# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

# HURRICANE DANNY

(AL042015)

18 – 24 August 2015

Stacy R. Stewart
National Hurricane Center
19 January 2016

**VISIBLE PICTURE TAKEN FROM THE INTERNATIONAL SPACE STATION (ISS) OF HURRICANE DANNY NEAR ITS PEAK INTENSITY ON 20 AUGUST 2015 (IMAGE CREDIT NASA ASTRONAUT SCOTT KELLY ONBOARD ISS).**

Danny was a compact, Cape Verde-type category 3 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that moved generally westward in the deep tropics throughout its lifetime. Danny degenerated into a tropical wave while it moved through the northern Leeward Islands and into the northeastern Caribbean Sea, causing no significant damage.

# Hurricane Danny

**18 – 24 AUGUST 2015**

## SYNOPTIC HISTORY

Danny developed from a vigorous tropical wave that moved off of the coast of western Africa late on 14 August. The wave was accompanied by large surface pressure falls of more than 5 mb/24 h while it moved across western Africa before emerging over the eastern Atlantic Ocean, an indication of the strength and well-developed vertical structure of the wave while over tropical Africa. Shortly after moving over Atlantic waters, an elongated surface circulation developed along the wave axis early on 15 August when the disturbance was located more than 400 n mi southeast of the Cape Verde Islands. As the system moved westward over the next three days within a weak vertical wind shear environment, the low-level circulation gradually became better defined while deep convection steadily increased and became more concentrated near the center. By 0600 UTC 18 August, the low had acquired sufficient organized deep convection and had developed a well-defined surface circulation, as indicated by coincident ASCAT scatterometer surface wind data (not shown), for it to be classified as a tropical depression. The depression strengthened into a tropical storm 6 h later. The "best track" chart of the tropical cyclone's path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1[1].

Located south of a deep-layer subtropical ridge, Danny moved generally westward across the eastern and central tropical Atlantic over the next several days within a flow regime characterized by 850-200 mb wind shear values of less than 5 kt. However, the cyclone was surrounded by a dry Saharan Air Layer, and occasional intrusions of the SAL disrupted the convective development of the compact cyclone despite the otherwise favorable wind shear and above-normal sea-surface temperatures. Danny managed to strengthen despite the SAL environment, becoming a hurricane around 1200 UTC 20 August when the cyclone was located about 950 n mi east of the Windward Islands.

A period of significant strengthening began immediately after Danny achieved hurricane status, and the cyclone rapidly intensified into a 110-kt major hurricane by 1200 UTC 21 August. The 45-kt rapid strengthening phase coincided with the development of a well-defined 5-10 n mi diameter eye that appeared in microwave satellite imagery between 0600-0900 UTC 20 August (Fig. 4), and near zero values of 850-200 mb vertical wind shear.

[1] A digital record of the complete best track, including wind radii, can be found on line at ftp://ftp.nhc.noaa.gov/atcf. Data for the current year's storms are located in the *btk* directory, while previous years' data are located in the *archive* directory.

Danny's rapid development phase was short-lived, however. Intrusions of mid-level dry SAL air, along with increasing vertical wind shear, began affecting the hurricane, and the cyclone weakened as quickly as it had strengthened. Danny's intensity decreased 40 kt between 0000 UTC 22 August and 0000 UTC 23 August, with the cyclone becoming a tropical storm at the end of that period. Danny maintained a motion between west and west-northwest for the next 36 h, weakening to a tropical depression by 1200 UTC 24 August when the cyclone was moving through the central and southern Leeward Islands. Danny degenerated into an open wave just 6 h later as the system moved into the extreme northeastern Caribbean Sea. The remnants of Danny moved westward across the northern Leeward Islands, the Virgin Islands, Puerto Rico, and Hispaniola for the next day or so, bringing short-lived but beneficial rains to those drought-stricken islands.

# METEOROLOGICAL STATISTICS

Observations in Danny (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Danny.

Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from 6 flights of the NOAA Hurricane Hunters (3 missions; 12 fixes) and the 53rd Weather Reconnaissance Squadron (3 missions; 7 fixes) of the U. S. Air Force Reserve Command, which resulted in a total of 19 position fixes.

There were no ship reports of tropical-storm-force winds associated with Danny. Buoy reports of tropical-storm-force winds are given in Table 2.

## *Winds and Pressure*

An SFMR surface wind of 104 kt was measured by a NOAA WP-3D Hurricane Hunter aircraft at 1706 UTC 21 September. The aircraft also measured a 12,000-ft flight-level wind of 111 kt at 1620 UTC in the same general location within the northeastern quadrant of Danny's circulation. Although there is no established flight-level adjustment factor for missions conducted above the 700-mb/10,000-ft flight level, using the standard 90% adjustment factor for 700 mb yields an equivalent surface intensity of 100 kt, in good agreement with the SFMR observation. However, geostationary satellite imagery (Fig. 5) suggests that Danny's peak intensity was reached a few hours earlier and that Danny was likely weakening by the time the aircraft arrived

to reconnoiter the hurricane after 1600 UTC 21 August. Therefore, Danny is estimated to have achieved a peak intensity of 110 kt at 1200 UTC 21 August.

The estimated minimum central pressure of 960 mb at 1200 UTC 21 September is based on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship corresponding to a 110-kt hurricane.

## Casualty and Damage Statistics

There were no reports of damage or casualties associated with Danny.

# FORECAST AND WARNING CRITIQUE

The genesis of Danny was not particularly well forecast (Table 3). An area of disturbed weather was first introduced into the Tropical Weather Outlook (TWO) with a 20% (low) chance of formation in five days at 0600 UTC 16 August, only 48 h prior to genesis. The system was introduced in the 48-h forecast period at that same time with a 10% (low) chance of development. The 5-day and 48-h formation probabilities were increased to the medium chance category (30-50%) 42 h and 36 h, respectively, before genesis occurred. The 5-day genesis probability reached the high ($\geq$ 70%) chance category 24 h before genesis occurred; however, the 48-h probability did not reach the high chance category before Danny developed into a tropical cyclone. Although the global models indicated favorable vertical wind shear conditions that would typically support tropical cyclone formation, the presence of dry SAL air in the middle levels of the atmosphere inhibited the development of persistent deep convection near the low-level center, and this was the reason for the shorter-than-average genesis lead times.

A verification of NHC official track forecasts (OFCL) for Danny is given in Table 4a. Official forecast track errors were noticeably lower than the mean official errors for the previous 5-yr period at all forecast times, ranging from 20% to 30% lower than average. A homogeneous comparison of the official track errors with selected guidance models is given in Table 4b. OFCL track forecasts outperformed all of the available model guidance at all forecast times, except for the consensus model TVCA at 24h and 36 h, and the Florida State Super Ensemble (FSSE) model at 120 h.

A verification of NHC official intensity forecasts for Danny is given in Table 5a. In contrast to the exceptional OFCL track forecast errors, official forecast intensity errors were much higher than the mean official errors for the previous 5-yr period at all forecast times. For example, at the 96-h and 120-h periods, OFCL errors were more than twice the 5-yr average errors. The reason for these unusually large errors was due to several NHC intensity forecasts not predicting Danny's rapid intensification on 20-21 August, its peak intensity, and the rapid weakening that ensued shortly after Danny had reached its peak intensity (Fig. 6). Despite these large errors, the OFCL

intensity forecasts still outperformed all of the available guidance from 12 h through 48 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 5b.

Watches and warnings associated with Danny are given in Table 6.

Table 1. Best track for Hurricane Danny, 18-24 August 2015.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|---|---|---|---|---|---|
| 17 / 0000 | 9.6 | 29.3 | 1011 | 25 | low |
| 17 / 0600 | 9.6 | 30.4 | 1011 | 25 | " |
| 17 / 1200 | 9.7 | 31.5 | 1011 | 25 | " |
| 17 / 1800 | 10.0 | 32.6 | 1010 | 25 | " |
| 18 / 0000 | 10.3 | 33.7 | 1010 | 25 | " |
| 18 / 0600 | 10.4 | 34.8 | 1009 | 30 | tropical depression |
| 18 / 1200 | 10.5 | 35.9 | 1008 | 35 | tropical storm |
| 18 / 1800 | 10.7 | 37.1 | 1006 | 40 | " |
| 19 / 0000 | 10.9 | 38.4 | 1005 | 45 | " |
| 19 / 0600 | 11.0 | 39.5 | 1003 | 45 | " |
| 19 / 1200 | 11.2 | 40.6 | 1002 | 45 | " |
| 19 / 1800 | 11.5 | 41.5 | 1001 | 50 | " |
| 20 / 0000 | 11.7 | 42.5 | 1000 | 55 | " |
| 20 / 0600 | 11.9 | 43.5 | 998 | 60 | " |
| 20 / 1200 | 12.3 | 44.4 | 995 | 65 | hurricane |
| 20 / 1800 | 12.8 | 45.3 | 990 | 75 | " |
| 21 / 0000 | 13.2 | 46.2 | 981 | 85 | " |
| 21 / 0600 | 13.5 | 47.0 | 973 | 95 | " |
| 21 / 1200 | 13.8 | 47.8 | 960 | 110 | " |
| 21 / 1800 | 14.3 | 48.6 | 966 | 105 | " |
| 22 / 0000 | 14.7 | 49.4 | 973 | 95 | " |
| 22 / 0600 | 15.0 | 50.3 | 980 | 85 | " |
| 22 / 1200 | 15.3 | 51.4 | 985 | 75 | " |
| 22 / 1800 | 15.5 | 52.7 | 990 | 65 | " |
| 23 / 0000 | 15.6 | 54.0 | 999 | 55 | tropical storm |
| 23 / 0600 | 15.7 | 55.3 | 1001 | 50 | " |
| 23 / 1200 | 15.7 | 56.7 | 1002 | 45 | " |
| 23 / 1800 | 15.6 | 58.2 | 1004 | 40 | " |
| 24 / 0000 | 15.6 | 59.3 | 1007 | 40 | " |
| 24 / 0600 | 15.8 | 60.4 | 1008 | 35 | " |
| 24 / 1200 | 15.8 | 61.3 | 1009 | 30 | tropical depression |
| 24 / 1800 | | | | | dissipated |
| 21 / 1200 | 13.8 | 47.8 | 960 | 110 | minimum pressure and maximum intensity |

Table 2. Selected buoy reports with winds of at least 34 kt for Hurricane Danny, 18-24 August 2015.

| Date/Time (UTC) | Buoy call sign | Latitude (°N) | Longitude (°W) | Wind dir/speed (kt) | Pressure (mb) |
|---|---|---|---|---|---|
| 18 / 2200 | 41026 | 11.5 | 38.0 | 100 / 42 | --- |
| 23 / 1500 | 41300 | 15.9 | 57.5 | 070 / 37 | 1008.8 |

Table 3. Number of hours in advance of formation of Hurricane Danny associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

| | Hours Before Genesis | |
|---|---|---|
| | 48-Hour Outlook | 120-Hour Outlook |
| Low (≤30%) | 48 | 48 |
| Medium (40%-60%) | 36 | 42 |
| High (≥70%) | 0 | 24 |

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Danny. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | **20.4** | **34.6** | **47.9** | **54.4** | **78.1** | **109.7** | **158.9** |
| OCD5 | 27.4 | 52.7 | 89.6 | 132.8 | 187.2 | 228.6 | 294.5 |
| Forecasts | 23 | 21 | 19 | 17 | 13 | 9 | 5 |
| OFCL (2010-14) | 28.4 | 45.0 | 60.4 | 77.1 | 113.1 | 157.8 | 210.0 |
| OCD5 (2010-14) | 48.3 | 101.5 | 161.5 | 222.6 | 329.8 | 412.6 | 483.9 |

Table 4b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Danny. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

| Model ID | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 18.4 | 30.4 | 38.9 | 36.9 | 51.0 | 53.3 | 70.2 |
| OCD5 | 28.0 | 55.2 | 94.6 | 139.8 | 186.9 | 228.9 | 296.8 |
| GFSI | 22.9 | 33.8 | 44.3 | 49.0 | 66.6 | 76.6 | 105.5 |
| EMXI | 21.8 | 34.5 | 48.2 | 51.7 | 63.8 | 84.5 | 122.1 |
| UKMI | 21.2 | 33.7 | 42.0 | 43.8 | 85.1 | 155.3 | 286.5 |
| EGRI | 20.5 | 34.6 | 41.0 | 43.1 | 86.4 | 155.4 | 258.8 |
| CMCI | 20.6 | 35.7 | 54.2 | 66.2 | 120.5 | 126.0 | 84.8 |
| NVGI | 33.8 | 52.2 | 58.5 | 71.2 | 113.6 | 144.9 | 155.5 |
| AEMI | 23.2 | 40.1 | 58.7 | 58.7 | 79.8 | 85.8 | 72.6 |
| GHMI | 25.6 | 42.7 | 57.0 | 64.7 | 98.2 | 157.9 | 243.0 |
| HWFI | 26.2 | 46.4 | 68.7 | 78.7 | 94.5 | 135.6 | 228.4 |
| GFNI | 25.7 | 38.7 | 44.1 | 41.1 | 74.8 | 104.8 | 203.9 |
| FSSE | 20.7 | 31.6 | 43.5 | 44.0 | 53.2 | 62.3 | **27.8** |
| TCON | 19.7 | 31.0 | 43.6 | 48.5 | 67.6 | 102.0 | 178.7 |
| TVCA | 19.3 | **27.7** | **38.1** | 41.4 | 52.8 | 75.4 | 127.6 |
| BAMD | 29.0 | 54.0 | 78.5 | 99.5 | 141.7 | 144.3 | 144.2 |
| BAMM | 24.3 | 44.1 | 56.8 | 67.4 | 87.8 | 100.5 | 101.2 |
| BAMS | 25.2 | 44.3 | 61.9 | 67.9 | 78.0 | 101.7 | 139.4 |
| LBAR | 28.2 | 54.6 | 83.4 | 105.3 | 159.5 | 215.4 | 218.1 |
| Forecasts | 20 | 18 | 16 | 14 | 10 | 4 | 2 |

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Danny. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

| | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 10.4 | 14.8 | 17.4 | 17.4 | 16.9 | 27.8 | 43.0 |
| OCD5 | 13.5 | 20.8 | 28.2 | 34.2 | 29.6 | 21.9 | 31.0 |
| Forecasts | 23 | 21 | 19 | 17 | 13 | 9 | 5 |
| OFCL (2010-14) | 6.2 | 9.4 | 11.5 | 13.3 | 14.6 | 14.6 | 15.8 |
| OCD5 (2010-14) | 7.3 | 10.8 | 13.3 | 15.3 | 17.7 | 17.8 | 17.6 |

Table 5b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Danny. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 5a due to the homogeneity requirement.

| Model ID | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 10.5 | 15.3 | 18.1 | 18.1 | 15.0 | 30.6 | 43.3 |
| OCD5 | 13.7 | 21.6 | 29.2 | 35.4 | 27.4 | **22.4** | **37.3** |
| DSHP | 12.1 | 18.0 | 21.4 | 20.4 | **13.2** | **29.0** | 50.0 |
| LGEM | 12.1 | 18.1 | 21.4 | 21.7 | 19.6 | 37.5 | 60.0 |
| HWFI | 12.7 | 19.1 | 20.7 | 20.3 | **13.0** | **14.5** | **18.3** |
| GHMI | 12.0 | 16.5 | 19.7 | 19.9 | **12.6** | **12.0** | **25.0** |
| GFNI | 13.2 | 20.0 | 26.3 | 25.8 | 23.2 | **11.3** | **12.7** |
| FSSE | 11.6 | 16.8 | 18.9 | 19.9 | **13.3** | **20.1** | **33.7** |
| ICON | 11.8 | 17.3 | 19.8 | 19.8 | **12.3** | **23.0** | **38.3** |
| IVCN | 11.8 | 17.3 | 19.8 | 19.8 | **12.3** | **23.0** | **38.3** |
| GFSI | 14.1 | 21.1 | 27.7 | 31.8 | 19.0 | **14.4** | **30.3** |
| EMXI | 16.5 | 27.0 | 35.4 | 40.5 | 31.3 | **9.6** | **10.3** |
| Forecasts | 22 | 20 | 18 | 16 | 12 | 8 | 3 |

Table 6. Watch and warning summary for Hurricane Danny, 18-24 August 2015.

| Date/Time (UTC) | Action | Location |
|---|---|---|
| 22 / 1500 | Tropical Storm Watch issued for | Antigua, Barbuda, Montserrat, St. Kitts, Nevis, Anguilla, Saba, St. Eustatius, and St. Maarten. |
| 22 / 1800 | Tropical Storm Watch issued for | Guadeloupe, St. Martin, and St. Barthelemy. |
| 23 / 0900 | Tropical Storm Watch changed to Tropical Storm Warning | Antigua, Anguilla, Barbuda, Montserrat, Nevis, Saba, St. Eustatius, and St. Kitts. |
| 23 / 1500 | Tropical Storm Watch discontinued | Guadeloupe, St. Martin, and St. Barthelemy. |
| 23 / 1500 | Tropical Storm Watch issued for | Puerto Rico, Culebra, Vieques, and U.S. Virgin Islands. |
| 24 / 0000 | Tropical Storm Warning discontinued for | Anguilla. |
| 24 / 0300 | Tropical Storm Watch discontinued for | Puerto Rico, Culebra, Vieques, and U.S Virgin Islands |
| 24 / 0900 | Tropical Storm Warning discontinued for | Antigua, Barbuda, Montserrat, St. Kitts, and Nevis. |
| 24 / 1200 | Tropical Storm Warning discontinued for | Saba and St. Eustatius. |
| 24 / 1200 | Tropical Storm Watch discontinued for | St. Maarten. |

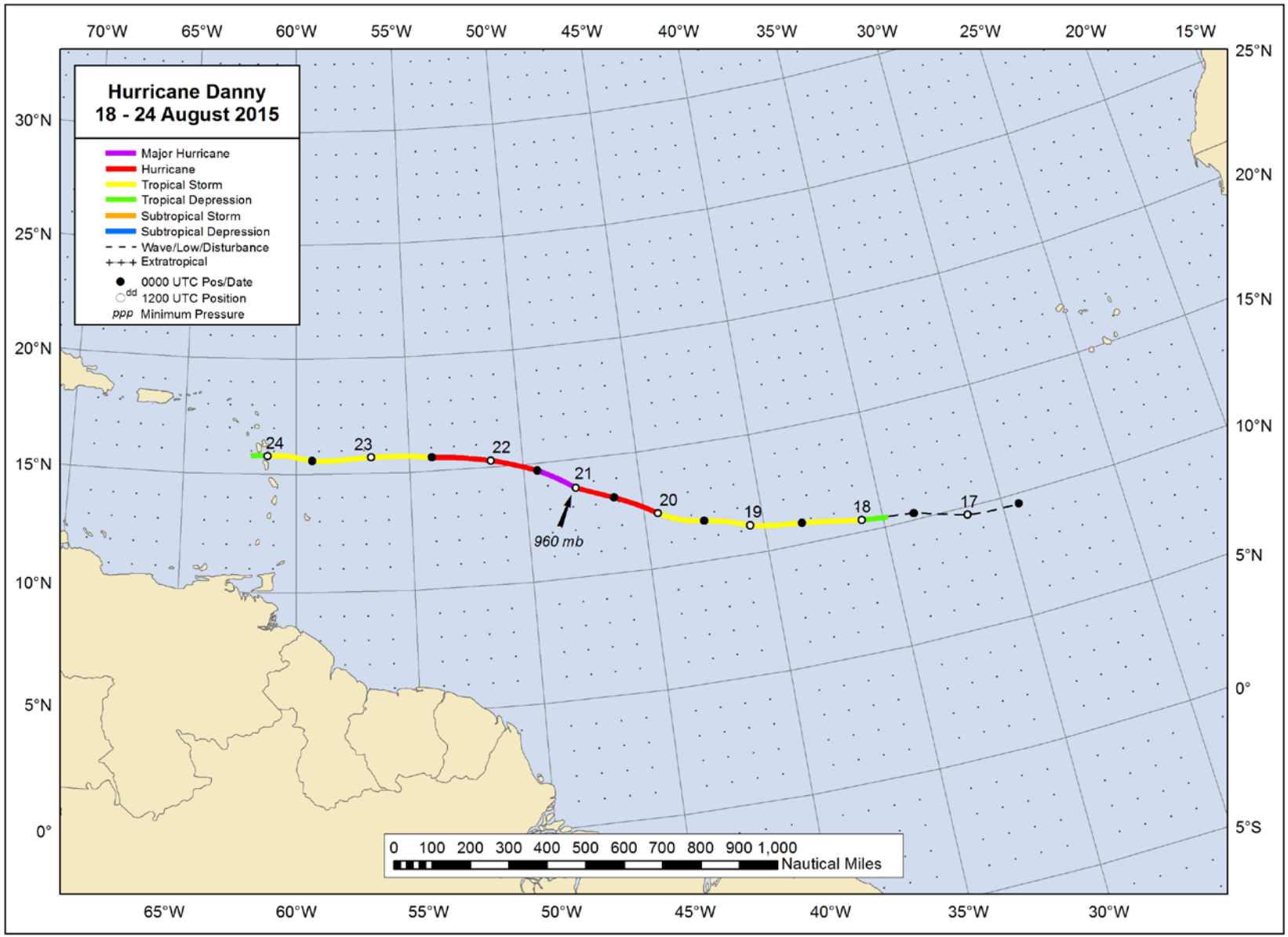


Figure 1. Best track positions for Hurricane Danny, 18-24 August 2015.

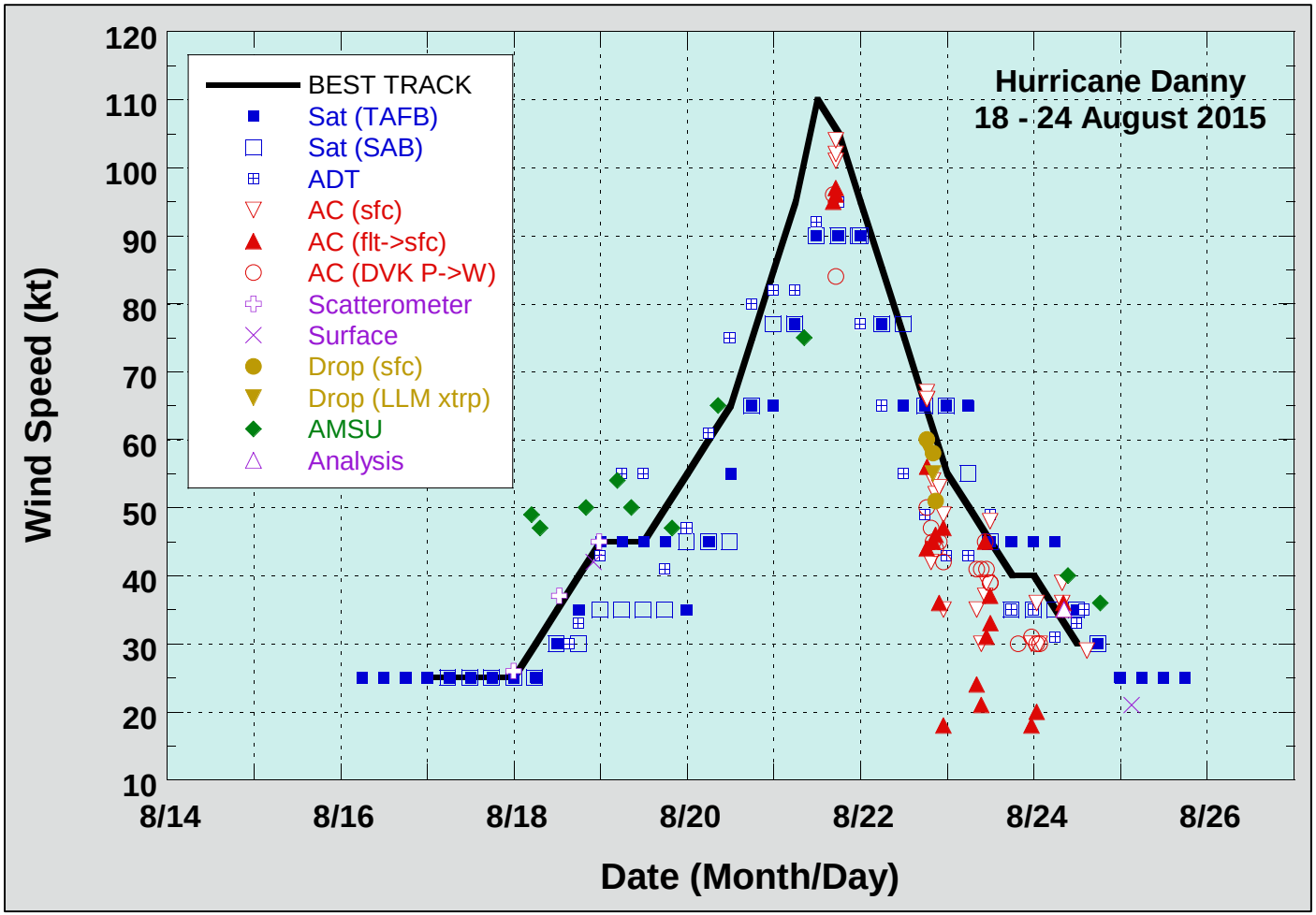


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Danny, 18-24 August 2015. Aircraft observations have been adjusted for elevation using adjustment factors of 75%, 80%, and 90% for observations from the 925 mb, 850 mb, and 700 mb levels, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

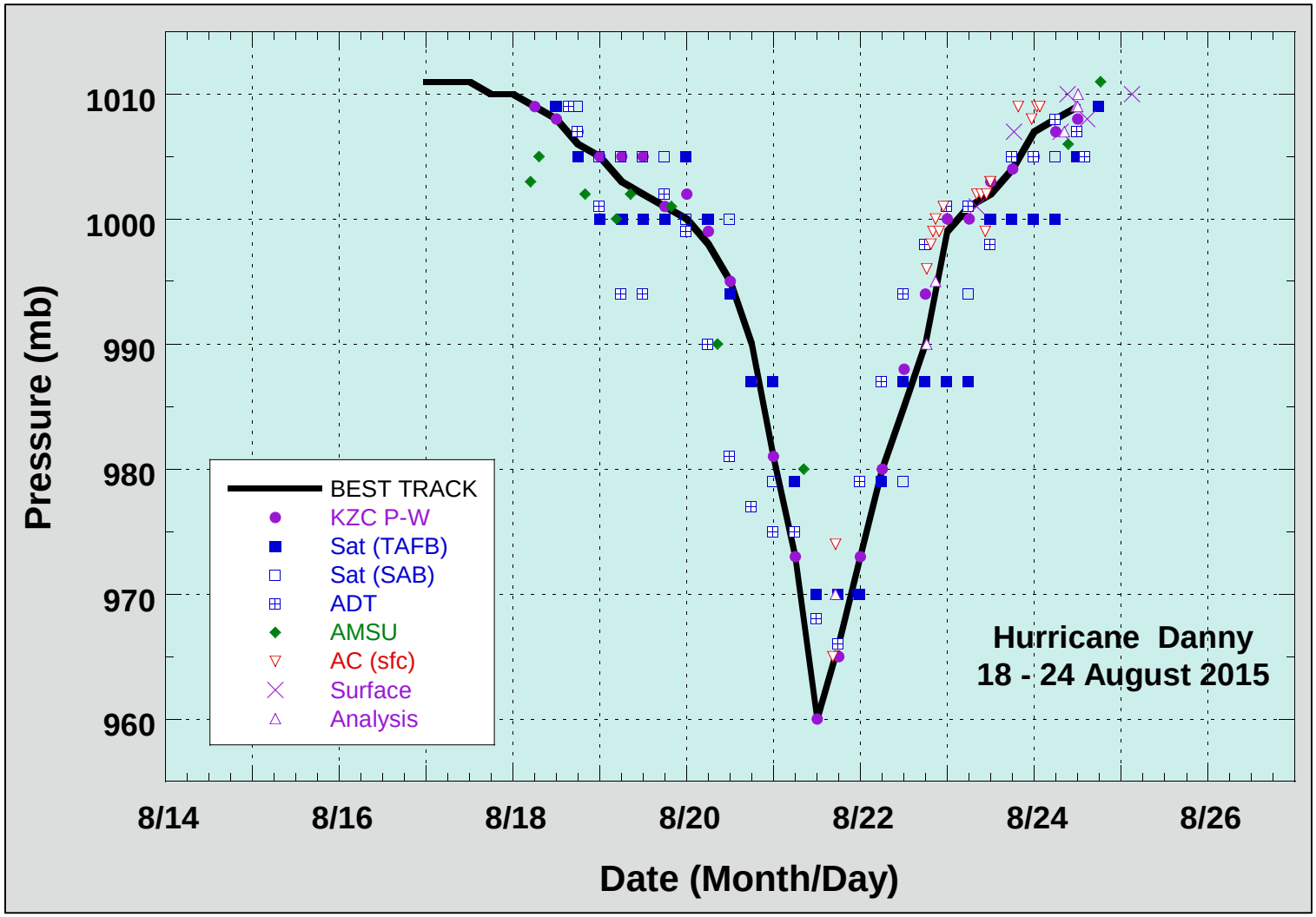


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Danny, 18-24 August 2015. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.

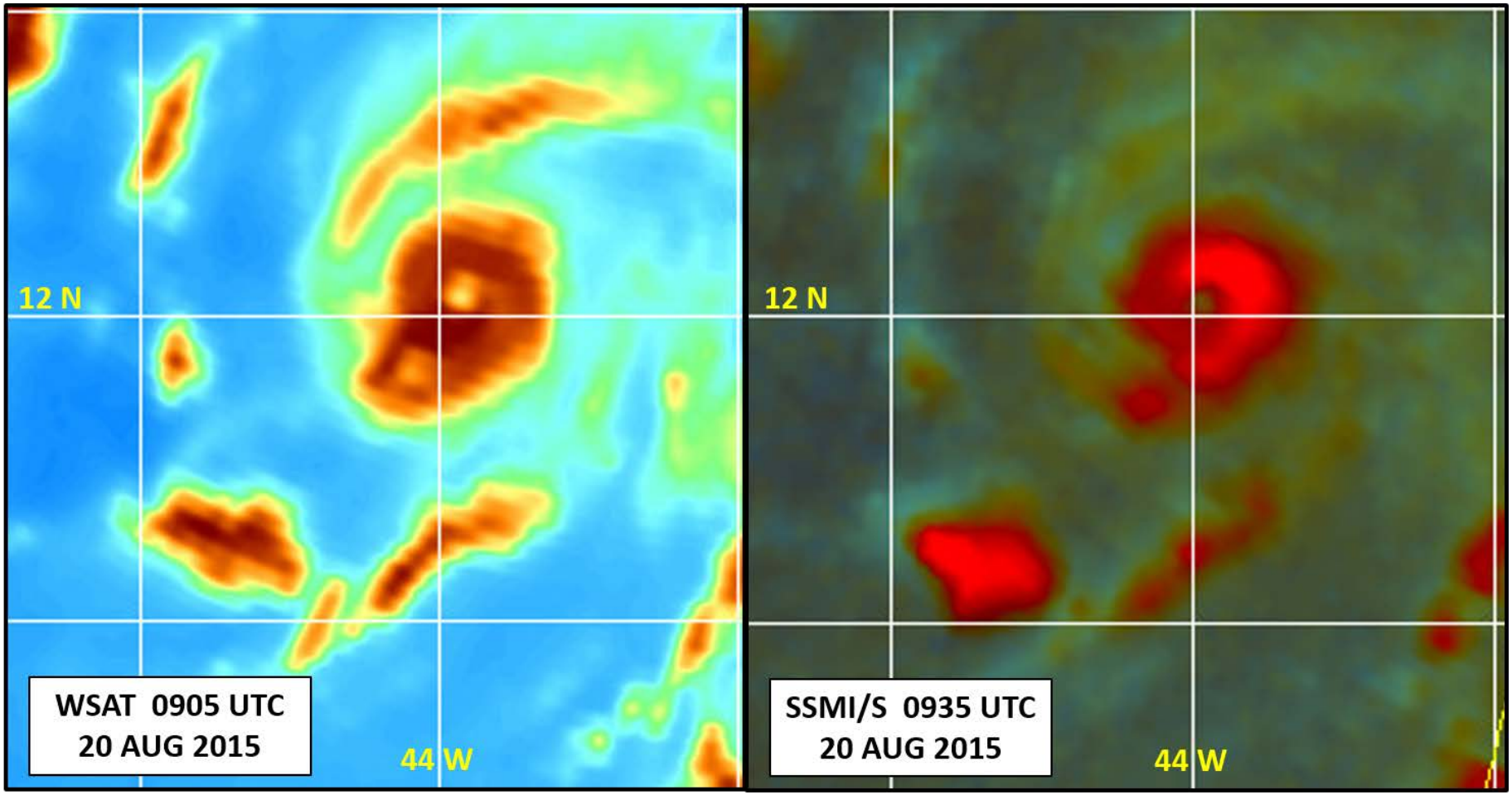


Figure 4. WindSAT (WSAT) and Special Sensor Microwave Imager/Sounder (SSMI/S) passive microwave images at 0905 UTC and 0935 UTC 20 August, respectively, showing the small eye of Hurricane Danny that had formed. A 24-h period of rapid intensification ensued immediately after the appearance of the 5-10 n mi diameter eye. Images courtesy U.S. Navy FNMOC, Monterey, CA.

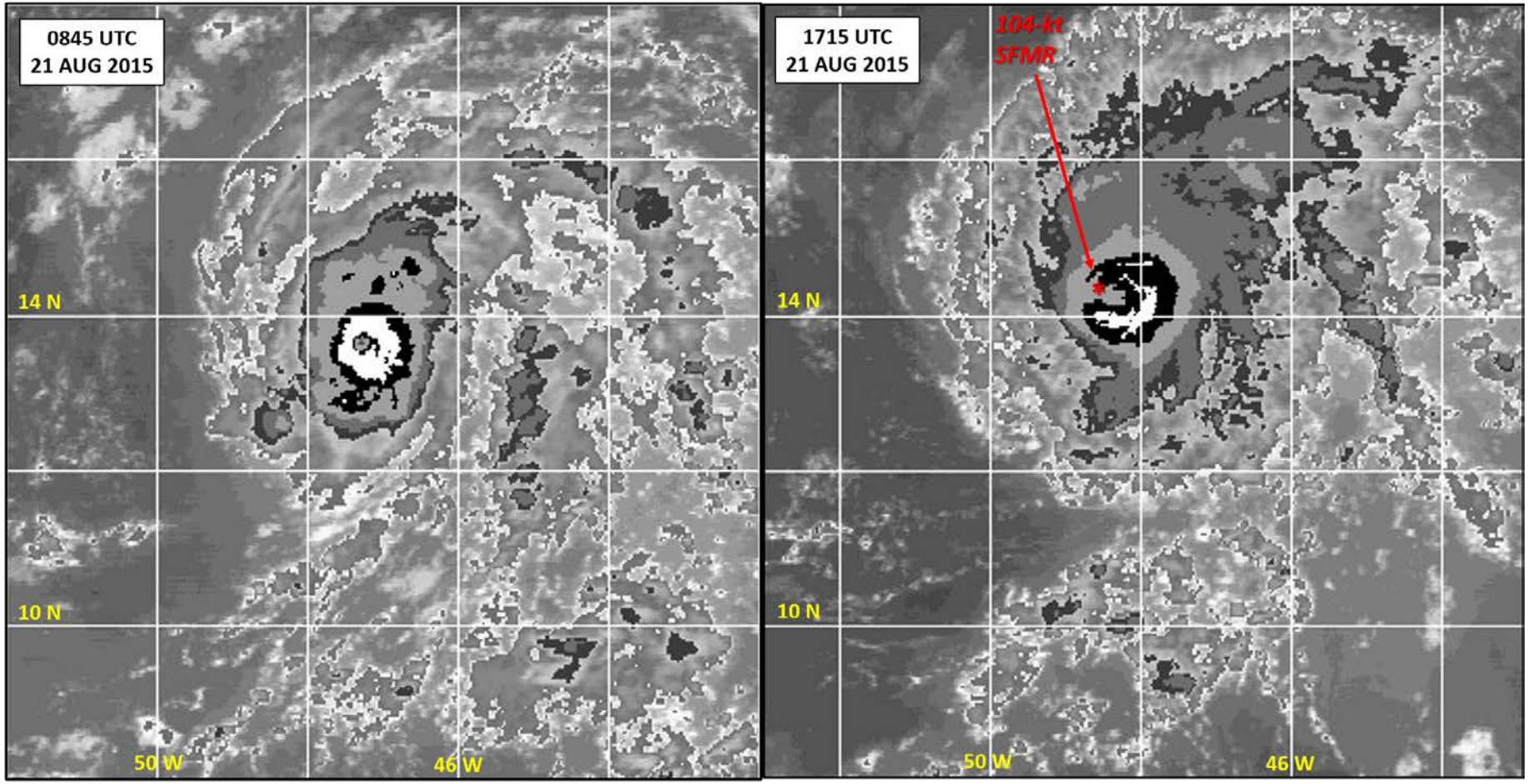


Figure 5. GOES-13 Infrared (BD-enhancement curve) satellite images at 0845 UTC and 1715 UTC 21 August 2015 when Danny was at its estimates peak intensity (left). Reconnaissance aircraft measured a SFMR surface wind value of 104 kt and a 700-mb flight-level wind of 111 kt (right) at the onset of the hurricane's rapid weakening trend. Images courtesy FNMOC, Monterey, CA.

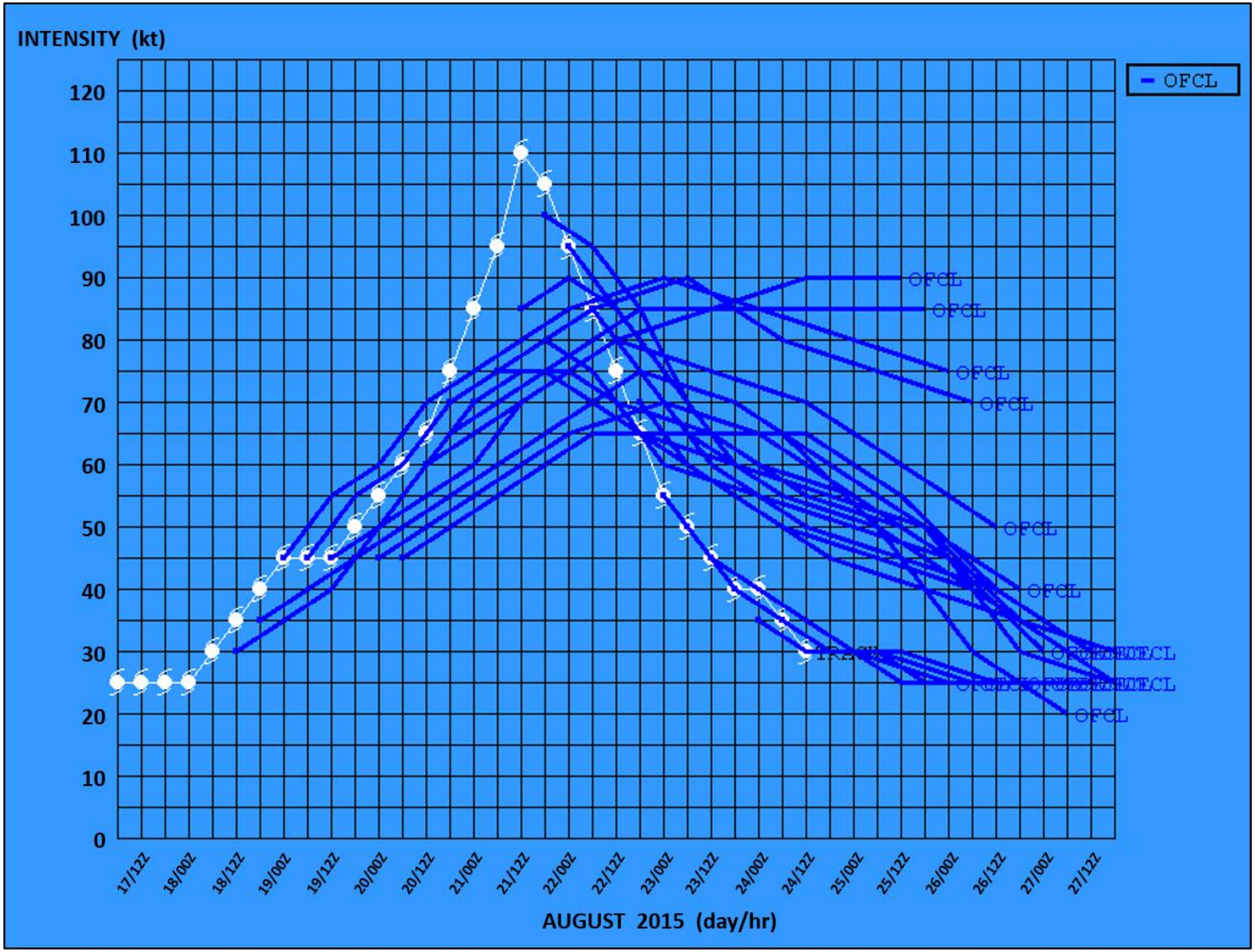


Figure 6. NHC official intensity forecasts (solid light blue lines) plotted against official intensity 'best track' (solid white line with tropical cyclone symbols) for Hurricane Danny, 18-24 August 2015.