, 68.5W (COA); 60 kt ESE and 999 mb at 16Z at 29.2N, 67.6W (micro); 50 kt SSW and 997 mb at 18Z at 29.1N, 67.7W (COA). 12 other gales of 35-50 kt and five other low pressures of 1001-1005 mb. Aircraft highlights: Navy center fix at either 1450 or 1540Z at 29.3N, 68.6W with 995 mb central pressure and 100 kt maximum flight-level winds encountered (micro). “Thereafter the storm moved northeastward with waning force, passed over Bermuda the night of the 11<sup>th</sup>, where only gale winds were experienced. Little or no damage was caused at Bermuda” (MWR). “Dolly... continued to recurve, and by 11/0630Z, was moving northeast. At the same time it began to accelerate under the influence of the westerlies aloft at about 2 kt per 6 hr. At about 11/1200Z it attained its highest intensity with winds of approximately 100 kt, which were reported by a Navy reconnaissance flight” (ATS).

#### September 12:

HWM analyzes a low of at most 1000 mb centered near 34.6N, 61.8W. A stationary front undergoing frontogenesis is plotted from 40N, 75W to 38N, 69W to just north of Dolly, becoming a warm front near 37N, 59W, extending to 33N, 51W. HURDAT lists this as a 55 kt tropical storm at 34.9N, 61.8W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 993 mb pressure and the MWR post-season track map shows a 12Z position near 34.7N, 62.1W. ATS shows a 1230Z

map time position near 34.7N, 61.4W. Microfilm analyzes a low of at most 999 mb centered near 34.9N, 62.2W. Ship highlights: 40 kt SE and 1007 mb at 00Z at 30.5N, 64.5W (micro); 45 kt NE and 999 mb at 18Z at 37.8N, 59.5W (COA, micro). One other gale of 35 kt and one other low pressure of 1001 mb. Land/station highlights: close or approximate center fix at Bermuda at 0550Z (ATS, micro); 15 kt WNW and 998 mb at 0630Z at Bermuda (micro); 41 kt (max w) G 56 at Bermuda (ATS, micro). Aircraft highlights: Air Force center fix (loran) at 1435Z at 35.5N, 60.5W with 994 mb central pressure, 50 kt max winds with gusts to hurricane force and min 700 mb height of 9,980 ft (micro, ATS). “[The cyclone] moved rapidly northeastward over the Atlantic during the 12<sup>th</sup> and 13<sup>th</sup> beyond the range of reconnaissance aircraft” (MWR). “However, Dolly made a considerable eastward turn, and at 9 P.M. on September 11<sup>th</sup>, Hurricane Warning No. 5 was hoisted to indicate that the hurricane was expected to pass a short distance to the east of Bermuda, and the local Meteorological Station advised that the risk of hurricane force winds in the early hours of the 12<sup>th</sup> was now considerable. As things turned out, the centre of the hurricane passed over the colony about 2 A.M. on Saturday September 12<sup>th</sup> – but by that time ‘Dolly’ had been losing wind-velocity for the previous six hours and was no longer blowing at hurricane, but strictly at gale force. 400 telephones were put out of action by wind and rain but other damage was slight” (Tucker). “All evidence indicated that Dolly would continue on a NE course, which was almost directly toward Bermuda. An Air Force reconnaissance flight verified this forecast as well as the sharp decrease in intensity to 70 kt by 12/0000Z and continued acceleration. Kindley Air Force Base, Bermuda, reported the eye over that station at 12/0550Z with minimum pressure of 997.6 mb, and maximum sustained surface winds of 41 kt with gusts to 56 kt. The speed was then about 20 kt. The eye was further described as open to the south and west. All this supported the belief that Dolly, under the influence of westerlies below the 500 mb level, already possessed extratropical characteristics. The last aerial reconnaissance of Dolly was accomplished on the 12<sup>th</sup> by the Air Force. At 12/1435Z it had moved on to the NE and accelerated to 30 kt. Except for near hurricane force winds in squalls, the highest sustained velocity was 50 kt. [Advisories] on Dolly were discontinued after 12/2200Z” (ATS).

#### September 13:

HWM analyzes a low of at most 1005 mb centered near 40.5N, 48.5W with a warm front extending from the low southward to 35N, 46W, and a cold front extending from the low west-southwestward to 37N, 60W. HURDAT lists this as a 50 kt extratropical cyclone at 41.7N, 48.0W. The MWR tracks of centers of cyclones shows a 12Z position near 42.1N, 48.5W with a 1004 mb pressure and the MWR post-season track map shows a 12Z position near the same position. ATS shows a 1230Z map time position near 40.2N, 52.1W. Microfilm at 12Z analyzes an elongated low of at most 1005 mb centered near 41.7N, 48.2W. Ship highlights: 45 kt ENE and 1012 mb at 00Z at 40.4N, 57.8W (COA); 35 kt SSW and 1001 mb at 18Z at 42.0N, 46.0W (COA). Ten other gales between 35-45 kt and one other low pressure of 1005 mb.

#### September 14:

HWM analyzes a low of at most 1005 mb centered near 42.6N, 40.0W with a warm front extending south-southeastward from the low to 40N, 37W to 36N, 36W and a cold front

extending from the low to 42N, 39W to 39N, 39W to 37N, 46W to 37N, 49W. HURDAT lists this as a 45 kt extratropical cyclone at 43.0N, 40.0W. The MWR tracks of centers of cyclones shows a 12Z position near 43.8N, 41.5W with a 1004 mb pressure. Ship highlights: 35 kt SSW and 1004 mb at 00Z at 42.0N, 44.0W (COA); 50 kt E and 1009 mb at 00Z at 42.9N, 43.3W (COA); 40 kt NW and 1011 mb at 06Z at 40.5N, 47.5W (COA). Four other gales of 35 kt and three other low pressures of 1004-1005 mb.

#### September 15:

HWM analyzes a low of at most 1010 mb centered near 44.5N, 34.5W with a dissipating occluded front extending from the low to 45N, 31W to a triple point near 41N, 29W. A warm front extends southeastward from the triple point and a cold front extends southwestward from the triple point. HURDAT lists this as a 45 kt extratropical cyclone at 42.9N, 35.0W. The MWR tracks of centers of cyclones shows a 12Z position near 44.4N, 37.6W with a 1009 mb pressure. Ship highlights: 35 kt E and 1010 mb at 12Z at 45.0N, 32.0W (COA); 35 kt NE and 1007 mb at 18Z at 46.0N, 32.0W (COA). One other gale of 35 kt.

#### September 16:

HWM analyzes a low of at most 1005 mb centered near 41.3N, 23.5W with an occluded front extending from the low to a triple point near 41N, 19W. A warm front extends south-southeastward from the triple point to 39N, 18W, and a cold front extends southwestward from the triple point. HURDAT lists this as a 35 kt extratropical cyclone at 42.0N, 23.8W. The MWR tracks of centers of cyclones shows a 12Z position near 42.1N, 24.9W with a 1004 mb pressure. Ship highlights (through 12Z only): 20 kt WNW and 1004 mb at 06Z at 41.8N, 31.4W (COA); 20 kt WSW and 1004 mb at 12Z at 40.5N, 23.0W (COA). One other low pressure of 1004 mb.

#### September 17:

HWM analyzes a broad low of at most 1010 mb centered near 42.0N, 14.1W with an occluded front extending from 43N, 13W to 40N, 10W to 35N, 13W. HURDAT lists this as a 25 kt extratropical cyclone at 41.8N, 13.2W.

#### September 18:

HWM analyzes a low of at most 1000 mb centered near 58.0N, 11.5W with an occluded front extending from 59N, 9W to 58N, 1W to 55N, 7E. HURDAT no longer lists a system on this day.

Dolly likely formed from a tropical wave that was first noted on 5 September as it approached the Lesser Antilles. HURDAT begins this system as a 40 kt tropical storm at 20.3N, 65.9W at 06Z on 8 September. There is no clear evidence of a closed circulation prior to the genesis time in HURDAT, so no change in made to the timing of genesis. Available observations do, however, indicate that Dolly was further south and weaker than was previously listed in the original HURDAT. A major track change is introduced into HURDAT for the first point- the position at 06Z on the 8<sup>th</sup> is adjusted slightly over 2 degrees south-southeast of the previous position. After 12Z on the 8<sup>th</sup>, all track changes for the rest of the tropical portion of the lifetime of Dolly are 1 degree or less. Dolly

recurred around 18Z on the 10<sup>th</sup> near 25N, 71W before passing nearly directly over Bermuda as a tropical storm on the 12<sup>th</sup>. The intensity at the genesis point is analyzed to be a 30 kt tropical depression (down from 40 kt originally at that time). At 00Z on the 9<sup>th</sup>, a ship reported 45 kt winds, but at 1345Z on the 9<sup>th</sup>, aircraft reconnaissance recorded a central pressure of 1005 mb. This value is added to HURDAT at 12Z on the 9<sup>th</sup>, and equals 37 kt according to the Brown et al. (2006) southern pressure-wind relationship. Later on the 9<sup>th</sup>, at 21Z, a ship recorded 40 kt winds concurrent with a 1005 mb pressure. Intensities of 45 and 50 kt are chosen for 12 and 18Z on the 9<sup>th</sup> (down from 65 and 85 kt respectively). It is analyzed that Dolly first attained tropical storm strength at 12Z on 8 September (six hours later than shown in HURDAT originally). On the 10<sup>th</sup> at 04Z, a ship in the storm center reported a central pressure of 999 mb, which equals 49 kt according to the southern pressure-wind relationship (the 999 mb central pressure is added to HURDAT at 06Z on the 10<sup>th</sup>). At 1400 and 1645Z on the 10<sup>th</sup> respectively, aircraft reconnaissance recorded central pressures of 990 and 989 mb respectively. The 995 mb central pressure value listed in HURDAT 12Z on the 10<sup>th</sup> is replaced by a 990 mb central pressure value. A central pressure of 990 mb equals 64 and 62 kt respectively according to the intensifying subsets of the southern and north of 25N pressure-wind relationships. The 989 mb central pressure measured at 1645Z is added to HURDAT at 18Z, and this value yields 65 and 61 kt according to the southern and north of 25N pressure-wind relationships respectively. Intensities of 60 and 65 kt are chosen for 12 and 18Z on the 10<sup>th</sup> respectively (down from 100 kt at both times originally). Dolly is analyzed to have first attained hurricane intensity at 18Z on 10 September (30 hours later than in HURDAT originally- a major change). At 06Z on the 11<sup>th</sup>, with Dolly moving north-northeastward near 27N, 70W, a ship recorded a 60 kt wind concurrent with a 993 mb pressure, and at 10Z on the 11<sup>th</sup>, a ship may have passed through the center (without reporting a central pressure) and reported maximum winds encountered of 60 kt estimated. Although an aircraft reconnaissance fix reported a central pressure of 995 mb at about 15Z on the 11<sup>th</sup>, a central pressure of 995 mb is not added to HURDAT. This is because ship observations indicate that the central pressure at 12Z was less than or equal to 991 mb and at 18Z was less than or equal to 992 mb. No central pressures are added to HURDAT on the 11<sup>th</sup>, but the 65 kt intensity is maintained through 18Z on the 11<sup>th</sup>. By the time that Dolly made its closest approach to Bermuda around 05Z on the 12<sup>th</sup>, it had weakened to a tropical storm. The peak intensity analyzed for Dolly is 65 kt from 18Z on the 10<sup>th</sup> through 18Z on the 11<sup>th</sup> (previously 100 kt from 06Z on the 10<sup>th</sup> to 18Z on the 10<sup>th</sup>). When Bermuda was inside the RMW, the 06Z observation on the 12<sup>th</sup> was 15 kt concurrently with a 998 mb pressure. A 996 mb central pressure is added to HURDAT at 06Z on the 12<sup>th</sup> based on this observation. A central pressure of 996 mb yields a wind speed of 50 kt according to the north of 25N pressure wind relationship. The maximum wind experienced at Bermuda was 41 kt with a gust to 56 kt. At 1435Z on the 12<sup>th</sup>, aircraft reconnaissance recorded a central pressure of 994 mb, and this value is added to HURDAT at 12Z on the 12<sup>th</sup>. A central pressure of 994 mb yields 53 and 58 kt according to the pressure-wind relationships for north of 25N and north of 35N respectively. The RMW was smaller than average and the forward speed of the storm was a very fast 30 kt. Intensities of 55 kt are chosen at both 06 and 12Z on the 12<sup>th</sup> (down from 60 kt originally at 06Z). Dolly is analyzed to have weakened from a hurricane to a tropical storm at 00Z on the 12<sup>th</sup> (no change from HURDAT previously). Late on the 12<sup>th</sup>, Dolly was moving

rapidly east-northeastward over the central Atlantic. Dolly is analyzed to have become extratropical by 00Z on the 13<sup>th</sup> (six hours later than originally) with a 00Z position on the 13<sup>th</sup> of 38.5N, 56.4W and a 50 kt intensity. After extratropical transition, Dolly turned toward a due east directional movement by 00Z on the 14<sup>th</sup> along 43N, and it passed north of the Azores early on the 16<sup>th</sup> of September. Although Dolly slightly strengthened briefly as an extratropical system from 50 kt early on the 13<sup>th</sup> to 55 kt from 18Z on the 13<sup>th</sup> to 00Z on the 14<sup>th</sup>, it subsequently weakened very gradually. At 12Z on the 16<sup>th</sup>, the HURDAT position of 42.0N, 23.8W is unchanged, and the intensity is lowered from 35 to 30 kt. Observations indicate that the extratropical remnant of Dolly dissipated after 12Z on the 16<sup>th</sup> (30 hours earlier than shown in HURDAT originally- a major change).

Additional quote: “This was one of the season’s storms that lost force rapidly without apparent cause, after attaining considerable intensity” (MWR).

“Hurricane Dolly’s initial direction of movement caused considerable alarm to the Bahamas, and also in Florida where large parts of the peninsula were already soggy with rain. The threat of hurricane winds is always cause for alarm, but this storm was really ‘wet’ – it dropped up to 10.5 inches of rain on the Virgin Islands as it passed. This threat to the mainland was eased as the storm recurved towards Bermuda. Fortunately for that island, it weakened as it drew nearer and winds of only about 50 knots were experienced as it passed” (ATS).

#### 1953 Storm 7 (new to HURDAT)

HWM and COADS indicate that a short-lived tropical storm, previous undocumented in HURDAT existed in the north Atlantic in September from the 10<sup>th</sup> to the 11<sup>th</sup>. David Roth lists this storm in his list of suspects.

#### September 8:

HWM analyzes a closed low of at most 1005 mb (not the feature of interest) centered near 41.5N, 32.5W with a warm front extending from the low northward to 45N, 32.5W to 50N, 30W and a dissipating cold front extending from the low to 43N, 31W to 42N, 25W to 39N, 24W to 35N, 25W to 32N, 28W. HURDAT did not previously list this system.

#### September 9:

HWM analyzes a closed low of at most 1010 mb (the feature of interest) centered near 36.8N, 34.4W. David Roth (DR hereafter) lists a 12Z position of 38N, 34W with a 25 kt intensity. No gales or low pressures.

#### September 10:

HWM analyzes a closed low of at most 1005 mb centered near 44.8N, 34.0W (the feature of interest) and another closed low of at most 1005 mb near 40N, 41.7W. DR lists a 12Z position near 45N, 33W with a 30 kt intensity. Ship highlights: 45 kt S and 1014 mb at

00Z at 39.2N, 30.7W (COA); 40 kt SSE and 1011 mb at 06Z at 41.8N, 30.9W (COA); 40 kt S and 997 mb at 18Z at 47.0N, 35.6W (COA).

#### September 11:

HWM analyzes a closed low of at most 1000 mb centered near 54.2N, 40.3W with a trough axis extending from the low southeastward and then southward. The west end of a W-E warm front is located 150 nmi north of the cyclone. HWM analyzes another closed low of at most 1000 mb centered near 51.9N, 51.4W. Ship highlights: 15 kt SE and 1001 mb at 09Z at 52.8N, 35.5W (COA); 10 kt SE and 1000 mb at 18Z at 55.6N, 38.1W (COA). A couple of other low pressures.

#### September 12:

HWM analyzes a closed low of at most 995 mb centered near 59.9N, 35.3W with a NE-SW trough axis running through the low from the west end of a W-E warm front near 61N, 34W to a spot low plotted near 56N, 46W. The north end of a cold front is located a couple hundred nmi south of the possible remnant of the feature of interest.

On 8 September, a large, broad, and relatively weak extratropical system was located over the north Atlantic in the vicinity of 40N, 30 to 35W. On the 9<sup>th</sup>, a small vortex began to form on the southeast side of the broad circulation. This small vortex is analyzed to have become a tropical cyclone and attained a closed circulation at 06Z on 10 September at 42.5N, 32.5W as a 45 kt tropical storm. A ship recorded a 45 kt south wind at 00Z associated with the developing tropical cyclone. At 06Z, a different ship recorded a wind a 40 kt. The storm moved north-northwestward; its track was likely somewhat affected by the weak extratropical cyclone to its west. The tropical cyclone may have partially revolved in a counterclockwise direction around the broad extratropical low. At 18Z on the 10<sup>th</sup>, a ship east of the center recorded 40 kt S with a 997 mb pressure (this ship is found to be biased about 3 mb too low). Assuming that the correct pressure for that ship at the time was about 1000 mb, a peripheral pressure of 1000 mb suggests winds of at least 49 kt according to the Landsea et al. north of 35N pressure-wind relationship. A 50 kt intensity is chosen for 12 and 18Z on the 10<sup>th</sup> because environmental pressures in the area were low due to the presence of the other low. On the 11<sup>th</sup>, evidence of a closed circulation decreases, and no more gales are observed. It is analyzed that the tropical cyclone became extratropical by 06Z on the 11<sup>th</sup> at 50.6N, 37.8W with a 35 kt intensity. The cyclone is analyzed to have weakened to 30 kt by 12Z on the 11<sup>th</sup>, and the final point before dissipation is listed at 18Z on the 11<sup>th</sup> at 54.5N, 40.5W as a 30 kt extratropical cyclone.

This system contained a small-scale closed circulation with gales and low pressures near the center and little to no temperature gradient across the low on the 10<sup>th</sup>. At genesis (06Z on the 10<sup>th</sup>) absolute temperatures were in the upper-60s and SSTs were in the lower 70s. Both the absolute temperatures and the SSTs decreased by about 5 to 7 degrees during the next 18 hours as the tropical cyclone moved northward, and then it is analyzed that the cyclone became extratropical.

## 1953 Storm 8 (Edna) – (originally Storm 6)

Minor track changes and major intensity changes are analyzed for this hurricane. Major changes are also introduced for the dissipation. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Tucker (1995).

## September 11:

From Truchelut's warm anomaly study... "Hurricane Edna: Sig anom centered near 10N 42W on 9/11/12Z" (Truchelut).

## September 12:

"NW wind on 9/12/06z, 1012slp, 25kt winds but sparse obs" (Truchelut).

## September 13:

HURDAT does not yet list a system on this day.

## September 14:

HWM analyzes a spot low in a trough near 17.3N, 61.4W. HURDAT lists this as a 35 kt tropical storm at 17.0N, 62.4W. The MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 16.8N, 62.1W. Ship highlights: 40 kt E at 1530Z (ATS); 40 kt E and 1013 mb at 1910Z at 19.4N, 62.4W (ATS, micro); 50 kt ESE and 1015 mb at 1945Z at 19.9N, 61.5W (ATS). Aircraft highlights: 45 kt estimated surface winds between 19-23N, 60-62W at 2030Z (ATS). "Following closely behind Dolly, Edna began forming in a squally wave over and to the north of the Leeward Islands on September 14" (MWR). From the 14/2230Z San Juan Weather Bureau Public Advisory (Edna Advisory #1)... "The disturbance east and northeast of the Virgin Islands does not yet appear to have a definite closed circulation and is still only an area of showers, thunderstorms, and squalls. Showers and thunderstorms with strong gusty winds are occurring over a broad semicircular area north of the island from St. Croix to Antigua..." (WB advisories),

## September 15:

HWM analyzes a hurricane of at most 1005 mb centered near 20.6N, 66.8W. HURDAT lists this as a 65 kt hurricane at 20.9N, 67.0W. The MWR tracks of centers of cyclones shows a 12Z position near 21.6N, 67.5W with a 998 mb pressure and the MWR post-season track map shows a 12Z position near 21.0N, 67.4W. Microfilm at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 21.2N, 67.1W. Ship highlights: 45 kt SE and 1010 mb at 06Z at 19.1N, 62.7W (micro); 75 kt SE and 1012 mb at 18Z at 23.2N, 67.3W (micro). Nine other gales between 35-55 kt and one low pressure of 1004 mb. Aircraft highlights: radar center fix at 0600Z at 20.0N, 65.2W; Navy center fix at 1300Z at 21.0-21.1N, 67.0W with 995 mb central pressure and 100 kt maximum flight-level winds at the NE RMW (micro, ATS); Navy center fix at 1830Z with 987 mb central pressure, 100 kt estimated surface winds, 700 mb height 8,890 ft [I think may have been a typo] and 700 mb temperature 9.5C (micro); Navy center fix (loran) at 2100Z at 22.6N,

68.5W with 700 mb height 9,600 ft (micro); Navy center fix at 2130Z at 22.8N, 68.5W (micro). “On the morning of the 15<sup>th</sup> the center was first definitely located at about 20N, 66W” (MWR).

September 16:

HWM analyzes a hurricane of at most 995 mb centered near 24.3N, 70.6W. HURDAT lists this as a 110 kt hurricane at 24.8N, 71.1W. The MWR tracks of centers of cyclones shows a 12Z position near 25.2N, 70.9W with a 989 mb pressure and the MWR post-season track map shows a 12Z position near 24.5N, 71.1W. Microfilm at 12Z analyzes a tropical cyclone of at most 990 mb centered near the HURDAT position. Ship highlights: 35 kt and 997 mb at 03Z (micro); 65 kt E and 1004 mb at 06Z at (micro); 65 kt S and 1010 mb at 13Z at (HWM, micro). 11 other gales of 35-60 kt and five other low pressures of 997-1004 mb. Aircraft highlights: radar center fixes at 0138, 0300, and 0500Z between 23.1-23.5N, 69.3-70.0W (micro); Air Force center fix (loran) at 1112Z at 24.5N, 70.8W with 977 mb central pressure (micro); center fixes (all with loran) at 1300, 1400, and 1500Z between 24.9-25.0N, 70.7-71.0W with 700 mb height 9,580 ft and 500 mb height 18,840 ft (micro); Air Force center fix at 1906Z (loran) at 26.1N, 71.3W with 700 mb height 9,830 ft (micro); Air Force center fix (loran) at 2022Z at 26.2N, 70.8W with 976 mb central pressure and 700 mb height 9,630 ft (micro); Air Force center fix (loran) at 2045Z at 26.4N, 71.0W with 500 mb height 18,650 ft (micro); Air Force center fix at 2105Z at 26.3N, 70.9W with 969 mb dropsonde surface pressure (micro). “Thereafter the storm strengthened rapidly to a hurricane with strongest winds about 125 mph and followed a broad curve to the north and northeast that very closely paralleled the course taken by Dolly a few days earlier” (MWR). “Edna was centered... at 16/2020Z by loran fix. Max wind of 70 kt from the SE was estimated in the north quadrant. The shape of the eye is elliptical and 20 miles across as determined by radar observation. Minimum pressure 976 mb. Winds over 65 kt extend 60 miles from the eye in [all quadrants]. The strongest quadrant of the storm is northeast. The eye was not very well-defined but was roughly elliptical in shape. Major axis oriented NW/SE. Very difficult to find actual center of low pressure, and center of storm seemed to be moving very erratic. Position fixed again 26.3N, 70.9W at 2105Z. Lowest pressure by dropsonde 969 mb” (micro).

September 17:

HWM analyzes a hurricane of at most 995 mb centered near 29.3N, 69.1W with a NE-SW cold front approaching from the northwest located about 200 nmi northwest of the cyclone. Another NE-SW cold front is plotted further west parallel to the other cold front. HURDAT lists this as a 105 kt hurricane at 29.5N, 69.7W. The MWR tracks of centers of cyclones shows a 12Z position near 29.7N, 68.9W with a 985 mb pressure and the MWR post-season track map shows a 12Z position near 29.2N, 69.7W. Microfilm at 12Z analyzes a tropical cyclone of at most 996 mb centered near 29.3N, 68.9W with the closest front located about 400 nmi NNW of the cyclone. Ship highlights: center fix at 13Z at 29.2N, 68.9W with 966 mb central pressure (micro); 70 kt NW from same ship at a different time (micro). Two other gales of 35-40 kt and two other low pressures of 1002-1005 mb. Aircraft highlights: Navy radar center fixes at 0326, 0400, 0500, and 0600Z between 27.5-28.2N, 70.1-70.5W (micro); Air Force center fix at 1227Z at 29.2N,

69.0W with 700 mb height 9,200 ft (micro); center fix (loran) at 1330Z at 29.5N, 68.7W with 966 mb central pressure and 70 kt maximum winds encountered (micro); center fixes at 1429 and 1459Z (loran and radar) between 29.8-29.9N, 68.4-68.5W (micro); Air Force center fixes (all with loran) at 1900, 2000, and 2100Z between 30.9-31.5N, 66.8-67.1W with 962 mb central pressure at 2000Z, 700 mb height in the eye of 9,070 ft at 1900Z and estimated maximum winds encountered of 80 kt (micro).

September 18:

HWM analyzes a hurricane of at most 995 mb centered near 36.7N, 59.3W. A cold front intersects with a warm front near 40N, 60W. The warm front extends east-northeastward from that position to 41N, 56W, and the cold front extends southwestward from that position to 38N, 62W to 36N, 64W to 33N, 69W to 31N, 79W. A dissipating cold front is plotted from 32N, 62W to 29N, 68W to 28N, 71W. HURDAT lists this as an 85 kt hurricane at 37.0N, 60.2W. The MWR tracks of centers of cyclones shows a 12Z position near 36.6N, 58.6W with a 996 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a somewhat asymmetric, closed low of at most 996 mb centered near 36.6N, 58.6W. Ship highlights: 80 kt and 995 mb at 03Z (micro); 75 kt N and 995 mb at 03Z at 33.3N, 65.8W (micro); 65 kt W and 1003 mb at 13Z at 35.4N, 58.7W (HWM, micro); 60 kt ENE and 990 mb at 18Z at 39.5N, 56.7W (COA, micro). Three other gales of 40-60 kt and three other low pressures of 991-1003 mb. Land highlights: gust to 92 kt SSE (peak gust) at Bermuda (ATS, micro); 994 mb (min p) at Bermuda around ~0120Z (ATS); 56 (kt or mph?) (elevated?) SSW (max wind) G 89 kt at 0230Z at Bermuda (micro, ATS). Aircraft highlights: Air Force center fix (loran) at 1641Z at 38.0N, 57.8W with 700 mb height 9,340 ft, 1001 mb minimum peripheral pressure encountered and 75 kt maximum wind encountered (micro, ATS). “The center passed a short distance to the north of Bermuda during the evening of the 17<sup>th</sup> and gave winds in gusts up to 120 mph which caused considerable damage on the island” (MWR). “This was a major hurricane, with maximum winds locally of over 120 mph, and one gust of 126. The centre of the storm was estimated by Dr. Macky, the Government Meteorologist, to have come within 50 miles of the colony to the west at about 9:30 P.M. [on the 17<sup>th</sup>, or 0130Z or 0230Z on the 18<sup>th</sup>]. After the centre passed, the wind, which had been blowing at a steady 85 mph from the SE with gusts of 120 mph shifted to the SW and then west. Nearly 3 inches of rain fell between 7 P.M. and midnight. Damage to H.M. Dockyard was first estimated at 50,000 British Pounds and later at double that amount. The winds ripped across the colony, tearing off roofs and felling trees through the whole length of the islands. At Prospect the heavy stone pillars at the Officers’ Mess snapped like match sticks. Many homes were flooded in the torrential rains. The speed with which the hurricane moved was a blessing to Bermuda – by 6 A.M. on the 18<sup>th</sup>, she was 200 miles to the northeast moving away at 30 mph. This third hurricane to affect Bermuda in September 1953 although not centered over the islands as was that of a week earlier yet lashed them with hurricane winds for five hours. Before darkness had set in, aircraft had been forced to give up locating the storm, and for some hours Bermuda was the sole source of information on the hurricane’s course. As usual in these fortunate isles, the human casualties were slight. Tremendous havoc was caused to the boats in Hamilton Harbour. Everywhere on land, hundreds of dead cedars were uprooted. At the Elbow Beach Surf

Club, the lobby ceiling collapsed; no-one was injured, although many rooms were flooded” (Tucker).

#### September 19:

HWM analyzes a closed low of at most 995 mb centered near 44.3N, 42.6W with a warm front extending from the low eastward and a cold front extending from the low southwestward. HURDAT lists this as a 35 kt extratropical cyclone at 44.3N, 41.0W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 995 mb pressure, and the MWR post-season track map shows a 12Z position near 43.5N, 45.4W. Microfilm last shows an elongated, closed low at 06Z before the cyclone travels off the north edge of the map of at most 999 mb centered near 42.4N, 45.7W. Ship highlights: 55 kt SE at 00Z at 40.8N, 55.7W (micro); 50 kt SW and 992 mb at 18Z at 45.5N, 37.5W (COA). Six other gales of 35-50 kt and five other low pressures of 999-1005 mb.

#### September 20:

HWM analyzes a low of at most 960 mb centered near 51.5N, 21.2W with an occluded front extending from the low to a triple point near 51N, 15W. A warm front extends from this triple point to 46N, 12W to 42N, 7W and a cold front extends from the triple point to 46N, 16W to 42N, 21W to 39N, 29W. HURDAT lists this as a 30 kt extratropical cyclone at 51.3N, 21.3W. The MWR tracks of centers of cyclones last shows a position at 06Z at 51.5N, 26.6W. Ship highlights: 80 kt SW and 962 mb at 12Z at 50.3N, 21.1W (HWM, COA); 70 kt SW and 989 mb at 15Z at 48.0N, 20.0W (COA); 60 kt NNW and 983 mb at 18Z at 52.0N, 22.0W (COA). At least 17 other gales between 50-65 kt, at least 30 other gales between 35-45 kt, at least 5 other low pressures between 965-970 mb, and at least 50 other low pressures of less than 1005 mb.

#### September 21:

HWM analyzes a closed low of at most 965 mb centered near 53.9N, 6.6W. A dissipating occluded front is plotted from 58N, 4W to 56N, 3E to a triple point near 50N, 5E. A warm front extends south-southeastward from the triple point and a cold front extends south-southwestward from the triple point. HURDAT no longer lists a system on this day. Ship highlights: 50 kt WSW and 972 mb at 00Z at 51.2N, 13.9W (COA); 65 kt W and 985 mb at 06Z at 50.0N, 11.6W (COA). At least 34 other gales between 50-60 kt, at least 75 other gales between 35-45 kt, at least 12 other low pressures between 971-979 mb, and well over 100 other low pressures between 980-1005 mb.

Edna took a very similar track to Dolly, which occurred just a week prior to this storm. HURDAT originally started this system at 06Z on 14 September as a 25 kt tropical depression at 16.0N, 61.7W. Available observations indicate that although gales were occurring along the wave axis north of the northernmost Leeward Islands on the 14<sup>th</sup>, a low-level closed low had not yet formed. The aircraft reconnaissance flight during the afternoon of the 14<sup>th</sup> mentioned that the forming disturbance was not yet closed. Available observations indicate that the low was closed by 00Z on the 15<sup>th</sup>, so genesis is delayed by 18 hours in the revised HURDAT. Genesis is analyzed to have occurred at 00Z on 15 September as a 45 kt tropical storm at 19.0N, 64.0W. Edna is analyzed to have

become a tropical storm 12 hours later than shown originally in HURDAT. Edna moved northwestward and recurved around 18Z on the 16<sup>th</sup> near 25.8N, 71.1W. Then is passed very near Bermuda just after 00Z on the 18<sup>th</sup> on a northeastward course. All track changes from genesis to the time it passed Bermuda are one degree or less. For intensity, aircraft central pressures of 995 and 987 mb were obtained on the 15<sup>th</sup> at 1300 and 1830Z respectively, and these values are added to HURDAT at 12 and 18Z on the 15<sup>th</sup>, respectively. These central pressures yield 56 and 68 kt, respectively, according to the intensifying subset of the Brown et al. southern pressure-wind relationship. The 65 and 75 kt intensities shown in HURDAT at 12 and 18Z respectively are not changed. Edna is analyzed to have attained hurricane intensity at 12Z on the 15<sup>th</sup> (no change to HURDAT). A 977 mb aircraft central pressure was obtained on the 16<sup>th</sup> at 1112Z, and this value is added to HURDAT at 12Z on the 16<sup>th</sup>. A 977 mb central pressure yields 82 and 80 kt according to the intensifying subsets of the southern and north of 25N pressure-wind relationships respectively. 80 kt is chosen for the 12Z intensity (down from 110 kt originally- a major change). At 2022Z on the 16<sup>th</sup>, although aircraft reconnaissance reported a central pressure of 976 mb (presumably by low-level penetration), a dropsonde splash pressure of 969 mb was obtained less than one hour later. Furthermore, the aerologist commented that there was much difficulty in finding the location of the lowest pressure since the center was distorted and not well-defined. The 976 mb observation is not treated as a central pressure, and the 969 mb dropsonde observation is treated as an upper bound for what the central pressure was at that time. At 2105Z on 16 September, a central pressure of less than or equal to 969 mb yields a wind speed of greater than or equal to 89 kt according to the intensifying subset of the north of 25N pressure-wind relationship. Intensities of 90 and 95 kt are chosen for 18Z on the 16<sup>th</sup> and 00Z on the 17<sup>th</sup> (down from 110 kt respectively at both times). At 1300 and 1330Z, respectively, on the 17<sup>th</sup>, a ship and an aircraft both measured a central pressure of 966 mb and fixed the center within a couple tenths of a degree of each other, and this 966 mb central pressure is added to HURDAT at 12Z on the 17<sup>th</sup>. A central pressure of 966 mb yields 89 kt according to the north of 25N pressure-wind relationship, and 95 kt is chosen for 12Z on the 17<sup>th</sup> (down from 105 kt originally). A 962 mb central pressure was measured by aircraft at 2000Z on the 17<sup>th</sup>, and this value is added to HURDAT at 18Z on the 17<sup>th</sup>. A 962 mb central pressure yields 93 kt according to the north of 25N pressure-wind relationship and 97 kt for its intensifying subset, and forward speed was fast at the time. A 100 kt intensity is chosen for 18Z on the 17<sup>th</sup> (down from 105 kt originally), and the 100 kt intensity shown in HURDAT at 00Z on the 18<sup>th</sup> is maintained. The analyzed peak intensity for Edna is 100 kt from 18Z on the 17<sup>th</sup> through 00Z on the 18<sup>th</sup> (previously 110 kt from 12Z on the 16<sup>th</sup> through 06Z on the 17<sup>th</sup>), so the new peak occurs about a day later than shown previously. Edna passed very near Bermuda around 00Z to 03Z on the 18<sup>th</sup>. At 0230Z, Bermuda reported 56 kt SSW G 89 kt, although all commentary and information seems very convincing that Bermuda experienced hurricane force winds and damage indicative of about a Category 1 hurricane. Tucker claims that the maximum gust on Bermuda was 126 mph. The U.S. Weather Bureau Advisories said that the strongest wind from Bermuda was "about 100 mph." The averaging times for the 56 kt wind and the 89 kt gust are unknown. The 56 kt wind may have been a 5-minute or 10-minute wind, and the 89 kt wind was likely a gust with an averaging time of less than 1-minute (probably 10 seconds). Bermuda is analyzed to have experienced hurricane

conditions. There is a slight chance that Bermuda experienced Category 2 conditions, but it is more likely that only Category 1 conditions were experienced. The lowest pressure reported on Bermuda was 994 mb around 0120Z on the 18<sup>th</sup>. The revised track has the center passing about 40 nmi NW of Bermuda around the time of the lowest pressure (the previous HURDAT track showed a closest approach of about 70 nmi). In Tucker, it says that the meteorologist in Bermuda estimated that the center passed 50 miles west of Bermuda. At the same time Edna was passing northwest of Bermuda, there were ships in the storm area reporting hurricane force winds. Although there was one more aircraft flight later on the 18<sup>th</sup>, only a 700-mb height was reported, which suggests a central pressure in the range of 955-973 mb at 1641Z on the 18<sup>th</sup>. This pressure range yields a wind speed range of 80-93 kt according to the Landsea et al. (2004) north of 35N pressure-wind relationship. The intensities listed in HURDAT on the 18<sup>th</sup> from 00Z to 12Z (100, 95, and 85 kt) are unchanged, but the 70 kt intensity listed in HURDAT at 18Z on the 18<sup>th</sup> is increased to 80 kt. During this day, the hurricane accelerated northeastward over the open Atlantic, and track changes were less than one degree. Edna became extratropical at 00Z on 19 September (no change to timing of ET) near 41N, 52W with a 70 kt intensity (up from 55 kt originally). On 19 and 20 September, Edna continued moving rapidly east-northeastward. The largest single track alteration for the entire lifetime of Edna was at 06Z on the 19<sup>th</sup>, when the position is moved about 110 nmi WSW of the previous HURDAT position. HURDAT previously listed a final position for Edna at 18Z on 20 September as a 30 kt extratropical cyclone at 52.4N, 16.7W, but available observations indicate that Edna strengthened into a powerful extratropical cyclone with 80 kt winds on the 20<sup>th</sup> and there were no other areas of low pressure anywhere in the region to absorb Edna. The revised intensities at 12Z on the 19<sup>th</sup> and 20<sup>th</sup> are 60 and 80 kt (up from 35 kt and 30 kt respectively- major changes). Edna is extending for at least an additional 48 hours as an extratropical cyclone. The analyzed position on the 21<sup>st</sup> at 12Z is 54.3N, 6.6W as a 65 kt extratropical cyclone, and by 18Z on the 22<sup>nd</sup>, the cyclone was near 57.0N, 0.5E with a 50 kt intensity.

Additional quotes:

“Hurricane Edna came close on the heels of Dolly and followed almost the same path. Bermuda this time, however, received winds of about 90 kt and suffered considerable damage, though none apparently of a major hurricane” (ATS).

1953 Storm 9 (originally Storm 7)

U.S. Landfall:

9/20/1953 – 17Z – 29.0N, 82.8W – 35 kt

Major track changes and major intensity changes are analyzed for this unnamed tropical storm. Major changes are made to the genesis of this cyclone, the time tropical storm intensity was attained, and the peak intensity value. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), and climatological data summaries from NCDC.

**September 13:**

HWM does not analyze any features of interest on this day. HURDAT does not yet list a system on this day. No gales or low pressures.

**September 14:**

HWM analyzes a closed low of at most 1010 mb centered near 23.1N, 94.2W. HURDAT lists this as a 40 kt tropical storm at 23.1N, 94.2W. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered near 22.6N, 94.5W. No gales or low pressures.

**September 15:**

HWM analyzes a closed low of at most 1010 mb centered near 22.5N, 91.6W. HURDAT lists this as a 60 kt tropical storm at 23.0N, 91.3W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered 22.4N, 92.6W. No gales or low pressures.

**September 16:**

HWM analyzes a broad, closed low of at most 1010 mb located between 18-29N, 84-95W with the WSW end of a WSW-ENE cold front located near 28N, 94W, extending east-northeastward to 30N, 90W to 32N, 85W to 34N, 79W to 36N, 76W. HURDAT lists this as a 60 kt tropical storm at 25.9N, 87.8W. Microfilm at 12Z analyzes a tropical cyclone of at most 1008 mb centered near 25.9N, 86.8W with a WSW-ENE front extending from 30N, 93W to 33N, 86W. Ship highlights: 40 kt N at 12Z at 26.4N, 87.4W (micro); 40 kt NNE and 1008 mb at 15Z at 26.4N, 87.2W (micro). Aircraft highlights: center fix (loran) at 2207Z at 26.4N, 85.2W with 1004 mb central pressure and 35 kt maximum winds (micro).

**September 17:**

HWM analyzes a closed low of at most 1005 mb centered near 25.0N, 86.1W with the WSW end of a WSW-ENE dissipating cold front located near 28N, 86W extending east-northeastward from there and becoming a cold front near 30N, 79W and continuing east-northeastward. HURDAT lists this as a 60 kt tropical storm at 25.9N, 85.5W. The MWR tracks of centers of cyclones shows a 12Z position near 26.2N, 85.5W with a 1005 mb pressure. Microfilm at 18Z analyzes a broad low centered near 26.2N, 84.8W with a frontal feature plotted extending from 32N, 91W to 31N, 88W to 32N, 85W to 34N, 81W. Ship highlights: 10 kt NNE and 1005 mb at 06Z at 25.2N, 86.7W (COA). Two other low pressures of 1004-1005 mb.

**September 18:**

HWM analyzes a closed low of at most 1010 mb centered near 27.5N, 86.5W with a warm front extending from 38N, 87W to 34N, 88W, becoming a cold front near 32N, 87W, extending eastward to 31N, 85W to 31N, 77W to 32N, 72W. HURDAT lists this as a 60 kt tropical storm at 25.8N, 88.5W. The MWR tracks of centers of cyclones shows a 12Z position near 25.2N, 88.9W with a 1008 mb pressure. Microfilm at 12Z analyzes a spot low near 25.5N, 87.1W with the closest front due north of the low near 32N. Ship highlights: 40 kt E and 1009 mb at 00Z at 26.6N, 85.7W (micro).

**September 19:**

HWM analyzes a closed low of at most 1010 mb centered near 28.7N, 87.8W with a warm front extending from the low eastward to 28N, 73W and a dissipating cold front extending from the low west-southwestward to 28N, 90W, becoming a dissipating warm front near 30N, 91W, extending to 35N, 87W to 40N, 84W. HURDAT lists this as a 60 kt tropical storm at 28.5N, 88.0W. The MWR tracks of centers of cyclones shows a 12Z position near 28.4N, 86.4W with a 1007 mb pressure. Microfilm at 12Z analyzes a spot low near 29.7N, 88.5W with a SSW-NNE front extending from near or just west of the low north-northeastward to 37N, 86W. No gales or low pressures.

**September 20:**

HWM does not analyze a closed low, but analyzes a dissipating cold front extending from 40N, 81W to 35N, 82W to 31N, 86W to 28N, 91W. HWM also analyzes a SW-NE stationary front intersecting a W-E warm front near 32N, 79W with the southwest end of that stationary front near 27N, 85W. HURDAT lists this as a 50 kt tropical storm at 29.6N, 84.7W. The MWR tracks of centers of cyclones shows a 12Z position near 29.4N, 83.9W with a 1005 mb pressure. Microfilm at 12Z analyzes a broad low of at most 1008 mb centered near 28.6N, 83.5W with the nearest front plotted from 35N, 90W to 37N, 83W to 38N, 82W. Ship highlights: 10 kt W and 1005 mb at 12Z at 25.7N, 86.2W (COA). Land/station highlights: 10 kt E and 1002 mb at 12Z at Cross City, FL (micro); 5 kt ESE and 1004 mb at 18Z at Ocala, FL (micro). Two other low pressures of 1005 mb. "The combined action of an eastward moving Gulf low pressure center of tropical nature and a cold front from the northwest passing across [Georgia] caused generally heavy rains, beginning on the 19<sup>th</sup> and ending in the coastal area on the 21<sup>st</sup>; maximum 24 hour rainfalls of 2 to 5 inches were recorded in the coastal area" (climo).

**September 21:**

HWM analyzes a SW-NE stationary front extending from 26N, 85W to 31N, 80W, becoming a cold front near 33N, 76W, extending north-northeastward to 40N, 73W, where it intersects with a warm front that extends south-southeastward from that point. Another cold front is plotted from 41N, 76W to 35N, 85W to 32N, 92W. HURDAT last lists this system at 00Z as a 25 kt tropical depression at 32.0N, 80.2W. The MWR tracks of centers of cyclones shows a 12Z position near 39.0N, 73.7W with a 1005 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 38.7N, 73.6W with fronts extending from the low. Land/station highlights: 5 kt E and 1005 mb at 00Z at Ocala (micro).

**September 22:**

HWM analyzes a closed low of at most 1000 mb centered near 54.2N, 56.3W with multiple fronts extending through and plotted near the low. The MWR tracks of centers of cyclones shows a 12Z position near 53.4N, 57.3W with a 1000 mb pressure.

**September 23:**

HWM analyzes a closed low of at most 1005 mb centered near 61.1N, 38.0W with a warm front extending southeastward from the low and a cold front extending

southwestward from the low. The MWR tracks of centers of cyclones shows a 12Z position near 62.7N, 45.7W with a 1004 mb pressure.

Storm 7 formed from some unsettled weather in the Gulf of Mexico. HURDAT originally listed genesis as having occurred at 06Z on 14 September at 23.1N, 95.0W as a 30 kt tropical depression. Although there appears to at least have been a trough of low pressure in the area on the 14<sup>th</sup>, there is no conclusive evidence for or against the existence of a tropical cyclone due to limited observations. However, late on the 14<sup>th</sup>, a new disturbance appeared a few hundred miles east of the other disturbance. The former was weakening and the latter was becoming better defined. This second disturbance continued to intensify and went on to become Tropical Storm 7. Since there is no evidence that first disturbance on the 14<sup>th</sup> ever attained a closed circulation, and since the latter disturbance was definitely not closed prior to the 15<sup>th</sup>, the 14<sup>th</sup> is eliminated from HURDAT. On the 15<sup>th</sup> around 12Z, an aircraft reconnaissance flight did not find a closed circulation but reported a moderate easterly wave oriented NE-SW. Other surface observations show that the circulation at 12Z was starting to become better defined, and by 18Z on the 15<sup>th</sup>, it was likely a tropical cyclone. However, genesis is analyzed to have occurred at 12Z on the 15<sup>th</sup> as a 30 kt tropical depression located at 23.4N, 89.6W (about 1.7 degrees east of the previous HURDAT position). The cyclone traveled in a small loop in the eastern Gulf of Mexico on the 16<sup>th</sup> and 17<sup>th</sup>, and on the 18<sup>th</sup>, it moved slowly northward, the 19<sup>th</sup> slowly northeastward, and then made landfall in Florida not far from Cedar Keys as a 35 kt tropical storm at 17Z on 20 September. After the loop was completed, available observations indicate that the positions listed in the original HURDAT from 12Z on the 18<sup>th</sup> to 18Z on the 19<sup>th</sup> are too far west, and these positions are adjusted eastward accordingly. From 18Z on the 18<sup>th</sup> to 06Z on the 19<sup>th</sup>, the position is adjusted about 2 degrees to the east of the previous HURDAT positions, and although these are minor track changes, they are close to major changes. On the 16<sup>th</sup> at 2207Z, aircraft reconnaissance measured a central pressure of 1004 mb and this value is added to HURDAT at 00Z on the 17<sup>th</sup>. A central pressure of 1004 mb yields 36 kt according to the Brown et al. north of 25N pressure-wind relationship. A 40 kt intensity is chosen for 00Z on the 17<sup>th</sup> (down from 60 kt originally- a major change) because the RMW was smaller than climatology for that latitude and central pressure. This cyclone is analyzed to have first attained tropical storm intensity at 00Z on the 16<sup>th</sup> (36 hours later than originally). A peak intensity of 40 kt is analyzed from 06Z on the 16<sup>th</sup> through 00Z on the 18<sup>th</sup> (previously 60 kt from 06Z on the 15<sup>th</sup> through 00Z on the 20<sup>th</sup>). The highest wind observation from a ship for the entire lifetime of the cyclone was 40 kt (on three separate occasions), and the 1004 mb aircraft ob was the only central pressure reported during this storm. Available data indicates that the tropical storm weakened to a tropical depression around 18Z on the 18<sup>th</sup>, and it is analyzed that the cyclone re-attained tropical storm strength by 06Z on the 20<sup>th</sup> as it was approaching the Gulf Coast of Florida. Major downward intensity revisions ranging from 20 to 30 kt are implemented at all times from genesis at 12Z on the 15<sup>th</sup> until just before landfall at 06Z on the 20<sup>th</sup>. It is analyzed that the 35 kt tropical storm made landfall at 29.0N, 82.8W at 17Z on 20 September. No strong winds were reported in Florida, but the lowest observed pressure from a land station was 1002 mb at Cross City. A handful of other 1004 and 1005 mb observations were recorded in Florida. A central pressure of less than or equal to 1002 mb at landfall

suggests a landfall intensity of at least 40 kt according to the north of 25N pressure-wind relationship. Due to the fact that only light winds were observed in Florida and that the environmental pressures were low, a 35 kt intensity is chosen for the landfall (HURDAT previously listed 50 and 40 kt for the 12 and 18Z intensities, respectively, on the 20<sup>th</sup>. The cyclone is analyzed to have weakened to a 25 kt tropical depression by 00Z on the 21<sup>st</sup>, and then it dissipated after 00Z. Although there is no change to the timing of dissipation or to the intensity at dissipation, a major track change is made to HURDAT at the final point of this cyclone's lifetime (00Z on the 21<sup>st</sup>). The position is adjusted more than three degrees to the SSW of the previous HURDAT position.

Additional quotes:

“During the life of Edna, the Gulf also was under surveillance by reconnaissance aircraft. A storm tried to form in the southwestern Gulf but developed winds of only 20-25 kt” (ATS).

1953 Storm 10 (Florence) – (originally Storm 8)

U.S. Landfall:

9/26/1953 – 16Z – 30.3N, 86.2W – 80 kt – 975 mb – 1008 mb OCI – 225 nmi ROCI

Minor track changes and major intensity changes are analyzed for Hurricane Florence, which made landfall in the Florida panhandle as a hurricane. A major change is made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, Dunn and Miller (1960), Connor (1956), Jarrell et al. (1992), and Barnes (2001).

September 23:

HWM does not yet analyze any features of interest other than the ITCZ running through the southwestern Caribbean Sea. HURDAT first lists a 35 kt tropical storm at 12Z at 16.9N, 75.8W. The MWR tracks of centers of cyclones shows a 12Z position near 16.9N, 76.0W with a 1002 mb pressure and the MWR post-season track map shows a 12Z position near 16.8N, 76.1W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 16.5N, 75.6W. Ship highlights: 40 kt SE and 1008 mb at 12Z at 15.9N, 74.9W (COA, ATS); 35-45 kt and 1004 mb at 12Z at 16.6N, 75.6W (micro). “The easterly wave from which Florence formed was traced from the Lesser Antilles westward through the Caribbean Sea on the 21<sup>st</sup> and 22<sup>nd</sup>, but the first signs of the beginning of intensification were noted on September 23 about 100 miles southeast of Jamaica” (MWR). “Florence first developed in the Caribbean, south of Jamaica, on September 23” (Barnes).

September 24:

HWM analyzes a closed low of at most 1005 mb centered near 19.5N, 83.3W with the ITCZ analyzed to be running through the low. HURDAT lists this as a 60 kt tropical storm at 19.4N, 83.9W. The MWR tracks of centers of cyclones shows a 12Z position near 19.0N, 84.4W with a 1002 mb pressure and the MWR post-season track map shows a 12Z position near 19.7N, 83.9W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 20.0N, 83.9W. Ship highlights: 40 kt NE and 1005 mb at 18Z at 21.7N, 86.3W (micro); 30 kt NNW and 997 mb at 2040Z at 21.9N, 85.6W (micro). Three other gales of 35-40 kt and two other low pressures of 1005 mb. Land/station highlights: 30 kt S and 1004 mb at 21Z at 21.7N, 84.8W (micro). One other low pressure of 1004 mb at the same station at 18Z. Aircraft highlights: Navy center fix at 1700Z at 21.1N, 85.5W with 1002 mb central pressure and 65 kt max winds (micro, ATS); center fix (loran) at 2239Z at 22.2N, 86.1W with 999 mb peripheral pressure and 80 kt max winds (micro). "Squalliness was observed to be increasing, but no definite center could be located until the forenoon of the 24<sup>th</sup> when the storm was approaching the Yucatan Channel. It increased to hurricane strength while passing through the Channel into the Gulf of Mexico during the afternoon..." (MWR).

#### September 25:

HWM analyzes a hurricane of at most 995 mb centered near 24.0N, 87.5W. HURDAT lists this as a 110 kt hurricane at 24.4N, 87.3W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 990 mb pressure and the MWR post-season track map shows a 12Z position near 25.0N, 87.6W. Microfilm at 12Z analyzes a tropical cyclone of at most 1002 mb centered near the HURDAT position. Ship highlights: 60 kt SE and 1000 mb at 03Z at 22.7N, 86.2W (micro); 60 kt SE at 18Z at 26.3N, 86.7W (micro). 26 other gales between 35-55 kt and 19 other low pressures between 999-1005 mb. Aircraft highlights: radar center fixes at 0700, 0800, 0900, 1045, 1145, and 1200Z between 23.6-24.8N, 87.0-87.5W (micro); center fix at 1346Z at 25.4N, 88.3W with 968 mb central pressure and 110 kt maximum flight-level winds encountered (micro); Navy center fix at 2030Z at 26.5N, 87.2W (micro). "[Florence] reached its greatest force on the 25<sup>th</sup> as it curved northward. Aircraft estimated top winds of 110 to 120 kt, and lowest pressure was given at 968 mb on the 25<sup>th</sup>, but it is thought that these estimates of wind may have been somewhat too high since nearby ship reports did not appear to confirm them" (MWR). "On September 25, it reached its greatest force while in the central Gulf, where reconnaissance aircraft reported winds of up to 138 mph" (Barnes). "Lost at sea was the fishing trawler *Miss Tampa*, which was last heard from on the 25<sup>th</sup>" (Barnes).

#### September 26:

HWM analyzes a hurricane of at most 990 mb centered near 29.5N, 86.2W with a west end of a W-E warm front located about 150 to 200 nmi NE of the cyclone and another front located several hundred nmi NW of the cyclone. HURDAT lists this as an 80 kt hurricane at 29.7N, 86.8W. The MWR tracks of centers of cyclones shows a 12Z position near 30.1N, 86.4W with a 990 mb pressure and the MWR post-season track map shows a 12Z position near 29.7N, 87.1W. Microfilm at 12Z analyzes a closed low of at most 993 mb centered near 30.0N, 86.4W with the WSW end of a WSW-ENE front located about 75 to 100 nmi NE of the cyclone. Ship highlights: 35 kt SSW and 1002 mb

at 00Z at 24.9N, 85.7W (COA); 60 kt SSE and 1004 mb at 03Z at 27.3N, 86.1W (micro); 35 kt SSW and 1005 mb at 18Z at 27.5N, 83.7W (COA). 13 other gales between 35-45 kt and ten other low pressures between 1002-1005 mb. Land highlights: Panama City land-based radar center fixes at 0840Z at 29.5N, 86.5W and at 1115Z at 29.7N, 86.2W (micro); 70 kt NNE and 993 mb at 1245Z at Shalimar, FL (30.4N, 86.6W) (micro); 50 kt (max wind) G 64 kt at 1430Z at Pensacola (ATS); 40 kt N and 989 mb (min p) at Valparaiso, FL (30.5N, 86.5W) (ATS, micro); 76 kt (max wind) at Panama City (Barnes?). At least 30 other gales in Florida, Georgia, and Alabama between 34-50 kt and at least 57 other low pressures between 991-1005 mb. Aircraft highlights: radar center fixes at 0755, 0855, 0955, and 1100Z between 29.5-29.9N, 86.2-86.8W (micro). “Over the next few hours, its course edged toward the north and then northeast, bringing it closer to the northwest Florida shore. The next morning, just before making landfall, Hurricane Florence shifted abruptly toward the east-northeast and missed Pensacola, turning instead toward a more sparsely populated stretch of coast near Seagrove Beach. Sustained winds of 87 mph were recorded at Panama City, where the barometer measured 29.35 inches. The lowest observed pressure was 29.26 inches at De Funiak Springs. Tides were five feet above normal at Apalachicola and Carrabelle and ‘six or seven feet’ at Panacea. Pensacola only received winds gusts of 75 mph and a tide of three feet” (Barnes). “In any case, when the center reached the northwest Florida coast near midday of the 26<sup>th</sup>, the strongest wind reported was about 80 to 90 mph. However, the center passed inland over a sparsely settled area between Fort Walton and Panama City and winds might have been a little higher in this area where no measuring equipment is located. This may also account for the relatively light damage which was estimated at around \$200,000 by the New Orleans Forecast Center. The Red Cross reported 421 homes damaged, but only 3 destroyed. There was also some crop damage from wind and heavy rain in a few counties of northwestern Florida and extreme southeastern Alabama, but the storm lost force rapidly after passing inland. There were no deaths or injuries...” (MWR). “The hurricane’s winds tore down utility poles and trees and unroofed several houses. Flooding near Carrabelle destroyed numerous homes, and fishing boats and docks were damaged. According to the Red Cross’s review of the storm’s damages, Franklin and Okaloosa Counties were the hardest hit areas. It was estimated that in those two counties alone, 273 homes were destroyed, and another 145 buildings were damaged. Damages estimates in extreme northwestern Florida topped \$200,000, and crop losses in southeastern Alabama were over \$3,000,000. At least two deaths resulted from the storm” (Barnes). From the September, 1953 Florida Monthly Climatological Data Summary... “This hurricane formed in the Caribbean and moved through the Yucatan Channel on the 24<sup>th</sup> and inland on the extreme northwest Florida coast during the morning of the 26<sup>th</sup>. The center moved inland over a sparsely settled area between Fort Walton and Panama City. This probably accounts for the rather small amount of damage, probably one hundred to two hundred thousand dollars in extreme northwest Florida” (climo). From the September, 1953 Alabama Monthly Climatological Data Summary... “Tropical hurricane ‘Florence’ moved inland between Fort Walton and Panama City, FL during the morning of September 26<sup>th</sup> and was centered just east of Fort Walton at 10 am CST (1600Z). The center of this storm passed near Dothan, AL, during the 26<sup>th</sup> and was centered northeast of Albany, GA, on the morning of the 27<sup>th</sup>. A peculiar feature of this hurricane is that the heaviest rainfall occurred on the north and west sides of the of the

storm center. Lockhart, AL reported a storm total of 14.71 inches. Wind velocities seemed to have averaged 30 to 40 mph, with gusts up to 50 to 60 mph [in Alabama] on the 26<sup>th</sup>. It is estimated that this storm caused damages of some \$3,002,000 to crops in south-east Alabama from wind and rain. Grand total of all damages was estimated at \$3,162,500” (climo). From the September, 1953 Local Climatological Data Report for Pensacola, FL... “The hurricane on the 25<sup>th</sup> and 26<sup>th</sup> caused only minor damage in the Pensacola area. A drive-in theater was the only structure reported completely demolished. Other damage was confined to shrubbery and trees together with a few roofs which have a few shingles missing. Glass damage was very light. Crop damage was confined to corn which was blown over making harvesting difficult. Total damage believed to be less than \$50,000” (climo). From the September, 1953 Local Climatological Data Report for Apalachicola, FL... “During the passage of the Gulf hurricane on the 25<sup>th</sup> and 26<sup>th</sup>, only minor damage was done mostly to awnings and fish-house docks. Value of damage believed to be less than \$1,500” (climo). From the September, 1953 National Monthly Climatological Data Summary storm reports... “Location: Florida, northwest portion; Date: 26<sup>th</sup>; Time: morning; Width of path: 50 mi; Length of path: 100 mi; Property damage (exclusive of crops): \$125,000; Crop damage: \$40,000; Character of storm: hurricane; Remarks: Center of hurricane reached coast between Fort Walton and Panama City about 8 am [13 or 14Z] accompanied by hurricane-force winds. Winds diminished considerably as storm moved north-northeastward across the northwestern portion of Florida. Location: Alabama, southeastern portion; Date: 26<sup>th</sup>; Property damage (exclusive of crops): \$160,500; Crop damage: \$3,002,000; Character of Storm: hurricane; Remarks: [same quote as Alabama State Monthly Climatological Data Summary” (climo). “Tropical Cyclones in Florida – NW FL – Sept. 26 – Minimal – Damage \$150,000” (“Minimal” has maximum winds of 74 to 100 mph and central pressure 983 to 996 mb - (Dunn and Miller). “Florence – FL, 1 (NW) – 985 mb” (Jarrell et al. 1992).

#### September 27:

HWM analyzes a closed low of at most 1000 mb centered near 32.2N, 82.0W with a warm front extending from the low to 35N, 80W, becoming a dissipating warm front near 36N, 74W, extending to 37N, 69W, and HWM analyzes a cold front extending from the low to 30N, 85W to 30N, 88W. HURDAT lists this as a 40 kt extratropical cyclone at 31.6N, 82.3W. The MWR tracks of centers of cyclones shows a 12Z position near 32.0N, 83.1W with a 1000 mb pressure and the MWR post-season track map last shows a position at 00Z near 31.2N, 85.3W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 31.8N, 82.9W with a warm front extending from the low east-northeastward and a cold front undergoing frontogenesis extending from the low south-southwestward. Ship highlights (through 18Z only): 35 kt WNW and 1006 mb at 12Z at 29.3N, 85.8W (COA); 40 kt SSW and 1008 mb at 18Z at 29.2N, 78.3W (micro). Two low pressures of 1004 and 1002 mb at 00 and 06Z with winds below gale force. Land/station highlights: 35 kt NNE and 1003 mb at 00Z at Lagrange, GA (33.0N, 85.0W) (micro); 10 kt SE and 994 mb at 00Z at 31.2N, 85.4W (micro); 30 kt WNW and 1002 mb at 06Z at Panama City, FL (micro). At least 22 other low pressures between 996-1004 mb between 00Z-06Z. From the September, 1953 Georgia Monthly climatological data summary... “A hurricane of considerable energy moved into the Gulf of Mexico on the

24<sup>th</sup>, continuing north and recurving to moved east-northeastward across the southern portion of Georgia on the 26-27<sup>th</sup>. This storm evidently lost much of its energy prior to its reaching the Georgia border, and no wind damages resulted, but very heavy rains occurred, especially in the coastal area, where crops were damaged from washing effects and oversaking of the soil, and moderate losses, partly from heavy rains but mostly from heavy seas, occurred to property in the Brunswick area” (climo). Also from the Georgia Monthly Climatological Data Summary... “A Gulf hurricane, originating to the east of the West Indies, moved into the Gulf Coast near Mobile on the 26<sup>th</sup> and passed through the southern portion of Georgia on the 27<sup>th</sup>. Very heavy rains were produced in its path across Georgia, especially in the coastal area, but the storm’s intensity was reduced enough so that no damages from high winds occurred. Damages from other causes were limited to the Brunswick area, total losses amounting to approximately \$16,000. In the city of Brunswick, strong northeast winds and heavy rains intensified rising tides during the four days, 23-26<sup>th</sup>, and caused flooding of many city blocks, mostly at times of high tides. Losses were \$1,000, occurring mainly to yards and business house fronts; transportation and outside work were suspended. The lower coast of St. Simons Island was subjected to the battering effect of heavy seas and unusually high tides during the four days, 23-26<sup>th</sup>. Causeways were inundated and broken in numerous places and a number of beach homes were undermined to settle dangerously from previously weakened foundations, with heavy damages sustained by an expensive home. Several people were injured in efforts to hold bulkheads against the rising sea. Total losses along the coast amounted to \$15,000” (climo).

September 28:

HWM analyzes a closed low of at most 1000 mb centered near 37.6N, 69.7W with a stationary front extending from the low north-northeastward and a cold front extending from the low south-southwestward. HURDAT lists this as a 35 kt extratropical cyclone at 37.0N, 69.7W. Microfilm at 12Z does not analyze a closed low, but at 18Z, microfilm analyzes two lows- one is a closed low of at most 999 mb centered near 42.2N, 63.5W, and the other is a closed low of at most 1008 mb centered near 30.0N, 78.3W with a front connecting the two lows and another front extending south-southwestward from the southernmost low.

HURDAT originally listed the genesis of Florence at 12Z on 23 September at 16.9N, 75.8W as a 35 kt tropical storm, and there is no evidence to change the timing of genesis. Florence is started as a 40 kt tropical storm at about the same location due to a ship observation at 12Z on the 23<sup>rd</sup> of 40 kt. All track changes between genesis on the 23<sup>rd</sup> and Florida landfall on the 26<sup>th</sup> are six-tenths of a degree or less. Florence moved west-northwestward and then gradually made a northward turn. The cyclone passed south of Jamaica, south of the Cayman Islands, and moved northwestward through the Yucatan Channel, passing about midway between the Yucatan Peninsula and the western tip of Cuba late on the 24<sup>th</sup>. It turned northward in the eastern Gulf of Mexico, and then turned north-northeastward before making landfall in the Florida panhandle during midday on the 26<sup>th</sup>. Regarding the intensity, at 17Z on 24 September, aircraft reconnaissance measured a central pressure of 1002 mb. However, at 18Z on the 24<sup>th</sup>, ship data indicates the central pressure was 1001 mb or possibly slightly lower (a ship recorded winds of 40

kt concurrent with a 1005 mb pressure about 55 nmi from the analyzed center position). The aircraft data at 17Z indicates an RMW near 11 nmi at the time. A central pressure of 1001 mb is added to HURDAT at 18Z on the 24<sup>th</sup>, and this value yields a wind speed of 45 kt according to the Brown et al. southern pressure-wind relationship. The RMW is smaller than the climatological value suggested by Vickery et al. (2000) for that latitude and central pressure, and the forward speed of the cyclone is a fast 17 kt, and 55 kt is chosen for the intensity at 18Z on the 24<sup>th</sup> (down from 70 kt originally). Three hours later, at 2040Z on the 24<sup>th</sup>, ship data indicates that the central pressure had fallen to a value equal to or slightly less than 994 mb. Florence was rapidly deepening during this time, and the central pressure fell from 1001 mb at 18Z on the 24<sup>th</sup> to 968 mb at 1346Z on the 25<sup>th</sup> (with the hurricane approaching 25N in the eastern Gulf of Mexico). The 968 mb central pressure (acquired by aircraft reconnaissance) listed in HURDAT at 12Z on the 25<sup>th</sup> is maintained. This central pressure value yields 93 and 91 kt according to the southern and north of 25N pressure-wind relationships, respectively. The RMW and speed of the storm were about average, and 90 kt is chosen for the intensity at 12Z on the 25<sup>th</sup> (down from 110 kt originally). It is analyzed that Florence attained hurricane intensity at 00Z on the 25<sup>th</sup> (six hours later than originally). Since Hurricane Florence later weakened slightly before landfall, a peak lifetime intensity of 90 kt is analyzed from 12Z on the 25<sup>th</sup> through 00Z on the 26<sup>th</sup>. The previous HURDAT peak was 110 kt from 06Z to 18Z on the 25<sup>th</sup>. Major downward intensity adjustments of 20 to 30 kt were made at all synoptic times on the 25<sup>th</sup>. Although 90 kt is analyzed as the peak intensity, it possibly could have been slightly stronger from 18Z on the 25<sup>th</sup> to 06Z on the 26<sup>th</sup>, but there is not data to indicate that. The peak intensity observation for the lifetime of Florence is the 968 mb aircraft central pressure at 1346Z on the 25<sup>th</sup>.

Florence made landfall the next day- 26 September at 16Z in the Florida panhandle between the cities of Valparaiso and Panama City. There are no observations of the peak intensity of Florence available during the 26 hours between the 968 mb aircraft central pressure and the landfall, although there were a couple of ships in the periphery that recorded winds of 60 kt. The highest observed wind from a coastal station at landfall was 76 kt at Panama City, FL (very likely sometime between 1530Z to 1730Z on the 26<sup>th</sup> with a concurrent pressure of 993 mb or possibly even lower). The lowest observed pressure was 989 mb at Valparaiso, FL at 1630Z on the 26<sup>th</sup> concurrent with at least 40 kt of wind. The center is analyzed to have passed 17 nmi to the right of Valparaiso and 29 nmi to the left of Panama City at closest approach to the cities. The closest approach to Panama City was about 30 minutes before closest approach to Valparaiso. The closest approach to Panama City is about the same time as landfall and the latter closest approach is about 30 minutes after landfall. No central pressure was recorded at landfall. Also, the RMW is unknown. However, it is believed that the RMW was large due to an aircraft report 5 hours before landfall of an oblong eye with the long axis 70 mi long. The means that the eye radius is some value less than 35 nmi... probably around 25 to 30 nmi, which means that the RMW may have been very large. After plotting time series of several station observations, none of these locations could be determined with certainty to have been inside of the radius of maximum winds. We do have a central pressure estimate 11 hours later landfall based on land observations of 994 mb so use of the Ho et al. inland-pressure decay model was investigated, but after plugging in the numbers, it spit out a 966 mb

central pressure, which appears too intense based on other data. None of the other data provides evidence of a higher intensity than the wind speed listed in HURDAT at the point before landfall (80 kt). Since the highest observed wind is 76 kt, 80 kt is chosen for the landfall intensity, maintaining Florence as a Category 1 hurricane for northwest Florida, although it is possible that Florence could have been a low-end Category 2 at landfall. The Brown et al. pressure-wind relationships were utilized to back out a central pressure from the 80 kt wind speed analyzed for the landfall, and 975 mb is chosen for the central pressure at landfall. After landfall, Florence turned toward the ENE and traveled over southern Georgia. Runs of the Kaplan and DeMaria inland decay model yield intensities of 66, 49, 39, and 30 kt for 18Z on the 26<sup>th</sup>, 00Z on the 27<sup>th</sup>, 06, and 12Z respectively. Highest observed winds within 2 hr of synoptic times are 76, 49, 39, and 30 kt on the 26<sup>th</sup> at 18Z, 27<sup>th</sup> at 00, 06, and 12Z respectively. Intensities of 70, 50, 40, and 40 kt are chosen for the 26<sup>th</sup> at 18Z through 12Z on the 27<sup>th</sup> (down from 60 and 50 kt at 00 and 06Z on the 27<sup>th</sup> originally at those times, respectively). HURDAT previously listed Florence as having become extratropical at 00Z on the 27<sup>th</sup>, but it is analyzed that Florence did not become extratropical until 06Z on the 27<sup>th</sup>. Since the Kaplan and DeMaria inland decay model is not valid after extratropical transition, it was not relied upon for the intensity determination at 06 and 12Z on the 27<sup>th</sup>, although other data indicated an intensity within 5 kt of the Kaplan and DeMaria inland decay model at those times. Florence is analyzed to have dissipating after 18Z on the 27<sup>th</sup> (1 day earlier than listed in HURDAT). The final position at 18Z on the 27<sup>th</sup> is analyzed to be 32.1N, 81.3W as a 40 kt extratropical cyclone. The HURDAT positions on the 28<sup>th</sup> are actually following a new, separate extratropical low that had developed north of the dissipating extratropical remnant of Florence.

Additional quotes:

“At about the same time, Jamaica experienced 10 inches of rainfall in 12 hours with the passage of a squally easterly wave that moved westward across the Caribbean. A naval reconnaissance plane investigating this wave found Hurricane Florence in the western Caribbean. Florence moved into the Gulf through the Yucatan Channel, adding its influence to an already bad weather picture where small ships operating between Cuba and Florida were suffering damage by severe squalls. The Florida Peninsula was waterlogged, with large areas flooded, and the hurricane rains threatened a disaster of major proportions. Actual damage was somewhat minimized by the storm’s northerly course, which spared the Florida Peninsula the extreme rainfall. The winds diminished as it entered the north Florida coast. Due to the rapid dissipation of the storm circulation, significant damage was confined to the vicinity of the point where it entered the mainland” (ATS).

1953 Storm 11 (Gail) – (originally Storm 9)

Major track changes and major intensity changes are analyzed for this cyclone. Major changes are made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather

Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), U.S. Weather Bureau public advisories, and Truchelut's warm anomaly study.

September 28:

HWM analyzes a closed low of at most 1010 mb centered near 10.2N, 20.5W. HURDAT does not yet list a system on this day. No gales or low pressures.

September 29:

HWM analyzes a closed low of at most 1010 mb centered near 11.8N, 22.0W. HURDAT does not yet list a system on this day. No gales or low pressures.

September 30:

HWM analyzes a closed low of at most 1010 mb centered in the general vicinity of 11.6N, 23.1W. HURDAT does not yet list a system on this day. No gales or low pressures. From Truchelut's warm anomaly study... "Sig anoms near 10N 27W with closed circ... 25kt wind, possible closed circ near 10n 27w on 9/30" (Truchelut).

October 1:

HWM analyzes a closed low of at most 1010 mb centered near 12.5N, 35.4W with the ITCZ analyzed running through the low. HURDAT does not yet list a system on this day. No gales or low pressures.

October 2:

HWM analyzes a closed low of at most 1005 mb centered near 13.3N, 39.1W with the ITCZ analyzed running through the low. HURDAT lists this as a 45 kt tropical storm at 13.5N, 37.0W. The MWR post-season track map shows a 12Z position near the HURDAT position. Truchelut's warm anomaly study (hereafter referred to as *RT*) lists a 12Z position at 13.1N, 36.0W with a 1009 mb central pressure. No gales or low pressures. "The intensification of an easterly wave was noted on the morning of October 2 near 14N, 37W" (MWR). From Truchelut's warm anomaly study... "Anoms 3sd+ on 10/2/00z, 1010 closed contour and strong +vort near 13N 32W" (Truchelut).

October 3:

HWM analyzes a closed low of at most 1000 mb centered near 15.3N, 42.2W. HURDAT lists this as a 65 kt hurricane at 14.8N, 42.8W. The MWR post-season track map shows a 12Z position near 14.5N, 43.2W. *RT* lists a 12Z position at 13.8N, 41.9W with a 998 mb central pressure. *ATS* shows a 1230Z map time position near 14.9N, 42.9W. Ship highlights: 65-70 kt (max wind estimated encountered) at 15.5N, 43.0W (MWR); 986 mb (min pressure encountered) (*ATS*, micro); 45 kt W and 991 mb 10Z at 14.6N, 42.9W (micro). "On the morning of the 3<sup>rd</sup>, the S.S. Thorbjorg passed near the center. At 1200Z this vessel reported westerly winds at 44 kt and lowest pressure 29.12 inches with rough seas. Maximum winds were estimated at 75 to 80 mph at the time the ship passed near the center. This observation was made near 15.5N, 43W. No definite fixes were obtained thereafter" (MWR). "[Ship: Thorbjorg at] 14.6N, 42.9W [45 kt W concurrent with 991 mb]. Passed low center 986 mb [at] 1000Z. Wind veered NE to W during last hour" (micro, *ATS*).

October 4:

HWM analyzes a hurricane of at most 1000 mb centered near 16.0N, 47.0W. HURDAT lists this as a 45 kt tropical storm at 13.8N, 46.1W. The MWR post-season track map shows a 12Z position near the HURDAT position. RT lists a 12Z position at 13.9N, 44.1W with a 998 mb central pressure. ATS analyzes a tropical cyclone of at most 993 mb centered near 16.9N, 46.8W at 1230Z. A NE-SW cold front extends from 31N, 43W to 26N, 49W to 21N, 56W. No gales or low pressures. "At 04/1600Z, [Advisory] Number Two [placed] the center at 16.5N, 48.5W moving WNW to NW at 13 kt. Due to [sparse reports], it was stated that the next [advisory] would be issued at 05/1600Z. At about this time, an extending trough began to have a strong influence on Gail. This trough was associated with an intense north Atlantic storm, contained a frontal system, and was moving eastward at a nearly constant speed of 23 kt. The discontinuities in this frontal system were not pronounced south of 25N, but were of sufficient strength to very nearly disrupt the tropical cyclone as it attempted to move up the trough. During the period from 04/1230Z to 05/1230Z, the frontal discontinuities almost succeeded in eradicating the tropical characteristics of the cyclone" (ATS).

October 5:

HWM analyzes a closed low of at most 1005 mb centered near 18.3N, 41.9W. An ENE-WSW cold front is plotted from 28N, 34W extending west-southwestward becoming a dissipating cold front near 27N, 39W and continuing to 26N, 44W to 26N, 50W. HURDAT lists Gail as a 30 kt tropical depression at 12.1N, 48.0W and HURDAT lists Storm 11 as a 55 kt tropical storm at 19.2N, 40.7W. The MWR post-season track map shows a position for Gail near the HURDAT position for Gail. RT lists a 12Z position at 17.7N, 45.9W with a 1000 mb pressure. ATS at 1230Z analyzes a tropical cyclone of at most 999 mb centered near 19.0N, 42.6W. A weak extratropical low of a most 1011 mb is plotted centered in the general vicinity of 20N, 48W with a warm front extending from that low east-northeastward to 22N, 44W, where it becomes a cold front and continues northeastward to 33N, 31W. A cold front extends from the weak extratropical low south-southwestward to 18N, 48W to 15N, 50W to 13N, 53W. Ship highlights: 55 kt NE and 1001 mb at 23Z at 20.7N, 41.6W (ATS). "Synoptic reports [around 05/1230Z] showed that the wind intensities could no longer be hurricane force, and [Advisory] Number Three, issued at 05/1600Z, was the last warning issued on this storm. The trough continued eastward leaving the greatly weakened storm stagnant near 20N, 40W. The tropical circulation absorbed the discontinuities of the front and reformed, thereby attesting to its original strength. The storm regenerated for a brief period late on the 5<sup>th</sup> and early on the 6<sup>th</sup> as shown by the 05/2300Z report of the ship *Robinhood*. At that time at 20.7N, 41.6W, this ship reported with NE 55 kt, pressure 1000.7 mb, tendency [negative] falling steady. With the effect of the trough removed, Gail again came under the influence of easterlies aloft and a westward movement resulted" (ATS).

October 6:

HWM analyzes a closed low of at most 1010 mb centered near 20.2N, 41.3W with the SW end of a SW-NE stationary front located about 300 nmi NNE of the low. HURDAT no longer lists Gail, but lists Storm 11 as a 50 kt tropical storm at 20.9N, 44.0W. RT lists

a 12Z position near 20.3N, 44.1W with a 998 mb central pressure. ATS shows a 1230Z map time position near 20.0N, 39.0W. No gales or low pressures. “The area was void of upper air information and the ensuing days (6<sup>th</sup> and 7<sup>th</sup>) brought few surface reports, none of which were believed to be near the center” (ATS).

October 7:

HWM analyzes a large, broad closed low of at most 1010 mb between 13-23N, 37-46W. HURDAT lists this as Storm 11 as a 40 kt tropical storm at 22.0N, 48.2W. RT lists a 12Z position at 20.1N, 46.0W with a 1002 mb central pressure. ATS shows a 1230Z map time position near 20.0N, 43.1W. No gales or low pressures.

October 8:

HWM analyzes a large, broad closed low of at most 1010 mb between 20-24N, 47-56W. HURDAT lists this as Storm 11 as a 35 kt tropical storm at 22.8N, 53.8W. RT lists a 12Z position at 21.9N, 49.4W with a 1005 mb pressure. ATS at 1230Z analyzes a tropical cyclone of at most 1002 mb centered near 23.2N, 51.3W. No gales or low pressures. “[Observations] did however show the existence of a low moving westward at about 23.1N, 51.3W at 08/1230Z” (ATS).

October 9:

HWM analyzes a closed low of at most 1010 mb centered near 23.4N, 57.0W. A warm front is plotted well to the north of the low extending from 34N, 54W to 30N, 58W to 29N, 61W to 29N, 68W. HURDAT last lists Storm 11 at 00Z as a 25 kt tropical depression at 23.0N, 57.4W. RT lists a 12Z position at 24.4N, 56.6W with a 1009 mb pressure. ATS at 1230Z analyzes a tropical cyclone of at most 999 mb centered near 24.7N, 56.6W. A cold front extends from 39N, 48W to 35N, 50W to 30N, 54W to 29N, 57W, becoming a stationary front near 29N, 62W, continuing westward to 28N, 68W to 27N, 73W. Ship highlights: 55 kt at 19Z at 25.0N, 58.0W (micro, ATS). “On 9 October, while Tropical Storm Hazel was crossing the Florida peninsula, the following report was received: ‘Pireps Mats C97 CSAL/KBQN (Cape Verde to Bermuda) reports suspicious area 25N, 58W at 09/1900Z. Encountered heavy thunderstorms, moderate turbulence, and reported surface winds about 55 kt with wind direction changing from 120 degrees to 240 degrees in one hour.’ This coincided well with the 09/1230Z surface analysis though only meager data was available, and the Joint Hurricane Warning Center believed this to be the remnants of Gail and accordingly the area was kept under close surveillance” (ATS).

October 10:

HWM does not analyze any features of interest on this day associated with the cyclone of interest, but does analyze Hazel as a closed low of at most 995 mb centered near 31.8N, 73.9W with a warm front extending eastward from Hazel to 32N, 64W to 35N, 55W to 35N, 48W. HURDAT no longer lists this system. RT lists a 12Z position at 26.5N, 62.2W with a 1001 mb pressure. ATS shows a 1230Z map time position near 20.7N, 59.9W. No gales or low pressures. “Late on the evening of the 10<sup>th</sup>, the following report was relayed from Kindley Air Force Base: ‘Urgent hurep boac post flight reports hurricane estimate position 26N, 61W; reports high swells and hurricane cloud structure.

Reported received 10/2030Z.’ These position indicated that the center was moving less than 10 kt which was a considerable deceleration from the apparent movement in the past few days. On the basis of this report, and the belief that the center, when found, would be in the Air Force area of primary responsibility, the Air Force was requested... to perform reconnaissance on this storm on 11 October” (ATS).

October 11:

HWM analyzes two lows- Hazel and one other low. Hazel is analyzed as a closed low of at most 995 mb centered near 37.0N, 64.5W with a warm front extending east-northeastward from Hazel. The other is a low of at most 1000 mb centered near 32.8N, 68.3W. Neither of these two lows are the feature of interest. Microfilm at 12Z analyzes a tropical cyclone of at most 1002 mb centered near 30.3N, 61.0W. RT lists a 00Z position at 29.1N, 63.2W with a 999 mb central pressure. ATS at 1230Z analyzes a tropical cyclone of at most 999 mb centered near 29.9N, 60.9W located within the warm sector of a larger scale extratropical cyclone (formerly Tropical Storm Hazel). ATS also analyzes an extratropical cyclone (formerly Tropical Storm Hazel) of at most 996 mb centered near 37N, 66W, with its warm front extending eastward to 39N, 61W to 40N, 56W to 41N, 46W and its cold front extending south-southwestward to 33N, 68W to 30N, 71W to 27N, 74W to 24N, 75W. Aircraft highlights: center fix at 1050Z at 30.4N, 59.9W with 55 kt maximum surface winds (micro); center fix (loran) at 1513Z at 30.7N, 60.8W with 997 mb central pressure, 55 kt max winds, and minimum 700 mb height of 9,950 ft (micro, ATS); center fix (loran) at 1615Z at 30.9N, 60.4W (micro). “At 11/1305Z the plane sent the following: ‘[Plane] position at 1250Z 27.4N, 60.5W; flight altitude 10,000 feet; in storm area. Returning to Kindley.’ A message was sent immediately by the Joint Hurricane Warning Center requesting a search be made of the area 30N, 60W prior to return to base. Duck Special six sent from 30.3N, 61.5W at 1428Z indicated they had received the message, and this was confirmed by the 1451Z report sent from 30.4N, 59.9W. A message was received from the plane at 11/1542Z reporting that the eye had been found. The post flight summary is quoted instead of the message because of the additional data: ‘Post flight summary: Tropical storm was located by Air Force hurricane hunters at [30.7N, 60.8W] at 11/1513Z by loran fix. Max wind of 55 kt from the southwest was estimated in the south quadrant. The shape of the eye is horseshoe and 50 miles across as determined by radar observation. Minimum pressure [997 mb]. Winds over 45 kt extend 50 miles from the eye in the south quadrant. The strongest quadrant of the storm is south. The north and east quadrants are open [in terms in radar reflectivity]. The south quadrant is solid for the first 40 miles then broken the last ten miles. Vivid lightning throughout the south. Storm approximately 50 miles in diameter. Lowest 700 mb height 9,950 feet. North quad- winds SE 35 kt... squall lines 40 miles long, 5 miles wide [oriented N/S?] 20 miles west of storm. [Squall line] apparently dissipated between 1515Z and 1615Z.’ Coordination with the Weather Bureau firmed the opinion that the storm was weakening rapidly due to its proximity to the circulation of the now extratropical storm Hazel, and at 11/1625Z, the Fleet Weather Central, Washington, D.C., was advised that in view of the above, the Hurricane Warning Center would not issue [advisories] on this low” (ATS, micro).

October 12:

HWM analyzes a closed low (the extratropical remnant of Tropical Storm Hazel) of at most 990 mb centered near 43.5N, 51.3W with a warm front extending eastward from Hazel and a cold front extending south-southwestward from Hazel to 40N, 52W to 37N, 55W to 33N, 60W to 28N, 64W to 23N, 70W. Microfilm at 00Z analyzes a closed low of at most 1002 mb centered near 32.8N, 58.9W located within the warm sector of the extratropical cyclone of post-Hazel, with the cold front now located about 200 nmi west of the low. Ship highlights: 50 kt SSE at 00Z at 33.0N, 58.4W (micro).

The disturbance that became Gail likely emerged off the coast of Africa as a tropical wave on 27 or 28 September. On 29 September at 18Z, ship observations indicate the tropical disturbance was likely located near ~10.5N, 25W. There is not quite enough convincing evidence on the 29<sup>th</sup> and 30<sup>th</sup> of a closed circulation, although there is almost enough evidence, based on available ship data, to indicate genesis of a tropical depression at either 18Z on the 29<sup>th</sup> or sometime on the 30<sup>th</sup>. On 1 October as the disturbance continued westward, the observations are sparser than on the 29<sup>th</sup> and 30<sup>th</sup> of September. HURDAT originally starts this cyclone at 06Z on 2 October at 13.1N, 35.5W as a 30 kt tropical depression. Ship observations at 00 and 06Z on the 2<sup>nd</sup> indicate that the HURDAT position looks accurate, so no change is made to the HURDAT positions on the 2<sup>nd</sup>. Also, no change is made to the timing of genesis. As the cyclone continued westward, a ship passed through the center around 10Z on 3 October near 15, 43W, recorded a 986 mb central pressure, and also estimated maximum winds encountered of 65 to 70 kt. A central pressure 986 mb is added to HURDAT at 12Z on the 3<sup>rd</sup>, and this value equals 70 kt according to the Brown et al. southern pressure-wind relationship. A 70 kt intensity is chosen for 12Z on the 3<sup>rd</sup> (up from 65 kt originally). Since there was no data near the center prior to that observation, a 5 kt per 6 hr increase in intensity is implemented backwards in time from the 70 kt value at 12Z on the 3<sup>rd</sup>. Therefore, the intensity at the first point at 06Z on the 2<sup>nd</sup> is chosen to be 45 kt (up from 30 kt originally). This eliminates the unrealistic intensity increase shown in HURDAT originally during the first six hour period from 06Z to 12Z on the 2<sup>nd</sup>. On the 2<sup>nd</sup> and 3<sup>rd</sup>, only a couple of very minor adjustments were made to the track, and minor increases to the intensity are also implemented.

The original HURDAT indicates that Gail decelerated, turned southwestward, weakened, and dissipated on the 4<sup>th</sup> and 5<sup>th</sup> of October with a final position of 11.7N, 48.3W as a 25 kt tropical depression at 18Z on 5 October. Available data and commentary suggests that there is no evidence that the cyclone dissipated near the location given in HURDAT. Instead, multiple sources indicate that Gail was picked up by a westward moving trough or cold front on the 4<sup>th</sup>, and that it moved northeastward on the 5<sup>th</sup>. However, the tail end of that cold front (which was likely associated with an extratropical storm in the north Atlantic) was apparently not powerful enough to dissipate the cyclone or to continue carrying it northeastward. At 23Z, on 5 October, a ship measured 55 kt NE with 1001 mb at 20.7N, 41.6W, and the analyzed position of Gail at 00Z on 6 October is 20.0N, 41.7W. HURDAT originally lists Storm 11 at 20.0N, 41.9W at 00Z on the 6<sup>th</sup>. But several sources including ATS, Truchelut's warm anomaly study, HWM, and COADS indicate that the cyclone located near 20.0N, 41.7W at 00Z on the 6<sup>th</sup> was the same as the cyclone located near 15N, 43W on October 3 (Gail). From about 18Z on the 5<sup>th</sup> through 00Z on

the 9<sup>th</sup>, the new HURDAT positions for Gail are near the previous HURDAT positions for Storm 11, with only minor track alterations. Gail is analyzed to have been at hurricane intensity from 06Z on 3 October through 18Z on 4 October. It is analyzed that Gail weakened to a 60 kt tropical storm at 00Z on the 5<sup>th</sup>, and maintained a constant intensity of 60 kt as a tropical storm from that time until 00Z on the 10<sup>th</sup>. From 00Z on the 6<sup>th</sup> to 00Z on the 9<sup>th</sup>, Gail moved west-northwestward from 20.0N, 41.7W to 23.2N, 56.0W. HURDAT previously listed a final position for Storm 11 at 00Z on the 9<sup>th</sup> at 23.0N, 57.4W, but later observations show that Gail continued as a tropical storm into the 12<sup>th</sup> of October. On the 9<sup>th</sup> at 19Z, a ship recorded winds of 55 kt and reported a wind shift of 120 degrees in 1 hour near 25N, 58W. The analyzed position at 18Z on the 9<sup>th</sup> is 24.8N, 58.2W as a 60 kt tropical storm. On the 10<sup>th</sup>, there is again a lack of data, but the 11<sup>th</sup>, Gail was located again- this time by aircraft reconnaissance, which measured a central pressure of 997 mb at 1513Z with a center fix of 30.7N, 60.8W (the analyzed position at 12Z on the 11<sup>th</sup> is 30.4N, 60.5W). A central pressure of 997 mb is added to HURDAT for Gail at 18Z on the 11<sup>th</sup>. A central pressure of 997 mb equals 49 kt according to the Brown et al. north of 25N pressure-wind relationship, and 50 kt is chosen for the intensity at all times on the 11<sup>th</sup> (which shows a very gradual decrease from the 60 kt intensity analyzed for the 9<sup>th</sup> of October). Late on the 11<sup>th</sup> and early on the 12<sup>th</sup>, the cold front associated with the extratropical cyclone of former Tropical Storm Hazel was approaching Gail from the west. However, observations and analyses from the NHC microfilm map at 00Z on 12 October indicate that Gail was probably not absorbed yet by 00Z on the 12<sup>th</sup>, and a 50 kt ship observation supports an analyzed intensity of 55 kt at 00Z on the 12<sup>th</sup>. Gail is analyzed to have become extratropical at 06Z on the 12<sup>th</sup> and to have been absorbed by the front after 06Z on the 12<sup>th</sup>.

Notes: The analysis indicates that Storm 9 (Gail) occurred from 2 to 12 October. Storm 11 is removed from HURDAT since Storm 11 is analyzed to have been a continuation of Gail.

Additional quotes:

“Hurricane Gail was another storm that appeared full-fledged out of the little traveled reaches of the Atlantic, far to the east of the Antilles. Unlike Carol, this storm was weakening when discovered. Due to lack of data, it was difficult to follow its movements. Toward the end of its course it threatened Bermuda briefly, but it did no damage as far as is known” (ATS).

1953 Storm 12 (originally Storm 10)

U.S. Close Approach:

10/4/1953 - 00Z – 35 kt (SE FL immediate coastline from the upper Keys northward through Palm Beach County experienced 35 kt winds- a tropical storm impact – but the center remained offshore). At 10/4 00Z, the center of the cyclone was inland over Cuba when the strong winds were experienced on the SE FL coast. The center made its closest approach to the SE FL coast 24 hours later- around 00Z on the 5<sup>th</sup>, but tropical storm winds were no longer being experienced by that time.

Major track changes and minor intensity changes are analyzed for this tropical storm. A major change is made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, and the Monthly Climatological Data Summaries from NCDC.

October 3:

HWM analyzes a trough axis extending from 32N, 73W to 23N, 80W. HURDAT first lists this at 18Z as a 35 kt tropical storm at 20.3N, 79.0W. Microfilm at 12Z does not analyze a closed low, but the isobaric analysis clearly indicates a trough oriented approximately from 28N, 78W to 17N, 84W. Microfilm at 18Z analyzes a closed low of at most 1008 mb centered near 22.8N, 81.5W. Ship and station highlights: 40 kt E and 1012 mb at 18Z at 26.5N, 77.0W (330 nmi NE of the analyzed center) (micro).

October 4:

HWM analyzes a closed low of at most 1005 mb centered near 24.0N, 79.5W with a trough axis extending from the low north-northeastward to 33N, 74W. HURDAT lists this as a 35 kt tropical storm at 23.3N, 80.3W. The MWR tracks of centers of cyclones first shows a position at 18Z at 24.8N, 80.8W. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near the HURDAT position. Ship and station highlights: 40 kt NE (elevated) and 1009 mb at 00Z Carysfort Reef Lighthouse (25.2N, 80.2W) (140 nmi north of center) and 35 kt ENE and 1007 mb at 06Z at Carysfort Reef Lighthouse (micro); 15 kt ENE and 1005 mb at 12Z at 25.2N, 80.0W (COA); 50 kt ENE and 1013 mb at 12Z at 30.3N, 80.2W 410 nmi north of center (COA); 10 kt ENE and 1004 mb at 18Z at 25.3N, 80.0W (COA); 15 kt SE and 1004 mb at 25.9N, 78.3W (COA).

October 5:

HWM analyzes a closed low of at most 1005 mb centered near 28.8N, 77.8W with a trough axis extending from the low north-northeastward to 32N, 77W to 38N, 70W. HURDAT lists this as a 40 kt tropical storm at 27.8N, 78.1W. The MWR tracks of centers of cyclones shows a 12Z position near 27.8N, 78.5W with a 1001 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near the HURDAT position. Ship and station highlights: 20 kt NE and 1005 mb at 00Z at 26.4N, 79.6W (micro); 20 kt NW (elevated) and 1003 mb at Carysfort Reef Lighthouse (micro); 10 kt NW and 1003 mb at 06Z 25.4N, 75.8W (COA); 20 kt SSE and 1004 mb at 12Z at 28.3N, 77.4W (micro); 30 kt ENE and 1006 mb at 18Z at 31.8N, 79.4W 190 nmi north of the analyzed center (micro).

October 6:

HWM analyzes an elongated closed low of at most 995 mb centered near 35.8N, 72.4W with a front running through the low and a trough extending from the low. The front consists of a stationary front that extends from 40N, 67W to the low where it becomes a cold front and extends to 34N, 75W to 36N, 77W to 39N, 76W to 39N, 79W to 37N, 82W to 35N, 85W. The trough extends from the low south-southwestward to 28N, 78W. HURDAT lists this as a 45 kt extratropical storm at 34.0N, 71.2W. The MWR tracks of

centers of cyclones shows a 12Z position near 37.8N, 70.8W with a 993 mb pressure. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 36.7N, 71.2W embedded with a frontal system similar to the HWM analysis. Ship and station highlights: 40 kt NNE and 1005 mb at 00Z at 32.3N, 78.6W 150 nmi NW of the analyzed center (micro); 20 kt SSE and 1001 mb at 06Z at 33.7N, 74.2W (COA); 35 kt S and 1006 mb at 12Z at 39.0N, 64.0W (COA); 30 kt NE and 1000 mb at 18Z at 39.7N, 70.2W (COA).

October 7:

HWM analyzes a closed low of at most 995 mb centered near 47.1N, 53.9W with a warm front extending from the low eastward to 50N, 39W and a cold front extending from the low south-southwestward to 45N, 53W becoming a warm front near 44N, 57W, continuing southwestward until the warm front intersects a second low, not closed, near 41N, 65W. A cold front extends south-southwestward from the second low to 35N, 65W to 30N, 70W. HURDAT lists this as a 60 kt extratropical cyclone at 40.5N, 65.0W. The MWR tracks of centers of cyclones shows a 12Z position near 47.6N, 53.6W with a 992 mb pressure. The MWR tracks of centers of cyclones shows the 12Z position of another low near 42.4N, 67.6W with a 998 mb pressure. Microfilm at 12Z analyzes a closed low of at most 990 mb centered near 46.5N, 55.0W with fronts analyzed similar to the HWM analysis. Ship and station highlights: 45 kt SW and 999 mb at 00Z at 39.0N, 61.0W (COA); 15 kt S and 990 mb at 00Z at 41.5N, 63.5W (COA); 45 kt SSW and 997 mb at 12Z at 44.1N, 53.5W (COA, HWM); 40 kt SW and 1004 mb at 18Z at 44.5N, 50.1W (micro).

October 8:

HWM analyzes two closed lows- both of at most 995. The first [which I believe is Storm 10] is centered near 53.0N, 38.5W, and the other is centered near 47.0N, 59.3W. A warm front extends from the first low east-northeastward and an occluded front extends west-southwestward from this first low. A dissipating cold front extends southwestward from the first low to 50N, 40W to 48N, 45W and becomes a warm front near 48N, 50W. This warm front continues westward to a triple point associated with the second low, and this triple point is located near 48N, 55W. An occluded front extends from the second low to the triple point, and a cold front extends from the triple point south-southwestward. HURDAT lists this as a 60 kt extratropical cyclone at 47.0N, 60.2W. The MWR tracks of centers of cyclones shows 12Z positions near 52.8N, 40.9W with a 990 mb pressure and 46.8N, 59.6W with a 993 mb pressure. Ship and station highlights: 45 kt SE and 1006 mb at 03Z at 50.0N, 39.0W (COA); 45 kt S and 1004 mb at 06Z at 50.7N, 37.8W (COA).

October 9:

HWM analyzes [the second] closed low to be of at most 995 mb centered near 53.5N, 46.2W with an occluded front extending eastward from the low to a triple point from which a stationary front extends east-northeastward and a cold front extends southward. HURDAT lists this as a 50 kt extratropical cyclone at 53.4N, 46.2W. The MWR tracks of centers of cyclones show 12Z position near 56.6N, 26.7W with a 995 mb pressure and 51.5N, 42.6W with a 993 mb pressure.

October 10:

HWM analyzes closed lows near 59.3N, 17.3W [possibly the remnant of Storm 10] and near 57.3N, 29.8W (the second low). An occluded front extending east-northeastward from the second closed low to the first closed low. A warm front extends eastward from this first low, and a cold front extends south-southwestward from this first low. HURDAT lists this as a 50 kt extratropical cyclone at 57.0N, 30.3W. The MWR tracks of centers of cyclones shows a 12Z position near 57.0N, 32.6W with a 985 mb pressure.

October 11:

HWM analyzes [the second] closed low to be of at most 985 mb centered near 61.7N, 19.4W. An occluded front extends east-northeastward from this low for several hundred miles. HURDAT no longer lists a system on this day.

On 3 October, a broad area of low pressure or a trough extended from the Bahamas across Cuba to the northern Caribbean Sea. This low pressure area is analyzed to have formed into a tropical cyclone by 18Z on 3 October (no change to the timing of genesis in HURDAT). The analyzed position at the time of genesis is inland over Cuba near 22.7N, 81.3W (a major track change from the 20.3N, 79.0W listed in HURDAT) as a 30 kt tropical depression (down from 35 kt originally). The depression is analyzed to have strengthened to a tropical storm at 00Z on 4 October (six hours later than originally) while the center was still inland over Cuba. At 00Z on the 4<sup>th</sup>, strong winds were experienced on the southeastern coast of Florida, and a tropical storm impact is analyzed for southeast Florida for 35 kt winds along the immediate shoreline from the upper Keys northward up the southeast Florida coastline. By 06Z on the 4<sup>th</sup>, the slow-moving cyclone had emerged over water north of Cuba, and the position at 12Z on the 4<sup>th</sup> (23.4N, 80.3W) is virtually unchanged from the previous HURDAT position and no change is made to the 35 kt intensity in HURDAT at that time. The center made its closest approach to SE FL around 00Z on the 5<sup>th</sup>, but tropical storm winds were no longer occurring on the coast during that time. On the 5<sup>th</sup> and 6<sup>th</sup>, the cyclone traveled generally northeastward and passed about 90 nmi SSE of Cape Hatteras. Only minor track adjustments are implemented on the 5<sup>th</sup>. Storm 10 became extratropical at 12Z on the 6<sup>th</sup> near 36.3N, 71.9W with a 45 kt intensity. No change was made to the timing of extratropical transition or the intensity of 45 kt at 12Z on the 6<sup>th</sup>, but the position is adjusted about 2.5 degrees NNW of the previous HURDAT position (a major change). Major track changes are made at all points from 06Z on 6 October until dissipation on the 8<sup>th</sup>. Late on the 6<sup>th</sup> and early on the 7<sup>th</sup> Storm 10 accelerated and moved quickly northeastward. At the same time, genesis of a separate extratropical low was occurring closer to the northeast coast of the United States. The original HURDAT positions listed for Storm 10 from the 7<sup>th</sup> through the 10<sup>th</sup> follow the new low that developed instead of following Storm 10, which was racing northeastward. The analyzed position of Storm 10 at 12Z on 7 October is 47.8N, 53.9W (originally listed in HURDAT as 40.5N, 65.0W). Analyses and observations from HWM and microfilm, observations from COADS, and the MWR tracks of lows chart all indicate two separate lows by the 7<sup>th</sup>, and they all also indicate that the low near 47.8N, 53.9W is Storm 10, and the low near the HURDAT position is a new low that had developed. Storm 10 continued racing east-northeastward,

but the circulation became extremely elongate on the west side early on the 8<sup>th</sup> as a front extended from Storm 10 to the other low further west. After the 7<sup>th</sup>, no more northwest winds were observed west of southwest of the center, and it is analyzed that the cyclone was no longer closed after 06Z on the 8<sup>th</sup>. The new final position for Storm 10 is at 06Z on 8 October at 51.2N, 43.6W as a 55 kt extratropical cyclone. The original HURDAT position at that time is listed as 45.2N, 61.6W at the location of the other low.

#### 1953 Storm 13 (Hazel) – (originally Storm 12)

##### U.S. Landfall:

10/9/1953 - 15Z - 26.6N, 82.3W - 65 kt - 987 mb - 1011 mb OCI - 300 nmi ROCI

10/9/1953 - 16Z - 26.7N, 82.1W - 65 kt - 987 mb - 1011 mb OCI - 300 nmi ROCI

Minor track changes and major intensity changes are analyzed for Hazel. The U.S. landfall intensity and the peak intensity is increased from a tropical storm to a hurricane. A major change is also made to the dissipation of this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, NHC microfilm of synoptic weather maps, U.S. Navy (flight log book), the Local, State, and National Monthly Climatological Data Summaries from NCDC, U.S. Weather Bureau public advisories, and Dunn and Miller (1960).

##### October 7:

HWM analyzes a broad, closed low of at most 1010 mb with a dissipating cold front running through the low centered in the general vicinity of 20.0N, 86.2W. HURDAT lists this as a 35 kt tropical storm at 21.0N, 86.3W. The MWR tracks of centers of cyclones shows a 12Z position near 19.2N, 88.3W with a 1007 mb pressure and the MWR post-season track map shows a 12Z position near 21.2N, 86.7W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near the HURDAT position. No gales or low pressures.

##### October 8:

HWM analyzes a closed low of at most 1005 mb centered near 23.1N, 86.4W with a warm front extending from the low eastward to 26N, 84W to 26N, 75W. HURDAT lists this as a 45 kt tropical storm at 22.7N, 86.0W. The MWR tracks of centers of cyclones shows a 12Z position near 22.6N, 86.4W with a 1006 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near the HURDAT position with a front extending from 25N, 89W to 28N, 85W to 29N, 80W to 29N, 77W. Ship highlights: 45 kt SE and 1008 mb at 21Z at 24.4N, 83.2W (micro); 35 kt NNW and 1002 mb at 21Z at 24.0N, 87.2W (micro) (that 1002 mb ship is found to be biased about 4 mb too low). One other gale of 35 kt and four other low pressures of 1002-1005 mb. Land/station highlights: 35 kt SE and 1010 mb at 2310Z at Dry Tortugas, FL (micro). Aircraft highlights: Navy center fix at 1934Z at 23.2N, 85.7W with 1002 mb central pressure and 45 kt max winds (micro, ATS); Navy center fix at 2120Z at 23.8N, 85.4W

(micro); 40 kt ESE at flight-level and 1002 mb at 2130Z at 24.3N, 85.0W (micro). “[Hazel] was born in the Yucatan Channel on October 8” (MWR).

October 9:

HWM analyzes a tropical storm of at most 1000 mb centered near 26.3N, 82.8W. The WSW end of a WSW-ENE warm front is located about 100 nmi NE of the cyclone. HURDAT lists this as a 60 kt tropical storm at 26.2N, 83.0W. The MWR tracks of centers of cyclones and the MWR post-season track map show 12Z positions near the HURDAT position with the former showing a 993 mb pressure. Microfilm at 12Z analyzes a tropical cyclone of at most 996 mb centered near the HURDAT position with the WSW end of a WSW-ENE front located about 100 nmi NNE of the cyclone. Ship highlights: 55 kt SSW and 999 mb at 12Z at 25.6N, 83.0W (COA, micro); 55 kt NE and 1002 mb at 12Z at 26.6N, 83.5W (micro); 40 kt and 996 mb at 23Z at 28.2N, 78.8W (micro). Eight other gales between 35-40 kt and 14 other low pressures between 1002-1005 mb. Land/station highlights: 52 kt SSW (max wind/1-minute) with a gust to 70 kt at Okeechobee City, FL (climo); 987 mb (min p) at Okeechobee City, FL (climo); 50 kt N (max wind/1-minute) at Arcadia, FL (climo). At least 15 other gales between 35-50 kt and well more than six other low pressures between 994-1005 mb over the Florida peninsula. Aircraft highlights: center fix at 1339Z at 26.2N, 83.1W with a central pressure of 997 mb reported with 55 kt max winds (micro). “It moved northeastward and increased to almost hurricane force by the time it moved into Florida just north of Ft. Myers about 1100 EST [1600Z] of the 9<sup>th</sup>. Winds up to 60 to 70 mph attended the storm’s northeastward transit of Florida. It passed into the Atlantic near Vero Beach at about 1700 EST [2200Z] of the 9<sup>th</sup>. Damage was light to moderate, as would be expected from winds of only gale force, and totaled \$250,000 or slightly more. One, and possibly two small tornadoes occurred on the storm’s leading edge as it crossed Florida: one occurred at St. James City on Pine Island west of Ft. Myers and traced a path 3 or 4 miles in length destroying several houses; there were indications of another tornado near Okeechobee City where a hanger was badly damaged and an airplane wrecked. The lowest pressure, 987 mb, and also the strongest wind gusts, 80 mph, were reported from Okeechobee City” (MWR). Regarding the flooding from rainfall in Florida... “The rainfall associated with Hazel added to the flood conditions existing from previous rains in several of the river valleys of Florida, as well as some of the Everglades area. The overall flood damage is estimated at 9 to 10 million dollars, but it is not possible to separate the flood damage caused by Hazel from that caused by the other rains. The upper St. Johns River reached the highest stage ever known, exceeding by 1 ½ feet the previous record and covering 6 miles of highway between Melbourne and Kissimmee” (MWR). From the October, 1953 Florida State Climatological Summary... “A tropical storm with highest winds slightly less than hurricane force crossed the southern portion of the state on the 9<sup>th</sup> and brought 3 to 5 inches of rain to the already flooded Kissimmee and St. Johns River Valleys... Heavy rains fell on the Peninsula and in northeast Florida the 8<sup>th</sup>-9<sup>th</sup> associated with the tropical storm, the center of which reached the state in the Fort Myers-Punta Gorda area and emerged into the Atlantic in the vicinity of Vero Beach... ‘Hazel,’ the eighth tropical disturbance of the season, was born in the Yucatan Channel on October 8<sup>th</sup>, and grew to a husky youngster during the night while moving northeastward. It moved into Florida via Charlotte Harbor between Fort Myers and Punta

Gorda about 11:30 am (1630Z) of the 9<sup>th</sup> with winds slightly below hurricane force, and continued rapidly northeastward across the state and entered the Atlantic near Vero Beach about 5:00 pm (2200Z). Some typical gust velocities (mph) were: Fort Myers, 62; Captiva, 70; Okeechobee City, 80; and Patrick AF Base, Cocoa, 64. The lowest pressure recorded was 29.15 inches (987 mb) at the U.S. Engineers Office at Okeechobee City, and this station also reported the strongest winds. We believe, however, that these resulted from a tornado-like squall rather than sustained conditions in the tropical storm. There were one or more small tornadoes associated with this storm, one of which occurred at St. James City on Pine Island west of Fort Myers, and there was some evidence of tornadic type squalls near Okeechobee City. On Pine Island, several houses were damaged or destroyed by the tornado, and at Okeechobee City, a hanger was damaged and an aeroplane wrecked. Otherwise damage was mostly of a minor nature. The wind damage is estimated at about \$250,000, \$96,000 of which occurred in the area of the west coast from the Fort Myers area northward to Sarasota. Fort Myers Beach was flooded to a depth of 1 to 2 feet by tides. There were no deaths or serious injuries reported. The rainfall associated with this storm was not very heavy south of the center, but near the center and to the north amounts ranged from 3 to more than 5 inches” (climo). From the October, 1953 National Climatological Data Summary storm reports... “Place: Florida, southern portion; Date: 9; Time: 11:30 am – 5 pm; Width of path: 100 miles; Length of path: 150 miles; Property damage (exclusive of crops): \$9,250,000; Character of storm: Tropical storm; Remarks: Rainfall amounted to 3 to 5 inches near the center and to north, augmenting an already serious flood condition. Impossible to say how much storm rains added to flood damage, but overall flood damage estimated at \$9,000,000. Flood damage partly property and partly crops, with major portion of property damage suffered by roadways, streets, and drainage systems” (climo). “Tropical Cyclones in Florida – Oct. 9 – SW FL – Minor – Okeechobee City bar. 29.15 in.” (“Minor” – winds less than 74 mph, pressure greater than 996 mb- Dunn and Miller).

October 10:

HWM analyzes a closed low of at most 995 mb centered near 31.8N, 73.9W with a warm front extending from just north of the low center eastward from 33N, 73W to 34N, 70W to 33N, 67W to 32N, 64W to 34N, 58W. HURDAT lists this as a 60 kt tropical storm at 32.4N, 73.6W. The MWR tracks of centers of cyclones shows a 12Z position near 32.6N, 73.9W with a 995 mb pressure and the MWR post-season track map shows a 12Z position near the HURDAT position. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 32.0N, 73.6W. Ship highlights: 35 kt S and 996 mb at 00Z at 29.4N, 78.3W (micro); 55 kt N and 1005 mb at 12Z at 33.2N, 77.0W (COA, micro); 50 kt SW and 997 mb at 12Z at 30.5N, 74.7W (COA, micro). At least nine other gales between 35-45 kt and at least 27 other low pressures between 999-1005 mb. Aircraft highlights: 60 kt estimated surface winds from the SE, 60 kt flight-level winds from the SE, and 990 mb at 1352Z at 31.9N, 73.3W (micro); center fix (loran) at 1630Z at 32.2N, 70.9W (or 70.2?) with 989 mb central pressure and 70 kt estimated maximum winds (micro). “After leaving Florida, the storm moved rapidly northeastward and lost force, becoming extra-tropical by the time it reached 35N” (MWR).

## October 11:

HWM analyzes a closed low of at most 995 mb centered near 37.0N, 64.5W with a warm front extending from the low eastward to 39N, 55W. HWM analyzes a second closed low of at most 1000 mb centered a few hundred nmi SW of the feature of interest with a cold front undergoing frontogenesis from 29N, 69W to 25N, 75W to 24N, 78W. HURDAT lists this as a 45 kt extratropical cyclone at 36.4N, 65.1W. The MWR tracks of centers of cyclones shows a 12Z position near the HURDAT position with a 995 mb pressure and the MWR post-season track map shows a 12Z position near 36.5N, 65.4W. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 36.0N, 65.4W with a front extending east-northeastward from the low and another front extending south-southwestward from the low. Microfilm also analyzes another closed low- a tropical cyclone of at most 997 mb (Tropical Storm Gail) centered near 30.3N, 61.0W. Ship highlights: 45 kt N and 1009 mb at 00Z at 35.3N, 75.2W (COA); 35 kt NNE and 993 mb at 06Z at 34.9N, 69.9W (COA); 45 kt NE and 997 mb at 18Z at 38.9N, 64.1W (COA). At least 11 other gales between 35-40 kt and at least 53 other low pressures between 997-1005 mb.

## October 12:

HWM analyzes a closed low of at most 990 mb centered near 43.5N, 51.4W with a warm front extending from the low eastward and a cold front extending from the low south-southwestward. HURDAT lists this as a 35 kt extratropical cyclone at 42.7N, 53.2W. The MWR tracks of centers of cyclones shows a 12Z position near 42.9N, 53.5W with a 989 mb pressure. Microfilm at 12Z analyzes a closed low of at most 996 mb centered near 44.0N, 52.0W with a front extending from the low south-southwestward. Ship highlights: 45 kt S and 1000 mb at 12Z at 41.6N, 50.6W (COA); 45 kt SE and 986 mb at 19Z at 48.0N, 46.0W (COA); 20 kt S and 978 mb at 23Z at 48.0N, 46.0W (COA). At least 14 other gales between 35-40 kt and at least 47 other low pressures between 989-1005 mb.

## October 13:

HWM analyzes a closed low of at most 975 mb centered near 53.2N, 41.7W. An occluded front extends from 53N, 35W to a triple point near 45N, 31W from which a warm front and a cold front extend. The MWR tracks of centers of cyclones shows a 12Z position near 53.2N, 42.0W with a 962 mb pressure. Ship highlights: 60 kt SW at 00Z at 48.2N, 45.3W (COA); 60 kt E and 965 mb at 06Z at 51.9N, 42.8W (COA); 60 kt SW and 982 mb at 12Z at 50.8N, 39.5W (COA). A few other 60 kt wind observations.

## October 14:

HWM analyzes a closed low of at most 975 mb centered near 56.3N, 38.6W. A dissipating occluded front extends from 63N, 27W to 55N, 20W to a triple point near 48N, 23W. A warm front and cold front extend from the triple point south-southeastward and south-southwestward respectively. The MWR tracks of centers of cyclones shows a 12Z position near 57.0N, 40.2W with a 980 mb pressure. Ship highlights: 45 kt NNW and 962 mb at 06Z at 55.5N, 44.5W (COA); 50 kt N and 971 mb at 12Z at 55.0N, 44.0W (COA). At least three other 50 kt observations this day.

October 15:

HWM analyzes a closed low of at most 970 mb centered near 58.5N, 31.0W with a N-S occluded front plotted east of the cyclone extending from 59N, 20W to 55N, 16W to 50N, 17W to 46N, 18W. The MWR tracks of centers of cyclones shows a 12Z position near 58.0N, 28.4W with a 969 mb pressure. Ship highlights: 55 kt W and 987 mb at 00Z at 51.4N, 34.9W (COA); 60 kt W and 992 mb at 06Z at 51.5N, 36.0W (COA); 25 kt W and 968 mb at 06Z at 55.2N, 34.2W (COA); 50 kt SE and 983 mb at 18Z at 63.5N, 24.5W (COA). Numerous other gales and low pressures.

October 16:

HWM analyzes a closed low of at most 980 mb centered near 62.5N, 28.5W. The MWR tracks of centers of cyclones shows a 12Z position near 62.2N, 26.9W. Ship highlights: 45 kt WSW and 997 mb at 00Z at 52.7N, 36.8W (COA); 35 kt SW and 1000 mb at 12Z at 53.0N, 29.8W (COA). Several other gales and low pressures.

HURDAT begins this cyclone at 06Z on 7 October as a 35 kt tropical storm at 20.5N, 86.4W. At 12Z on the 7<sup>th</sup>, available observations confirm a closed circulation, while there is no evidence on the 6<sup>th</sup> that the cyclone started prior to the time shown in HURDAT. Therefore, no change is made to the timing of genesis. No change is made to the position at the genesis point either, but this cyclone is begun as a 25 kt tropical depression at genesis (down from 35 kt originally). The cyclone moved northward through the Yucatan Channel and into the eastern Gulf of Mexico before turning northeastward on the 8<sup>th</sup> and 9<sup>th</sup>. The track on the 7<sup>th</sup> and 8<sup>th</sup> is virtually unchanged from the previous HURDAT track. On the 8<sup>th</sup> at 12Z, a ship recorded winds of 25 kt with a 1005 mb pressure (likely outside the RMW but within 50 nmi of the center), and at 18Z, ship observations of 25 kt with 1002 mb and 30 kt with 1005 mb were recorded. At 1934Z, aircraft reconnaissance recorded a central pressure of 1002 mb, and this value is added to HURDAT at 18Z on the 8<sup>th</sup>. A central pressure of 1002 mb equals 43 kt according to the Brown et al. southern pressure-wind relationship. The first gale from a ship was recorded at 21Z on the 8<sup>th</sup> (45 kt with 1008 mb and another 35 kt with 1002 mb). A 45 kt intensity is chosen for 18Z on the 8<sup>th</sup> (down from 55 kt originally). It is analyzed that this cyclone became a tropical storm by 18Z on the 7<sup>th</sup> (12 hours later than originally in HURDAT). On the 9<sup>th</sup>, Hazel moved northeastward toward southwest Florida and strengthened. Track changes on the 9<sup>th</sup> are three-tenths of a degree or less. By 12Z on the 9<sup>th</sup>, the position is 26.0N, 83.3W, which is only about 60 nmi away from making landfall in southwest Florida. At that time, two separate ships recorded winds of 55 kt, one of them was observed simultaneously with a 999 mb pressure. At 1352Z, aircraft reconnaissance reported that they has measured a central pressure of 997 mb, but ship data and well as data over Florida a few hours later suggests that the 997 mb pressure was likely not a central pressure reading, so no central pressure is added to HURDAT at 12Z. No changes are made to the 55 and 60 kt intensities shown in HURDAT at 00 and 06Z on the 9<sup>th</sup>.

Hazel made landfall around 15Z on 9 October on the barrier islands and passed between Fort Myers and Punta Gorda around 16Z. It traveled between northeastward and east-northeastward across the Florida peninsula and made oceanfall around 21Z on the 9<sup>th</sup> near

27.8N, 80.5W. The highest recorded 1-minute wind in Florida was 52 kt at Okeechobee City and the lowest observed pressure was 987 mb, also at Okeechobee City. The lowest available pressure from a station on the west coast of Florida is 994 mb from Fort Myers (simultaneous with a NW wind of unknown velocity). But there were no reported minimum pressure values from any stations near the path of the center. Due to damage descriptions from both Sanibel Island and from the Okeechobee City area, there is a good chance the central pressure was deeper than 994 mb at landfall. Due to other data in concordance with the 987 mb pressure from Okeechobee City, a landfall central pressure of 987 is analyzed. The 994 mb central pressure listed in HURDAT at 18Z on the 9<sup>th</sup> is replaced by a 987 mb central pressure. A 987 mb central pressure equals 66 kt according to the intensifying subset of the Brown et al. north of 25N pressure-wind relationship. More than one piece of information indicates that the RMW was likely smaller than average. Although the outer closed isobar was a large 300 nmi, the speed of the storm was a fast 20 kt, and 65 kt is chosen for the landfall intensity, making Hazel a hurricane at landfall rather than a 60 kt tropical storm as shown previously in HURDAT. A 65 kt intensity is chosen for 12Z and landfall (up from 60 kt originally). Since the peak observations from Okeechobee City occurred near 18Z, the analyzed intensity at 18Z is 60 kt (up from 55 kt originally). Hazel continued east-northeastward, and based on ship data late on the 9<sup>th</sup> and early on the 10<sup>th</sup>, all of the intensities listed in HURDAT on the 10<sup>th</sup> are maintained. HURDAT previously listed Hazel as having become extratropical at 18Z on the 10<sup>th</sup>, but Hazel is analyzed to have become extratropical by 12Z on the 10<sup>th</sup> (six hours earlier than originally). On the 10<sup>th</sup> at 1630Z, a 989 mb central pressure was measured via an Air Force center fix near 32-33N, 71-72W, and this value is added to HURDAT at 18Z on the 10<sup>th</sup>. Hazel accelerated as an extratropical system and reached 46.0N, 49.0W by 18Z on 12 October (originally 44.7N, 51.0W) (the final point shown in HURDAT originally). It is analyzed that Hazel was not absorbed or dissipated until after 18Z on 16 October, and four days are added to the dissipation as an extratropical system. Positions/intensities at 12Z each day from the 13<sup>th</sup> through 16<sup>th</sup> are: 53N, 42W, 65 kt; 56N, 40W, 55 kt; 58N, 31W, 65 kt; and 62.5N, 28.1W, 45 kt.

Additional quotes:

“Tropical Storm Hazel was a compact little storm which originated near the tip of the Yucatan peninsula. The winds associated with this storm caused no serious damage as it crossed Florida, but it brought the usual torrential rainfall. Hardest hit were the Kissimmee and St. John’s valleys, north of Lake Okeechobee, which were at record flood stage prior to the storm’s arrival. This newly added rainfall caused such severe flooding in the wake of the storm that certain portions of the state were declared disaster areas on 14 October” (ATS).

1953 Storm 14 – (originally Storm 13)

Major track changes and minor intensity changes are analyzed for this cyclone. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, Monthly Weather Review, and NHC microfilm of synoptic weather maps.

November 19:

HWM analyzes a dissipating NE-SW stationary front oriented from 27N, 45W to 21N, 55W. HURDAT does not yet list a system on this day. No gales or low pressures.

November 20:

HWM analyzes a trough axis extending from 24N, 51W to 22N, 56W to 17N, 59W. HURDAT does not yet list a system on this day. No gales or low pressures.

November 21:

HWM analyzes a trough axis extending from 25N, 52W to 22N, 57W to 17N, 59W. HURDAT does not yet list a system on this day. No gales or low pressures.

November 22:

HWM analyzes a sharp NNE-SSW trough with the trough axis extending from 27N, 53W to 22N, 58W to 17N, 59W. HURDAT does not yet list a system on this day. No gales or low pressures.

November 23:

HWM analyzes an elongated but closed low of at most 1010 mb centered near 25.2N, 54.2W with a trough axis running through the low extending from 27N, 46W to 27N, 49W to the low to 18N, 60W. HURDAT lists this as a 35 kt tropical storm at 22.8N, 56.3W. Microfilm at 12Z analyzes a closed low of at most 1011 mb centered in the general vicinity of 22.8N, 55.4W. No gales or low pressures.

November 24:

HWM analyzes a closed low of at most 1005 mb centered near 27.3N, 52.7W with a trough axis running through the low extending from 28N, 49W to the low to 24N, 57W to 20N, 60W. HURDAT lists this as a 45 kt tropical storm at 27.5N, 52.0W. The MWR tracks of centers of cyclones shows a 12Z position near 27.8N, 54.6W with a 1004 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1005 mb centered near 27.6N, 53.1W. Ship highlights: 40 kt NE and 1005 mb at 18Z at 29.7N, 55.3W (COA, micro). Aircraft highlights: Air Force center fix at 1939Z at 29.7N, 55.6W with 999 mb central pressure and 40 kt max winds (micro).

November 25:

HWM analyzes a closed low of at most 1010 mb centered near 28.5N, 55.6W with a trough axis running through the low extending from 31N, 49W to 23N, 62W. HURDAT lists this as a 45 kt tropical storm at 29.0N, 56.0W. The MWR tracks of centers of cyclones shows a 12Z position near 29.4N, 56.7W with a 1007 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 30.8N, 55.2W. Ship highlights: 40 kt E and 1016 mb at 06Z at 33.8N, 55.8W (COA). Aircraft highlights: possibly a center fix at 1828Z at 30.2N, 57.3W (micro).

November 26:

HWM analyzes a closed low of at most 1015 mb centered near 30.8N, 58.7W with a trough axis running through the low extending from 32N, 52W to the low to 25N, 65W. HWM also analyzes a N-S cold front several hundred miles west of the low extending from 37N, 67W to 30N, 68W to 25N, 70W to 22N, 72W. HURDAT lists this as a 30 kt tropical depression at 32.2N, 57.1W. The MWR tracks of centers of cyclones shows a 12Z position near 33.5N, 57.9W with a 1010 mb pressure. Microfilm at 12Z analyzes a closed low of at most 1014 mb centered near 31.8N, 57.0W with an approaching NNE-SSW cold front located several hundred miles west of the low. No gales or low pressures.

November 27:

HWM and microfilm no longer analyze the feature of interest on this day, and HURDAT no longer lists a system on this day. The MWR tracks of centers of cyclones shows a 12Z position near 39.7N, 63.3W with a 1000 mb pressure. HWM and microfilm indicate that the low near the MWR position is a separate extratropical low with a warm front analyzed extending east-northeastward from the low and a cold front extending south-southwestward from the low.

November 28:

The MWR tracks of centers of cyclones shows a 12Z position near 52.1N, 51.3W with a 998 mb pressure.

On 19 November, the tail end of front dissipated into a trough, which remained weak until it became a sharp trough on the 22<sup>nd</sup> and a closed low on the 23<sup>rd</sup>. HURDAT starts this system at 06Z on 23 November as a 35 kt tropical storm at 22.0N, 56.5W. No changes are made to the timing of genesis or the 35 kt intensity, but the position at 06Z on the 23<sup>rd</sup> is shifted a degree east of the previous position. The cyclone moved northward reaching a position near 27.8N, 53.8W by 12Z on the 24<sup>th</sup>, which is about 1.8 degrees west of the previous HURDAT position. The cyclone was stronger on the 24<sup>th</sup> as well. At 18Z on the 24<sup>th</sup>, a ship observed a 40 kt wind concurrent with a pressure of 1005 mb, and at 1939Z, aircraft reconnaissance measured a central pressure of 999 mb, and this value is added in to HURDAT at 18Z on the 24<sup>th</sup>. A central pressure of 999 mb equals 45 kt according to the Brown et al. north of 25N pressure-wind relationship and 47 kt for its intensifying subset. The 45 kt intensity shown in HURDAT at 18Z on the 24<sup>th</sup> is not changed. Ship data and also the aircraft fix indicate that the position in HURDAT at 18Z on the 24<sup>th</sup> is more than 2.5 degrees too far east, so major westward track adjustments are implemented from 18Z on the 24<sup>th</sup> through 00Z on the 25<sup>th</sup>. No intensity changes were made to HURDAT from genesis at 06Z on the 23<sup>rd</sup> through 06Z on the 25<sup>th</sup>. Late on the 25<sup>th</sup>, the cyclone began to weaken. The last available gale recorded occurred at 06Z on the 25<sup>th</sup> – a 40 kt observation a few hundred nmi north of the center. After that, the system, rapidly dissipated and could not be identified by 12Z on the 26<sup>th</sup>. However, due to the sparse observations, the timing of dissipation shown in HURDAT – after 18Z on the 26<sup>th</sup> – is unchanged. This tropical storm is analyzed to have weakened to a tropical depression six hours earlier than shown in HURDAT originally. A few very minor downward intensity adjustments were made from the 25<sup>th</sup> at 12Z on the 26<sup>th</sup> at

06Z. The final point – 18Z on the 26<sup>th</sup> – is 33.4N, 57.1W as a 25 kt tropical depression (no change to position or intensity at the final point).

#### 1953 Storm 15 (Irene) – (originally Storm 14)

Major track changes and major intensity changes are analyzed for this December tropical storm. Evidence for these alterations comes from the Historical Weather Map Series, the COADS ships database, NHC microfilm of synoptic weather maps, and the U.S. Navy (flight log book).

##### December 6:

HWM analyzes a spot low near 15.5N, 50.9W and a NE-SW stationary front extending from 29N, 34W to 28N, 43W to 24N, 49W to 21N, 54W. HURDAT does not yet list a system on this day. No gales or low pressures.

##### December 7:

HWM analyzes a closed low of at most 1010 mb centered near 17.3N, 51.5W with the SW end of a SW-NE dissipating warm front located about 200 nmi north of the low. HURDAT first lists this at 18Z as a 30 kt tropical depression at 20.8N, 51.5W. No gales or low pressures.

##### December 8:

HWM analyzes a tropical storm of at most 1000 mb centered near 21.7N, 55.8W. HURDAT lists this as a 35 kt tropical storm at 20.9N, 54.6W. Microfilm at 12Z analyzes a closed low of at most 1002 mb centered near 21.2N, 55.7W. Ship highlights: 40 kt NE at 09Z at 20.5N, 55.2W (micro); 40-50 kt NW and 999 mb at 10Z from the same ship as the 09Z observation (micro); 40 kt S at 11Z from the same ship (micro); 35 kt E and 1013 mb at 12Z at 26.0N, 56.3W (COA); 10 kt NE and 1004 mb at 12Z at 20.5N, 60.8W (COA). “Esso Fawley: 0900 GMT located 20.5N, 55.2W- passed through center of small intense storm. Wind NE [40 kt]. Sea very high. 1000 GMT- barometer [999 mb], wind NW [40 to 50 kt], sea high and confused. 1100 GMT- barometer rising, wind S 40 kt, storm center estimated traveling NW” (micro).

##### December 9:

HWM analyzes a tropical storm of at most 1005 mb centered near 20.7N, 59.6W. HURDAT lists this as a 30 kt tropical depression at 21.2N, 59.6W. Microfilm at 12Z analyzes a closed low of at most 1008 mb centered near 22.3N, 59.7W. Ship highlights: 25 kt NE and 1004 mb at 00Z at 21.1N, 60.2W (micro).

##### December 10:

HWM analyzes a NNE-SSW trough with the trough axis extending from 30N, 62W to 25N, 67W to 20N, 69W to 16N, 70W. HURDAT no longer lists a system on this day.

This tropical storm formed in a similar location and likely from a similar type of synoptic mechanism as the tropical storm in November (the tail end of a front). HURDAT begins

this cyclone at 18Z on 7 December as a 30 kt tropical depression at 20.8N, 51.5W. No changes are made to the timing of genesis. Observations at that time and subsequent observations early on the 8<sup>th</sup> indicate that the HURDAT positions from 18Z on the 7<sup>th</sup> to 06Z on the 8<sup>th</sup> are too far north. A major track change is implemented at the first point only – the position at 18Z on the 7<sup>th</sup> is analyzed to be more than 3 degrees SSW of the previous HURDAT position. The cyclone which had been moving northwestward, turned toward the west by 12Z on the 8<sup>th</sup> near 20.8N, 55.5W. The analyzed position at 12Z on the 8<sup>th</sup> is 1 degree west of the previous HURDAT position. At 10Z on the 8<sup>th</sup>, a ship recorded 40-50 kt winds concurrent with a 999 mb pressure, and this was the highest observed wind and the lowest observed pressure for the lifetime of this cyclone. A central pressure of less than 999 mb yields winds of greater than 49 kt according to the Brown et al. southern pressure wind relationship. A 55 kt intensity is analyzed for 12Z on the 8<sup>th</sup> (up from 35 kt originally – a major change). The storm continued moving westward, but it began to weaken early on the 9<sup>th</sup>. At 00Z on the 9<sup>th</sup>, a ship observed a 1004 mb pressure concurrent with 25 kt winds. Thereafter, no more gales or low pressures were recorded. Observations on the 9<sup>th</sup> continue to indicate a position about one degree west of the previous HURDAT position throughout the day. A steady decrease of the intensity is shown on the 9<sup>th</sup>, although minor upward intensity adjustments are implemented from the original HURDAT. No changes were made to the timing of dissipation (18Z on the 9<sup>th</sup>), and the final position is analyzed at 21.0N, 62.0W as a 30 kt tropical depression. The cyclone dissipated after 18Z on the 9<sup>th</sup>.

Additional quotes:

“Tropical Storm Irene developed late in the year in an area of very sparse reports. Winds remained light and the circulation dissipated in its early stages” (ATS).

1953 additional notes

1)

HWM indicates that a frontal low on 24 March was located near 39N, 43W. It moved slowly southeastward, occluded, and became very large and powerful by the 26<sup>th</sup>. This large, baroclinic low persisted for several days with gales at least through the 28<sup>th</sup>. After the 28<sup>th</sup>, it began to weaken very gradually. However, the low stayed in the same general area of the Atlantic until the end of the month. During the first two days of April, the low continued to weaken, and it moved east-northeastward. By 3 April, it had dissipated. David Roth lists this system as a potential subtropical storm; however, HWM observations and analyses indicate that the low was not likely to have been subtropical.

DAY	LAT	LON	STATUS
Mar 24	39N	43W	Extratropical
Mar 25	38N	42W	Extratropical
Mar 26	33N	43W	Extratropical
Mar 27	34N	39W	Extratropical
Mar 28	37N	35W	Extratropical

Mar 29	38N	30W	Extratropical
Mar 30	36N	28W	Extratropical
Mar 31	32N	28W	Extratropical
Apr 1	33N	26W	Extratropical
Apr 2	36N	20W	Extratropical
Apr 3			Dissipated

2)

A low formed along a frontal boundary on 10 May on the western Atlantic. The front dissipated as it moved away, but a weak, broad area of low pressure was left behind. This low pressure area appears to have contained a weak, closed circulation on a broad scale until 14 May when it may have denigrated into an open trough. This persisted until 18 May when the area of low pressure ceased to exist. The highest wind observed with this system was 30 kt and no low pressures were observed. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
May 10	33N	72W	Extratropical
May 11	33N	70W	Broad low
May 12	33N	70W	Broad low
May 13	32N	69W	Broad low
May 14	30N	67W	Broad low/trough
May 15	28N	66W	Broad low/trough
May 16	28N	66W	Broad low/trough
May 17	29N	64W	Broad low/trough
May 18			Dissipated

3)

HWM, microfilm, COADS, and Ryan Truchelut's warm anomaly study indicates that a tropical depression formed in the Gulf of Mexico on 26 June. It moved slowly northwestward. Microfilm maps show that it possibly moved inland as a tropical depression on the 28<sup>th</sup>. The 18Z microfilm map on the 28<sup>th</sup> shows the tropical depression inland at 31N, 94W followed by dissipation. The highest observed wind from a ship while this system was over water was 30 kt, and the lowest observed pressures were around 1008-1009 mb. The Monthly climatological data from NCDC indicates maximum monthly wind speeds of 41 kt SE at Port Arthur (on the 29<sup>th</sup>) and 37 kt SE at Galveston (also on the 29<sup>th</sup>). After plotting a time series of 6-hourly observations from New Orleans, Lake Charles, Port Arthur, and Galveston, it was determined that these two gales were not associated with any tropical cyclone. These gales occurred with a much higher pressure than the day before when the pressures were lower but winds were light. Any tropical depression that existed dissipated by the 29<sup>th</sup> anyway. The gales observed on the 29<sup>th</sup> may have been associated with a squall line or thunderstorms. This system is not added to HURDAT.

DAY	LAT	LON	STATUS
Jun 25	25N	89W	Spot low
Jun 26	27N	91W	Tropical depression
Jun 27	28N	92W	Tropical depression
Jun 28	29N	93W	Tropical depression
Jun 29			Dissipated

4)

HWM and Truchelut's warm anomaly study indicate that a tropical depression formed near the Cape Verde Islands on 24 August. There is clear evidence of a closed circulation of the 24<sup>th</sup> and 25<sup>th</sup>. The system moved west-northwestward, but was lost in the typical data-sparse region of the Atlantic by the 27<sup>th</sup>. No gales or low pressures were observed. Thus, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Aug 24	14N	25W	Tropical depression
Aug 25	15N	29W	Tropical depression
Aug 26	16N	33W	Tropical depression
Aug 27	17N	37W	Open wave
Aug 28			Dissipated

5)

Ryan Truchelut's warm anomaly study suggests a possible disturbance. No gales or low pressures were observed with this suspect. Thus, it is not added to HURDAT.

DAY	LAT	LON	STATUS
Sep 21	9N	36W	Open wave/weak low
Sep 22	10N	40W	Tropical depression
Sep 23	11N	43W	Tropical depression
Sep 24	13N	45W	Tropical depression
Sep 25	17N	44W	Open wave/trough
Sep 26	22N	43W	Weak low/trough
Sep 27			Dissipated

6)

HWM, the MWR tracks of lows, COADS, and microfilm indicate that a tropical depression formed by 15 October near 26N, 69W. The low shown in HWM on 15 October near 33N, 71W is a completely different feature and is not associated with the depression. Microfilm plots a tropical storm symbol on their October 15 18Z and October 16 00Z maps, although there are no observations of gales or low pressures from any source on the 15<sup>th</sup> or 16<sup>th</sup>. The depression came under the influence of a frontal system to its north late on the 16<sup>th</sup>, and it rapidly accelerated east-northeastward. It was probably still a closed tropical depression at 00Z on the 17<sup>th</sup>, and may have been so

through 06Z that day, but by 12Z on the 17<sup>th</sup>, it had already been absorbed by the front and was no longer closed. There was one gale of 35 kt observed directly related to this system at 06Z on the 17<sup>th</sup>, around or just before the time it became absorbed by the front. Since there is no definitive evidence that low was still closed at 06Z, and since there is only one piece of evidence anyway, this system is not added to HURDAT.

DAY	LAT	LON	STATUS
Oct 15	26N	69W	Tropical depression
Oct 16	30N	65W	Tropical depression
Oct 17	37N	49W	Absorbed by front before 12Z.

7)

A very broad area of low pressure developed in the western Atlantic on 21 and 22 October. On the October 22 12Z microfilm map, the closed 1008 mb contour stretches from 26-39N, 61-70W, and that is the innermost counter plotted, although observations and the HWM analysis indicate pressures below 1000 mb in a smaller area from 35-37N, 64-67W. Despite the area of more intense activity, observations do indicate an area of winds less than 10 kt with pressures around 1005 mb about 500 to 700 nmi across. Numerous gales are observed with this system prior to the time it takes on frontal characteristics (later on the 23<sup>rd</sup>). However, all of these gales are located in a very tight synoptic pressure gradient (about 20 mb / 300 nmi) north and west of the center. A 1032 mb high was located over Maine and SE Canada. The low became extratropical on 23 October. The aforementioned observations and analyses indicate that this system was never a tropical or subtropical cyclone. Thus, this suspect is not added to HURDAT.

DAY	LAT	LON	STATUS
Oct 21	Open trough 39N 64W to 21N 72W		
Oct 22	36N	66W	Broad low
Oct 23	38N	70W	Broad low
Oct 24	38N	70W	Extratropical
Oct 25			Dissipated

8)

HWM, microfilm, COADS, Jack Beven's list of suspects, and David Roth indicate that a broad low might have become a tropical depression on 13 December moving rapidly west-northwestward from about 15N, 48W on the 12<sup>th</sup> to 22N, 70W on the 15<sup>th</sup>. The highest observed wind from any source was 30 kt and there were no low pressures observed other than two observations of 995 mb from the same ship that are found to be bad observations. These pressure values are incorrect, and it is difficult to determine from the available data whether the ship's pressure was simply biased way too low or whether the ship's barometer was stuck on reporting a value of 995 mb. This system is not added to HURDAT.

DAY	LAT	LON	STATUS
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Dec 12	15N	48W	Broad low/trough
Dec 13	18N	56W	Tropical depression
Dec 14	19N	64W	Tropical depression
Dec 15	22N	70W	Open trough
Dec 16			Dissipated