NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM BERTHA

(AL022020)

27–28 May 2020

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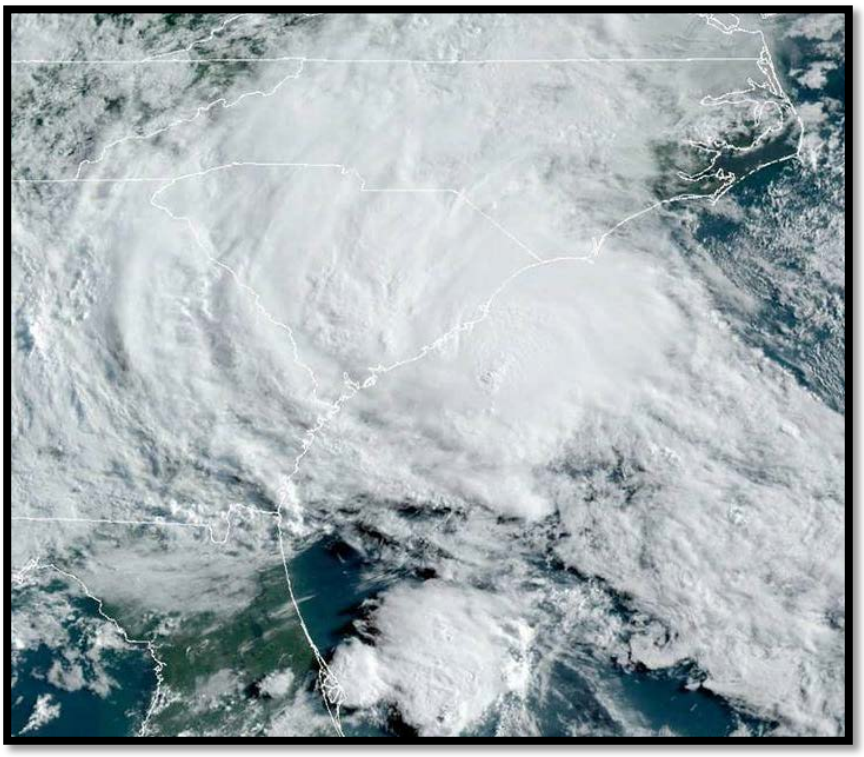

GOES-16 GEOCOLOR SATELLITE IMAGE OF TROPICAL STORM BERTHA AT 1206 UTC 27 MAY 2020.

Bertha was a short-lived pre-season tropical storm that formed just off the coast of the southeast U.S. and made landfall in South Carolina. The storm produced mostly minor damage.

Tropical Storm Bertha

27–28 MAY 2020

SYNOPTIC HISTORY

The origins of Bertha appear to be from an upper-level disturbance and associated surface trough that developed over the southeastern Gulf of Mexico late on 24 May. The surface trough moved slowly northeastward, and the combination of low-level convergence, a stream of tropical moisture and upper-level diffluence aided in the development of widespread showers and thunderstorms across portions of Florida, the Bahamas, and the adjacent waters of the Gulf of Mexico and the western Atlantic during the next day or two. On 26 May, a weak and elongated low developed over central and northeastern Florida, but the associated showers and thunderstorms remained disorganized. It wasn't until the system was very near the Georgia and South Carolina coasts that it developed a well-defined center and enough organized deep convection to be considered a tropical cyclone by 0600 UTC 27 May. It should be noted that Bertha had characteristics of both a tropical and subtropical cyclone at the time of its formation. However, given the system's small radius of maximum winds and central convection, it is designated as a tropical cyclone. At the time of genesis, Bertha was producing maximum winds of 40 kt. The "best track" chart of Bertha'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]

After formation, Bertha strengthened slightly and reached its peak intensity of 45 kt by 1200 UTC 27 May, when it was located about 30 n mi east-southeast of Charleston, South Carolina (cover image). Bertha was a compact cyclone with well-defined curved bands evident in Doppler radar images just before landfall (Fig 4.). The tropical storm maintained the 45-kt intensity when it made landfall around 1330 UTC that day near the Isle of Palms, South Carolina. After landfall, the small storm quickly weakened as it moved northwestward and then northward along the western periphery of a subtropical ridge. Bertha weakened to a tropical depression by 1800 UTC that day and became an extratropical cyclone by 0600 UTC 28 May over western Virginia. The extratropical cyclone dissipated about 12 h later over the Ohio Valley.

METEOROLOGICAL STATISTICS

Observations in Bertha (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB). Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU),

[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.

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 Bertha. The National Weather Service WSR-88D radar network provided data for tracking Bertha across the far western Atlantic and the eastern United States.

Selected surface observations from land stations and data buoys are given in Table 2.

Winds and Pressure

The peak intensity of 45 kt is based on Doppler radar and buoy data. The minimum pressure of 1005 mb is based on two surface stations that reported pressures of 1005 mb and 1006 mb near the center of Bertha.

The highest reported sustained wind was 43 kt with a gust of 51 kt at an elevation of 4 m at NOAA buoy 41004, located about 30 n mi east of Edisto Beach, South Carolina. A wind gust of 39 kt and a minimum pressure of 1005.8 mb were reported at Coastal Ocean Research and Monitoring Program buoy 41029 at an elevation of 3 m, just offshore of Charleston. A National Ocean Service (NOS) observation in Lake Moultrie, South Carolina, reported a minimum pressure of 1005.4 mb when Bertha was very near that location (Table 2).

Storm Surge[2]

The storm surge flooding from Bertha was minor. The highest storm surge inundations were generally between 1 and 1.5 ft above ground level from northeastern Florida to southeastern North Carolina. The highest measured water levels were 1.32 ft above Mean Higher High Water (MHHW) by a NOS site at Wrightsville Beach, North Carolina, and 1.31 ft above MHHW by an NOS site at Ft. Pulaski, Georgia. The highest water level measured in South Carolina was 1.28 ft MHHW at Charleston. This resulted in minor coastal flooding in some locations.

Rainfall and Flooding

Bertha produced an area of 2 to 4 inches of rain, with isolated locations of 5 inches, across portions of eastern South Carolina (Table 2). Much higher rainfall amounts of up to 15 inches occurred across portions of southeastern Florida in association with the precursor disturbance of Bertha.

[2] Several terms are used to describe water levels due to a storm. **Storm surge** is defined as the abnormal rise of water generated by a storm, over and above the predicted astronomical tide, and is expressed in terms of height above normal tide levels. Because storm surge represents the deviation from normal water levels, it is not referenced to a vertical datum. **Storm tide** is defined as the water level due to the combination of storm surge and the astronomical tide, and is expressed in terms of height above a vertical datum, i.e. the North American Vertical Datum of 1988 (NAVD88) or Mean Lower Low Water (MLLW). **Inundation** is the total water level that occurs on normally dry ground as a result of the storm tide, and is expressed in terms of height above ground level. At the coast, normally dry land is roughly defined as areas higher than the normal high tide line, or Mean Higher High Water (MHHW).

Tornadoes

There were no tornadoes reported in association with Bertha.

CASUALTY AND DAMAGE STATISTICS

There were no reports of casualties associated with Bertha. The storm produced some areas of minor flood and tree damage near the landfall location in South Carolina. Several streets were flooded and temporarily closed in downtown Charleston. More notable flood damage occurred across portions of southeast Florida associated with the precursor disturbance of what became Bertha.

FORECAST AND WARNING CRITIQUE

The genesis of Tropical Storm Bertha was not well anticipated. Table 3 provides the number of hours in advance of formation associated with the first NHC Special Tropical Weather Outlook (TWO) forecast. A Special TWO was first issued on the afternoon of 25 May, about 39 h before genesis occurred, giving the system a low (<40%) chance of tropical cyclone formation during the next two and five days. Although the probability of genesis increased slightly before the cyclone formed, it failed to reach the medium or high categories. Bertha's genesis was challenging to forecast due to its short window of time to form before it interacted with the landmass of the southeastern United States.

Due to Bertha's short existence, there was only one verifying 12-h forecast. Thus, a comprehensive verification of official and guidance track and intensity forecast errors is not provided. The one official 12-h forecast had a track error of 24.5 n mi and an intensity error of 0.0 kt. These compare to the mean 12-h official track and intensity errors for the previous 5-yr period (2015–2019) of 24.1 n mi and 5.2 kt, respectively.

Watches and warnings associated with Bertha are given in Table 4. It should be noted that the tropical storm warning in South Carolina was short fused. As noted above, Bertha's genesis and strengthening to a tropical storm was not well anticipated.

Table 1. Best track for Tropical Storm Bertha, 27–28 May 2020.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
27 / 0600	31.5	78.8	1006	40	tropical storm
27 / 1200	32.6	79.5	1005	45	"
27 / 1330	32.9	79.7	1005	45	"
27 / 1800	33.7	80.1	1007	30	tropical depression
28 / 0000	34.9	80.7	1008	25	"
28 / 0600	37.1	81.1	1011	20	extratropical
28 / 1200	39.9	80.6	1011	20	"
28 / 1800					dissipated
27 / 1200	32.6	79.5	1005	45	maximum wind and minimum pressure
27 / 1330	32.9	79.7	1005	45	landfall near Isle of Palms, SC

Table 2. Selected surface observations for Tropical Storm Bertha, 27–28 May 2020.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)	Storm tide (ft)	Estimated Inundation (ft)	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
Buoys									
CARO-COOPS Nearshore (41029) (32.81N 79.63W)	27/1308	1005.8	27/1308	30 (3 m)	39				
NDBC Edisto (41004) (32.50N 79.10W)	27/1100	1009.2	27/1118	43 (4 m)	50				
United States									
South Carolina									
Pinopolis/Lake Moultrie National Ocean Service (PNOS1) (33.25N 80.03W)	27/1550	1005.4	27/1540	22	32				
Folly Beach Pier Weather Flow (XFOL) (32.65N 79.94W)	27/1344	1009.0	27/1024	31	37				
Winyah Bay Weather Flow (XWIN)	27/1506	1010.0	27/1511	38	46				
Murrells Inlet Weather Flow (XMUR)	27/1622	1012.0	27/1652	39	31				
National Ocean Service (NOS) Sites									
Charleston, Cooper City River Entrance	27/1400	1010.0				2.06		1.3	
Springmaid Pier	27/1836	1016.2				2.01		1.0	
Oyster Landing (N Inlet Estuary)						2.35		1.0	
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites									
Wadmalaw Island (SC-CR-98) (32.63N 80.20W)									4.66
Mount Pleasant (SC-CR-112) (32.90N 79.79W)									4.00
Kiawah Island (SC-CR-154) (32.60N 80.07W)									3.85
Kiawah River (SC-CR-189) (32.63N 80.12W)									3.72
Charleston (SC-CR-60) (32.72N 79.95W)									3.37
Pineville (SC-BK-29) (33.42N 80.03W)									3.19
Isle of Palms (SC-CR-166) (32.80N 79.76W)									2.88
Georgia									
NOS Sites									
Ft. Pulaski	27/0900	1011.9				1.98		1.3	
North Carolina									

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)	Storm tide (ft)	Estimated Inundation (ft)	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)				
NOS Sites									
Wrightsville Beach	27/1918	1015.0				1.42		1.3	

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Except as noted, sustained wind averaging periods for C-MAN and land-based reports are 2 min; buoy averaging periods are 8 min.

Table 3. Number of hours in advance of formation associated with the first NHC Special 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 (<40%)	39	39
Medium (40%-60%)	-	-
High (>60%)	-	-

Table 4. Tropical storm warning summary for Tropical Storm Bertha, 27–28 May 2020.

Date/Time (UTC)	Action	Location
27 / 1230	Tropical Storm Warning issued	Edisto Beach to South Santee River, SC
27 / 1800	Tropical Storm Warning discontinued	Edisto Beach to South Santee River, SC

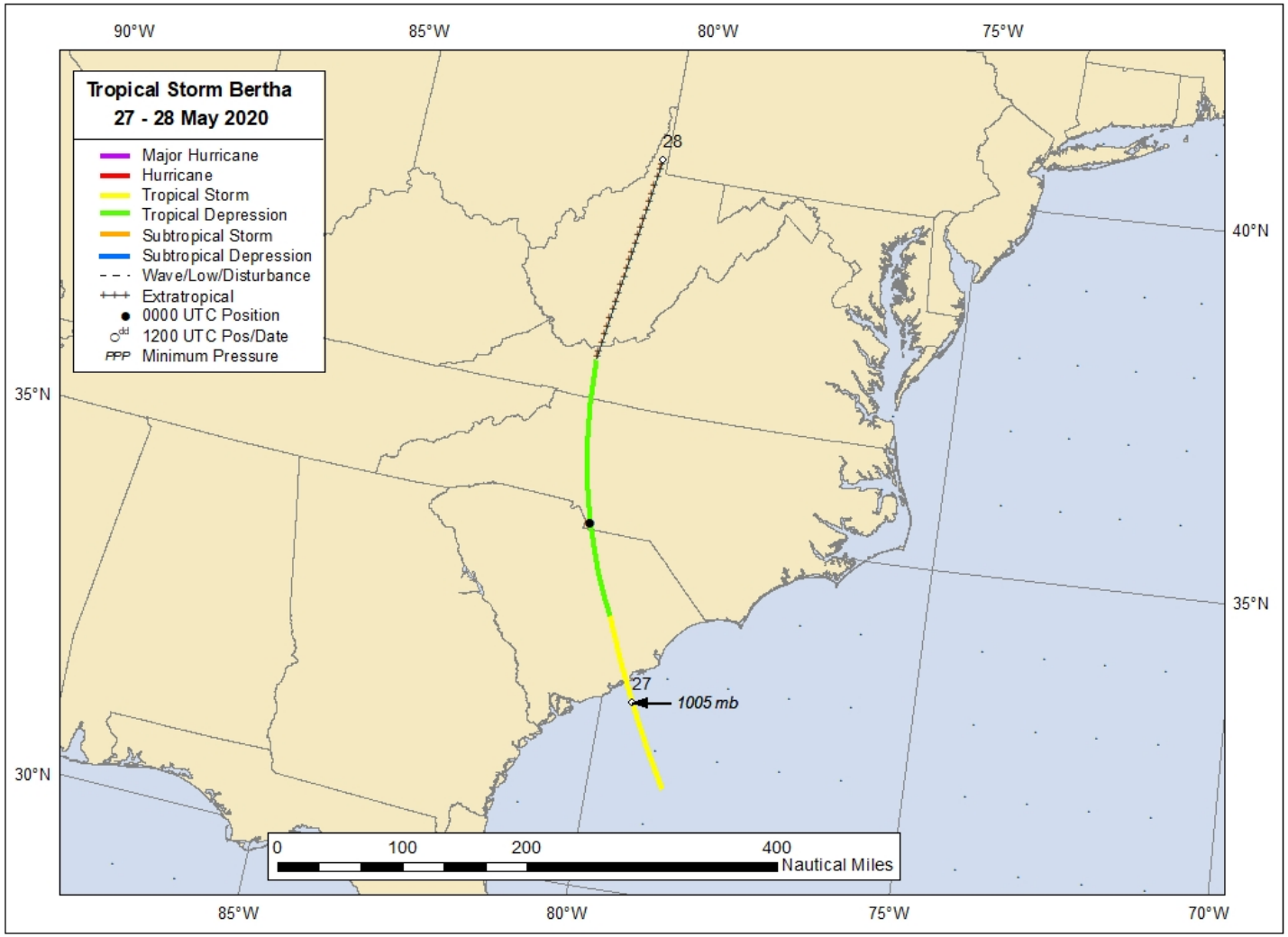

Figure 1. Best track positions for Tropical Storm Bertha, 27–28 May 2020. Tracks during the extratropical stage are partially based on analyses from the NOAA Weather Prediction Center.

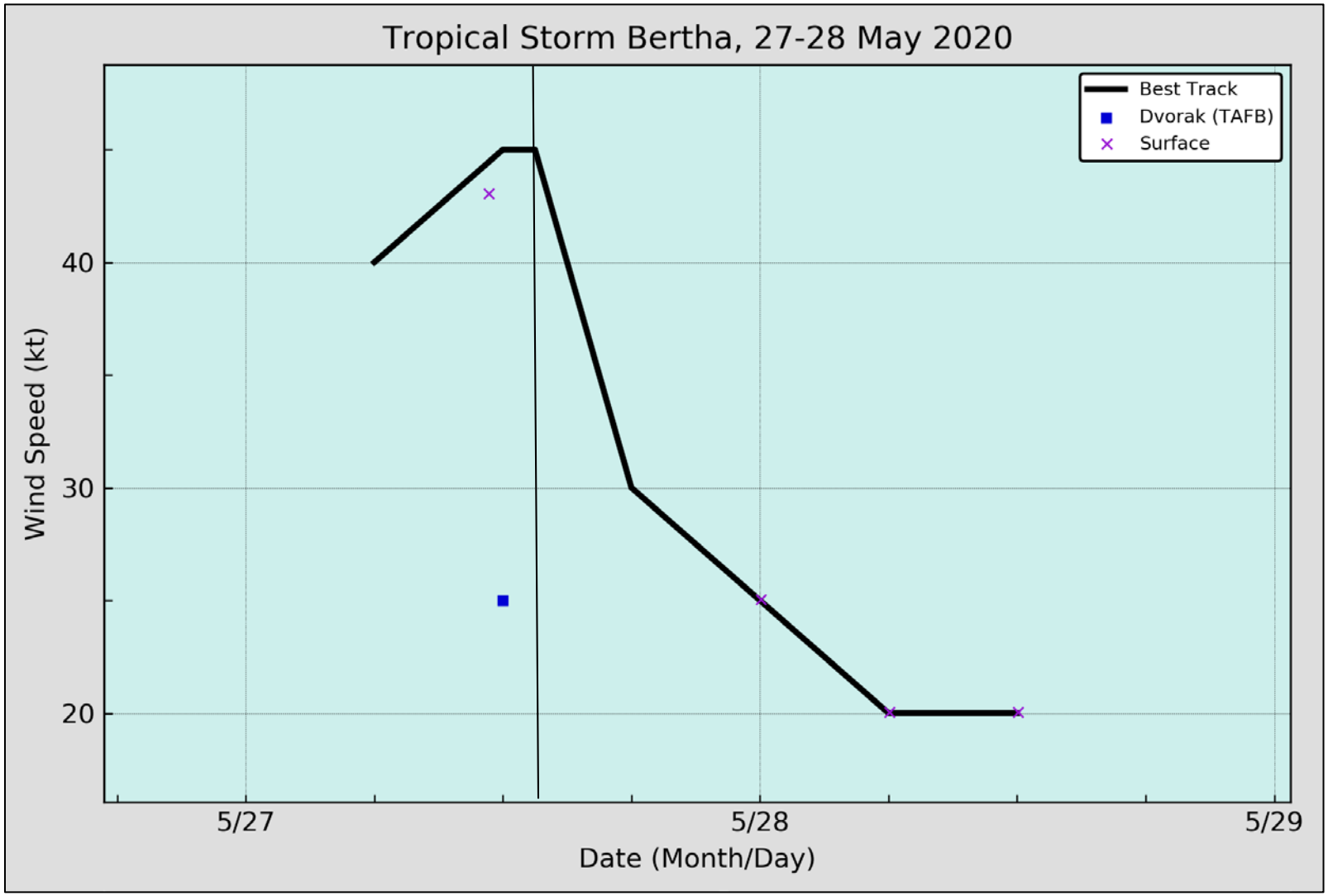

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Bertha, 27–28 May 2020. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line correspond to landfall.

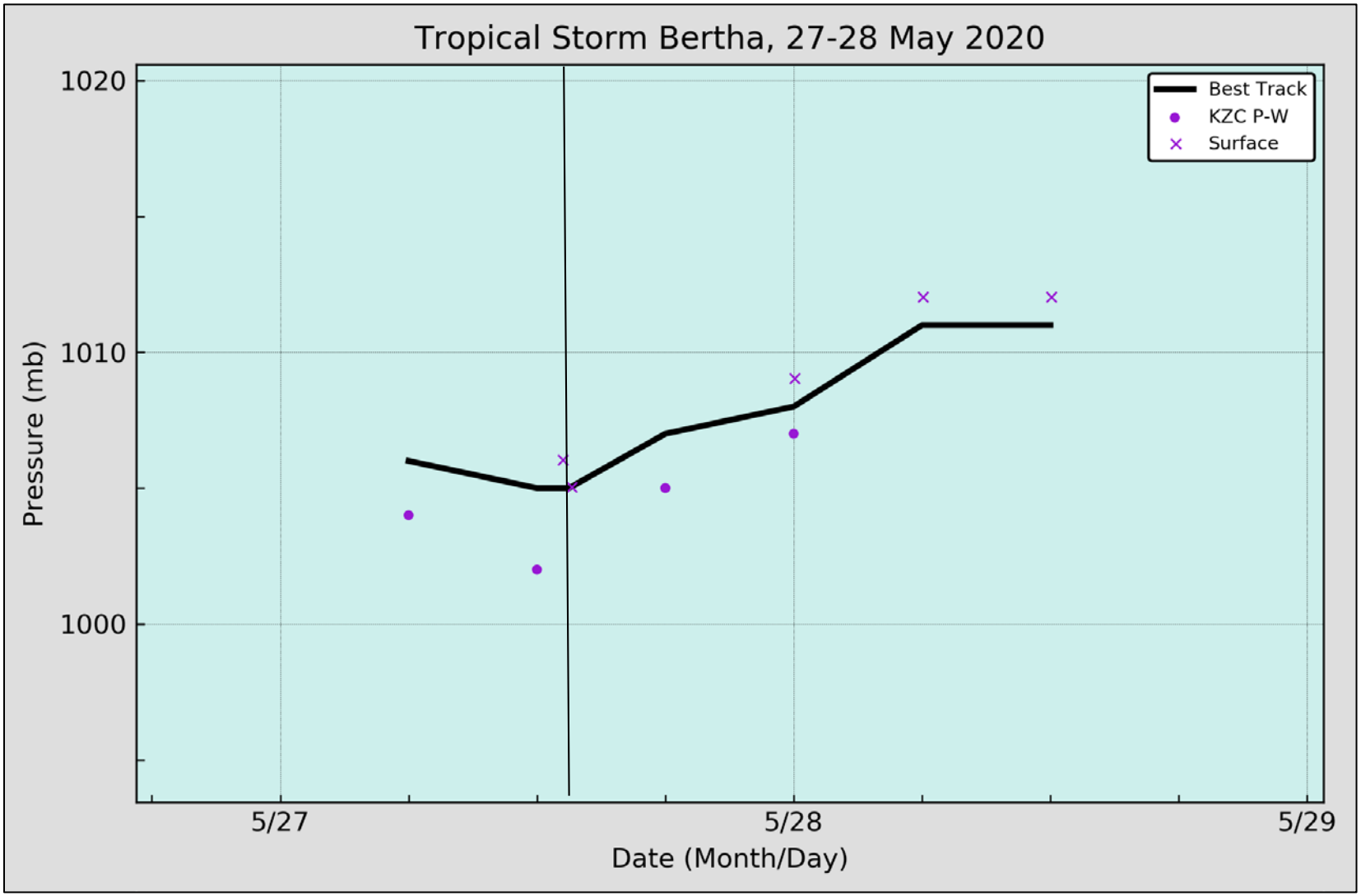

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Bertha, 27–28 May 2020. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and the solid vertical line correspond to landfall.

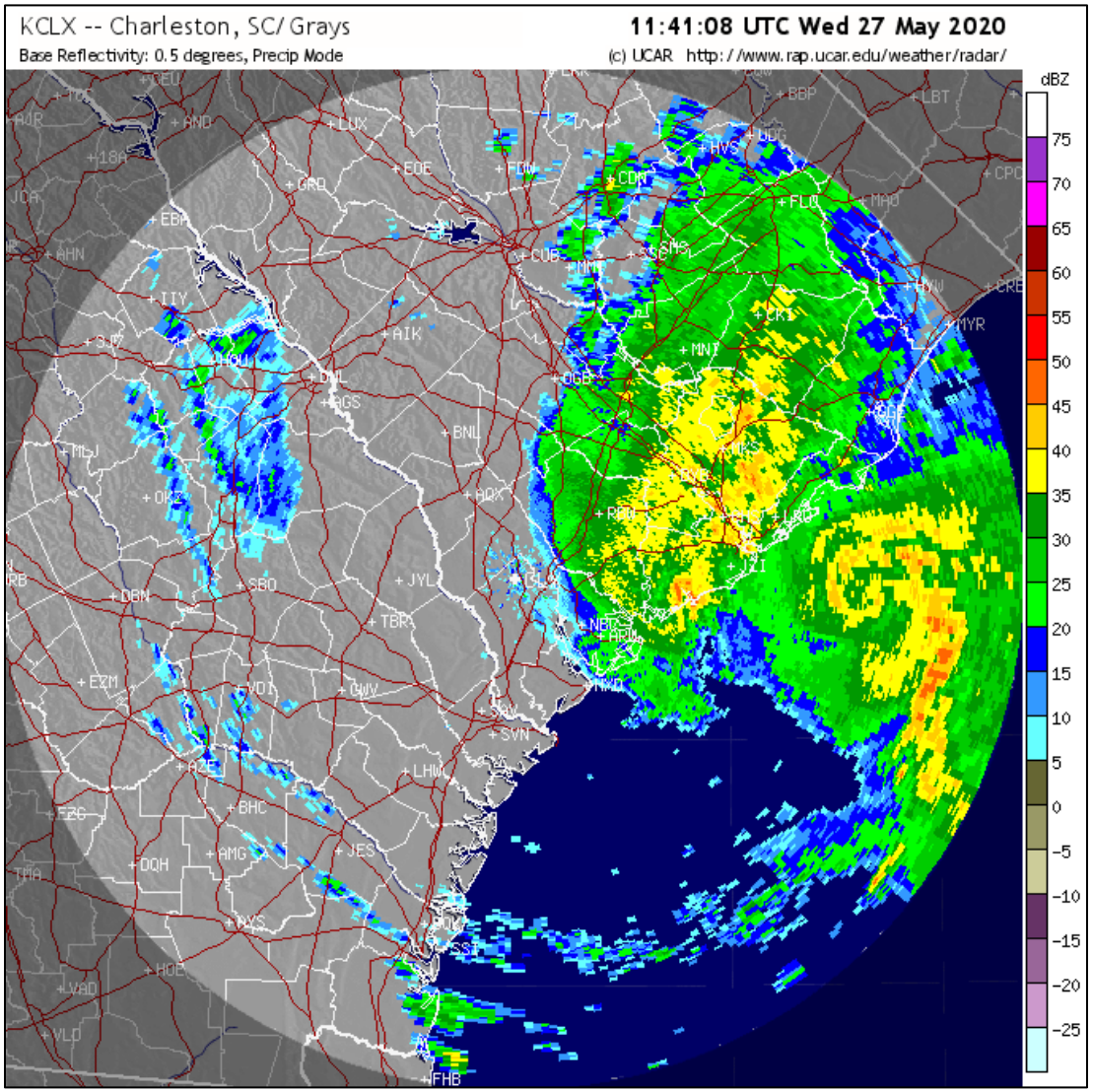

Figure 4. Doppler radar reflectivity image from Charleston, South Carolina, at 1141 UTC 27 May of Tropical Storm Bertha. Image courtesy of the University Corporation of Atmospheric Research.