

## Best Track Committee Re-Analysis Comments for 1946

General comments:

1. If not already present for all cyclones and suspects, please create binder maps for at least a day before the proposed genesis and at least a day after the proposed dissipation. This will make it easier for the committee to evaluate the genesis and dissipation.

**These have now been provided both in the binder and in the on-line archive.**

1946 Storm #1:

1. The committee concurs with the earlier time of genesis. Could you please state somewhere in the discussion what the Re-Analysis criteria is for differentiating between a 25-kt low pressure area and a 25-kt tropical depression?

**A pre-genesis Low is not a viable category in the pre-satellite era. This category first appears in HURDAT2 in 1987. While it may be possible to go back with this category to ~1970, further in time is not feasible. Thus if a system is identified in 1946 with a closed circulation with 25 kt peak winds within ~300 km or so, over water, non-baroclinic, then it is assumed to be a tropical depression.**

2. The microfilm maps consistently show a station near the mouth of the Mississippi River. Is this Boothville or Pilottown? Is there a detailed record available from this station?

**This station is Burrwood (29.0N 89.4W). The original observations (eight times daily) have been obtained from the NCDC EV2 site. This data did not reveal any low pressures or high winds.**

3. On a related note, is there a record available for the Grand Isle observation, or for any other station near the coast south and west of New Orleans?

**No. The only additional observation found was from Lake Charles on the EV2 site under Local Climatological Data. Lake Charles had a max wind on the 16<sup>th</sup> of 23 mph SE.**

4. Were any pressure reported by the ships or reconnaissance aircraft? The various maps show very high external pressures (1016-1020 mb), so the normal wind-pressure relationships used to determine the intensity might not apply here.

**Some of the aircraft observations in the Excel spreadsheet have pressures. The lowest one in the spreadsheet appears to be 1014 mb on the afternoon of the 13<sup>th</sup>.**

5. The statement in the metadata discussion “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” should be changed to “The depression is analyzed to be about 1.5 degrees to the NW of the HURDAT position based on aircraft observations from the 1830Z microfilm map”.

**Done. Thank you.**

6. Since there are no actual observations of tropical-storm force winds, please add a comment to the metadata summary that there is a chance the cyclone was never a tropical storm. Neither the Monthly Weather Review (MWR) nor the Louisiana Climatological Data mention any significant wind or tide impact from this system despite its proximity to the Louisiana coast. This suggests it didn't have a lot of punch.

**Done. Thank you.**

1946 Storm #2:

1. What is the significance of the 2330 UTC 3 July microfilm map in the binder? This shows a low pressure area near the Bahamas, which in theory could be the system that became the tropical cyclone. Please add a discussion of 3-4 July to the daily metadata, and also add the appropriate scanned maps.

**The available microfilm and HWM maps have been added into the binder and on-line archive for the 3<sup>rd</sup> and 4<sup>th</sup> of July. These – though the data is quite sparse – do not support any earlier genesis.**

2. Please better explain the proposed revised genesis location. The metadata summary says that the cyclone formed 100 n mi east of Daytona Beach, Florida, which is consistent with the old HURDAT position. However, the new proposed position is nearly 150 n mi north of the old position. The southern position would be more consistent with the low pressure area mentioned in point 1, while the northern position would be more consistent with development along the baroclinic zone near the southeastern U. S. coast. It should be noted that the microfilm map for that time shows no data near either position.

**The original HURDAT showed an unrealistic deceleration in the speed of the track during the first 12 hours with a 06-12Z speed of 28 kt then 12-18Z speed of 9 kt. During the remainder of the 5<sup>th</sup>-6<sup>th</sup>, the track shows a northward movement of about 7 kt each six hourly period. Other than the first point at 06Z on the 5<sup>th</sup>, the largest change made to the HURDAT position on the 5<sup>th</sup> and 6<sup>th</sup> was only 0.4 degrees. No additional revisions have been made. The proposed revised genesis location has now been better explained in the metadata summary.**

3. Please also provide a better discussion of how this system formed. The microfilm maps and the Historical Weather Maps (HWM) show a significant baroclinic zone (for July) in the area where the cyclone formed/tracked. Grady Norton's report on this cyclone (in the binder) mentions that a 500-700 mb wave moved from near the Bahamas northward into the baroclinic zone, which caused the genesis. If the cyclone formed along the baroclinic zone, should it be given an extratropical status for at least part of its lifetime?

**The cyclone developed from the interaction of a west-northwestward moving tropical wave and a frontal boundary that had pushed off of the Carolina coast. The original HURDAT indicated that the system originated as a tropical storm at 06Z on the 5th of July. However, it appears – though data away from the coast is sparse – that the cyclone was still extratropical on the 5th. Tropical transformation is now indicated to have occurred around 00Z on the 6th.**

4. Is there a text summary available for the Hatteras Original Monthly Record (OMR)? Please provide it if it is available.

**No. The notes (where any text summary would be found) is on page 16 of the July, 1946 Cape Hatteras OMR. It only lists the time when lightning was experienced and time when fog was experienced. There is no write-up about the TC.**

5. Given the 40 kt wind reports from Carolina and Wrightsville Beaches, could the intensity during that time be increased to 45 kt?

**Yes. Agreed to increase intensity from 40 kts to 45 kts at 06Z and 12Z on the 6<sup>th</sup>. This changes the U.S. landfall intensity from 40 kts to 45 kts.**

6. Please state what data leads to the statement in the metadata summary that “this eastward turn is analyzed to have occurred farther north than in HURDAT”.

**Ship and coastal data at 12Z on the 7<sup>th</sup> support a farther north position than what was provided in HURDAT. This is now made more clear in the metadata writeup.**

7. In the metadata summary, please better explain the ship observations below 1000 mb on 9-10 July.

**On the 9th and 10th there were three ship observations (the same ship #43986) with pressures below 1000 mb. It appears, but is not certain, that based upon comparison of the ship at 12Z on the 9<sup>th</sup> with coastal station data, that these pressures may be 5 to 10 mb too low.**

1946 Storm #3:

1. The HWM for 1200 UTC 24 August shows a south wind over the Bay of Campeche. Can this be used to justify an earlier genesis time as a tropical depression?

**This measurement was a Mexican station, misplotted slightly to appear as though that wind observation was taken over water. (Note how many of the land observations are plotted north of where they should be on that HWM map, likely because the USWB/Navy meteorologists were using carbon paper to make multiple copies of their reanalysis.) The COADS data for the 24<sup>th</sup> had already been obtained and analyzed. After looking at the**

**data again, there is not enough evidence of a closed low or a tropical depression on the 24<sup>th</sup> to justify an earlier genesis time. The south wind may have been a land breeze.**

2. The MWR states that this system was located by “reconnaissance flights”. Where is the data from these flights, which the committee would very much like to see?

**Unfortunately, there is no microfilm available for these dates, which is our main source of aircraft reconnaissance data. A search for other sources for this flight data was unsuccessful.**

3. The proposed upgrade in intensity is based on a second-hand report of 60 mph winds in Tampico, Mexico quoted in the advisories from New Orleans. Has the Mexican Meteorological Service been contacted to obtain the original record of this observation? What other information do they have on this storm?

**All of the Mexican observations have been scanned in and our available on the EV2 website of NCDC. While there are a few dozen stations available from August 1946 on the site, Tampico, unfortunately, is not. Apparently, these data were lost and unavailable.**

4. The committee withholds judgment on this system pending the resolution of points 2 and 3.

**The original intensity of 35 kt at peak and at landfall is thus retained.**

1946 Storm #4:

1. Please add discussions of 10-11 September to the daily metadata.

**Done.**

2. The committee concurs with the earlier genesis time.

**Thank you.**

3. Given the uncertainties of aircraft winds in 1946, are the proposed changes in the intensity for 0600-1800 UTC 12 September appropriate? The committee is not opposed to them, but it would like a better justification.

**There was a significant amount of uncertainty in reported aircraft wind speeds in 1946. However, for tropical storm strength systems, when planes were flying low and not far from land, there was less uncertainty than average. From the other observations available, there is enough data to justify the slight decrease in intensity. Two additional sentences have been added to the metadata summary about this topic.**

4. Is it clear that the Hopetown observation on 13 September was not in the eye? If so, please state that in the metadata summary. Also, the metadata summary comments that no observations were available from Great Abaco Island. It should be noted somewhere in the summary that Hopetown is on a small island next to Great Abaco.

**Done- it has been noted in the metadata summary that Hopetown is on a small isolated island next to Great Abaco. On one of the microfilm maps from 9/13, it says “Hopetown 060020 EST Bar. 29.38 Wind W 65 gusts to 85 mph.” It is not certain what the “06” means since it is September 13<sup>th</sup>. However, this description does indicate that at that specific time, the winds were 65 mph and the barometer was 995 mb. The eye was therefore not over Hopetown at that time. 995 mb was a peripheral pressure value.**

5. In the metadata summary, please re-write the justification of the 85 kt peak intensity to use the small aircraft-observed radius of maximum wind (RMW) than the term “small hurricane”.

**Done.**

6. Please provide a better justification of the proposed change in the time of extratropical transition. The lack of inner core data at 0000 and 0600 UTC 15 September does not support changing the existing HURDAT transition time of 1200 UTC. Perhaps the aircraft data from near 1800 UTC 14 September could strengthen the argument?

**Yes. The aircraft data near 1800 UTC on 14 September indicates the low is starting to look frontal in its wind structure. Even so, there does not appear to be enough evidence to call this extratropical at 00Z. However, there does appear to be enough evidence that it was extratropical by 06Z given the structure and available data from obs at that time. ET timing is changed to 06Z, and discussion is added to metadata about aircraft obs at 14/1800 UTC.**

7. Is the binder map for 18 September correct? The latitude-longitude labels on it do not match the underlying geography, so it’s hard to tell whether it is actually covering the area where the cyclone was supposed to be.

**The handplotted 00Z/18<sup>th</sup> map simply used different lat/long grids than the original map. Please ignore the original geography and latitude lines.**

1946 Storm #5 (new):

1. The committee does not concur with adding this system to HURDAT at this time. There are major issues with this submission:

a. The HWM show that this system was near or part of a large deep-layer low that persisted over the Azores for several days. There is a possibility this is a bad analysis. However, if it is correct, then the proposed track is almost impossible meteorologically. Instead, a looping

track similar to Tropical Storm Grace (2009) may be more correct. If available, please check the ECMWF/GFS global re-analyses, along with any upper-air observations from the Azores, to see if they support or disprove the HWM analysis. Then please revise the track accordingly.

**The 20<sup>th</sup> Century Reanalysis has been obtained from the NOAA/ESRL laboratory. This data, along with further analysis of existing observations, indicates that the system began as a (new) tropical storm, which then transitioned into a very large extratropical cyclone reaching hurricane-strength causing severe damages to the Azores. The proposed track, intensity, and structure have been significantly revised, as has the metadata writeup.**

b. There is no mention of the thermal structure of the system anywhere in the submission. Please analyze the thermal structure and include it in the appropriate parts of the discussion, with emphasis on why the frontal structures shown in the HWM might be wrong.

**The HWM analyses were indeed severely in error on the 1<sup>st</sup> and 2<sup>nd</sup> of October, but did a more reasonable job on the 3<sup>rd</sup> through the 6<sup>th</sup>. This is now discussed.**

c. Does the Meteorological Service of Portugal concur that this was a hurricane, or do they think it was some kind of hybrid cyclone? What data do they have on the system? What station metadata can they provide to aid the analysis of the cyclone (e. g. elevation and averaging period of the station that reported 98 mph, sustained wind or a gust)? Please contact them and obtain this information.

**The Meteorological Service of Portugal has been contacted, but they have not been able to provide any additional information regarding these observations, the impacts, or the interpretation of this cyclone.**

2. The reported severity of the storm along with climatology suggests that the system could have had tropical cyclone characteristics. The committee will examine this again once it gets the revised submission.

**Again after further analyses and additional information, the cyclone began as a tropical storm, but then transitioned into a large and powerful extratropical cyclone with hurricane-force winds.**

1946 Storm #6 (old #5):

1. There is a glitch in the HURDAT printout – it looks like lines are missing for 12-13 October.

**There is no 2<sup>nd</sup> line for the 12<sup>th</sup> and 13<sup>th</sup> as no changes were made to the HURDAT track or intensity on those days.**

2. The committee concurs with the delayed genesis and the reduced intensity at genesis. Is it possible that the center was closer to Belize City and its southwest winds at the time of genesis? The drawback is such a position would not fit the 25 kt/1004 mb ship report as well.

**It is possible that the center could be closer to Belize City, especially if the 1004 mb ship is biased a couple mb too low. There is a time series of that ship, but there are not enough observations near that ship at any other time to get a gauge on whether it is biased too low. The 18Z position on the 5<sup>th</sup> is shifted 0.5 degrees west to 87.5W. In addition, given the available observations, it makes sense to shift the 00Z position on the 6<sup>th</sup> slightly westward as well. This position has been shifted 0.4 degrees to the west to 86.7W. At 06Z on the 6<sup>th</sup>, the longitude is shifted 0.2 degree west to 86.0W.**

3. Please re-examine some of the intensities on 6-7 October. First, regarding the 75 kt intensity at 1800 UTC 6 October, is there any information about the aircraft-reported RMW or about the external pressures that might justify an adjustment? Second, a Navy ship reported 85 kt winds at 2230 UTC 6 October. An 85-kt intensity is probably better at 0000 UTC and 0600 UTC 7 October, unless there is some reason not to take the ship report at face value.

**There is no mention of RMW on the aircraft flight(s) on 6 October. Environmental pressures appear to be about normal, as seen on microfilm synoptic maps. Regarding the 85 kt report late on the 6<sup>th</sup> from the quote from the Florida Climatological Data, the words “Navy Destroyer” were used, which implies a ship. MWR states that winds of 85 mph were measured from ships and aircraft. Microfilm observations show the ship with 75 kts and aircraft with 85 kts. The Florida Climatological Monthly Data Summaries were written by the hurricane forecasters/analysts. They appeared to have misquoted MWR or WB write-up on the storm. The max winds estimated by recon were 85 kt, but it is uncertain whether this was a max flight-level or surface wind estimate. Given that there is good evidence of surface winds of 75 kts were measured/estimated by the ship, the intensity is analyzed at 75 kt at 18Z 6<sup>th</sup> and 80 kt at 00Z 7<sup>th</sup>.**

4. Does Perez have any detailed data from western Cuba on this system, especially any observed pressures? The committee notes that the requested intensity change in point 2 would make the cyclone a category 2 hurricane in Cuba instead of the Category 1 analyzed by Perez.

**Perez was able to provide some additional observations from Cuba for this hurricane. In particular, San Juan y Martinez reported SSE 45 kt and 982 mb, likely inside the RMW. This supports a central pressure of 977 mb at landfall. The south of 25N pressure-wind relationship suggests an intensity of 81 kt. This is consistent with the first draft of the reanalysis of a high end (80 kt) Category 1 hurricane for Cuba, and consistent with that analyzed previously by Perez.**

5. Please make whatever efforts are possible to get more information on the 80-100 kt ship reports mentioned in the Monthly Weather Review.

**The highest wind from a direct ship observation was 75 kts. MWR sometimes interchanged “kt” with “mph” incorrectly and it is possible they meant “mph” in this case. Another**

**explanation is that since aircraft reported 115 kt, MWR wanted to state that the highest ship observations were only a little bit lower than that, instead of a lot lower than that, so that they would look politically correct and consistent. A third possibility is that perhaps a ship or ships did measure winds that high, but were never specifically recorded. However, it is extremely likely that the 115 kt intensity shown in HURDAT originally was placed there solely due to the aircraft report.**

6. Is the wind report from the Dry Tortugas a 1-minute average? If not, please report the appropriate adjusted 1-minute wind in the metadata summary.

**The MWR quote states that an “extreme wind velocity” of 84 mph was recorded. “Extreme” during this time period means fastest mile. A fastest mile wind of 84 mph is a wind speed averaged over a period of about 43 seconds. Utilizing a conversion to a 1-min average, the 84 mph reading should be divided by a factor of 1.02 to obtain the 1-min wind. This yields 82 mph, or 72 kts. This has been added to the metadata summary.**

7. The committee concurs with the proposed reduction in intensity over the southeastern Gulf of Mexico.

**Thank you.**

8. The 8 October daily metadata has several passages describing storm impacts. Please remove them unless they are important for the intensity determination.

**Done.**

9. Please explain the basis for the 70 kt intensity at 0600 UTC 8 October given that the center was over land, the highest winds near that time were 65 kt, and that the decay-SHIPS output gives 60 kt.

**Since the 65 kt observation occurred at 04Z, it is agreed that 65 kt is a better assessment of the 06Z intensity instead of 70 kt. This change has now been implemented.**

10. Did this system bring Category 1 hurricane conditions to northwestern Florida?

**Yes. Added “AFL1” for Category 1 hurricane conditions for northwestern Florida.**

11. The microfilm maps suggest that a frontal system was in place over Florida as the hurricane approached, and the weakening over the Gulf of Mexico suggests the possibility of shear or the onset of extratropical transition. Please check to see if extratropical transition was complete before the current 1200 UTC 9 October.

**The microfilm maps indicate that the wind structure become more elongated and the temperature gradient had increased sufficiently that the cyclone had likely completed extratropical transition by about 06 UTC on 9 October, 6 hours earlier than originally assessed. At 00Z on the 9<sup>th</sup>, although it was undergoing extratropical transition, it was**

**likely not complete yet as there was a minimal temperature gradient across the low, and the wind structure had not become as elongated and frontal yet as it was at 06Z.**

12. Please clarify the source of the 63-kt 1-min wind from Greenville, South Carolina. This is not mentioned in the 8 October daily metadata and seems to come out of nowhere in the metadata summary. The daily metadata and the OMR mention a gust of 79 mph, but none of the sustained winds shown in the OMR would support a 63-kt 1-min wind. It should be noted that if the 63-kt 1-min wind is correct, Greenville may be far enough from the mountains that it cannot be explained by topography.

**This was an “extreme” wind velocity reported in the Greenville, SC OMR on page 12 and again on page 15 of the OMR. “Extreme” velocity means fastest mile wind. A 63 kt (72 mph) fastest mile wind is a wind averaged over a period of about 50 seconds. This converts to a 1-min wind of 62 kt after dividing by 1.01. It is possible that it could be a transcribing error or perhaps there was a new, young observer on duty who thought extreme wind meant a much shorter duration gust. Because of all the scratch out marks seen in this OMR, it leads us to believe that this may be the case of an inexperienced observer who was not sure what he was doing.**

1946 Storm #7 (old #6):

1. Regarding the proposed delayed genesis: The microfilm maps show that Guantanamo, Cuba had northwesterly winds at 0600 and 1200 UTC 31 October, and a northwest wind on Jamaica at 1200 UTC. If these were not some orographic effect, it suggests the possibility that the original HURDAT genesis time was right with the genesis location a bit to the west of the original position. Please re-examine this.

**The winds at both of those stations at 06 and 12 UTC are blowing from an inland direction to the ocean, which means they could both be land breezes. There are other surface observations that suggest the low is not closed, such as Port-au-Prince at 06Z on the 31<sup>st</sup> and northern Hispaniola and Port-au-Prince at 12Z on the 31<sup>st</sup>. Additionally, Simpson (1948) finds that the low was not closed at low-levels on the morning of the 31<sup>st</sup>. With the surface data available, there is enough evidence that a closed circulation was not yet present until late on the 31<sup>st</sup>.**

2. Is there a text notes page available for the Miami OMR for this month? Also, is any kind of airport observation record or OMR available from Palm Beach?

**Yes, there is a text notes page available for the Miami OMR. It makes no mention of any tropical cyclones during the month. It mentions hail on the 16<sup>th</sup> and excessive precipitation on the 11<sup>th</sup>. The observations shown in the first draft were from West Palm Beach via the microfilm maps. The EV2 website did not have West Palm Beach (nor Fort Lauderdale), but did have Miami (and the next location up the coast is Vero Beach).**

3. The committee concurs with the remainder of the proposed changes.

**Thank you.**

1946 Storm #8 (new):

1. The committee does not concur with adding this system to HURDAT at this time, as it rather resembles a coastal trough development with a tight wind center. Please re-examine the thermal structure of the cyclone, including any available upper-air data, to better determine its nature. At the very least, please provide a more rigorous analysis of the surface temperature structure, where the microfilm maps suggests a baroclinic zone/temperature gradient was present.

2. The Hatteras OMR does not include a text notes page, and the land observations are not included on the observations log in the binder. Please provide these.

**It is agreed that this system was a short-lived, baroclinic low along a weak frontal boundary. This system has now been moved to the Additional Notes section.**

1946 Additional Notes:

1. Suspect #1:

a. Are any microfilm maps or other detailed analyses readily available for this period?

**No, other than the Historical Weather Maps which are available in the library and on-line at: <http://docs.lib.noaa.gov/rescue/swm/1946/>**

b. The committee concurs on not adding anything from this period to HURDAT at this time. The data from Port Arthur suggests a significant weather event occurred there on 19 May, but the nature of it is unclear. On one side, a sharp temperature drop (to 66 F) occurred when the strong winds began, suggesting a mesoscale convective event. This interpretation is supported by the Louisiana and Texas Climatological Data (CD) publications, which mention numerous severe thunderstorms with hail and tornadoes across the area during the time in question. However, this explanation is not perfectly consistent with the observed minimum pressure and wind shifts observed in Port Arthur a few hours later, and the Louisiana CD reports of strong winds along the Louisiana coast on the night of 19 May. What actually happened cannot be resolved given the available data.

**Thank you.**

2. Suspect #2: Additional information on this system is available in the binder in Grady Norton's report on storm #2. He mentions that the system became a near hurricane as it crossed the Atlantic during the next 8 days [**note from Landsea – the Norton report said “2 days”**],

which is a different conclusion than currently presented. Please re-analyze this system in light of the Norton report and make mention of the report in the revised summary.

**These comments from Grady Norton are now included into the metadata writeup. However, none of the additional information – which has not quantitative data - alters the conclusion that the system cannot be added into HURDAT. It may have been a tropical storm, but there is not enough evidence to include it.**

3. Suspect #5: Is a record of the Brownsville data available for the committee to examine? Has the Mexican Meteorological Service been contacted to see if they think a tropical cyclone affected northeastern Mexico during this time, or to obtain a data record from Tampico or Tuxpan? Please provide this information to the committee when it becomes available so it can make a decision.

**(Now Suspect #6) The Brownsville OMR has been obtained, but does not indicate any tropical storm force winds. The synoptic weather maps were not available from Mexico for late 1946 and all of 1947. Also, unfortunately, individual observations were not available for either Tampico or Tuxpan from the EV2 website.**

4. Suspect #9: Is the COADS ship record for this system available to be included in the binder? The MWR suggests that the system that affected the Alabama coast was a separate baroclinic development along the cold front that moved into the Gulf of Mexico on 18 December, and the HWM analysis of a low over the eastern Gulf of Mexico on 19 December looks dubious. The committee concurs on leaving this system out of HURDAT.

**(Now Suspect #10) COADS was obtained and included in the binder, but it only comprised of two half pages of ship observations.**

5. The MWR mentions a “tropical disturbance” that affected the North Carolina coast on 19-20 September. The HWM suggest this system was a baroclinic low, albeit one with an unusual northward and then westward track. Please investigate this system.

**(Now Suspect #5) The Monthly Weather Review wrote: “Tropical Disturbance - Storm developed off the South Carolina coast and moved inland near North Carolina border on the night of the 19th, then moved northeastward, leaving the State in the vicinity of Northampton County on the night of the 20th. Rains of 8 to 12 inches were general over the tidewater counties from the South Carolina border northward to the Pamlico River. Roads flooded; telephone service interrupted to some beach resorts due to high winds.” The system was clearly a baroclinic cyclone with well-developed frontal boundaries and cold air advection. It is thus not added into HURDAT, but is mentioned in the Additional Notes section because of the notation of “Tropical Disturbance” in MWR.**

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

**Thank you.**