# NATIONAL HURRICANE CENTER
# TROPICAL CYCLONE REPORT

## TROPICAL STORM BARRY

(AL022013)

17 – 20 June 2013

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GOES-13 VISIBLE IMAGE AT 1720 UTC 20 JUNE 2013 AFTER BARRY MADE LANDFALL. IMAGE COURTESY OF NASA.

Barry was a tropical storm that produced heavy rainfall and flooding across portions of Central America, the Yucatan Peninsula, and eastern Mexico; the flooding resulted in five direct deaths.

# Tropical Storm Barry

**17 – 20 JUNE 2013**

## SYNOPTIC HISTORY

The disturbance that spawned Barry was a tropical wave that moved off the African coast on 8 June. Over the next several days, the weak wave moved briskly westward across the tropical Atlantic and northern South America, and moved into the southwestern Caribbean Sea by early on 15 June. Upon reaching the Caribbean Sea, deep convection flared up along the wave axis, and surface observations and scatterometer wind data indicated that a broad low pressure area had formed by late that day just north of Panama. The low initially moved west-northwestward, then turned northwestward early on 16 June when it was located just west of San Andres Island, and moved inland over northeastern Nicaragua by 1500 UTC that day. Despite its interaction with land, the low continued to become better defined and convective bands developed both near the center and over water in the northern semicircle of the circulation. The well-defined center of the low moved back over water in the northwestern Caribbean Sea early on 17 June, and nearby surface observations and satellite intensity estimates indicated that a tropical depression had formed by 1200 UTC that day near Utila Island in Honduras Bay, or about 20 n mi north-northwest of La Ceiba, Honduras. 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].

The depression continued its west-northwestward motion and radar and surface data indicated that landfall occurred near Big Creek, Belize with peak winds of 30 kt around 2200 UTC 17 June. Shortly after making landfall, the cyclone began to weaken as it moved across southern Belize and northern Guatemala. Despite its trek over land for the next 18 h, the circulation of Barry contracted and became better defined, which set the stage for re-intensification upon its reaching the warm waters of the southern Bay of Campeche early on 19 June. Barry became a tropical storm around 1200 UTC that day when it was located about 90 n mi north-northeast of Coatzacoalcos, Mexico. Shortly after acquiring tropical storm status, Barry turned westward under the influence of a strong high pressure ridge located over the southern United States. The tropical storm maintained that motion and strengthened slightly before it made landfall along the cost of mainland Mexico, which occurred around 1115 UTC 20 June near Laguna La Mancha in the state of Veracruz, based on surface observations from a nearby station. Winds began to diminish as Barry moved across the rugged Sierra Madre Oriental mountain range, and the cyclone weakened to a depression by 1800 UTC that day and dissipated 12 h later when it was located inland over the Mexican state of Puebla.

[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.

# METEOROLOGICAL STATISTICS

Observations in Barry (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. Observations also include flight-level and stepped frequency microwave radiometer (SFMR) observations from one flight of the 53rd Weather Reconnaissance Squadron (WRS) of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), 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 Barry.

There were no reliable ship reports of tropical-storm-force winds associated with Barry.

## *Winds and Pressure*

One reconnaissance flight was made into Barry on 19 June by the 53rd WRS, which resulted in three center fixes; the last of these fixes was acquired more than 12 h prior to Barry's landfall along the coast of mainland Mexico. The estimated peak intensity of 40 kt is based on reconnaissance aircraft data, a blend of subjective Dvorak intensity estimates from TAFB and SAB, and UW-CIMSS ADT intensity estimates. The estimated minimum of pressure of 1003 mb is based on KZC pressure-wind relationship estimates.

Only a few significant surface wind reports were received in association with the tropical storm. Roatan Island (WMO ID **MHRO**) in Honduras Bay near the center of Barry reported a 1-minute sustained wind of 30 kt at 1200 UTC 17 June. The PEMEX oil rig **Ku-H** reported a 1-minute wind of 34 kt at an elevation of 35 m at 1300 UTC 18 June as the cyclone was emerging over the Bay of Campeche and PEMEX rig **IXTOC-ALFA** reported a 1-minute wind of 35 kt with a gust to 40 kt at an elevation of 27 m at around 0330 UTC 19 June. Lastly, the Perote Automated Weather Station (VR26) located near Veracruz, Mexico reported a 10-minute average wind of 44 kt at a station height of 7906 ft (2410 m) above sea-level.

## *Rainfall*

Only a few rainfall reports were received across portions of Central America and Mexico. The most significant rainfall totals reported by the National Meteorological Service of Mexico were 6.30 inches (160 mm) at Tenochtitlan, Veracruz and 5.51 inches (140 mm) at Teziutlan, Puebla.

# CASUALTY AND DAMAGE STATISTICS

Reports from emergency management officials and news media indicate that there were several casualties[2] associated with Barry, including five direct deaths – two in El Salvador and three in Mexico.

Barry's precursor disturbance produced significant rainfall that triggered floods and mudslides in 14 districts across eastern Nicaragua. After becoming a tropical cyclone, Barry produced locally heavy rainfall along its path. Across northern Honduras, heavy rains triggered floods and mudslides that damaged 60 homes and left at least 300 people homeless in La Ceiba and roads became blocked in Iriona. In the community of Limon, 9 homes were destroyed and 90 more damaged by a probable tornado. Four people were injured when their home was lifted by the strong winds and then dropped.

Nearly 10 inches of rain fell in 24 h across southern Belize, which caused several rivers to overflow their banks and many drainage culverts were damaged or washed away. At least 54 people had to be evacuated when their homes were flooded along Hope Creek.

Barry's effects were even felt along the Pacific coast of Central America. In El Salvador, six children were swept away by a flooded creek; five were rescued, but one remained missing at the time of this report and is presumed to have died. One person was killed and two people were injured after they were struck by lightning.

As Barry moved across the Mexican state of Yucatán, strong winds downed numerous trees and power lines. More than 26,000 people lost electrical service after lightning struck a power station and caused a fire. There were at least three direct fatalities in eastern Mexico. A mother and her 8-year old child drowned when the van they were traveling in was swept away by a rain-swollen river in Oaxaca. The third fatality occurred in the state of Veracruz where a 48-year old man drowned while trying to cross a river on horseback and was dragged under the water by the force of the current. Significant damage occurred in at least eight municipalities in Veracruz, where three more people were injured and 1,200 residents had to be evacuated. The hardest-hit Veracruz municipalities were Acatlan, Actopan, Altotonga, Alto Lucero, Atzalan, Banderilla, Coatepec, Las Minas, Las Vigas, Misantla, Naolinco, Tlalnelhuayocan, Tlapacoyan, Xalapa and Tihuatlan. Several mudslides also occurred in the Mexican states of Puebla and Guerrero.

There are no damage estimates available.

[2] Deaths occurring as a direct result of the forces of the tropical cyclone are referred to as "direct" deaths. These would include those persons who drowned in storm surge, rough seas, rip currents, and freshwater floods. Direct deaths also include casualties resulting from lightning and wind-related events (e.g., collapsing structures). Deaths occurring from such factors as heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads, etc., are considered indirect" deaths.

# FORECAST AND WARNING CRITIQUE

The genesis of Barry was not well anticipated. The first mention of the disturbance in the Atlantic Tropical Weather Outlook was at 0000 UTC on 15 June when it was introduced with a low probability (<30%) of formation. The probability was increased to the medium category (30% - 50%) only 18 h before genesis occurred, reaching a maximum probability of 40% just prior to genesis. The main anticipated inhibiting factor to tropical cyclone development was the disturbance's expected interaction with the landmasses of Central America and the Yucatan Peninsula of Mexico.

A verification of NHC official track forecasts for Barry is given in Table 2a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period through 72 h, especially at the latter period; however, there were only two forecasts available to verify that forecast period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. The NHC official forecast tracks bested all of the available guidance at all times except at 48 h where the consensus model TVCA was slightly better. The EMXI (interpolated ECMWF) model was not available for verification due to that model's failure to maintain Barry as a tropical cyclone in several model runs.

A verification of NHC official intensity forecasts for Barry is given in Table 3a. Official intensity errors were lower than the mean official errors for the previous 5-yr period at every available forecast period. However, there was only one forecast available to verify at 72 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. Every available intensity model outperformed the official forecast at one or more forecast periods through 72 h.

Watches and warnings associated with Barry are given in Table 4.

*Acknowledgements*

Special thanks are offered to John Cangialosi from the National Hurricane Center for his preparation of the track map, and to Fabián Vazquéz Romaña of PEMEX for providing observations from several oil rigs affected by Barry in the Bay of Campeche.

Table 1. Best track for Tropical Storm Barry, 17-20 June 2013.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|---|---|---|---|---|---|
| 16 / 0000 | 12.4 | 81.5 | 1009 | 20 | low |
| 16 / 0600 | 13.4 | 82.0 | 1009 | 20 | " |
| 16 / 1200 | 14.2 | 82.8 | 1008 | 25 | " |
| 16 / 1800 | 14.8 | 83.8 | 1008 | 25 | " |
| 17 / 0000 | 15.3 | 84.8 | 1008 | 25 | " |
| 17 / 0600 | 15.6 | 85.9 | 1008 | 25 | " |
| 17 / 1200 | 16.0 | 87.0 | 1007 | 30 | tropical depression |
| 17 / 1800 | 16.3 | 87.9 | 1007 | 30 | " |
| 17 / 2200 | 16.5 | 88.4 | 1006 | 30 | " |
| 18 / 0000 | 16.6 | 88.6 | 1007 | 30 | " |
| 18 / 0600 | 17.0 | 89.3 | 1009 | 25 | " |
| 18 / 1200 | 17.6 | 90.3 | 1008 | 30 | " |
| 18 / 1800 | 18.2 | 91.3 | 1008 | 30 | " |
| 19 / 0000 | 18.8 | 92.2 | 1007 | 30 | " |
| 19 / 0600 | 19.2 | 93.1 | 1007 | 30 | " |
| 19 / 1200 | 19.5 | 94.0 | 1006 | 35 | tropical storm |
| 19 / 1800 | 19.6 | 94.8 | 1005 | 40 | " |
| 20 / 0000 | 19.6 | 95.4 | 1003 | 40 | " |
| 20 / 0600 | 19.6 | 95.9 | 1003 | 40 | " |
| 20 / 1115 | 19.6 | 96.4 | 1003 | 40 | " |
| 20 / 1200 | 19.6 | 96.5 | 1004 | 40 | " |
| 20 / 1800 | 19.6 | 97.0 | 1007 | 30 | tropical depression |
| 21 / 0000 | 19.6 | 97.5 | 1011 | 25 | low |
| 21 / 0600 | | | | | dissipated |
| 20 / 0000 | 19.6 | 95.4 | 1003 | 40 | minimum pressure and maximum intensity |
| 17 / 2200 | 16.5 | 88.4 | 1006 | 30 | landfall near Big Creek, Belize |
| 20 / 1115 | 19.6 | 96.4 | 1003 | 40 | landfall near Laguna La Mancha, Mexico |

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Barry, 17-20 June 2013. 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 | **27.5** | **41.7** | **57.5** | **59.8** | **25.6** | | |
| OCD5 | 38.3 | 78.5 | 99.6 | 95.3 | 111.1 | | |
| Forecasts | 12 | 10 | 8 | 6 | 2 | | |
| OFCL (2008-12) | 28.6 | 45.8 | 62.2 | 78.6 | 116.6 | 160.0 | 206.4 |
| OCD5 (2008-12) | 47.5 | 99.7 | 161.4 | 224.0 | 329.7 | 417.5 | 493.1 |

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Barry, 17-20 June 2013. 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 2a due to the homogeneity requirement.

| Model ID | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 26.9 | 43.5 | 55.5 | 66.7 | | | |
| OCD5 | 39.0 | 85.9 | 128.8 | 156.0 | | | |
| GFSI | 27.2 | 47.2 | 68.8 | 86.9 | | | |
| HWFI | 30.5 | 46.9 | 59.6 | 71.4 | | | |
| GHMI | 33.7 | 45.0 | 70.8 | 69.6 | | | |
| AEMI | 27.4 | 48.6 | 68.5 | 80.9 | | | |
| UKMI | 152.4 | 121.2 | 242.7 | 253.5 | | | |
| TVCA | 41.2 | 44.2 | 67.9 | **52.7** | | | |
| BAMD | 35.8 | 55.9 | 81.4 | 93.1 | | | |
| BAMM | 38.3 | 45.9 | 62.5 | 67.3 | | | |
| BAMS | 57.5 | 74.1 | 112.6 | 130.8 | | | |
| LBAR | 40.8 | 88.7 | 133.2 | 162.4 | | | |
| Forecasts | 11 | 6 | 5 | 3 | | | |

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) Tropical Storm Barry, 17-20 June 2013. 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 | **4.2** | **7.0** | **8.1** | **9.2** | **5.0** | | |
| OCD5 | 3.3 | 3.5 | 6.4 | 7.0 | 5.5 | | |
| Forecasts | 12 | 10 | 8 | 6 | 2 | | |
| OFCL (2008-12) | 6.6 | 10.1 | 12.2 | 14.1 | 15.4 | 15.1 | 16.1 |
| OCD5 (2008-12) | 7.8 | 11.6 | 14.0 | 15.6 | 17.9 | 18.0 | 17.9 |

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Barry, 17-20 June 2013. 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 3a due to the homogeneity requirement.

| Model ID | Forecast Period (h) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| OFCL | 3.5 | 6.9 | 9.2 | 10.0 | 5.0 | | |
| OCD5 | 3.8 | **3.3** | **7.3** | **7.8** | **4.0** | | |
| DSHP | 4.1 | **4.9** | **8.0** | **5.8** | **2.0** | | |
| LGEM | 4.6 | **5.4** | **8.2** | **9.3** | **1.0** | | |
| HWFI | 4.9 | 7.1 | 13.7 | 18.8 | 14.0 | | |
| GHMI | 4.0 | **5.9** | 9.2 | 10.5 | **3.0** | | |
| ICON | 4.1 | **5.4** | **8.8** | 10.5 | **3.0** | | |
| IVCN | 4.1 | **5.4** | **8.8** | 10.5 | **3.0** | | |
| Forecasts | 10 | 8 | 6 | 4 | 1 | | |

Table 4. Watch and warning summary for Tropical Storm Barry, 17-20 June 2013.

| Date/Time (UTC) | Action | Location |
|---|---|---|
| 19 / 0300 | Tropical Storm Watch issued | Punta el Lagarto to Barra de Nautla |
| 19 / 0900 | Tropical Storm Watch changed to Tropical Storm Warning | Punta el Lagarto to Barra de Nautla |
| 20 / 0000 | Tropical Storm Warning modified to | Punta el Lagarto to Tuxpan |
| 20 / 2100 | Tropical Storm Warning discontinued | All |

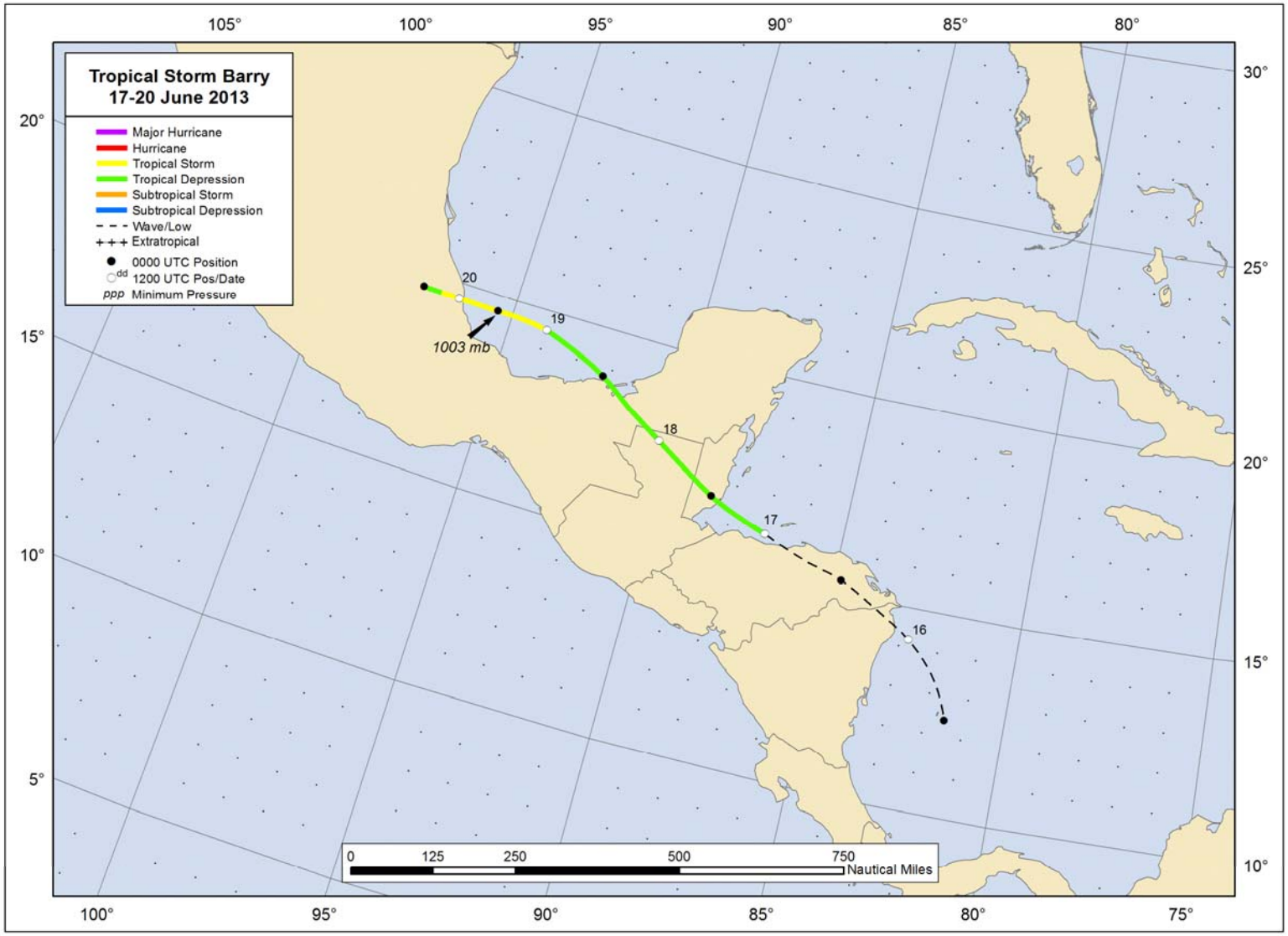


Figure 1. Best track positions for Tropical Storm Barry, 17-20 June 2013.

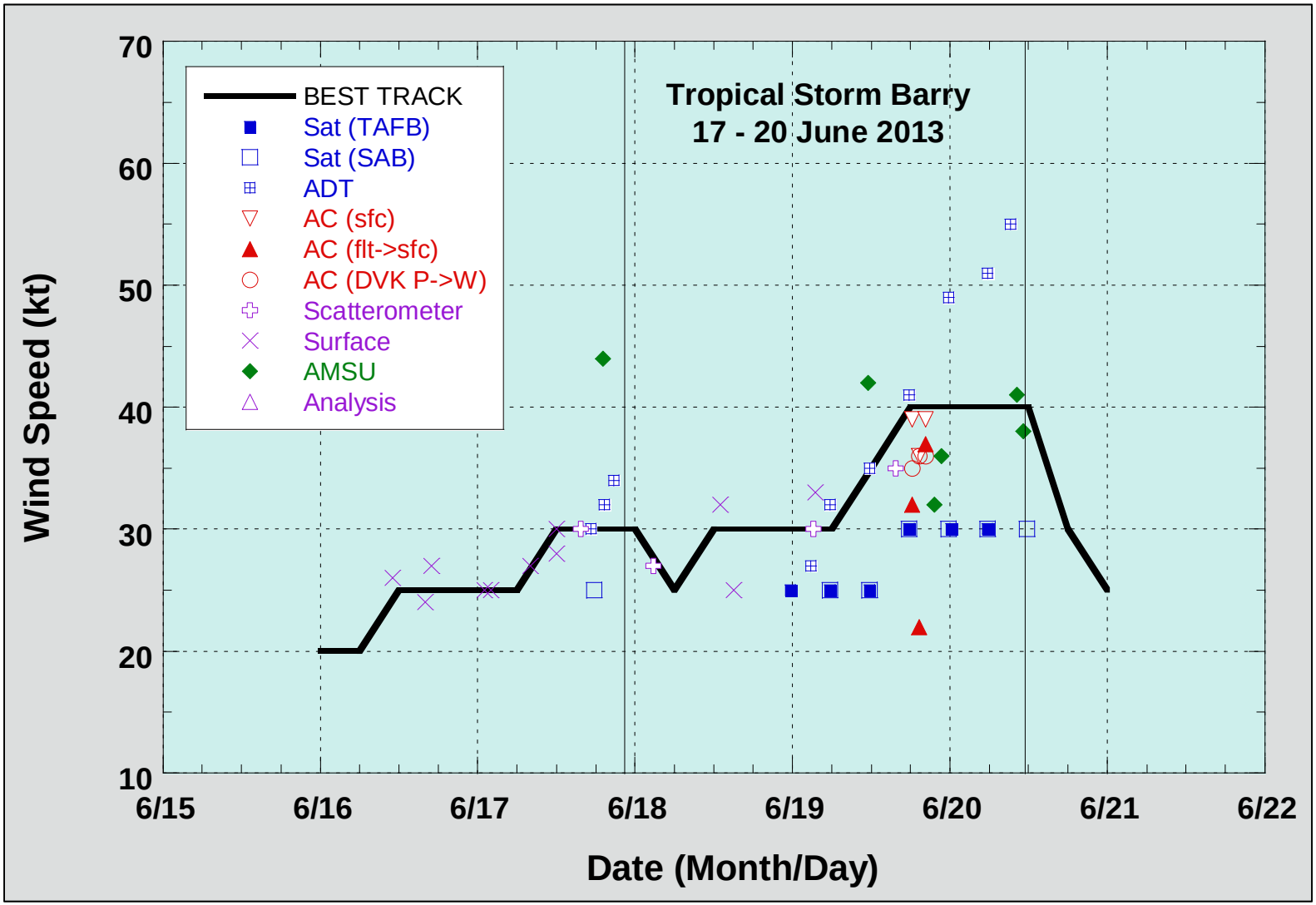


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Barry, 17-20 June 2013. Aircraft observations have been adjusted for elevation using an 80% adjustment factor for observations from 1500 ft, respectively. Advanced Dvorak Technique estimates 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, and solid vertical lines correspond to landfalls.

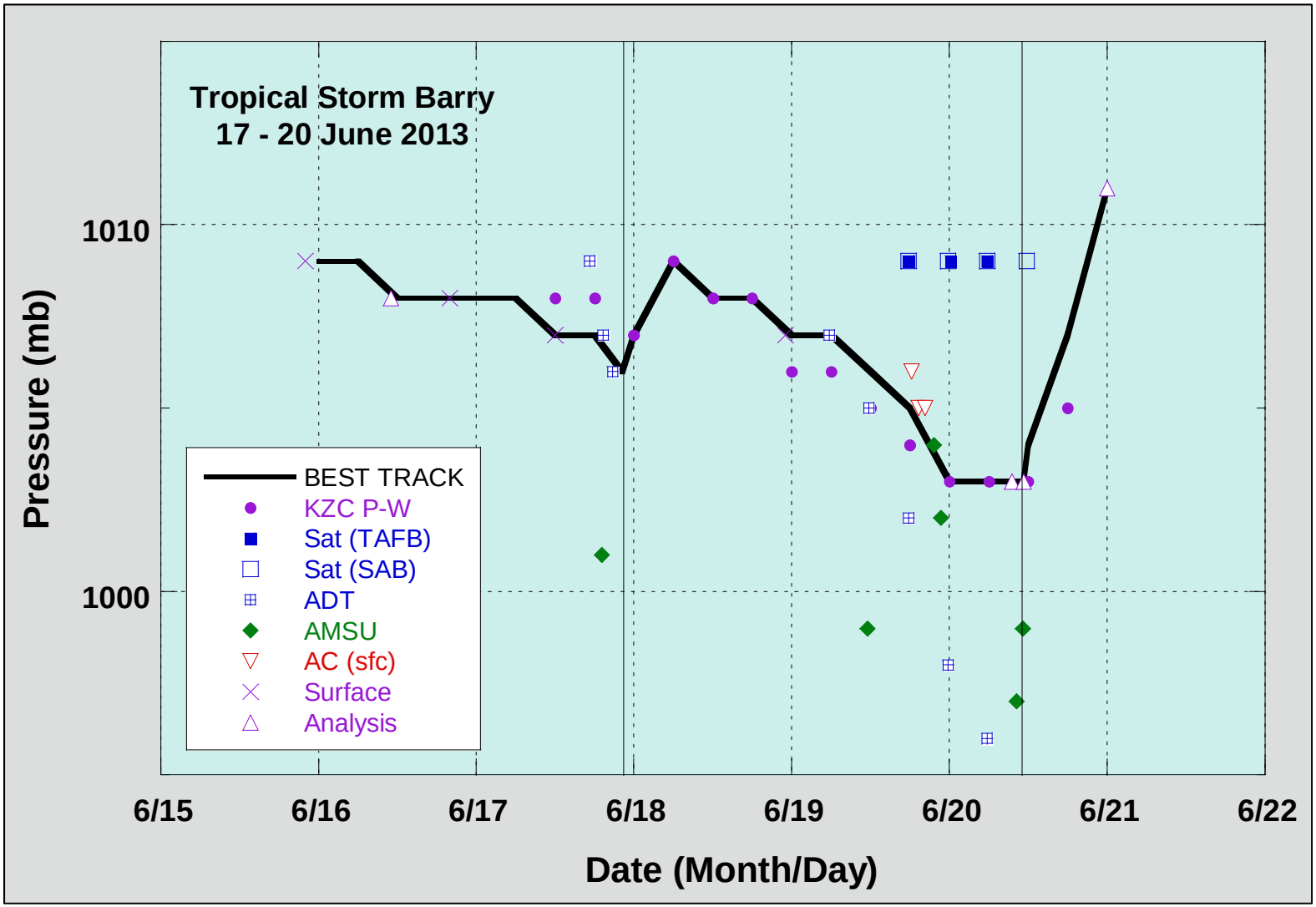


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Barry, 17-20 June 2013. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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, and solid vertical lines correspond to landfalls.