Best Track Committee Re-Analysis Comments for 1956

**(Responses provided by Chris Landsea and Sandy Delgado – July 2015)**

General comments:

1. Please include the 500 mb charts from the Historical Weather Maps (HWM) in the scanned material for storms #1, #2, Carla, Ethel, #10, and Greta. These data are important in determining the nature of the cyclones.

**Agreed. These are available on the W: drive.**

1a. On a related note, please check with Mike Brennan to see if the actual rawinsonde data for these cases can be downloaded for examination in N-AWIPS.

**Agreed. These rawindsondes have been obtained. They can be accessed within NAWIPS: narchive 1956 reanalysis.**

2. The National Hurricane Research Project (NHRP) report #52 has a catalog of research missions that were flown during 1956. Please use this to help find additional aircraft data for the systems of this season, especially those that were not documented elsewhere. Examples of these mission will be provided in the individual storms.

**A thorough search of available material was made at the NHC library, AOML and its library, the available AMS publications of the era - Monthly Weather Review and the Bulletin of the American Meteorological Society, and any relevant technical memorandum. Additionally, a request was made through the Tropical Storm email list. Unfortunately, very limited information were available for these first NHRP flights, which – for some unknown reason – were not included in the data archive of Shea and Gray (which began in late 1957).**

2a. There is a related issue for central pressures currently existing in HURDAT that cannot be tied directly to observations. While many of these pressures could be reasonable and accurate, we currently do not know whether the source was actual data or estimation by those who originally created HURDAT. There is a need to better determine where these pressure came from and whether they should be removed from HURDAT.

**It is agreed that it is critical to know whether a central pressure in HURDAT was based upon an actual observation or was an estimate. All possible sources have been obtained to help make these determinations. Unfortunately, a few such values remain ambiguous at this point. If it remains unknown whether a central pressure in HURDAT was from an observation or an estimate, then it would be prudent to keep such value in HURDAT. Only if a value can be determined to be significantly in error is it either removed or adjusted.**

3. The Annual Tropical Storm Report (ATSR) mentions investigative flights on 27, 28, and 30 September. Can the data for these flights be found, and can they be related to any of the systems included in the submission?

**The data from investigative flights for systems that were not officially named were not included within the ATSR reports. Many times, but not always, observations from these investigative flights were annotated on the microfilmed, synoptic maps.**

1956 Storm #1 (new):

1. The Committee concurs with adding this system to HURDAT, pending the resolution of the two points below.

1a. An examination of the 500 mb charts in the HWM suggests that this system formed under a rather cold upper-level trough (temperatures of -10C to -13C). That, plus the lack of evidence of an inner wind core, suggests the system was more subtropical than tropical. Please note this in the write-up.

**Agreed.**

1b. There is a concern that despite the lack of an analyzed front in the HWM that this system had some frontal characteristics. First, the microfilm maps show abundant dry air over land to the northwest of the system. Second, the circulation became elongated on 8 June with what appears to be a second low pressure area northeast of Cape Hatteras. Please re-examine the surface observations near the center to better locate whatever surface front may have been in the vicinity.

**Agreed that this system has some hybrid characteristics, including some cool and dry air advection northwest of the system (especially overland) on the 7th and 8th as well as a trough developing northeast of the system on the 8th, especially as depicted at 06 and 12Z. However, the inner core of the system remained warm and moist and no frontal boundary can be detected over or near the system on the 7th to late on the 9th. Therefore, appears that the system did meet the definition needed for a tropical (or perhaps subtropical, if satellite imagery were available) cyclone.**

1c. An example of the possible frontal issue involves the position at 0600 UTC 8 June. The proposed track puts the center near the ship report of 1001 mb. However, the microfilm maps show two reports of southwesterly winds well to the northeast of this position. What do these winds mean for the location and/or structure of the cyclone?

**See above.**

2. Give the apparent lack of an inner wind core, is it possible that the winds from the wind pressure relationships are too high? Perhaps a peak intensity of 40 kt is better given the available observations?

**Agreed to reduce the peak intensity to 40 kt.**

2a. On a related note, please re-examine the intensities on 7 June. The proposed 40 kt intensities could be too high give the lack of gale observations.

**Agreed to reduce the intensity to 35 kt on the 7th.**

3. Please re-examine the proposed extratropical transition and dissipation. The HWM and the microfilm maps suggest the possibility that the system lasted several days (through 12 June?) as an extratropical low – unless this was some other low that formed nearby and absorbed the cyclone. Please determine which of these scenarios actually occurred.

**By 12Z on the 10th, the system was becoming quite disorganized, though a center may still have existed near 37N 66.5W while moving toward the east-northeast. At 18Z, a center was no longer present along the frontal boundary. By 00Z on the 11th, a center from a new extratropical cyclone formed near 40N 63W. This new extratropical cyclone then lasted a couple more days until dissipation. Since the original center of the tropical storm dissipated, the extratropical cyclone that formed by 00Z on the 11th is a separate feature and not included within the HURDAT for this system.**

1956 Storm #2, Unnamed:

1. Please remove the proposed 1007 mb central pressure at 1200 UTC 12 June. While the data is clear that the pressure was below the 1009 mb reading in HURDAT, it is too uncertain to replace it with the 1007 mb value.

**Agreed.**

2. Please re-examine the proposed positions on 12-13 June to see if the forward speed of the track can be smoothed out.

**Agreed.**

3. There is a recon mission listed in the ATSR for 13 June that found 1009 mb, 40 kt winds, and “no circulation”. What is not available is whether that was a flight into this system. Can the data from this flight be found?

**Yes, the observations from this flight are plotted on the 18Z and 21Z June 13th microfilm maps. The peak observations seen on the map are 35 kt and 1011 mb. “No circulation” may refer to the center already being overland at this point.**

4. Please better explain the 1004 mb pressure at 1200 UTC 13 June. The New Orleans obs are used to estimate a pressure of 1002 mb at 1800 UTC, and data at McComb, Mississippi on the 0000 UTC 14 June microfilm map suggests a central pressure of 1004 mb at that time. These suggest the possibility of a lower landfall pressure. Please obtain the detailed observations from New Orleans, Baton Rouge, Louisiana, and McComb to see 1) when the minimum pressures occurred, and 2) where these stations were in relation to the center at the time. Also, please try to find pressure data from stations near the Louisiana coast southwest of New Orleans. It is possible the proposed pressures and intensities over Louisiana need some revising.

**A central pressure of 1004 mb was on the original HURDAT at 12Z on the 13th and appears to be an estimate, but it looks to be reasonable and is retained. Detailed hourly observations were obtained for Grand Isle, Burrwood, Baton Rogue, Lafayette, New Orleans (City Office), New Orleans (Airport Office), New Orleans (Naval Air Station), and McComb. Tropical storm force winds were reported at Grand Isle and Burrwood only. Lowest pressure obtained was 1004 mb at New Orleans (Airport and NAS) and McComb. These support a central pressure of 1001 mb at 00Z on the 14th. (Unfortunately, Burrwood and Grand Isle only reported every three and six hours, respectively, so higher winds and lower pressures may have occurred there, but not reported.)** T**he central pressure at landfall may have been around 998-1001 mb, but is not certain enough to include into HURDAT, so no value is now indicated at landfall at 17Z and at 18Z.**

5. Please remove the details about the rainfall from the 13 June daily metadata.

**Agreed.**

1956 Storm #3, Anna:

1. Are any microfilm maps available for 23-24 July? Since the Annual Tropical Storm Report (ATSR) excerpt mentions that development began on the 24th, these could be useful in examining the genesis.

**Yes, these have been obtained, but do not necessitate adjustment of the genesis of Anna.**

2. Please better explain the basis for the proposed landfall intensity of 75 kt given the lack of core data after the last reconnaissance mission.

**The intensity at landfall is estimated at 75 kt, but this has significant uncertain as there is no data from the core between 15Z and landfall around 21Z on the 26th. The last aircraft reconnaissance mission reached Anna at 2235Z on the 26th finding that the cyclone had already made landfall, and thus the plane only provided a radar fix position. MWR reports that Tampico experienced winds of 70 kt causing damage to numerous houses, yet the reports from the Annual Tropical Storm Report on Anna contradicts this information indicating that the city only experienced maximum winds of 42 kt and no damage was reported. Unfortunately, the original observations from Tampico are not available from any source. The intensity of 75 kt is based upon the reports from Tampico along with assumed continued quick intensification of the system (as observed earlier on the 26th) up until landfall.**

3. Has the Meteorological Service of Mexico been contacted for additional information on this system? Hopefully they can help resolve the conflicting information on how strong the winds were in Tampico and how close the RMW came to Tampico.

**The Meteorological Service of Mexico has been contacted, but they have no additional information on this system. Additionally, the Mexican observations on the EV2 site was consulted, but Tampico’s observations were lost and not amongst the couple dozen stations available.**

4. Please remove the speculation about how Anna could have been a Category 2 hurricane in the metadata summary.

**Agreed.**

1956 Storm #4, Betsy:

1. It is very problematic for this storm that both the ATSR and the Monthly Weather Review seem to have had access to aircraft data that is not included in the submission. Please make a concerted effort to find the data from the various penetration fixes.

**As discussed in the general notes, thorough searches have been conducted with no additional fixes becoming available for Betsy. Unfortunately, such information was not archived in a systematic way in this era, which has led to some of the aircraft data being unavailable. However, it is of note that aircraft reconnaissance observations were obtained every day from the 10th to the 18th.**

2. What is the basis for the proposed significant increases in intensity on 9 August? There seems to be no data to support a 20 kt change at 1800 UTC.

**Agreed to delay the onset of quick intensification until early on the 10th**.

3. Please add the reference to Colon’s analysis of this hurricane to the list of references.

**This already was in the references as “Monthly Weather Review 1959”. It is now clarified that this was written by Colon.**

4. Please re-examine the central pressure analyzed by Colon for the landfall in Guadeloupe and Puerto Rico. While there is no obvious evidence that the estimated central pressures are wrong, they are estimates made from peripheral data on Guadeloupe and possibly in the eye data on Puerto Rico. At the very least, please provide more details of the obs used to make these estimates – e. g. what were the winds in Guayama, Puerto Rico at the time of the 983 mb pressure.

5. Please contact the Meteorological Service of France for more data on the passage of Betsy across Guadeloupe.

**The Meteorological Service of France was contacted and they did provide an extensive written analysis of the impacts, but no additional new observations.**

6. Please better state the reasoning for increasing the intensity to 100 kt at 1200 UTC 13 August? Yes, the small size, fast motion, and high environmental pressures all favor an intensity greater than the 88 kt estimate from the (intensifying?) wind pressure relationship. However, the original HURDAT value is already above that estimate as well. Why increase it further? Please better justify this or use the original HURDAT value.

**A central pressure of 972 mb suggests maximum sustained winds of 88 kt south of 25N according to the pressure-wind relationship. (In the low latitudes, the intensifying subset of the pressure-wind relationship is nearly identical to the entire sample.) Due to the small size of the hurricane, fast forward speed and relatively high environmental pressures – each of which would suggest a moderate increase over the standard pressure-wind relationship, an intensity of 100 kt is selected for 12Z on the 13th. The combination of two or three of these independent factors is used to increase the maximum winds by 10-15 kt above the standard pressure-wind relationship (Landsea et al. 2008).**

7. Please delete the 960 mb pressure proposed for 1200 UTC 14 August if it cannot be related to the NHRP research mission (or any other reconnaissance flight) flown on this day. Note that the mission catalog says it was flown roughly from 1500 UTC to 2200 UTC, which casts doubts on the 960 mb value as a 1200 UTC pressure.

**The Navy book shows that penetration fixes were made on this date at 14Z, 1430Z, 1930Z and 20Z. In addition, as was pointed out by the committee, NHRP conducted a research mission from roughly 15Z to 22Z. It is unknown which of these fixes made the measurements but for this analysis it will be attributed to the fix at 14Z and a central pressure of 960 mb is added to HURDAT at 12Z.**

8. Please re-examine the final dissipation of the cyclone. While the HWM for 1200 UTC 21 August shows that the system as a trough, the peripheral data suggests the possibility the circulation is still closed.

**Agreed to retain the system for an additional six hour through 12Z on the 21st. This provides a total of 36 additional hours for Betsy’s weakening phase beyond what was originally included in HURDAT.**

1956 Storm #5, Carla:

1. Please correct the quote from the ATSR in the 4 September daily metadata.

**Done.**

2. The Committee concurs with the proposed later genesis.

**Agreed.**

3. The 1200 UTC 6 September microfilm maps shows what appears to be reconnaissance flight data (e. g. obs marked G-2, G-3, and G-4). Is any more information known about this mission?

**Observations from this mission were plotted on both the 12Z and 18Z maps. Neither indicated any low pressures or strong winds. These have now been noted in the daily metadata.**

3a. On a related note, the ATSR lists investigative flights on 6, 7, 9, and 10 September. Were there flights into Carla or some other system? Can the data for these flights be located?

**The investigation recon flights on the 6th and 9th were located from the microfilm maps and are included in the daily metadata writeup. No observations were available from the invest flight on the 7th, which might have been into pre-Carla.**

3b. The NHRP mission catalog shows “synoptic” flights at altitudes below 5000 ft on 4 September and below 14000 ft on 6 September near where Carla was forming. Can the data from these flights be found?

**No, despite a thorough search at archives at NHC, HRD, NOAA library, and the tropical storm email list, no additional observations have become available from NHRP research missions. However, conventional observations from ships and stations on the 4th (and the Navy recon on the 6th) were sufficient to determine that a tropical cyclone did not yet exist on either date.**

4. Please find a place in either the 9 September daily metadata or the metadata summary to include the remarks of the Air Force reconnaissance reports mentioned in the 9 September metadata.

**Done.**

5. Please re-examine the intensities that were derived from the wind-pressure relationships. This cyclone never developed a tropical cyclone type core, so intensities below those called for by the relationships may be appropriate when they don’t contradict the available data. Also, please note this lack of core structure somewhere in the write-up.

**Agreed. Intensities reduced slightly on 9th and early on the 10th.**

6. The 998 mb pressure in the original HURDAT at 0000 UTC 10 September is not supported by the data. Would this be a viable central pressure for 1800 UTC 9 September?

**Agreed to remove 998 mb central pressure at 00Z on the 10th. At 16Z on the 9th a ship reported 996 mb with SSW 40 kt winds, thus a central pressure of 998 mb would not be reasonable for the 18Z synoptic time either.**

7. The Committee concurs with the proposal of Carla becoming extratropical and of the track extension as an extratropical cyclone. However, it is concerned that 0000 UTC 10 September might be too early of a transition time. Please re-examine the data to see if 0000 UTC or 0600 UTC that day is a better time, as the transition seems to have completed before 1200 UTC that day.

**Agreed to indicate extratropical transition at 06Z on the 10th.**

1956 Storm #6, Dora:

1. The Committee concurs with the proposed changes.

**Agreed.**

2. Has the Meteorological Service of Mexico been contacted for additional information on this system?

**The Meteorological Service of Mexico has been contacted, but they have no additional information for this system.**

3. The Air Force research mission mentioned in the 11 September daily metadata was an NHRP mission flown at 8500 ft. Please locate the data from this flight.

**As discussed earlier, the observations from this research mission are currently unavailable despite an exhaustive search. Fortunately, there was an operational Navy reconnaissance mission flown at the same time, which we do have the details from.**

4. The references to an 8 n mi wide eye in the metadata need some revision. As currently phrased in the metadata, this suggests that the system had a well-defined inner core that might justify winds higher than those implied by the 1004 mb pressure. However, the text storm report on one of the 1200 UTC 12 September microfilm maps states that while the “eye” was 8 n mi wide and clear, the wall cloud was poorly defined and existed only in the eastern quadrant. This suggest the system had an exposed center rather than a true eye, which suggests a weaker system. Please review and revise the description of the “eye” where appropriate.

**Agreed and so revised.**

1956 Storm #7, Ethel:

1. The HWM 500 mb charts suggest a cold trough is over the cyclone as it develops on 11-12 September. Perhaps it should be considered a subtropical cyclone instead of a tropical cyclone?

**Agreed, this possibility is now mentioned in the summary writeup.**

2. The mission that measured the 66-kt wind was an NHRP research mission. However, the NHRP catalog suggests the aircraft changed flight level several times, so it is unclear what level it was measured at. Please find out as much as possible about this aircraft mission.

**As discussed earlier, a thorough search was conducted for any additional information regarding these early research missions. However, no further observations were obtained.**

2a. On a related note, the ATSR excerpt for 12 September indicates a 20 mile wide eye completely surrounded by a wall cloud. Can it be determined if the diameter is that of the calm center or of the radar eye, or both?

**This notation typically referred to the diameter of the eye based upon the aircraft nose radar imagery.**

3. Please re-examine the use of the 999 mb central pressure at either 1800 UTC 12 September or 0000 UTC 13 September. Given how quickly the central pressure could have been changing in this system, is this extrapolation of the 2030 UTC aircraft report appropriate?

**For this particular case, it appears that the system quickly intensified from 00Z to around 18-21Z on the 12th, then steadily weakened from 00Z on the 13th onward. Given that the 2030Z 999 mb central pressure occurred at about the time that the peak intensity occurred, using the 18Z synoptic slot to indicate the 999 mb central pressure is appropriate.**

4. A second NHRP mission was flown into Ethel on 13 September. The fixes mentioned in the 13 September daily metadata were not made by this flight, which occurred later.

**Agreed.**

1956 Storm #8, Flossy:

1. Richter and DiLoreto wrote a paper on the extratropical transition of Flossy that was published in the September 1956 MWR (page 343-352). Was this paper used in the re-analysis? If so, please include it in the references.

**This paper had not previously been used in the reanalysis, but is now included. The paper is consistent with Flossy becoming extratropical by late on the 25th.**

2. The Committee concurs with the earlier genesis and the track adjustments over the Yucatan Peninsula.

**Agreed.**

3. Please mention the observations from the ships “SS Tasculus” in the 23 September daily metadata. Also, what is the basis for believing that the ship’s position is wrong? Is it because it differs from the aircraft data? Please better state the basis for this.

**Agreed to add into the daily metadata. The position of the ship appears to be wrong in comparison with numerous nearby ships, but the pressure looks to be correct and has been added to HURDAT at 06Z.**

4. The penetration fix at 1830 UTC 23 September may have been by an NHRP flight. Please seen if the data can be found.

**As discussed earlier, a thorough search was conducted for any additional information regarding these early research missions. However, no further observations were obtained.**

5, Is there any way to get the original data from Grand Isle, Louisiana? The report of 80 kt sustained winds with a peak gust of 85 kt looks a little strange when considered from a gust factor standpoint. It should be noted that the table in the Climatological Data National Summary says these winds were estimated, as were the winds at Burrwood.

**The EV2 website from NCDC does not have Grand Isle (though it has all of the other relevant stations, including Burrwood). Given the information in the CDNS, the observations from Grand Isle and Burrwood are now considered to be estimates.**

6. In the 24 September daily metadata, please remove the parts of the MWR excerpt that are not relevant to the track and intensity of the cyclone.

**Agreed.**

7. Neither the daily data nor the metadata summary mention the pressures near 980 mb measured in the eye between Pensacola and Panama City, Florida that are present in the spreadsheet. Please re-write the metadata to include these observations.

**The 980 mb was measured at the Pensacola Naval Air Station along with 30 kt N winds at 2030Z on the 24th. This has now been included.**

8. The ATSR indicates that the aircraft that measured 974 mb at 2230 UTC 24 September entered the eye at “high level”, then apparently descended to 6000 ft. It is unclear how the pressure was measured. Shortly thereafter, the eye passed over several stations in the Florida Panhandle, and none of them reported pressures lower than 980 mb. Is it possible that the aircraft pressure is wrong? Is there room between the stations for a lower pressure to have passed through?

**The 974 mb central pressure from the aircraft is consistent with the 980 mb with 30 kt N winds (over land exposure) from Pensacola NAS, inside the RMW but not the calm eye. The eye passed just south of Pensacola and made landfall near Destin. A new observation from Graham and Hudson was 974 mb in the eye of a dredge at Destin at 2325Z on the 24th. The 974 mb central pressure at landfall is retained.**

8a. Pending the resolution of point 8, please re-examine the landfall intensity in the Florida Panhandle. While the wind-pressure relationships suggest 80 and 83 kt, the cyclone apparently had a large RMW (suggested by the 30 n mi wide eye and surface obs?) and was starting extratropical transition at the time of landfall. Perhaps an intensity lower than 85 kt is appropriate?

**Agreed to indicate lower than 85 kt at FL landfall. A central pressure of 974 mb suggests maximum surface winds of 80 kt from the north of 25N pressure-wind relationship and 83 kt from the intensifying subset. The 30 nm diameter eye suggests an RMW of about 22 nm, compared with 23 nm for climatology at that central pressure and latitude (Vickery et al.) Flossy had a near average forward speed (12 kt) and a slightly lower than average environmental pressure (OCI of 1010 mb). An intensity of 80 kt is thus selected at 18Z on the 24th and 00Z on the 25th. This also makes Flossy a high end Category 1 hurricane, same as that originally in HURDAT.**

9. Please re-examine the proposed central pressure of 996 mb at 1200 UTC 25 September. The 996 mb value appears possibly too high given the (peripheral?) pressure of 992 mb at Dothan, Alabama at 0930 UTC. Was a pressure lower than 998 mb measured at Albany, Georgia in between the obs reported in the spreadsheet?

**Agreed to remove the 996 mb central pressure at 12Z on the 25th. Albany’s hourly Surface Weather Observations contained altimeter settings, but not sea level pressures, so no additional observations were available beyond the microfilm maps.**

10. The Committee concurs with the proposed extension of the extratropical lifetime of Flossy.

**Agreed.**

1956 Storm #9, (new):

1. The microfilm maps at 1800 UTC 5 October show a ship with north winds 15 kt and a pressure of 1006.4 mb near 11N 41W. This report is not in the spreadsheet. Please added it if it is correct, and please re-write the metadata to reflect it.

**The observation appears to be 25 kt NNE with 1006 mb and has now been added into the spreadsheet and the daily metadata.**

2. Are the ships “SS Antonia” and “Del Sol” included in COADS? If so, can the pressures of the two ships be quality controlled? This could help resolve where the 989 mb from the former ship is correct.

**Neither ship are included in COADS. The 989 mb from the SS Antonia cannot be calibrated. However, the Del Sol has observations available every 6 hours for a couple of days and this one appears to have no significant pressure bias in comparison to other ships.**

3. One of the bulletins issued on this system indicated that an aircraft was supposed to investigate it on 9 October. Can the data from this flight be located? It should be noted that the ATSR mentions an investigative flight from San Juan on this date that found 1013 mb, 20 kt winds, and “no circulation”. This could be the flight in question.

**The observations from this aircraft can be seen plotted on the 12Z microfilm maps. These measurements indicate that the reconnaissance mission only went as far east as 51W for some unknown reason. Thus the aircraft did not go far enough east to provide a center fix of the system.**

4. The Committee withholds judgement on this system until the quality of the ship pressures has been investigated. It seems there is a good case for adding this to HURDAT. However, the forecasters of the time wrote advisories on the system and seemed to have the gale obs. They elected not to call it a tropical storm. In addition, Cry - who added several new storms when he, Haggard, and White published the first track book in 1959 – did \*not\* add this system. Is there some data we are missing that persuaded them not to do so?

**The reanalysis did not rely upon the 989 mb pressure reading, as it is uncertain as to the reliability of the measurement. Instead, the two independent measurements of 40 kt and 1004 mb from the Del Sol (as well as a 10 mb drop in 21 hours from aboard the ship) are sufficient to establish tropical storm intensity for this system. It is unknown why forecasters in 1956 did not “name” the system and initiate advisories, nor why Cry et al. did not include the system into the 1959 track book. Perhaps its non-inclusion was due to its somewhat weak and short-lived nature. This discussion is added into the summary.**

1956 Storm #10, (new):

1. The Committee concurs with the addition of this system to HURDAT, although the write-up should emphasize that this was more likely a subtropical storms than a tropical storm.

**Agreed.**

2. Please better explain the basis for showing the system had gale-force winds on 14 October. The metadata summary includes a statement about the strong pressure gradient creating gales 300 miles from the center, but states these were not directly due to the cyclone. What is the data that justifies a 35-40 kt intensity?

**It is now clarified that these winds were occurring on the 15th. However, the assessed intensity of the system does not take into account these indirect gale force winds.**

2a On a related note, please better explain in the metadata summary the overall thought process behind the intensities. The proposed intensities seemingly do not match up well with the observations, especially since 2 obs of 55 kt are ignored.

**The 55 kt ship observation at 00Z on the 15th appears to be somewhat too high in comparison with neighboring observations. However, the intensity has been boosted from 40 to 50 kt at this time. The 55 kt ship observation at 00Z on the 16th is now the basis for the assessed intensity of 55 kt at that time.**

3. Have the coastal pressures been checked to make sure the actual minimum pressures were included in the re-analysis? In particular, the ship report of 996 mb and 50 kt at 1500 UTC 17 October suggests a central pressure lower than 996 mb. However, this doesn’t seem to be supported by the pressures along the Carolina coast. A similar check might be needed regarding the ship with 997 mb and 30 kt winds at 0600 UTC that day, and for the land observation of 35 kt and 998 mb on 16 October from Cape Canaveral.

**Yes, the minimum pressures from coastal stations had been included already within the reanalysis. Agreed, that because of the uncertainties, no central pressure is indicated in HURDAT at either 12Z or 18Z on the 17th. As was discussed in the writeup at 06Z on the 17th, a ship reported 10 kt NW and 999 mb and another reported 30 kt SW and 997 mb, suggesting a central pressure of around 996 mb (given the uncertainties in the accuracy of the two ships’ barometers), which has been added to HURDAT. It is agreed that the observation late on the 16th from Cape Canaveral complicates obtaining a central pressure. The 997 mb value for 18Z on the 16th has been removed.**

4. Could the time of extratropical transition be delayed 6 or even 12 hours? While there does seem to be a warm front developing to the northeast of the center, the 50 kt ship report at 1500 UTC 17 October suggests the system might have had an inner wind core at that time.

**Agreed to delay extratropical transition by 6 hours.**

5. Please consider adding a position at 0000 UTC 19 October. The microfilm maps shows a low pressure area near where the cyclone was six hours earlier. Is this the cyclone or a separate development?

**Agreed to add a 00Z October 19th position.**

6. In the last sentence of the metadata summary, please change “tropical cyclone” to “cyclone”.

**Agreed.**

7. The NHRP made a series of flights labeled “synoptic” that covered portions of this cyclone on 14-18 October. Please see if the data from these flights can be found.

**Despite a thorough search at archives at NHC, HRD, NOAA library, and the tropical storm email list, no additional observations have become available from NHRP research missions.**

1956 Storm #11, Greta:

1. Please remove the reference to the eastern Pacific monsoon trough in the metadata summary.

**Agreed.**

2. Has the Meteorological Services of Cuba and the Bahamas been contacted for any information they have on this system?

**The Meteorological Services of Cuba and the Bahamas have no additional information regarding the tropical depression stage of Greta.**

3. The Committee concurs with a later genesis time. However, there are conflicting signals of when that should be. Could 0000 or 0600 UTC 31 October be a more appropriate time give the apparent circulation near the eastern end of Cuba at that time? Or could it be later, since the rawinsonde launch from the ship “Crawford” suggests the system was still cold core near that time?

**Agreed to** **begin genesis at 00Z on the 31st given the circulation apparent near the eastern end of Cuba.**

4. Please re-examine the existing and proposed central pressure of 992 mb at 0000 UTC 2 November. The NHRP catalog shows two flight into Greta around 2100 UTC that day, with a “synoptic” mission around 2100 UTC 1 November. It needs to be determined which of these missions observed the 992 mb pressure.

**Despite a thorough search at archives at NHC, HRD, NOAA library, and the tropical storm email list, no additional observations have become available from NHRP research missions. Given that there was a pre-existing 992 mb central pressure in HURDAT at 00Z on the 2nd, it would stand to reason that it was the synoptic mission late on the 1st which measured this pressure.**

5. The 1500 UTC 3 November microfilm map has three ships with pressures of 989-990 mb. The 1800 UTC map has two ships of 987-988 mb. Please mention these at some appropriate point in the metadata.

**All of these (and dozens more) had already been hand digitized and included into the excel database. One ship at each time has now been added into the daily summary.**

6. Please re-examine some of the intensities on 3-4 November. The 1200 UTC 3 November intensity is based on a reconnaissance pressure of 982 mb, and 60 kt was chosen as the intensity due to the large size and low environmental pressures. At 0000 UTC 4 November a ships with 986 mb and 40 kt (also suggesting a 982 mb pressure) was used as the basis for a 65 kt intensity estimate. Why the inconsistency?

**Because of the increase in forward speed and the subsequent hurricane force winds later in the day, an intensity of 65 kt is selected at 00Z on the 4th, bringing Greta to hurricane intensity.**

7. The 1500 UTC 4 November microfilm map has an ob of 977 mb and 45 kt. Please mention these at some appropriate point in the metadata.

**Agreed.**

8. Please re-examine the central pressure and the reconnaissance flights during the afternoon of 4 November. The ATSR shows that a Navy mission around 1900 UTC that day did not penetrate the center due to issues on the aircraft. Instead, it twice reported pressures of 982 mb with simultaneous hurricane force winds. It also did not mention any eye diameter. Did the fix and central pressure information come from an NHRP mission that was in the storm at about the same time?

**It is likely that the 970 mb central pressure already in HURDAT was from the NHRP mission. This is now so clarified.**

9. Is the ob of 50 kt and 976.7 mb on the 1200 UTC 5 November HWM valid? If so, please include it in the metadata.

**Yes, it appears valid (actually is 45 kt, as the HWM in this era was plotted in mph) and is now added to the daily metadata.**

10. Please re-examine the intensity of Greta at 1200-1800 UTC 5 November. The ATSR shows that the Navy plane that reported 970 mb at 1320 UTC also reported a radar eye that was 10 miles wide and diffuse. Does that change the estimated intensity at this time? The Committee concurs that 120 kt is too high of a peak intensity, but it is unclear whether 85 kt is too high, too low, or just right.

**Given that the eye was described as “diffuse”, this places doubt as to whether a 5-10 nm RMW is appropriate. Thus the other factors (speed of Greta and overall size) are considered to obtain the 85 kt intensity estimate.**

10a. It should be noted that the penetration fix at 2220 UTC may have been from an NHRP mission. Data from it could help resolve point 10.

**So noted.**

11. Please re-examine the time of extratropical transition on 6 November. While the Committee concurs that transition occurred earlier than 0000 UTC 7 November, there does not appear to be enough data on the 0600 UTC 6 November maps to justify transition at that time. Perhaps 1200 UTC or 1800 UTC is better?

**Agreed to indicate extratropical transition at 12Z on the 6th.**

12, Please re-examine the final time of dissipation of former Greta on 7-8 November. The Northern Hemisphere Map series suggests the system may have been trackable until 0000 UTC 8 November, with the caveat that this is in poor agreement with the data presented in the other maps provided to the committee.

**The numerous observations available and plotted every six hours through 06Z on the 8th indicate that the system was unlikely to be a closed low after 12Z on the 7th, but appears to still be closed at 12Z. Thus we’re extending the best track by six hours to 12Z on the 7th.**

1956 Storm #12, (new):

1. As with system #9 above, the Committee withholds judgement on this system until the quality of the ship pressures has been investigated (point #2). Again, it seems there is a good case for adding this to HURDAT. However, it has concerns that the evidence doesn’t meet the criteria of needing two independent obs, especially if the 1002 mb ship pressure is too low. And as with system #9, Cry et al did \*not\* add this system. Is there some data we are missing that persuaded them not to do so?

**Unfortunately, we’ll likely never know why Cry added some systems, but not others. There are two independent pieces of evidence for the system being of tropical storm intensity: the quality-controlled 1002 mb (see below) from ship #74252 and the quality-controlled 35 kt from ship #13672. This latter ship was compared against other neighboring ships for four days and the winds from it have no apparent bias.**

2. Have the pressures from the ship that reported 1002 mb been quality controlled?

**This ship was compared for four days against neighboring ships and the pressures do not appear to be biased. Additionally, the ship showed a 9 mb 24 hour pressure drop (1011 to 1002 mb) and a 14 mb 48 hour pressure drop (1016 to 1002 mb).**

1956 Additional Notes:

1. Suspect #4: What were the stations that were checked for surface weather observation in the western Florida Panhandle? As seen during Flossie, there are several stations between Pensacola and Panama City and several of the microfilm maps are missing their obs.

**Apalachicola, Crestview, Eglin, Milton Whiting, Panama City (airport), Panama City (AFB), Pensacola (NAS), Pensacola (airport), and Valpariso (as well as Mobile in AL) were all checked via the EV2 website for the 6th and 7th. None contained sustained tropical storm force winds.**

2. Suspect #6: Please contact the Meteorological Service of the Cape Verde Islands for any information they may have on this system. It is noted that the MWR excerpt stated that there were ship reports of 35-40 kt winds, but none of the data presented to the Committee shows winds that strong. Can these ships be located? The Committee favors leaving this system out of HURDAT based on the currently available data. However, locating the MWR’s gale ships could change this decision.

**The Meteorological Service of the Cape Verde Islands has no additional information on this system. Unfortunately, no specifics of these 35-40 kt ships from MWR could be located, as these were not available in the microfilm/HWM maps nor in COADS.**

3. Are any maps available for suspects #7 and #8?

**These have been made available.**

4. Suspect #12: Are the microfilm maps for 4 November centered on this system or on the baroclinic low to the north? It is noted that the 1800 UTC 4 November map shows a ship with 991 mb and 35 kt. If that is related to the suspect and not the low to the north, it means the suspect had a very low central pressure in its own right. Is there a spreadsheet of obs available for this system?

**These maps are indeed centered on the system. All of the COADS data have now been made available.**

5. The committee concurs with leaving the remainder of the suspect systems out of HURDAT.

**Agreed.**