

The revised Atlantic hurricane database (HURDAT2) - Chris Landsea – September 2012

The National Hurricane Center (NHC) conducts a post-storm analysis of each tropical cyclone in its area of responsibility to determine the official assessment of the cyclone's history. This analysis makes use of all available observations, including those that may not have been available in real time. In addition, NHC conducts ongoing reviews of any retrospective tropical cyclone analyses brought to its attention, and on a regular basis updates the historical record to reflect changes introduced via the Best Track Change Committee. NHC has traditionally disseminated the tropical cyclone historical database in a format known as HURDAT. This report updates the original HURDAT documentation (Jarvinen et al. 1984) to reflect significant changes to both the format and content for the tropical cyclones and subtropical cyclones of the Atlantic basin (i.e., North Atlantic Ocean, Gulf of Mexico, and Caribbean Sea).

The original HURDAT format substantially limited the type of best track information that could be conveyed. The format of this new version - HURDAT2 (HURricane DATa second generation) - is based upon the “best tracks” available from the b-decks in the Automated Tropical Cyclone Forecast (ATCF – Sampson and Schrader 2000) system database and is described below. Reasons for the revised version include: 1) inclusion of non-synoptic (other than 00, 06, 12, and 18Z) best track times for landfall and peak intensity; 2) inclusion of non-developing tropical depressions; and 3) inclusion of best track wind radii. The original format of HURDAT (Jarvinen et al. 1984) will be retired once the 2012 hurricane season best tracks become available.

An example of the new format for Hurricane Irene from 2011:

AL092011,	IRENE,	39,																
20110821, 0000, TS, 15.0N, 59.0W, 45, 1006, 105, 0, 0, 45, 0, 0, 0, 0, 0, 0, 0, 0, 0,																		
20110821, 0600, TS, 16.0N, 60.6W, 45, 1006, 130, 0, 0, 80, 0, 0, 0, 0, 0, 0, 0, 0, 0,																		
20110821, 1200, TS, 16.8N, 62.2W, 45, 1005, 130, 0, 0, 70, 0, 0, 0, 0, 0, 0, 0, 0, 0,																		
20110821, 1800, TS, 17.5N, 63.7W, 50, 999, 130, 20, 0, 70, 30, 0, 0, 0, 0, 0, 0, 0, 0,																		
20110822, 0000, TS, 17.9N, 65.0W, 60, 993, 130, 30, 30, 90, 30, 0, 0, 30, 0, 0, 0, 0, 0,																		
20110822, 0600, HU, 18.2N, 65.9W, 65, 990, 130, 60, 60, 90, 40, 25, 20, 35, 25, 0, 0, 0, 0,																		
20110822, 1200, HU, 18.9N, 67.0W, 70, 989, 160, 60, 60, 90, 40, 25, 20, 35, 25, 0, 0, 0, 0,																		
20110822, 1800, HU, 19.3N, 68.0W, 75, 988, 160, 60, 40, 90, 40, 30, 20, 35, 25, 0, 0, 0, 0,																		
20110823, 0000, HU, 19.7N, 68.8W, 80, 981, 160, 70, 50, 100, 70, 30, 30, 70, 25, 0, 0, 35,																		
20110823, 0600, HU, 20.1N, 69.7W, 80, 978, 180, 120, 90, 130, 90, 60, 40, 70, 45, 30, 20, 35,																		
20110823, 1200, HU, 20.4N, 70.6W, 80, 978, 180, 120, 90, 130, 90, 60, 40, 70, 40, 30, 20, 35,																		
20110823, 1800, HU, 20.7N, 71.2W, 80, 977, 180, 120, 90, 130, 75, 60, 40, 70, 35, 30, 20, 35,																		
20110824, 0000, HU, 21.0N, 71.9W, 80, 969, 180, 150, 90, 150, 70, 70, 40, 70, 35, 30, 25, 35,																		
20110824, 0600, HU, 21.3N, 72.5W, 95, 965, 180, 150, 90, 150, 70, 70, 40, 70, 35, 30, 25, 35,																		
20110824, 1200, HU, 21.9N, 73.3W, 105, 957, 180, 150, 90, 150, 90, 60, 45, 80, 45, 40, 25, 40,																		
20110824, 1800, HU, 22.7N, 74.3W, 100, 954, 200, 180, 100, 150, 100, 70, 50, 80, 50, 45, 25, 40,																		
20110825, 0000, HU, 23.5N, 75.1W, 95, 952, 220, 180, 100, 150, 100, 90, 50, 80, 60, 60, 25, 50,																		
20110825, 0600, HU, 24.1N, 75.9W, 95, 950, 220, 180, 100, 150, 100, 80, 50, 70, 60, 60, 25, 50,																		
20110825, 1200, HU, 25.4N, 76.6W, 90, 950, 250, 200, 100, 160, 100, 100, 50, 70, 60, 60, 25, 50,																		
20110825, 1800, HU, 26.5N, 77.2W, 90, 950, 250, 200, 125, 160, 110, 100, 50, 75, 70, 60, 25, 50,																		
20110826, 0000, HU, 27.7N, 77.3W, 90, 946, 250, 200, 125, 160, 110, 100, 50, 75, 70, 60, 25, 50,																		
20110826, 0600, HU, 28.8N, 77.3W, 90, 942, 250, 200, 130, 175, 125, 105, 75, 75, 80, 80, 50, 50,																		
20110826, 1200, HU, 30.0N, 77.4W, 85, 947, 250, 200, 130, 175, 125, 105, 75, 75, 80, 80, 50, 50,																		
20110826, 1800, HU, 31.1N, 77.5W, 80, 950, 250, 225, 140, 175, 125, 125, 80, 75, 80, 80, 50, 50,																		
20110827, 0000, HU, 32.1N, 77.1W, 75, 952, 225, 225, 140, 140, 125, 125, 90, 75, 80, 80, 40, 40,																		
20110827, 0600, HU, 33.4N, 76.8W, 75, 952, 225, 225, 140, 140, 125, 125, 90, 75, 80, 80, 40, 40,																		
20110827, 1200, HU, 34.7N, 76.6W, 75, 952, 225, 225, 150, 125, 125, 125, 90, 60, 80, 80, 40, 35,																		
20110827, 1800, HU, 35.5N, 76.3W, 65, 950, 210, 225, 150, 125, 125, 125, 80, 60, 75, 75, 35, 35,																		
20110828, 0000, HU, 36.7N, 75.7W, 65, 951, 210, 225, 150, 125, 150, 150, 80, 60, 75, 75, 0, 0,																		
20110828, 0600, HU, 38.1N, 75.0W, 65, 958, 230, 280, 160, 110, 150, 150, 80, 30, 75, 75, 0, 0,																		
20110828, 0935, TS, 39.4N, 74.4W, 60, 959, 230, 280, 160, 110, 150, 150, 80, 30, 0, 0, 0, 0,																		

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20110828, 1200, TS, 40.3N, 74.1W, 55, 963, 230, 280, 130, 50, 150, 150, 80, 30, 0, 0, 0, 0,
20110828, 1300, TS, 40.6N, 74.0W, 55, 965, 230, 280, 130, 50, 150, 150, 80, 30, 0, 0, 0, 0,
20110828, 1800, TS, 42.5N, 73.1W, 50, 970, 230, 280, 180, 50, 150, 150, 80, 30, 0, 0, 0, 0,
20110829, 0000, EX, 44.2N, 72.1W, 45, 979, 230, 315, 250, 50, 0, 0, 0, 0, 0, 0, 0, 0, 0,
20110829, 0600, EX, 46.5N, 69.5W, 40, 983, 360, 360, 360, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
20110829, 1200, EX, 49.1N, 66.7W, 40, 985, 360, 360, 300, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
20110829, 1800, EX, 51.3N, 63.8W, 40, 987, 0, 360, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
20110830, 0000, EX, 53.0N, 60.0W, 40, 991, 0, 270, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,

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There are two types of lines of data in the new format: the header line and the data lines. The format is both comma and space-delimited to maximize its ease in use. The header line has the following format:

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AL092011, IRENE, 39,
1234567890123456789012345689012345

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AL (Spaces 1 and 2) – Basin – Atlantic
09 (Spaces 3 and 4) – Storm number for that year
2011 (Spaces 5-8, before first comma) – Year
IRENE (Spaces 16-25, before second comma) – Name, if available, or else “UNNAMED”
39 (Spaces 28-34) – Number of best track entries – rows – to follow

Notes:

- 1) Storm number: The storms are numbered sequentially based upon the time of first tropical cyclone or subtropical cyclone stage in the best track. In most cases, the storm numbers follow sequentially (i.e., 01, 02, 03, etc). However, there are a few years where the storm numbers are out of sequence with respect to the time of the first tropical cyclone or subtropical cyclone stage (for example, the unnamed tropical storm [AL20 in 2011] that occurred from 31 August-3 September 2011, which is sequenced here between AL12-KATIA from 28 August-12 September and AL13-LEE from 2-6 September).
- 2) Name: Tropical cyclones were not formally named before 1950 and are thus referred to as “UNNAMED” in the database. Systems that were added into the database after the season (such as AL20 in 2011) also are considered “UNNAMED”. Non-developing tropical depressions formally were given names (actually numbers, such as “TEN”) that were included into the ATCF b-decks starting in 2003. Non-developing tropical depressions before this year are also referred to as “UNNAMED”. Note that the non-developing tropical depressions for 1988 are currently missing from the b-deck files and are therefore not available here either. (These should be included into the new HURDAT2 sometime during 2013.)

The remaining rows of data in the new format are the data lines. These have the following format:

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20110824, 1200, HU, 21.9N, 73.3W, 105, 957, 180, 150, 90, 150, 90, 60, 45, 80, 45, 40, 25, 40,
1234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567

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2011 (Spaces 1-4) – Year
08 (Spaces 5-6) – Month
24 (Spaces 7-8, before 1st comma) – Day
12 (Spaces 11-12) – Hours in UTC (Universal Time Coordinate)
00 (Spaces 13-14, before 2nd comma) – Minutes

HU (Spaces 17-18, before 3rd comma) – Status of system. Options are:

TD – Tropical Cyclone of Tropical Depression intensity (< 34 kt)

TS – Tropical Cyclone of Tropical Storm intensity (34-63 kt)

HU – Tropical Cyclone of Hurricane intensity (\geq 64 kt)

EX – Extratropical Cyclone (no wind speed threshold)

SD – Subtropical Cyclone of Subtropical Depression intensity (< 34 kt)

SS – Subtropical Cyclone of Subtropical Storm intensity (\geq 34 kt)

LO – Low Pressure, but not a Tropical Cyclone, a Subtropical Cyclone, nor an Extratropical Cyclone (no wind speed threshold)

WV – Tropical Wave (no wind speed threshold)

DB – Disturbance (no wind speed threshold)

21.9 (Spaces 21-24) – Latitude

N (Space 25, before 4th comma) – Hemisphere – North or South

73.3 (Spaces 28-32) – Longitude

W (Space 33, before 5th comma) – Hemisphere – West or East

105 (Spaces 36-38, before 6th comma) – Intensity (in knots)

957 (Spaces 41-44, before 6th comma) – Central Pressure (in millibars)

180 (Spaces 47-50, before 7th comma) – 34 kt wind radii maximum extent in northeastern quadrant (in nautical miles)

150 (Spaces 53-56, before 8th comma) – 34 kt wind radii maximum extent in southeastern quadrant (in nautical miles)

90 (Spaces 60-62, before 9th comma) – 34 kt wind radii maximum extent in southwestern quadrant (in nautical miles)

150 (Spaces 66-68, before 10th comma) – 34 kt wind radii maximum extent in northwestern quadrant (in nautical miles)

90 (Spaces 72-74, before 11th comma) – 50 kt wind radii maximum extent in northeastern quadrant (in nautical miles)

60 (Spaces 76-78, before 12th comma) – 50 kt wind radii maximum extent in southeastern quadrant (in nautical miles)

45 (Spaces 84-86, before 13th comma) – 50 kt wind radii maximum extent in southwestern quadrant (in nautical miles)

80 (Spaces 90-92, before 14th comma) – 50 kt wind radii maximum extent in northwestern quadrant (in nautical miles)

45 (Spaces 72-74, before 15th comma) – 64 kt wind radii maximum extent in northeastern quadrant (in nautical miles)

40 (Spaces 76-78, before 16th comma) – 64 kt wind radii maximum extent in southeastern quadrant (in nautical miles)

25 (Spaces 84-86, before 17th comma) – 64 kt wind radii maximum extent in southwestern quadrant (in nautical miles)

40 (Spaces 90-92, before 18th comma) – 64 kt wind radii maximum extent in northwestern quadrant (in nautical miles)

Notes:

1) Time: The vast majority of times included are at the synoptic time of 0000, 0600, 1200, and 1800 UTC (Universal Time Coordinate). From 1851 to 1935 and again from 1991 onward, non-synoptic times are included for the time of tropical cyclone landfalls in the United States. Non-United States landfalls at non-synoptic times have been included from 1992 onward. Also, occasionally a non-synoptic time will be included beginning in 1995 if the peak intensity (and/or minimum central pressure) was determined to be at a non-synoptic time (such as AL15-MARILYN in 1995), though most tropical cyclones it is difficult to determine the peak intensity at a precision of less than six hours. Lastly, recording best track data to the nearest minute became available within the b-decks beginning in 1991 and some tropical cyclones since that year have the landfall best track to the nearest minute.

2) Status: Tropical cyclones with an ending Tropical Depression status (the dissipating stage) were first used in the best track beginning in 1871, primarily for systems weakening over land. Tropical cyclones with beginning Tropical Depression (the formation stage) were first included in the best track beginning in 1882. Subtropical Depression and Subtropical Storm status were first used beginning in 1968 at the advent of routine satellite imagery for the Atlantic basin. The Low status is used for cyclones that are not currently tropical cyclone or subtropical cyclones, nor extratropical cyclones. These typically are assigned at the beginning

of a system's lifecycle and/or at the end of a system's lifecycle. The Low status was first used in 1987. The Tropical Wave (WV) status is used almost exclusively for cyclones that weaken and are no longer tropical cyclones (or even a Low) for a time, but then do redevelop later in time into a tropical cyclone (for example, AL10-DENNIS in 1981 between 13 and 15 August). The WV status was first used in 1981. The Disturbance (DB) status is similar to WV and was first used in 1980. It should be noted that for WV and DB status that the location given is for the approximate position of the lower tropospheric vorticity center, as the surface center no longer exists for these stages.

3) Intensity: Intensity (maximum 1-min average wind associated with the tropical cyclone at an elevation of 10 m with an unobstructed exposure) values are given to the nearest 10 kt for the years 1851 through 1885. From 1886 onward, the intensity has a resolution of 5 kt. A value is assigned for every cyclone at every best track time. Note that the non-developing tropical depressions of 1967 did not have intensities assigned to them in the b-decks. These are indicated as “-99” currently, but will be revised and assigned an intensity when the Atlantic hurricane database reanalysis project (Hagen et al. 2012) reaches that hurricane season.

4) Central Pressure: These values are given to the nearest millibar. Originally, central pressure best track values were only included if there was a specific observation that could be used explicitly. Missing central pressure values are noted as “-999”. Beginning in 1979, central pressures have been analyzed and included for every best track entry, even if there was not a specific in-situ measurement available.

5) Wind Radii – These values have been best tracked since 2004 and are thus available here from that year forward with a resolution to the nearest 5 nm. Best tracks of the wind radii have not been done before 2004 and are listed as “-999” to denote missing data. Note that occasionally when there is a non-synoptic time best track entry included for either landfall or peak intensity, that the wind radii best tracks were not provided. These instances are also denoted with a “-999” in the database.

General Notes:

The database goes back to 1851, but it is far from being complete and accurate for the entire century and a half. Uncertainty estimates of the best track parameters available for are available for various era in Landsea et al. (2011), Hagen et al. (2012), Torn and Snyder (2012), and Landsea (2012). Moreover, as one goes back further in time in addition to larger uncertainties, biases become more pronounced as well with tropical cyclone frequencies being underreported and the tropical cyclone intensities being underanalyzed. That is, some storms were missed and many intensities are too low in the pre-aircraft reconnaissance era (1944 for the western half of the basin) and in the pre-satellite era (late-1960s for the entire basin). Even in the last decade or two, new technologies affect the best tracks in a non-trivial way because of our generally improving ability to observe the frequency, intensity, and size of tropical cyclones. See Vecchi and Knutson (2008), Landsea et al. (2010), Vecchi and Knutson (2012), Uhlhorn and Nolan (2012) on methods that have been determined to address some of the undersampling issues that arise in monitoring these mesoscale, oceanic phenomenon.

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