

Tropical Cyclone Report
Hurricane Charley
9-14 August 2004

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Hurricane Charley strengthened rapidly just before striking the southwestern coast of Florida as a Category 4 hurricane on the Saffir-Simpson Hurricane Scale. Charley was the strongest hurricane to hit the United States since Andrew in 1992 and, although small in size, it caused catastrophic wind damage in Charlotte County, Florida. Serious damage occurred well inland over the Florida peninsula.

a. Synoptic History

A tropical wave emerged from western Africa on 4 August. Radiosonde data from Dakar showed that this wave was accompanied by an easterly jet streak of around 55 kt near the 650 mb level. The wave also produced surface pressure falls on the order of 5 mb over 24 h near the west coast of Africa. On satellite images this system was not particularly impressive just after crossing the coast, since it had only a small area of associated deep convection. As the wave progressed rapidly westward across the tropical Atlantic, the cloud pattern gradually became better organized, with cyclonic turning becoming more evident in the low clouds. The first center position estimates were given by the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB) in the vicinity of 9-10°N, 47°W at 2345 UTC 7 August, although at that time the system was still too weak to classify by the Dvorak technique. The first Dvorak T-numbers were assigned 24 h later, when the system was centered near 11°N, 55°W. Curved banding of the deep convection became better defined over the ensuing 12 h, and this, along with surface observations from the southern Windward Islands, indicated that a tropical depression had formed by 1200 UTC 9 August, centered about 100 n mi south-southeast of Barbados. Figure 1 depicts the “best track” of the tropical cyclone’s path. The wind and pressure histories are shown in Figs. 2 and 3, respectively. Table 1 is a listing of the best track positions and intensities.

Late on 9 August, the depression moved into the southeastern Caribbean Sea. A strong deep-layer high pressure area to the north of the tropical cyclone induced a swift west-northwestward motion, at 20-24 kt. With low vertical shear and well-established upper-level outflow, the depression strengthened into Tropical Storm Charley early on 10 August. Fairly steady strengthening continued while the storm moved into the central Caribbean Sea, and when Charley approached Jamaica on 11 August, it became a hurricane. By this time, the forward speed had slowed to about 14 kt. Charley’s core remained offshore of Jamaica; the center passed about 35 n mi southwest of the southwest coast of the island around 0000 UTC 12 August. The hurricane then turned northwestward, and headed for the Cayman Islands and western Cuba. It continued to strengthen, reaching Category 2 status around 1500 UTC 12 August, just after passing about 15 n mi northeast of Grand Cayman. As Charley neared the western periphery of a mid-tropospheric ridge, it turned toward the north-northwest, its center passing about 20 n mi east of the east coast of the Isle of Youth at 0000 UTC 13 August. The eye of the hurricane crossed the south coast of western Cuba very near Playa del Cajío around 0430 UTC 13 August. Charley strengthened just before it hit western Cuba. Cuban radar and microwave imagery suggests that the eye shrank in size, and surface observations from Cuba indicate that the maximum winds were about 105 kt as it crossed the island. By 0600 UTC, the eye was emerging

from the north coast of Cuba, about 12 n mi west of Havana. Based on aerial reconnaissance observations, Charley weakened slightly over the lower Straits of Florida. Turning northward, the hurricane passed over the Dry Tortugas around 1200 UTC 13 August with maximum winds near 95 kt.

By the time Charley reached the Dry Tortugas, it came under the influence of an unseasonably strong mid-tropospheric trough that had dug from the east-central United States into the eastern Gulf of Mexico. In response to the steering flow on the southeast side of this trough, the hurricane turned north-northeastward and accelerated toward the southwest coast of Florida. It also began to intensify rapidly at this time. By 1400 UTC 13 August, the maximum winds had increased to near 110 kt. Just three hours later, Charley's maximum winds had increased to Category 4 strength of 125 kt. Since the eye shrank considerably in the 12 h before landfall in Florida, these extreme winds were confined to a very small area – within only about 6 n mi of the center. Moving north-northeastward at around 18 kt, Charley made landfall on the southwest coast of Florida near Cayo Costa, just north of Captiva, around 1945 UTC 13 August with maximum sustained winds near 130 kt. Charley's eye passed over Punta Gorda at about 2045 UTC, and the eyewall struck that city and neighboring Port Charlotte with devastating results. Continuing north-northeastward at a slightly faster forward speed, the hurricane traversed the central Florida peninsula, resulting in a swath of destruction across the state. The center passed near Kissimmee and Orlando around 0130 UTC 14 August, by which time the interaction with land caused the maximum sustained winds to decrease to around 75 kt. Charley was still of hurricane intensity, with maximum sustained winds of 65-70 kt, when the center moved off the northeast coast of Florida near Daytona Beach at around 0330 UTC 14 August.

After moving into the Atlantic, the hurricane re-strengthened slightly as it accelerated north-northeastward toward the coast of South Carolina. This re-intensification proved to be temporary, however. Charley came ashore again near Cape Romain, South Carolina at about 1400 UTC 14 August as a weakening hurricane with highest winds of about 70 kt. The center then moved just offshore before making another landfall at North Myrtle Beach, South Carolina at around 1600 UTC 14 August, with intensity near 65 kt. Charley soon weakened to a tropical storm over southeastern North Carolina, and began to interact with a frontal zone associated with the same strong trough which had recurved it over Florida. By 0000 UTC 15 August, as the center was moving back into the Atlantic in the vicinity of Virginia Beach, Virginia, synoptic data indicate that the cyclone had become embedded in the frontal zone and was, therefore, an extratropical system. Charley's extratropical remnant moved rapidly north-northeastward to northeastward, and became indistinct within the frontal zone near southeastern Massachusetts just after 1200 UTC 15 August.

b. Meteorological Statistics

Observations in Charley (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB) and the U. S. Air Force Weather Agency (AFWA), as well as flight-level and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command (AFRES). Microwave satellite imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites were also helpful in monitoring Charley. Finally, National Weather Service doppler radars were extremely useful for tracking this tropical cyclone. Figure 4 is a radar image of Charley around the time of landfall on 13 August from the Tampa radar, and shows the very small, well-defined eye of the hurricane.

Ship reports of winds of tropical storm force associated with Charley are given in Table 2, and selected surface observations from land stations and data buoys are given in Tables 3, 4, and 5. Charley destroyed instruments at the C-MAN observing site at Dry Tortugas.

Charley deepened extremely rapidly as it approached the southwest coast of Florida. Based on dropsonde measurements on 13 August from the AFRES, the central pressure fell from 964 mb at 1522 UTC to 941 mb at 1957 UTC, around the time of landfall, a deepening rate of about 5.02 mb h^{-1} . The hurricane's peak intensity is estimated to be 130 kt, which occurred at landfall in Cayo Costa, FL. This estimate is based on maximum 700 mb flight-level winds of 148 kt measured in the southeastern quadrant of the hurricane's eyewall at 1955 UTC 13 August. As usual, there were no official surface anemometer measurements of wind speeds even approaching the intensity estimate near the landfall location. The wind sensor at the Punta Gorda ASOS site, which experienced the eyewall of Charley, stopped reporting after measuring a sustained wind of 78 kt at 2034 UTC with a gust to 97 kt at 2036 UTC. Ten minutes later, that site reported its lowest pressure, 964.5 mb. Since it is presumed that the center was closest to the Punta Gorda site at the time of lowest pressure, and since Charley's maximum winds covered an extremely small area, it is highly likely that much stronger winds would have been observed at the site, had the wind instrument not failed. Instrument failures remain a chronic problem in landfalling hurricanes. Based on the few wind sensors that did *not* fail, Charley carried strong winds well inland along its path across the Florida peninsula. For example, Orlando International Airport measured sustained winds of hurricane force (69 kt), with a gust to 91 kt.

Observations from Cuba (Table 3) indicate that Charley was of category 3 intensity as it crossed the island. Radar and microwave imagery suggest that the hurricane was strengthening as it approached the south coast of Cuba. Storm surge heights of 13.1 ft were determined from high water marks at Playa Cajio on the south coast.

Rainfall totals of up to about 5 inches were reported in western Cuba. Maximum rainfall totals from gauges in Florida ranged up to a little over 5 inches, but radar-estimated storm total precipitation over central Florida were as high as 6 to 8 inches. Rainfall totals of 5 to 7 inches, locally a little higher, were observed over portions of eastern South Carolina and eastern North Carolina.

There were nine tornadoes reported across the Florida peninsula in association with Charley, all of which occurred on 13 August. There was 1 tornado in Lee County (a waterspout that moved onshore), 1 in Hendry County, 1 in DeSoto County, 1 in Hardee County, 2 in Polk County, 1 in Osceola County, and 2 in Volusia County. The strongest tornado was in south Daytona Beach. This tornado struck around 2326 UTC, and produced a quarter mile long track of F1 damage. There were five tornadoes reported in eastern North Carolina on 14 August, in Onslow, Pitt, (mainland) Hyde, Tyrrell, and (Outer Banks) Dare Counties. The tornado in Dare County produced F1 damage in Kitty Hawk. There were also two tornadoes observed in Virginia, in Chesapeake and Virginia Beach.

A storm surge of 4.2 feet was measured by a tide gauge in Estero Bay, near Horseshoe Key. This is near Fort Myers Beach. Storm surges of 3.4 and 3.6 feet were measured on tide gauges on the Caloosahatchee River, near Fort Myers. There were also visual estimates of storm surges of 6 to 7 feet on Sanibel and Estero Islands.

c. Casualty and Damage Statistics

Charley was directly responsible for 10 deaths in the United States. In Charlotte County, Florida a husband and wife, who were in a mobile home destroyed by the hurricane, were killed,

and two men died after being struck by flying debris. In Lee County, Florida, a man died as a result of a tree falling onto the structure he was in. In Sarasota County, Florida, the severe weather associated with Charley caused a woman to drive off the road and hit a tree, resulting in her death. In DeSoto County, Florida, a man was killed while in a tool shed hit by strong winds. In Orange County, Florida, a girl died as a result of strong winds blowing a moving van into the vehicle she was in, and in Polk County, Florida, a man drowned when he drove off of a flooded highway into a lake. In Rhode Island, a man drowned in a rip current. There were also 4 deaths in Cuba and 1 in Jamaica. Therefore, the direct death toll due to Charley stands at 15. An additional 25 U.S. deaths, 24 in Florida and 1 in South Carolina, were indirectly caused by Charley.

There are two estimates of insured damages in the United States from Hurricane Charley. The Property Claims Service reports insured damages of 6.755 billion dollars in Florida, 25 million dollars in North Carolina and 20 million dollars in South Carolina, making a total of 6.8 billion dollars in insured losses. The Insurance Information Institute reports an estimated total of 7.4 billion dollars in insured losses. Using a two to one ratio of total damages to these two insured damage amounts, a rough preliminary estimate of the total damage is 14 billion dollars. This would make Charley the second costliest hurricane in U.S. history.

d. Forecast and Warning Critique

Average official track errors (with the number of cases in parentheses) for Charley were 37 (20), 71 (18), 89 (16), 83 (14), 176 (10), 459 (6), and 777 (2) n mi for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. In comparison, the longer-term average official track errors for the 10-yr period 1994-2003¹ are 44, 78, 112, 146, 217, 248, and 319 n mi. So the mean official track forecasts for Charley were better than the 10-yr average through 72 h, and significantly worse at 96 h and 120 h. It should be noted that there were very few forecasts to verify for the latter two forecast times, however. Table 6 lists the average errors from various numerical track prediction techniques for Charley. The GFS and FSU Superensemble generally performed best at hours 12-48, and the GFDL was best overall at 72-120 h – albeit for a small number of cases. Average official intensity errors were 7, 9, 14, 19, 25, 23 and 8 kt for the 12, 24, 36, 48, 72, 96, and 120 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1994-2003 are 6, 10, 12, 15, 19, 20, and 21 kt, respectively.

For about 24 h prior to hitting the United States, the official intensity forecasts called for Charley to strengthen from a category 2 to a category 3 hurricane by landfall on the west coast of Florida. A special advisory package was issued around 1800 UTC 13 August to report that Charley had strengthened into a category 4 hurricane. In this special advisory, a revised, eastward-shifted, track forecast was also issued, to account for a modest (by historical measures) deviation from the forecast track.

Although the official track forecasts for the landfall of Charley on the Florida west coast did, in general, have a left bias, the hurricane made landfall within the area covered by the hurricane watch and warning. One day prior to the Florida landfall, the 24-h track forecast error was 40 n mi, which is below the long-term average. Table 7 lists all of the watches and warnings issued for Charley. It can be seen that a hurricane watch was issued for the southwest coast of Florida, including the landfall location, just less than 35 h prior to landfall on that coast. A hurricane warning was issued for the same area just less than 23 h prior to landfall. No one near the landfall location should have been surprised by the arrival of this hurricane.

¹ Errors given for the 96 and 120 h periods are averages over the three-year period 2001-3.

Table 1. Best track for Hurricane Charley, 9-14 August 2004.

| Date/Time (UTC) | Latitude (°N) | Longitude (°W) | Pressure (mb) | Wind Speed (kt) | Stage |
|-----------------|---------------|----------------|---------------|-----------------|--|
| 09 / 1200 | 11.4 | 59.2 | 1010 | 30 | tropical depression |
| 09 / 1800 | 11.7 | 61.1 | 1009 | 30 | " |
| 10 / 0000 | 12.2 | 63.2 | 1009 | 30 | " |
| 10 / 0600 | 12.9 | 65.3 | 1007 | 35 | tropical storm |
| 10 / 1200 | 13.8 | 67.6 | 1004 | 40 | " |
| 10 / 1800 | 14.9 | 69.8 | 1000 | 45 | " |
| 11 / 0000 | 15.6 | 71.8 | 999 | 55 | " |
| 11 / 0600 | 16.0 | 73.7 | 999 | 55 | " |
| 11 / 1200 | 16.3 | 75.4 | 995 | 60 | " |
| 11 / 1800 | 16.7 | 76.8 | 993 | 65 | hurricane |
| 12 / 0000 | 17.4 | 78.1 | 992 | 65 | " |
| 12 / 0600 | 18.2 | 79.3 | 988 | 75 | " |
| 12 / 1200 | 19.2 | 80.7 | 984 | 80 | " |
| 12 / 1800 | 20.5 | 81.6 | 980 | 90 | " |
| 13 / 0000 | 21.7 | 82.2 | 976 | 90 | " |
| 13 / 0600 | 23.0 | 82.6 | 966 | 105 | " |
| 13 / 1200 | 24.4 | 82.9 | 969 | 95 | " |
| 13 / 1400 | 24.9 | 82.8 | 965 | 110 | " |
| 13 / 1700 | 25.7 | 82.5 | 954 | 125 | " |
| 13 / 1800 | 26.1 | 82.4 | 947 | 125 | " |
| 14 / 0000 | 28.1 | 81.6 | 970 | 75 | " |
| 14 / 0600 | 30.1 | 80.8 | 993 | 75 | " |
| 14 / 1200 | 32.3 | 79.7 | 988 | 65 | " |
| 14 / 1800 | 34.5 | 78.1 | 1000 | 60 | tropical storm |
| 15 / 0000 | 36.9 | 75.9 | 1012 | 40 | extratropical |
| 15 / 0600 | 39.3 | 73.8 | 1014 | 35 | " |
| 15 / 1200 | 41.2 | 71.1 | 1018 | 30 | " |
| 15 / 1800 | | | | | merged with front |
| 13 / 0430 | 22.7 | 82.6 | 966 | 105 | landfall on south coast of Cuba near Playa del Cajio |
| 13 / 1945 | 26.6 | 82.2 | 941 | 130 | landfall near Cayo Costa, FL, and minimum pressure |
| 13 / 2045 | 26.9 | 82.1 | 942 | 125 | Landfall near Punta Gorda, FL |
| 14 / 1400 | 33.0 | 79.4 | 992 | 70 | landfall near Cape Romain, SC |
| 14 / 1600 | 33.8 | 78.7 | 997 | 65 | landfall near North Myrtle Beach, SC |

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Charley, 9-14 August 2004.

| Date/Time (UTC) | Ship call sign | Latitude (°N) | Longitude (°W) | Wind dir/speed (kt) | Pressure (mb) |
|-----------------|----------------|---------------|----------------|---------------------|---------------|
| 10 / 0600 | 3FPS9 | 19.4 | 66.6 | 130 / 98 | 1018.0 |
| 10 / 2100 | WCZ523 | 16.1 | 70.2 | 110 / 47 | 1010.0 |
| 11 / 0100 | 41545 | 22.1 | 71.1 | missing / 39 | 1018.7 |
| 13 / 0900 | C6YC | 23.4 | 82.0 | 160 / 55 | 1008.0 |
| 13 / 1200 | C6YC | 23.2 | 82.9 | 230 / 52 | 1009.0 |
| 14 / 0600 | WDA406 | 29.1 | 77.4 | 130 / 35 | 1018.0 |
| 14 / 1200 | WDA406 | 28.9 | 78.6 | 150 / 35 | 1017.1 |
| 14 / 1500 | WGMJ | 31.7 | 77.6 | 180 / 38 | 1018.3 |
| 15 / 0300 | A8BZ6 | 37.0 | 74.6 | 220 / 42 | 1017.0 |

Table 3. Selected surface observations for Hurricane Charley, 9-14 August 2004.

| Location | Minimum Sea Level Pressure | | Maximum Surface Wind Speed | | | Storm surge (ft) ^c | Storm tide (ft) ^d | Total rain (in) |
|-----------------------------------|----------------------------|-------------|------------------------------|-----------------------------|-----------|-------------------------------|------------------------------|-----------------|
| | Date/time (UTC) | Press. (mb) | Date/time (UTC) ^a | Sustained (kt) ^b | Gust (kt) | | | |
| Grand Cayman Islands | | | | | | | | |
| Grand Cayman | 12/1300 | 1008.2 | 12/1142 | 21 | 34 | | | 0.90 |
| Cayman Brac | 12/0800 | 1008 | 12/1615 | 35 | 49 | | | 0.12 |
| Cuba | | | | | | | | |
| Punta del Este | 13/0000 | 1001.7 | 13/0100 | 36 | 45 | | | 4.95 |
| Nueva Gerona | 13/0200 | 1006.2 | 13/0045 | 39 | 49 | | | 1.95 |
| San Antonio de los Banos | 13/0453 | 989.4 | 13/0453 | 97 | 115 | | | |
| Guira de Melena | 13/0459 | 971.6 | 13/0450 | 92 | 116 | | | 3.88 |
| Bauta | 13/0530 | 971.0 | | | | | | 3.34 |
| Playa Baracoa | 13/0605 | 974 | 13/0530 | 103 | 130 | | | |
| Santiago de las Vegas | 13/0501 | 990.7 | 13/0620 | 63 | 79 | | | 4.19 |
| Casa Blanca | 13/0530 | 1001.7 | 13/0630 | 61 | 76 | | | 2.22 |
| Playa Cajio | | | | | | 13.1 | | |
| Florida | | | | | | | | |
| Key West (KEYW) | 13/1153 | 1009.8 | 13/1413 | 42 | 50 | | | 1.44 |
| Key West Naval Air Station (KNQX) | 13/1155 | 1010.2 | 13/1255 | 34 | 45 | | | 1.23 |
| Marathon (KMTH) | 13/0953 | 1012.4 | 13/1506 | | 34 | | | 0.53 |
| Summerland Key (NWS Handar) | | | 13/1250 | 29 | 45 | | | 0.30 |
| Big Pine Key (NWS Handar) | | | 13/1350 | 31 | 39 | | | 0.37 |
| Naples (*) (KAPF) | 13/1905 | 1004.4 | 13/1806 | 38 | 48 | | | 1.75 |
| Everglades City (KEGC) | | | 13/1801 | 40 | 55 | | | |
| Flamingo (KFLM) | | | 13/1606 | 38 | 47 | | | |
| Miami (KMIA) | 13/1941 | 1013 | 13/1710 | 26 | 34 | | | 0.47 |
| Fort Lauderdale (KFLL) | 13/1929 | 1010 | 13/1900 | 25 | 33 | | | 0.41 |
| West Palm Beach (KPBI) | 13/2045 | 1013 | 13/2000 | 26 | 33 | | | 0.40 |
| Brighton Reservation CO-OP | | | | | | | | 1.92 |
| Clewiston CO-OP | | | | | | | | 1.65 |
| Devils Garden CO-OP | | | | | | | | 1.75 |

| | | | | | | | | |
|---------------------------------------|---------|--------|---------|----|----|------|------|-------|
| Marco Island CO-OP | | | | | | | | 1.04 |
| Golden Gate CO-OP | | | | | | | | 2.08 |
| Punta Gorda (KPGD)* | 13/2046 | 964.5 | 13/2034 | 78 | 97 | | | |
| Fort Myers (KFMY) | 13/1953 | 998.1 | 13/2009 | 43 | 66 | | | |
| Fort Myers (KRSW) | 13/1957 | 1001.4 | 13/1949 | 53 | 68 | | | |
| Sarasota (KSRQ) | 13/2121 | 1003.4 | 13/0801 | 27 | 31 | | | |
| St. Petersburg (KPIE) | 13/2259 | 1008.5 | 13/2205 | 22 | 28 | | | |
| St. Petersburg (KSPG) | 13/2242 | 1007.1 | 13/0850 | 27 | 32 | | | |
| Tampa (KTPA) | 13/2332 | 1007.8 | 13/2257 | 20 | 26 | | | |
| Winter Haven (KGIF) | 13/2305 | 1000.3 | 13/2302 | 41 | 54 | | | |
| Kissimmee (KISM)* | | | 14/0035 | 53 | 65 | | | 5.20 |
| Orlando (KMCO)* | 14/0139 | 984.2 | 14/0134 | 69 | 91 | | | 2.11 |
| Orlando (KORL)* | 14/0129 | 980.7 | 14/0129 | 57 | 74 | | | 2.37 |
| Sanford (KSFB)* | 14/0213 | 983.4 | 14/0210 | 63 | 80 | | | 3.49 |
| Lessburg (KLEE) | 14/0158 | 1005.1 | 14/0135 | 29 | 34 | | | |
| Patrick AFB (KCOF) | | | 14/0044 | 28 | 43 | | | |
| Daytona Beach (KDAB)* | | | 14/0353 | 48 | 72 | | | 3.43 |
| Ormond Beach (KOMN) | | | 14/0315 | 59 | 76 | | | |
| Melbourne (KMLB) | 14/0100 | 1010.5 | 14/0222 | 29 | 39 | | | 1.44 |
| Ft. Pierce (KFPR) | | | 13/1910 | 21 | 26 | | | |
| Stuart (KSUA) | | | 13/1955 | 20 | 31 | | | |
| Vero Beach (KVRB) | | | 14/0136 | 23 | 30 | | | |
| Gainesville (KGNV) | 14/0442 | 1011.6 | 14/1952 | 10 | 13 | | | 0.04 |
| Jacksonville (KJAX) | 14/0612 | 1009.9 | 14/0358 | 17 | 20 | | | |
| Craig Field (Jacksonville) (KCRG) | 14/0521 | 1008.2 | 14/0501 | 21 | 29 | | | |
| NAS Jacksonville (KNIP) | 14/0456 | 1012.4 | 14/0433 | 30 | 34 | | | |
| NAS Mayport (KNRB)* | 14/0529 | 1007.2 | 14/0430 | 37 | 46 | | | |
| Fernandina Beach NOS | 14/0700 | 1008.5 | 14/0742 | 18 | 28 | 0.89 | 2.68 | 0.67* |
| Mayport NOS | 14/0700 | 1008.3 | 14/0500 | 30 | 42 | 1.61 | 2.19 | |
| Vilano Beach NOS (29.9°N 81.3°W) | | | 14/0500 | 27 | 44 | | | |
| Bings Landing NOS (29.6°N 81.2°W) | 14/0500 | 1000.6 | 14/0500 | 18 | 57 | | | |
| Crescent Beach NOS (29.8°N 81.3°W) | | | 14/0500 | 26 | 58 | | | |
| Georgia | | | | | | | | |
| St. Simons Island (KSSI) | 14/0723 | 1009.5 | 14/0654 | 18 | 22 | 0.68 | 3.82 | |
| Alma (KAMG) | 14/0747 | 1012.9 | 14/2103 | 8 | 11 | | | 0.01 |

| | | | | | | | | |
|-----------------------------|---------|--------|---------|-----|-----|--|--|------|
| Baxley CO-OP | | | | | | | | 0.51 |
| Savannah (KSAV) | 14/1024 | 1012 | 14/1143 | 13 | 17 | | | 0.53 |
| South Carolina | | | | | | | | |
| Charleston (KCHS) | 14/1258 | 1008 | 14/1322 | 25 | 33 | | | 1.02 |
| North Myrtle Beach (KCRE) | 14/1609 | 998 | 14/1538 | 36 | 50 | | | 1.52 |
| Myrtle Beach (KMYR) | | | 14/1550 | 35 | 45 | | | |
| Florence (KFLO) | 14/1552 | 1014 | 14/1742 | 20 | 25 | | | 0.03 |
| North Carolina | | | | | | | | |
| Wilmington (KILM) | 14/1750 | 1005 | 14/1731 | 48 | 64 | | | 2.02 |
| Southport (KSUT) | | | 14/1700 | 33 | 51 | | | 2.26 |
| Elizabethtown CO-OP | | | | | | | | 3.32 |
| Burgaw CO-OP | | | | | | | | 3.32 |
| Whiteville CO-OP | | | | | | | | 3.22 |
| New River (KNCA) | 14/1815 | 1008.1 | 14/1929 | 42 | 57 | | | |
| New Bern (KEWN) | 14/1900 | 1012.1 | 14/1847 | 34 | 46 | | | 1.26 |
| Cherry Point (KNKT) | 14/1855 | 1014.1 | 14/1857 | 31 | 44 | | | 2.08 |
| Beaufort (KMRH) | 14/1756 | 1017.1 | 14/1915 | 32 | 43 | | | 1.40 |
| Cape Hatteras (KHSE) | 14/2051 | 1017.4 | 14/2154 | 26 | 32 | | | 0.01 |
| Manteo (KMQI) | 14/2120 | 1015.1 | 14/2200 | | 35 | | | |
| Washington (KOCW) | 14/1900 | 1012.4 | 14/2001 | | 50 | | | |
| Edenton (KEDE) | | | 14/2140 | 38 | 56 | | | |
| Jacksonville (KOAJ) | 14/1835 | 1012.4 | 14/1835 | | 48 | | | 1.73 |
| Kinston (KISO) | 14/1920 | 1009 | 14/1920 | | 40 | | | |
| Greenville (KPGV) | 14/1901 | 1010.4 | 14/1921 | | 32 | | | |
| Elizabeth City (KECG) | 14/2106 | 1011 | 14/2249 | 38 | 56 | | | 2.30 |
| Greenville CO-OP | | | | | | | | 5.05 |
| Kinston CO-OP | | | | | | | | 4.38 |
| Richlands CO-OP | | | | | | | | 3.41 |
| Williamston CO-OP | | | | | | | | 2.50 |
| Ocracoke CO-OP | | | | | | | | 0.04 |
| Virginia | | | | | | | | |
| Norfolk (KORF) | 14/2305 | 1013 | 14/2208 | 31 | 39 | | | 3.72 |
| Norfolk NAS (KNGU) | 14/2356 | 1013 | 14/2314 | 27 | 38 | | | 2.66 |
| Newport News (KPHF) | | | 14/2218 | 16 | 27 | | | 2.34 |
| Hampton- Langley AFB (KLF1) | | | 14/2214 | e30 | e42 | | | |
| Wallops Island | 14/2354 | 1017 | 14/2354 | 18 | 23 | | | 3.17 |

| | | | | | | | | |
|----------------------------|---------|--------|---------|----|----|--|--|------|
| Washington National (KDCA) | 15/0051 | 1020.1 | | 13 | 16 | | | 0.60 |
| Maryland | | | | | | | | |
| Ocean City (KOXB) | | | 15/0053 | 17 | 25 | | | 1.86 |
| Patuxent NAS (KNHK) | 14/2355 | 1018.2 | 14/2355 | 15 | | | | |
| Baltimore (KBWI) | 15/0054 | 1020.0 | 15/0054 | 7 | 16 | | | 0.29 |

^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 ASOS reports are 2 min; buoy averaging periods are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^d Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

* Instrument failed.

Table 4. Selected Buoy and C-MAN observations for Hurricane Charley, 9-14 August 2004.

| Location | Minimum Sea Level Pressure | | Maximum Surface Wind Speed | | | Storm surge (ft) ^c | Storm tide (ft) ^d | Total rain (in) |
|--|----------------------------|-------------|------------------------------|-----------------------------|-----------|-------------------------------|------------------------------|-----------------|
| | Date/time (UTC) | Press. (mb) | Date/time (UTC) ^a | Sustained (kt) ^b | Gust (kt) | | | |
| C-MAN | | | | | | | | |
| Sand Key (SANF1) | 13/1159 | 1007.8 | 13/1159 | 44 | 54 | | | |
| Sombrero Key (SMKF1) | 13/1059 | 1012.4 | 13/1449 | 41 | 56 | 1.83 | | |
| Long Key (LONF1) | 13/1159 | 1012.0 | 13/1329 | 38 | 53 | 1.81 | | |
| Molasses Reef (MLRF1) | 13/0853 | 1012.9 | 13/0359 | 34 | 47 | | | |
| Dry Tortugas (DRYF1)* | 13/1059 | 1004.7 | 13/1059 | 36 | 46 | | | |
| Northwest Florida Bay (NFBF1) (USF) | 13/1200 | 1011.6 | 13/1554 | 31 | 39 | 2.13 | | |
| Egmont Key (EGKF1) | | | 13/2100 | 23 | 27 | | | |
| Anna Maria (ANMF1) | 13/2000 | 1008.1 | 13/2230 | 27 | 29 | | | |
| St. Augustine (SAUF1) | 14/0505 | 1000.7 | 14/0450 | 51 | 63 | | | |
| Folly Beach (FBIS1) | 14/1300 | 1005 | 14/1200 | 41 | 50 | | | |
| US Navy Tower (SPAG1) (31.4°N 80.6°W) | 14/1305 | 990 | | | | | | |
| Duck (DUCN7) | 14/2100 | 1016.1 | 14/2200 | 32 | 47 | | | |
| Cape Lookout (CLKN7) | 14/1900 | 1015.9 | 14/2000 | 30 | 46 | | | |
| Frying Pan Shoals (FPSN7) | 14/1600 | 1014.4 | 14/1700 | 33 | 43 | | | |
| Chesapeake Light (CHLV2) | 14/2200 | 1013 | 14/2251 | 43 | 63 | | | |
| Buoys | | | | | | | | |
| Buoy 41009- East of Cape Canaveral (28.5°N 80.2°W) | 14/0150 | 1011.0 | 14/0150 | 35 | 44 | | | |
| Buoy 41012- St. Augustine (30.0°N 80.6°W) | 14/0650 | 999.0 | 14/0450 | 37 | 47 | | | |
| Buoy 41004- Edisto (32.5°N 79.1°W) | 14/1250 | 1001 | 14/1250 | 43 | 64 | | | |
| Buoy 41008- Grays Reef (31.4°N 80.9°W) | 14/0850 | 1005 | 14/0850 | 33 | 43 | | | |
| Buoy 41013- Frying Pan Shoals (33.5°N 77.6°W) | 14/1550 | 1014.4 | 14/1650 | 36 | 49 | | | |
| Buoy 44009- Delaware Bay (38.5°N 74.7°W) | | | 15/0350 | 25 | 31 | | | |

^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 ASOS reports are 2 min; buoy averaging periods are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^d Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

* Instrument failed.

Table 5. Unofficial observations for Hurricane Charley, 9-14 August 2004.

| Location | Minimum Sea Level Pressure | | Maximum Surface Wind Speed | | | Storm surge (ft) ^c | Storm tide (ft) ^d | Total rain (in) |
|---|----------------------------|-------------|------------------------------|-----------------------------|-----------|-------------------------------|------------------------------|-----------------|
| | Date/time (UTC) | Press. (mb) | Date/time (UTC) ^a | Sustained (kt) ^b | Gust (kt) | | | |
| Florida | | | | | | | | |
| Key West Harbor | 13/1200 | 1010.2 | 13/1612 | 32 | 44 | 1.44 | | |
| Cudjoe Key | | | 13/1205 | | 44 | | | |
| Duck Key | | | 13/0300 | 33 | 45 | | | |
| Curry Hammock St. Park | | | | | | | | 1.04 |
| Tavernier | | | | | | | | 0.70 |
| Dry Tortugas/Fort Jefferson | | | | | | e 6.0 | | |
| Lake Okeechobee | | | 13/2000 | 35 | | | | |
| Vanderbilt Beach* | | | 13/1950 | | 73 | | | |
| Naples | | | 13/1930 | | 47 | | | |
| Moore Haven | | | 13/2045 | | 36 | | | |
| Immokalee | | | 13/2015 | | 26 | | | |
| North Naples | | | | | | | | 7.48 |
| Arcadia EOC | 13/2130 | 975.7 | 13/2140 | | 90 | | | |
| Charlotte County Airport | | | 13/2035 | | 139 | | | |
| Charlotte County Medical Center | | | 13/2035 | | 150 | | | |
| Port Charlotte | | | 13/2000 | | 61 | | | |
| Storm Chaser Mark Sudduth, near Port Charlotte (27.0°N 82.0°W) | 13/2057 | 943.6 | 13/2046 | 80 | 115 | | | |
| Storm Chaser Jim Leonard in Port Charlotte, near Faucet Memorial Hospital | 13/2051 | 950.0 | | | | | | |
| Storm Chaser Mike Theiss, near Charlotte Harbor | 13/2042 | 942.0 | | | | | | |
| Storm Chaser Jim Edds in Punta Gorda | 13/e2042 | 943.0 | | | | | | |
| Big Carlos Pass (Lee County) (26.4°N 81.9°W) | 13/1954 | 997.1 | 13/1936 | 60 | 83 | | | |
| Plant City | | | 13/2355 | | 54 | | | |
| Fort Myers Beach | | | 13/1930 | | 56 | | | |
| For Myers | | | 13/2023 | | 83 | | | |
| Cape Coral | | | 13/1940 | | 78 | | | |

| | | | | | | | | |
|--|---------|--------|---------|----|----|-------|--|------|
| Matanzas Pass Fort Myers Beach | | | | | | 5.82 | | |
| Estero Bay Horseshoe Key | | | | | | 4.46 | | |
| Port Boca Grand | | | | | | 4.30 | | |
| Sarasota | | | 13/2119 | | 44 | | | |
| Lakeland | | | 13/2336 | | 50 | | | |
| Haines City | | | 13/2325 | | 67 | | | |
| Lake Wales (10 mi East) | | | 13/2300 | | 65 | | | |
| Poinciana | | | 14/0000 | | 39 | | | |
| Archbold | | | 13/2100 | | 49 | | | |
| NASA Wind Tower 421 (28.78°N 80.8°W) | | | 14/0250 | 56 | 75 | | | |
| NASA Wind Tower 22 (28.8°N 80.8°W) | | | 14/0250 | 53 | 75 | | | |
| Daytona Beach International Airport Wind Shear | | | 14/0325 | | 84 | | | |
| 4 miles southwest of Wimauma | | 1005.8 | 13/2200 | 35 | 48 | 2.22 | | |
| South Florida Water Management District (SFWMD) station WRWX Polk County (28.05°N 81.40°W) | 14/0015 | 991.3 | 13/2116 | | 57 | | | |
| SFWMD S65DWX Highlands County (27.31°N 81.02°W) | | | 13/2306 | | 50 | | | |
| SFWMD S61W (28.14°N 81.35°W) | 14/0030 | 990.7 | 14/0028 | | 78 | | | |
| SFWMD S65CW (27.40°N 81.11°W) | | | 13/2242 | | 50 | | | |
| SFWMD S65DWX (27.31°N 81.02°W) | | | 13/2216 | | 50 | | | |
| SFWMD L001 (27.14°N 80.79°W) | | | 13/2234 | | 46 | | | |
| South Carolina | | | | | | | | |
| Downtown Charleston (wind- 10 min. avg.) | | | 14/1238 | 32 | 44 | | | 2.09 |
| Pineville (wind- 10 min. avg.) | | | 14/1520 | 17 | 24 | | | 0.19 |
| Isle of Palms | | | 14/1230 | 43 | 55 | | | 2.00 |
| Hampton | | | | | | | | 1.53 |
| Ravenel | | | | | | | | 0.45 |
| Walterboro | | | | | | | | 0.40 |
| Summerville | | | | | | | | 0.24 |
| Charleston Harbor | | | | | | e 2.0 | | |

| | | | | | | | | |
|--|---------|--------|---------|----|----|-------|------|------|
| Oyster Landing (N. Charleston County) | | | | | | 2.94 | | |
| Myrtle Beach Springmaid Pier (wind- 6 min. avg.) | 14/1542 | 998.2 | 14/1506 | 39 | 53 | e 6.0 | 7.19 | |
| Little River FD | | | | | 50 | | | 1.69 |
| Myrtle Beach Pavilion | | | | | 65 | | | 2.60 |
| Loris | | | | | 50 | | | 3.09 |
| Conway | | | | | | | | 4.25 |
| Conway Horry County EOC | | | | | | | | 3.97 |
| Outland (Georgetown County) | | | | | | | | 2.97 |
| North Carolina | | | | | | | | |
| Wrightsville Beach Johnnie Mercer Pier (wind- 6 min. avg.) | 14/1736 | 1007.3 | 14/1736 | 61 | 74 | | | |
| Sunset Beach | 14/1600 | 998 | 14/1500 | 46 | 53 | | | |
| Surf City | | | | | 44 | | | |
| Watha | | | | | 39 | | | |
| Wilmington Battleship USS NC | | | | | 61 | | | 1.39 |
| UNC Wilmington Marine Science Center | | | | | 72 | | | 2.14 |
| Wrightsville Beach US Coast Guard Station | | | | | 63 | | | |
| North Carolina St Port | | | | | 80 | | | |
| Bay Shore Estates | | | | | 81 | | | |
| Carolina Beach | | | | | 61 | | | |
| Myrtle Grove | | | | | 55 | | | |
| Southport | | | | | 74 | | | |
| Oak Island (39 th Place West) | | | | | 66 | | | |
| Oak Island (43 rd St. East) | | | | | 53 | | | |
| St. James Plantation | | | | | 58 | | | |
| Holden Beach | | | | | 74 | | | |
| Cedar Island | | | 14/2000 | | 42 | | | |
| Brunswick County | | | | | | e 7-8 | | |
| Bald Head Island | | | | | | e 2-3 | | |
| New Hanover County Onslow Bay | | | | | | e 5.0 | | |
| Pender County | | | | | | e 4.0 | | |
| Onslow County | | | | | | e 2-3 | | |

| | | | | | | | | |
|---------------------------------------|---------|------|---------|----|----|-------|--|------|
| Carteret County Bogue Banks | | | | | | e 2-3 | | |
| Whiteville Columbus County Airport | | | | | | | | 1.88 |
| Lumberton | | | | | | | | 0.62 |
| Longwood | | | | | | | | 1.80 |
| Moore's Creek | | | | | | | | 1.56 |
| Newport | | | | | | | | 2.30 |
| Havelock | | | | | | | | 2.28 |
| Perrytown | | | | | | | | 1.23 |
| Virginia | | | | | | | | |
| Chesapeake BBT | 15/0000 | 1013 | 14/2154 | 45 | 51 | | | |
| Sewell's Point | 14/2212 | 1015 | 14/2336 | 38 | 49 | | | |
| Kiptopeke | | | 14/2348 | 25 | 36 | | | |
| Maryland | | | | | | | | |
| Ridge | | | | | 16 | | | 2.07 |

^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 ASOS reports are 2 min; buoy averaging periods are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^d Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

Table 6. Preliminary forecast evaluation (heterogeneous sample) for Hurricane Charley, 9-14 August 2004. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecasts are shown in bold-face type. Verification includes the depression stage.

| Forecast Technique | Forecast Period (h) | | | | | | |
|---|---------------------|----------------|----------------|---------------|-----------------|-----------------|-----------------|
| | 12 | 24 | 36 | 48 | 72 | 96 | 120 |
| CLP5 | 53 (20) | 130 (18) | 201 (16) | 258 (14) | 394 (10) | 587 (6) | 969 (2) |
| GFNI | 52 (17) | 97 (13) | 156 (11) | 227 (9) | 227 (5) | | |
| GFDI | 40 (19) | 75 (17) | 101 (15) | 124 (13) | 159 (9) | 396 (5) | 797 (1) |
| GFDL | 36 (19) | 66 (17) | 89 (15) | 119 (13) | 128 (9) | 276 (5) | 629 (1) |
| GFDN | 56 (17) | 96 (14) | 147 (12) | 206 (10) | 326 (5) | | |
| LBAR | 43 (20) | 81 (18) | 109 (16) | 134 (14) | 204 (10) | 381 (6) | 726 (2) |
| GFSI | 35 (18) | 63 (16) | 91 (14) | 117 (11) | 169 (7) | 430 (3) | |
| GFSO | 35 (19) | 54 (17) | 74 (14) | 103 (12) | 167 (8) | 362 (4) | |
| AEMI | 33 (11) | 80 (9) | 111 (7) | 144 (5) | 67 (3) | | |
| AEMN | 40 (12) | 59 (10) | 91 (8) | 140 (6) | 64 (2) | 73 (1) | |
| BAMD | 50 (20) | 102 (18) | 163 (16) | 239 (14) | 358 (10) | 552 (6) | 956 (2) |
| BAMM | 52 (20) | 104 (18) | 156 (16) | 218 (14) | 348 (10) | 440 (6) | 711 (2) |
| BAMS | 60 (20) | 111 (18) | 154 (16) | 189 (14) | 308 (10) | 394 (6) | 649 (2) |
| NGPI | 49 (18) | 80 (16) | 105 (14) | 154 (12) | 302 (8) | 614 (4) | |
| NGPS | 62 (18) | 93 (16) | 109 (14) | 133 (12) | 245 (8) | 526 (5) | 1151 (1) |
| UKMI | 51 (16) | 98 (14) | 159 (12) | 221 (10) | 352 (7) | 697 (2) | |
| UKM | 64 (9) | 94 (8) | 136 (7) | 204 (6) | 338 (4) | 495 (1) | |
| A98E | 50 (20) | 99 (18) | 140 (16) | 170 (14) | 341 (10) | 592 (6) | 1064 (2) |
| A9UK | 55 (10) | 110 (9) | 154 (8) | 190 (7) | 305 (5) | | |
| GUNS | 44 (16) | 76 (14) | 103 (12) | 130 (10) | 224 (7) | 684 (2) | |
| GUNA | 39 (16) | 67 (14) | 90 (12) | 109 (10) | 187 (7) | 641 (2) | |
| FSSE | 36 (16) | 59 (14) | 79 (12) | 96 (10) | 187 (7) | 572 (3) | |
| CONU | 42 (18) | 71 (16) | 97 (14) | 119 (12) | 173 (8) | 459 (4) | |
| OFCL | 37 (20) | 71 (18) | 89 (16) | 83 (14) | 176 (10) | 459 (6) | 777 (2) |
| NHC Official, 1994-2003 mean (number of cases) | 44 (3172) | 78 (2894) | 112 (2636) | 146 (2368) | 217 (1929) | 248 (421) | 319 (341) |

Table 7. Watch and warning summary for Hurricane Charley, 9-14 August 2004.

| Date/Time (UTC) | Action | Location |
|-----------------|--|--|
| 10/1500 | Tropical Storm Watch Issued | Jamaica |
| 10/2100 | Tropical Storm Watch Issued | Cayman Islands |
| 10/2100 | Tropical Storm Watch changed to Tropical Storm Warning | Jamaica |
| 10/2100 | Tropical Storm Warning issued | Southwest Peninsula of Haiti from the Dominican Republic border westward including Port-au-Prince |
| 11/0300 | Hurricane Watch Issued | Jamaica |
| 11/0300 | Tropical Storm Watch changed to Tropical Storm Warning and Hurricane Watch | Cayman Islands |
| 11/0900 | Hurricane Watch Issued | Florida Keys from the Dry Tortugas to Craig Key |
| 11/0900 | Tropical Storm Warning and Hurricane Watch changed to Hurricane Warning | Cayman Islands |
| 11/1500 | Tropical Storm Warning Discontinued | Southwest Peninsula of Haiti from the Dominican Republic border westward including Port-au-Prince |
| 11/1500 | Hurricane Watch Issued | Cuban provinces of Pinar Del Rio, La Habana, Ciudad de la Habana, Matanzas, and the Isle of Youth |
| 11/2100 | Tropical Storm Warning and Hurricane Watch changed to Hurricane Warning | Jamaica |
| 11/2100 | Hurricane Watch Issued | East of Craig Key to Ocean Reef including Florida Bay and SW Florida from Flamingo to Bonita Beach |
| 12/0300 | Hurricane Watch Issued | North of Bonita Beach Florida to Anna Maria Island |
| 12/0900 | Hurricane Watch changed to Hurricane Warning | Florida Keys from the Dry Tortugas to the Seven Mile Bridge and SW Florida from E Cape Sable to Bonita Beach |
| 12/0900 | Tropical Storm Warning Issued | Florida Keys from Seven Mile Bridge to Ocean Reef including Florida Bay and on the mainland west of Ocean Reef to E Cape Sable |
| 12/0900 | Hurricane Watch Issued | N of Bonita Beach to Tarpon Springs |
| 12/1500 | Hurricane Watch Issued | N of Tarpon Springs to Suwannee River Florida |
| 12/1500 | Hurricane Watch changed to Hurricane Warning | Cuban provinces of Pinar Del Rio, La Habana, Ciudad de la Habana, Matanzas, and the Isle of Youth |
| 12/1500 | Hurricane Warning Discontinued | Jamaica |
| 12/2100 | Hurricane Watch changed to Hurricane Warning | N of Bonita Beach FL to Bayport |

| | | |
|---------|--|---|
| 12/2100 | Tropical Storm Watch Issued | Jupiter Inlet FL north to Altamaha Sound Georgia including Lake Okeechobee |
| 12/2100 | Hurricane Warning Discontinued | Cayman Islands |
| 13/0300 | Hurricane Watch changed to Hurricane Warning | N of Bayport to the Suwannee River |
| 13/0300 | Tropical Storm Watch changed to Tropical Storm Warning | Lake Okeechobee |
| 13/0300 | Tropical Storm Watch Issued | S of Jupiter Inlet FL to Ocean Reef and N of Altamaha Sound to South Santee River South Carolina |
| 13/0900 | Hurricane Warning Issued | N of the Suwannee River to the Steinhatchee River FL |
| 13/0900 | Tropical Storm Watch changed to Tropical Storm Warning | Cocoa Beach FL to Altamaha Sound Georgia |
| 13/0900 | Tropical Storm Watch Issued | N of South Santee River SC to Cape Fear North Carolina |
| 13/1100 | Hurricane Warning Discontinued | Cuban provinces of Pinar Del Rio, La Habana, Ciudad de la Habana, Matanzas, and the Isle of Youth |
| 13/1500 | Tropical Storm Watch Issued | North of Cape Fear NC to Oregon Inlet NC including Pamlico Sound |
| 13/1500 | Hurricane Watch Issued | Flagler Beach FL northward to the Savannah River near the GA/SC border |
| 13/1500 | Tropical Storm Watch changed to Tropical Storm Warning | S of Cocoa Beach FL to Jupiter Inlet FL |
| 13/1800 | Tropical Storm Warning changed to Hurricane Warning | Cocoa Beach FL to Altamaha Sound GA |
| 13/1800 | Tropical Storm Watch changed to Hurricane Warning | N of Altamaha Sound GA to South Santee River SC |
| 13/1800 | Tropical Storm Watch changed to Tropical Storm Warning and Hurricane Watch | N of South Santee River SC to Cape Lookout North Carolina |
| 13/2100 | Watches/Warnings Discontinued | S of Jupiter Inlet along the Florida E coast to Ocean Reef and for all of the FL Keys |
| 13/2100 | Tropical Storm Warning and Hurricane Watch changed to Hurricane Warning | N of South Santee River SC to Cape Lookout North Carolina |
| 13/2100 | Tropical Storm Watch Issued | N of Oregon Inlet NC to Chincoteague Virginia including Albemarle Sound and for Lower Chesapeake Bay South of Smith Point |
| 14/0100 | Watches/Warnings Discontinued | All of the Florida West Coast |
| 14/0300 | Tropical Storm Warning Discontinued | Lake Okeechobee, FL |
| 14/0300 | Tropical Storm Watch changed to Hurricane Warning | N of Cape Lookout NC to Oregon Inlet including Pamlico and Albemarle Sounds |

| | | |
|---------|--|---|
| 14/0300 | Tropical Storm Watch changed to Tropical Storm Warning | N of Oregon Inlet NC to Chincoteague VA including Lower Chesapeake Bay South of Smith Point |
| 14/0600 | Tropical Storm Warning Discontinued | S of Cocoa Beach FL to Jupiter Inlet FL |
| 14/0900 | Tropical Storm Watch changed to Hurricane Warning | N of Oregon Inlet NC to the N Carolina/Virginia state border |
| 14/0900 | Tropical Storm Warning Issued | N of Chincoteague Virginia to Sandy Hook New Jersey including Upper Chesapeake Bay, the Tidal Potomac and Delaware Bay |
| 14/0900 | Tropical Storm Watch Issued | N of Sandy Hook NJ to the Merrimack River Massachusetts including New York Harbor and Long Island Sound |
| 14/0900 | Hurricane Warning Discontinued | Altamaha Sound GA south to Cocoa Beach FL |
| 14/1500 | Hurricane Warning Discontinued | South of the South Santee River SC to Altamaha Sound GA |
| 14/1500 | Tropical Storm Watch changed to Tropical Storm Warning | N of Sandy Hook NJ to the Merrimack River MA including New York Harbor and Long Island Sound |
| 14/1800 | Hurricane Warning changed to Tropical Storm Warning | Little River Inlet South Carolina to the NC/VA border |
| 14/1800 | Hurricane Warning Discontinued | S of Little River Inlet SC to South Santee River SC |
| 14/2100 | Tropical Storm Warning Discontinued | S of Cape Lookout NC to Little River Inlet SC |
| 15/0000 | Tropical Storm Warning Discontinued | S of Oregon Inlet NC to Cape Lookout NC including Pamlico Sound and for Chesapeake Bay N of Smith Point including the Tidal Potomac |
| 15/0300 | Tropical Storm Warning Discontinued | W of New Haven Connecticut to Oregon Inlet NC and Long Island W of Fire Island |
| 15/1230 | Tropical Storm Warning Discontinued | W of Watch Hill Rhode Island and for Long Island |
| 15/1500 | All Warnings Discontinued | |

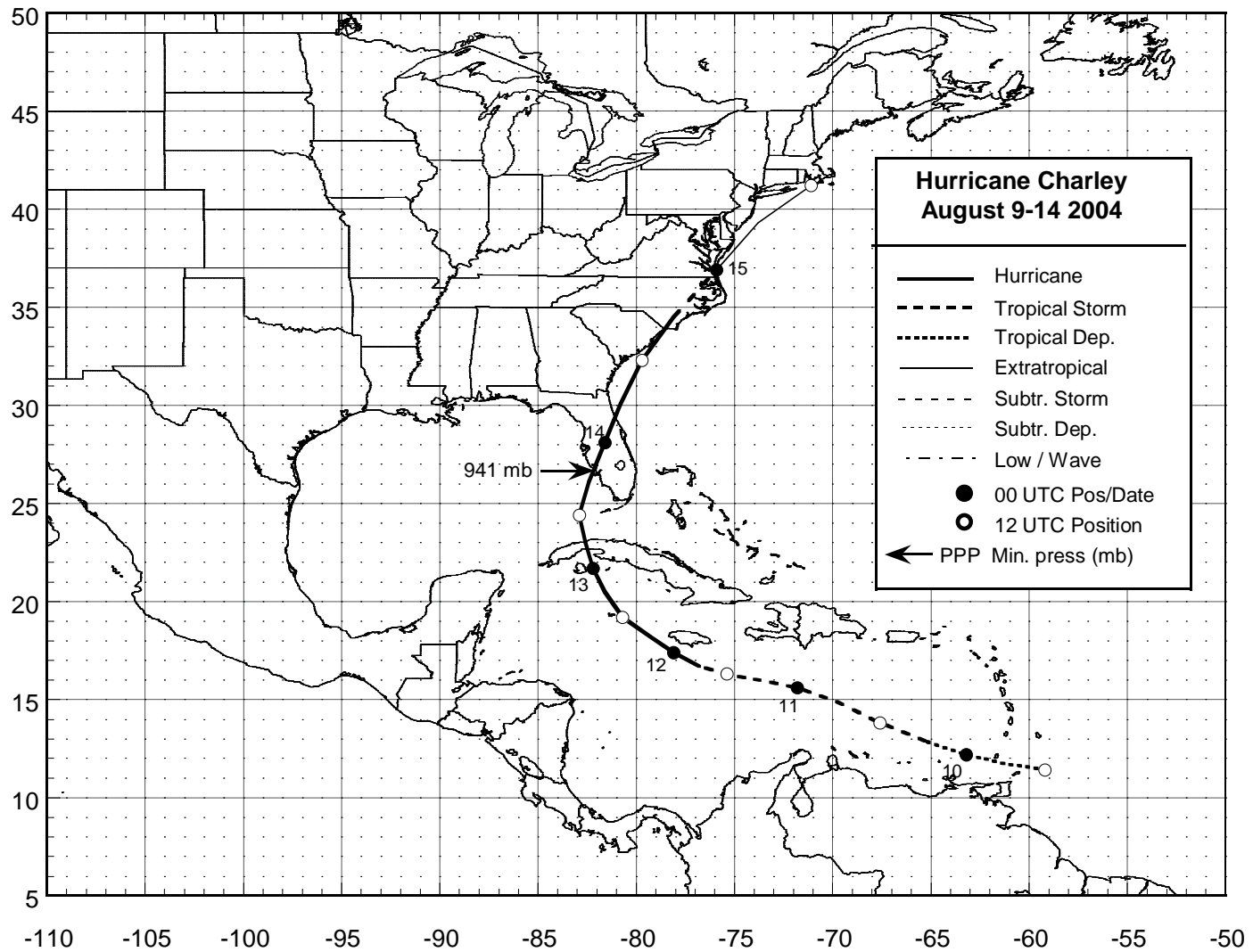


Figure 1. Best track positions for Hurricane Charley, 9-14 August 2004.

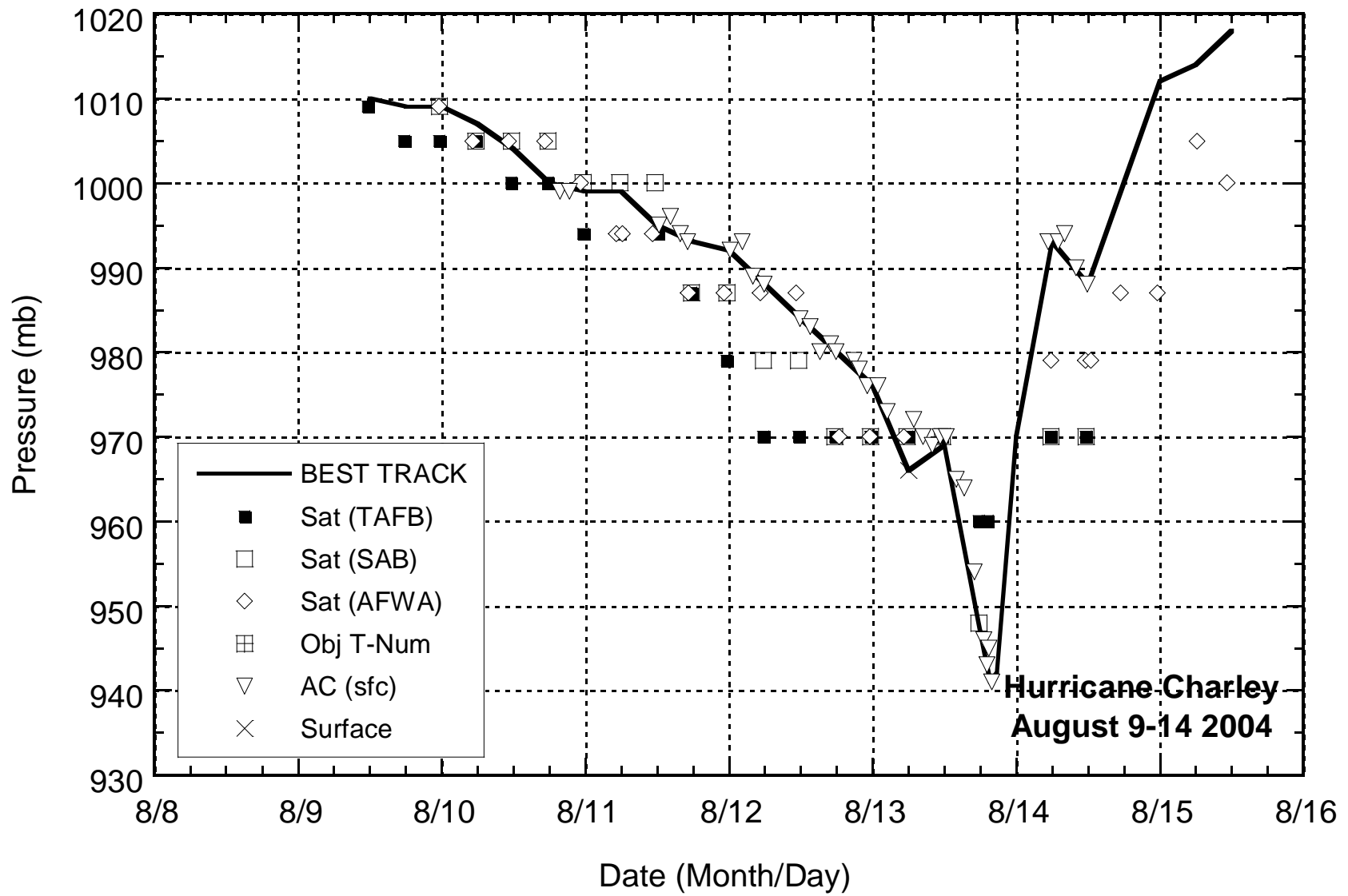


Figure 3. Pressure observations and minimum central pressure curve for Hurricane Charley, 9-14 August 2004.

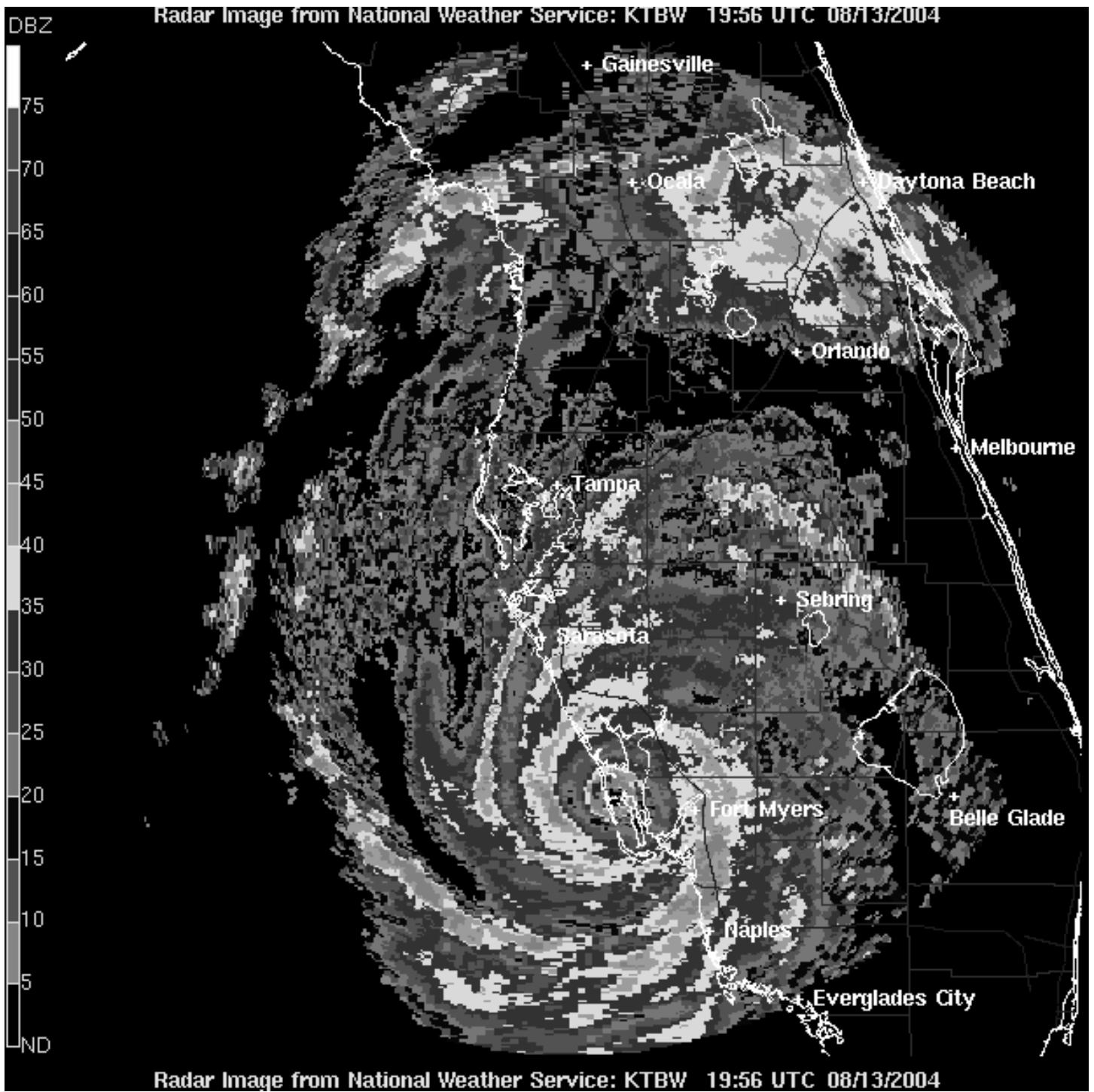


Figure 4. Radar image of Hurricane Charley from the Tampa Bay National Weather Service Forecast Office Doppler Radar at 2056 UTC 13 August 2004.