NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM ANDREA

(AL012013)

5 – 7 June 2013

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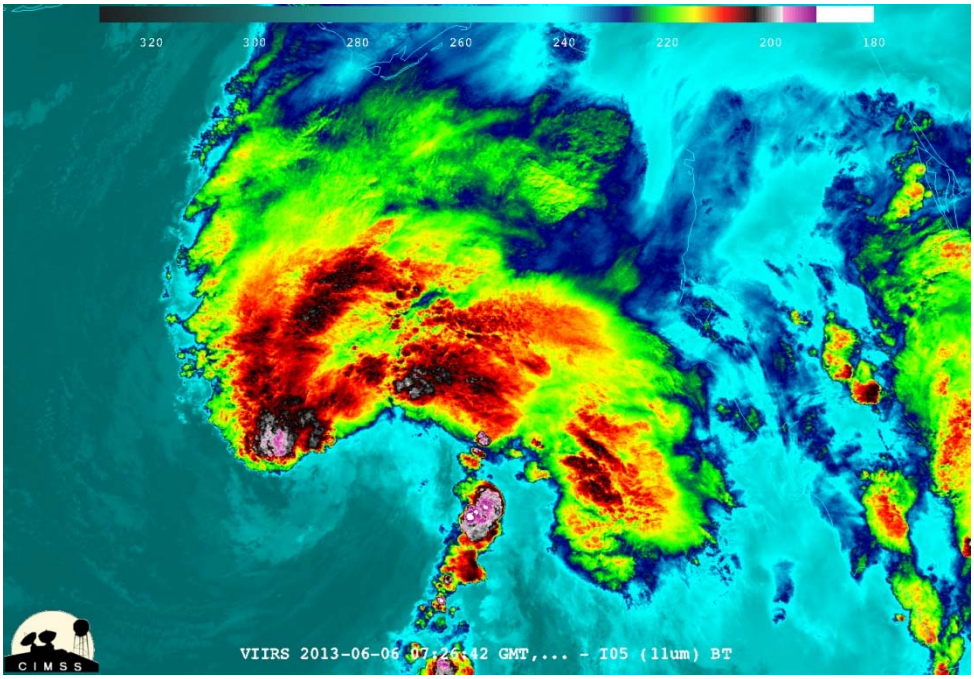
National Hurricane Center
22 August 2013



SNPP VIIRS INFRARED IMAGE OF ANDREA 0726 UTC 6 JUNE 2013. IMAGE COURTESY OF CIMSS

Andrea was a tropical storm that made landfall on the northwest coast of the Florida Peninsula. It became a gale-force extratropical low over the southeastern United States.

Tropical Storm Andrea

5 – 7 JUNE 2013

SYNOPTIC HISTORY

Andrea had a complex origin. The remnant low of eastern Pacific Hurricane Barbara reached the Bay of Campeche on 30 May, and it became part of a large and persistent cyclonic gyre that formed over southeastern Mexico and northern Central America. On 2 June, a trough developed northward from the gyre into the southern Gulf of Mexico, possibly in response to a tropical wave moving into the area from the northwestern Caribbean Sea. All of this led to the formation of a broad area of low pressure over the southern Gulf of Mexico on 3 June. However, an upper-level trough just west of the system caused moderate vertical wind shear and upper-level dry air entrainment, and this allowed only gradual development as the low drifted northward, with the associated convection displaced east of the center of the poorly defined low-level circulation. When the shear decreased somewhat on 5 June, a well-defined low-level circulation formed in the eastern side of the elongated low near an area of strong convection. Since the new circulation already had tropical-storm force winds, it is estimated that a tropical storm formed near 1800 UTC that day about 270 n mi southwest of St. Petersburg, Florida. 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]

Andrea initially moved slowly northward, but it turned northeastward and accelerated early on 6 June when it became embedded in southwesterly flow between the aforementioned upper-level trough and a subtropical ridge to the east. In an environment of moderate shear and strong upper-level divergence caused by the trough, Andrea strengthened to an estimated peak intensity of 55 kt by 1200 UTC that day. Dry-air entrainment subsequently disrupted the central convection, and it is estimated that the intensity decreased to 50 kt by 2200 UTC when the center of Andrea made landfall along the northwestern coast of the Florida Peninsula about 10 n mi south of Steinhatchee.

After landfall, Andrea moved northeastward with additional acceleration across northeastern Florida and southeastern Georgia, with the center passing over Savannah, Georgia near 0700 UTC 7 June. During this time, the storm maintained an intensity of 40 kt, with the strongest winds occurring mainly over water to the east and southeast of the center. As the cyclone moved into South Carolina, it started to merge with a baroclinic zone, which caused Andrea to become extratropical over northeastern South Carolina by 1800 UTC that day. The center of the post-tropical cyclone moved rapidly across eastern North Carolina and southeastern Virginia, over the Atlantic near the New Jersey coast, and across eastern Long

[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.

Island to eastern Massachusetts by 1100 UTC 8 June. The cyclone then moved over the Gulf of Maine, where it was absorbed late that day by a low pressure area developing over Nova Scotia.

METEOROLOGICAL STATISTICS

Observations in Andrea (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, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from flights 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 Andrea.

Ship reports of winds of tropical storm force associated with Andrea are given in Table 2, and selected surface observations from land stations and data buoys are given in Table 3.

Winds and Pressure

Andrea brought tropical storm conditions to portions of the coasts of the Florida Peninsula, Georgia, and South Carolina, with gale conditions occurring during the extratropical phase from coastal South Carolina through southeastern Virginia. A WeatherFlow station and a Citizens Weather Observer Program station in the Tampa, Florida area reported sustained winds of 41 kt at elevations of about 15 m. These were the highest sustained winds observed during the tropical storm phase. The strongest gust measured was 72 kt at a WeatherFlow station on the Jacksonville Beach Pier in Florida, which may have been due to a waterspout passing nearby. A 54-kt gust was reported at an unknown (but likely significant) elevation on the Ravenel Bridge near Charleston, South Carolina. During the extratropical phase, a WeatherFlow station at Salvo, North Carolina measured sustained winds of 43 kt at an elevation of 18 m.

The Carnival ship ***Fascination*** (call sign C6FM9, anemometer elevation 55 m) reported 45-kt winds at 0200 and 0300 UTC 7 June off the northeastern coast of the Florida Peninsula. The ***Horizon Trader*** (call sign KIRH) reported 44-kt winds at 0600 UTC 7 June, while the ***Horizon Navigator*** (call sign WPGK) reported 44-kt winds at 1700 UTC that day. The anemometer heights of these two ships are not known, but are likely well above 10 m.

The 55-kt estimated maximum intensity is based on 55-kt surface wind estimates from the SFMR and 71-kt flight-level winds (observed at 850 mb) from a 53rd WRS Hurricane Hunter aircraft near 1800 UTC 6 June. These winds were about 20 n mi southeast of the center.

There was little convection near the center at that time, and it is likely that the storm reached its peak intensity near 1200 UTC that day when strong convection was present.

The estimated minimum and landfall pressure of 992 mb is based on a pressure of 993.4 mb at Cross City, Florida with a simultaneous 14 kt wind at 2253 UTC 6 June. A dropsonde measured a pressure of 993 mb at 1853 UTC that day.

Storm Surge[2]

Andrea produced storm surges of mostly 1-3 ft along the coastal areas in its path (Table 4). A maximum storm surge of 4.55 ft occurred at Cedar Key, Florida, and storm surges of 2-4 ft occurred elsewhere along the West Coast of the Florida Peninsula south of Cedar Key to the Tampa Bay area. These surges produced estimated inundations of 1-3 ft, which resulted in minor coastal flooding.

Rainfall and Flooding

Andrea generally produced storm total rainfalls of 3-5 inches from Florida through New England, with isolated totals of 5-8 inches. The totals from North Carolina northward include a predecessor rain event caused mainly by the baroclinic zone that Andrea eventually merged with. These rains caused generally minor freshwater flooding. A localized area of very heavy rain occurred over southeastern Broward and northeastern Miami-Dade Counties in Florida on 7-8 June in association with a convergence zone trailing southwestward from the cyclone. This included a 24-h total of 13.94 inches at the South Florida Water Management District station in North Miami Beach. Storm-total rainfalls in this area ranged from 8-15 inches, with a maximum of 15.28 inches at the North Miami Beach station. These rains caused severe urban flooding in portions of the Miami-Fort Lauderdale metropolitan area.

The pre-Andrea low produced heavy rains over portions of western Cuba, particularly in the province of Pinar del Rio. La Capitana Mountain reported a 24-h total of 12.40 inches on 4-5 June, and there were numerous other 24-h reports in excess of 8 inches. These rainfalls caused freshwater flooding in portions of western Cuba.

Tornadoes

[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).

Andrea is known to have caused 11 tornadoes in the United States – 10 in Florida and 1 in North Carolina. The Florida tornadoes near Royal Palm Beach, Mayport, and Fernandina Beach were rated EF-1; the others were rated EF-0. The Meteorological Service of Cuba reported five tornadoes from either Andrea or the pre-Andrea low – two in the town of San Juan y Martínez, two in the town of Pinar del Rio, and one in the town of Sandino.

CASUALTY AND DAMAGE STATISTICS

Andrea apparently caused one direct death[3] - a surfer in Horry County, South Carolina went missing during the storm and has not been found. Traffic accidents related to the storm caused three indirect deaths – one in Virginia and two in New Jersey. There are no reports of casualties from Cuba.

The storm surge, freshwater flooding, and tornadoes associated with Andrea caused minor property damage in the United States, but the insured amounts were less than the $25 million threshold used by the Property Claims Service to declare a catastrophe. Thus, a specific damage estimate is not available. Media reports indicate that freshwater flooding and tornadoes caused some property damage in western Cuba. However, no monetary damage figures are available.

FORECAST AND WARNING CRITIQUE

The genesis of Andrea was fairly well forecast. The pre-Andrea disturbance was first mentioned in the Tropical Weather Outlook as early as 1 June, at which time it was given a low (less than 30%) chance of development in the ensuing 48 h. The development chance was raised to medium (30-50%) on 3 June about 42 h before genesis occurred. However, the chance was not raised to high (greater than 50%) until the time of genesis in the best track on 5 June, mainly due to an incorrect expectation that the ongoing shear would limit the disturbance's development.

A verification of NHC official track forecasts for Andrea is given in Table 5. Official forecast track errors were slightly greater than the mean official errors for the previous 5-yr period at 12 h, then much less than the previous 5-yr mean at 24 and 36 h. However, the number of forecasts is very small, ranging from 6 at 12 h to 2 at 36 h. The track forecasts generally called for a northeastward motion after genesis, which verified well.

[3] 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.

A verification of NHC official intensity forecasts for Andrea is given in Table 6. Official forecast intensity errors were slightly greater than the mean official errors for the previous 5-yr period at 12 h, then much less than the previous 5-yr mean at 24 and 36 h. However, the number of forecasts is again very small. There was a small negative bias in the intensity forecasts caused by underestimating how strong Andrea could become in the moderate-shear environment.

Watches and warnings associated with Andrea are given in Table 7.

In the wake of Hurricane Sandy, the National Weather Service changed operational procedures to allow NHC to continue advisories on post-tropical cyclones if they posed a significant threat to life and property, and when the transfer of responsibility to another office would result in an unacceptable discontinuity in service. Andrea's transition from tropical storm to gale-force extratropical low occurred over the southeastern United States, and there was the possibility of impacts in the Mid-Atlantic and New England States. Thus the NHC continued to issue advisories on the cyclone after extratropical transition until it reached the Gulf of Maine.

ACKNOWLEDGEMENTS

The Meteorological Service of Cuba provided rainfall and tornado data from Cuba. The National Weather Service Forecast Offices in Miami, Florida, Tampa, Florida, Melbourne, Florida, Jacksonville Florida, Tallahassee, Florida, Charleston, South Carolina, Wilmington, North Carolina, Morehead City, North Carolina, and Wakefield Virginia provided many of the surface observations and tornado data. David Roth of the Weather Prediction Center in Washington, D.C. provided much of the U. S. rainfall data. The National Data Buoy Center and the NOAA Chesapeake Bay Interpretive Buoy System (CBIBS) provided data for their stations. The National Ocean Service provided the meteorological and tide gauge data for its stations. WeatherFlow provided data for its stations, and the University of South Florida provided data for its Coastal Ocean Monitoring and Prediction System (COMPS). Other observations were provided by the U. S. Geological Survey, the, U. S. Army Corps of Engineers, the National Interagency Fire Center, the Citizens Weather Observer Program (CWOP), the National Estuarine Research Reserve System (NERRS), South Florida Water Management, Florida State University, the Incorporated Research Institutions for Seismology, the South Carolina Department of Transportation, the Coastal Ocean Research and Monitoring Program (CORMP), the Carolinas Coastal Ocean Observing and Prediction System (CaroCoops), the Northeastern Regional Association of Coastal and Ocean Observing Systems (NERACOOS), and the Weather Underground. John Cangialosi of the Hurricane Specialist Unit created the best track map.

Table 1. Best track for Tropical Storm Andrea, 5 – 7 June 2013.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
05 / 1800	25.1	86.6	1006	35	tropical storm
06 / 0000	25.6	86.5	1002	40	"
06 / 0600	26.7	86.1	999	50	"
06 / 1200	27.8	84.9	995	55	"
06 / 1800	28.9	83.9	993	55	"
06 / 2200	29.5	83.4	992	50	Minimum pressure and landfall about 10 n mi south of Steinhatchee, Florida
07 / 0000	29.8	83.0	993	40	"
07 / 0600	31.6	81.4	996	40	"
07 / 1200	33.5	80.2	996	40	"
07 / 1800	35.2	78.6	996	40	extratropical
08 / 0000	37.4	76.2	997	40	"
08 / 0600	39.9	73.6	997	40	"
08 / 1200	42.4	70.4	999	40	"
08 / 1800	44.5	67.0	1002	40	"
09 / 0000					absorbed by extratropical low
06 / 2200	29.5	83.4	992	50	Minimum pressure and landfall about 10 n mi south of Steinhatchee, Florida
06 / 1200	27.8	84.9	995	55	Maximum winds

Table 2. Selected ship reports with winds of at least 34 kt for Tropical Storm Andrea, 5 – 7 June 2013.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
05 / 1800	WTDL	24.7	83.5	150 / 35	1010.0
05 / 2200	WTAU	24.4	84.2	280 / 39	1007.0
07 / 0200	C6FM9	29.8	80.6	180 / 45	1004.0
07 / 0300	C6YR6	27.1	79.3	190 / 36	1011.0
07 / 0300	C6FM9	29.7	80.6	200 / 45	1005.0
07 / 0600	KIRH	30.3	80.7	220 / 44	1003.2
07 / 0700	WDD382	31.4	79.9	150 / 37	1002.0
07 / 1700	WPGK	35.3	73.2	170 / 44	1010.3
07 / 1800	A8TI2	33.5	76.3	160 / 41	1004.0
08 / 1200	3FPS9	42.8	66.1	160 / 37	1009.0
08 / 1500	PIAG	41.0	66.1	190 / 40	1010.9
08 / 1800	DGAF	42.9	66.1	240 / 37	1008.5

Table 3. Selected surface observations for Tropical Storm Andrea, 5- 7 June 2013.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Florida						
International Civil Aviation Organization (ICAO) Sites						
Brooksville (KBKV)	06/2053	1003.7	06/1621	21	34	2.37
Cape Canaveral Skid Strip (KXMR)	06/2258	1006.8	06/1252		36	1.48
Cross City (KCTY)	06/2253	993.4	06/2353	14	31	2.42
Ft. Lauderdale Intl. Aprt. (KFLL)						8.76
Ft. Myers Regional Southwest (KRSW)	06/2253	1007.8	06/1617	24	34	1.35
Gainesville Regional Aprt. (KGNV)	07/0053	999.7	06/2148	18	28	1.68
Jacksonville NAS (KNIP)	07/0153	1000.6	07/0253	25	38	1.76
Lakeland (KLAL)	07/2150	1005.1	06/0855		34	
Perry-Foley (K40J)	06/2153	998.9	06/2353	14	22	2.52
Punta Gorda (KPGD)	06/2053	1007.9	06/1704	32	50	1.81
St. Augustine Aprt. (KSGJ)	06/2358	1003.0	06/1520	23	35	1.69
St. Petersburg (KPIE)	06/1953	1004.5	06/1932	28	41	3.73
St. Petersburg Albert Whitted (KSPG)	06/1953	1004.0	06/1520	29	42	2.47
Sarasota (KSRQ)	06/1953	1005.3	06/1741	28	35	1.99
Tampa Inl.l Aprt. (KTPA)	06/1953	1004.4	06/1953	27	38	3.39
Tampa MacDill AFB (KMCF)	06/1958	1005.0	06/1606	30	40	2.98
Tampa Peter Knight Aprt. (KTPF)	06/2015	1004.7	06/2035	31	39	
Venice Municipal Aprt. (KVNC)	06/1935	1007.1	06/1635		38	
Vero Beach (KVRB)	06/2253	1007.8	06/1953		34	2.76
West Palm Beach (KPBI)	06/2053	1007.8	06/1934	31	41	1.91
Coastal-Marine Automated Network (C-MAN) Sites						

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Cedar Key (CDRF1) (29.14N 89.03W) (10.0 m)	06/2200	999.0	06/1930	36	49	
Fowey Rocks (FWYF1) (25.59N 80.10W) (43.9 m)	06/2200	1009.6	06/2350	40 (10-min)	47	
Keaton Beach (KTNF1) (29.82N 83.59W) (10.0 m)	06/2200	997.0	07/0400	23 (10-min)	31	
Long Key (LONF1) (24.84N 80.86W) (7.0 m)	06/2200	1010.5	06/2340	26 (10-min)	39	
Molasses Reef (MLRF1) (25.01N 80.38W) (15.8 m)	06/2200	1010.2	06/2300	27	40	
St. Augustine (SAUF1) (29.86N 81.27W) (16.5 m)	07/0000	1003.1	06/1510	30	42	
Sombrero Key (SMKF1) (24.83N 81.11W) (48.5 m)	06/1100	1009.2	06/2310	32	37	
Tyndall AFB Tower C (SGOF1) (29.41N 84.86W) (35.1 m)	06/2100	1001.3	06/1640	40 (10-min)	47	
National Ocean Service (NOS) Sites						
Cedar Key (8727520) (29.14N 83.03W)	06/2136	998.4	06/1918	35	44	
Clearwater Beach (CWBF1) (27.98N 82.83W) (6.4 m)	06/1836	1002.9	06/1942	35	43	
Fernandina Beach (FRDF1) (30.87N 81.47W) (6. 4m)	07/0400	999.2	07/1900	20	26	
Lake Worth (LKWF1) (26.61N 80.03W) (6.0 m)	06/2048	1007.7	06/1124	35	46	
St. Petersburg (SAPF1) (27.76N 82.63W) (6.1 m)	06/2018	1005.5	06/1906	30	42	
Tampa Berth 223 (ERTF1) (27.91N 82.43W)			06/1918	33	41	
Tampa Cruise Terminal 2 (TPAF1) (27.93N 82.43W)			06/2042	25	39	
Tampa East Bay Causeway (TSHF1) (27.93N 82.43W)			06/2042	21	39	
Tampa Old Port Tampa (OPTF1) (27.86N 82.55W)	06/2006	1004.5	06/2012	34	40	
Tampa Seabulk (SBLF1) (27.92N 82.45W)			06/2006	28	35	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Remote Automated Weather Stations (RAWS)						
Loxahatchee (LOHF1) (26.50N 80.22W)			06/2132		41	
South Florida Water Management Sites						
Alligator Lake (ALL2) (28.20N 81.24W)						6.51
Ave Maria (AVEMAR) (26.30N 81.43W)	06/2300	1008.0	06/1905		34	2.71
Boca Raton 12W (S-39) (26.36N 80.30W)						6.63
Coral Springs 31W (S-8) (26.33N 80.78W)						5.84
El Portal (S-27) (25.85N 80.19W)						8.19
Lake Okeechobee Center (LZ40) (26.90N 80.79W)	06/2045	1007.8	06/2030	26	40	2.63
Lake Okeechobee South (L006) (26.83N 80.78W)	06/2045	1005.5	06/1845	28	45	2.18
North Miami Beach (S-29) (25.93N 80.15W)						15.28
EAA2 (26.56N 80.71W)						5.61
ENR308 (26.62N 80.44W)	06/1930	1006.7	06/2000	26	39	
S-75 (27.19N 81.13W)	06/2300	1006.2	06/1757		48	4.71
S-331W (25.61N 80.51W)	06/1030	1008.0	06/2054		35	0.46
Univ. of South Florida COMPS Sites						
Buoy 42013/C10 (27.17N 82.93W) (2.8 m)	06/2030	1006.0	06/1830	29	35	
Buoy 42022/C12 (27.50N 83.72W) (3.2 m)			06/1200	29	36	
Aripeka (ARPF1) (28.43N 82.67W) (10.3 m)	06/2000	1002.4	06/2200	24	36	
Clam Bayou (CLBF1) (27.74N 82.69W) (5.5 m)	06/2012	1003.0	06/2136	25	34	
Egmont Key (EGKF1) (27.60N 82.76W) (10.0 m)	06/2006	1005.4	06/1412	31	41	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Fred Howard Park (FHPF1) (28.15N 82.80W)	06/1824	1003.1	06/1912	35	41	
Tarpon Springs (TARF1) (28.16N 82.76W) (7.0 m)	06/1824	1002.4	06/1906		39	
WxFlow Sites						
Anna Maria Island 6NNW (XGEM) (27.61N 82.76W) (12.8m)			06/1455		52	
Belleair 1 E (XBLA) (27.94N 82.80W) (21.3 m)			06/1910		37	
Boca Grande 2S (XBCG) (26.72N 82.26W) (10.0 m)			06/1620		43	
Charlotte Harbor 1WSW (XCHL) (26.96N 82.08W) (10.0m)			06/1630		36	
Dunedin 2NW (XDUN) (28.06N 82.81W) (10.7 m)	06/2031	1003.0	06/1832	39	45	
Grove City 1SE (XGRV) (26.90N 82.31W) (19.8 m)			06/1530		35	
Jacksonville Beach Pier (XJAX) (30.29N 81.39W) (10.0 m)	07/0317	999.0	06/2037		72	
Jekyll Island (XJEK) (31.05N 81.41W) (10.0 m)			07/0440	36	44	
Morse Shores 2ESE (XDSO) (26.67N 81.77W) (14.9 m)			06/1705		40	
Sarasota 2ENE (XSAR) (27.35N 82.52W) (19.8 m)			06/1915		37	
Tampa Cut J (XTAM) (27.76N 82.58W) (14.6 m)	06/2010	1002.0	06/1545	41	50	
Tampa MacDill AFB 3NNW (XSWT) (27.89N 82.53W) (22.6 m)			06/1835		37	
Citizens Weather Observer Program (CWOP) Sites						
Bald Point (D2896) (29.92N 84.33W)	06/2156	1000.3	06/1426	35	37	
Bloomingdale (C1912) (27.87N 82.25W) (16.8 m)	06/2107	1002.7	06/1236		38	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Melbourne (D8248) (28.05N 80.56W)	06/2128	1005.8	06/2047		34	
Mulberry (AU494) (27.91N 81.99W) (36.8 m)	06/2101	1005.5	06/1736		35	
St. George Island (C8103) (29.63N 84.94W)	06/2104	999.7	06/1634		36	
St. Petersburg (D9133) (27.79N 82.76W)	06/2019	1004.4	06/1418		34	
Seminole (AS052) (27.86N 82.80W) (9.8 m)	06/1851	1004.4	06/1600		39	
Tampa (C6730) (27.91N 82.45W) (14.9 m)			06/1558	41	49	
Treasure Island (C4299) (27.77N 82.77W) (0.6 m)	06/2014	1005.5	06/1613		44	
NWS Cooperative Observer Program (COOP) Sites						
Juno Beach (JUBF1) (26.86N 80.06W)						5.04
Lorraine 2SW (FRUF1) (27.42N 82.42W)						5.23
Hollywood Water Treatment Plant (HLWF1) (26.03N 80.13W)						9.15
South Bay 14SSE (SBYF1) (26.47N 80.64W)						5.31
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Aberdeen 3.7WNW (FL-PB-2) (26.58N 80.209W)						6.33
Biscayne Park 0.3E (FL-MD-33) (25.88N 80.18W)						8.49
Gulfport (FL-PN-35) (27.76N 82.72W)						5.04
Hollywood 1.1WNW (FL-BW-1) (26.04N 80.18W)						6.57
South Pasadena 0.6E (FL-PN-17) (27.75N 82.73W)						5.37
Union Park 2.9SSE (FL-OR-1) (28.52N 81.23W)						5.29

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Vero Beach 5.2S (FL-IR-32) (27.56N 80.39W)						6.30
Public/Other						
Horseshoe Beach USARRAY (665AX) (29.51N 83.26W)	06/2200	993.9				
FSU GCOOS Tower N7 (29.66N 84.37W) (19.0 m)	06/2115	1000.4	06/2147	40		
Georgia						
International Civil Aviation Organization (ICAO) Sites						
Brunswick/Glynco Aprt. (KBQK)	07/0515	998.6	07/0415	19	25	
Fort Stewart (KLHW)	07/0658	998.9	07/1224	16	21	3.57
Jesup (KJES)	07/0555	999.9	06/1835	13	21	
Savannah Hunter Army Air Field (KSVN)	07/0658	997.2	07/1458	17	23	1.66
Savannah Intl. Aprt. (KSAV)	07/0753	997.7	07/1346	16	24	3.38
St. Simons/Malcolm McKinnon Aprt. (KSSI)	07/0448	999.0	07/0601	23	39	1.72
National Ocean Service (NOS) Sites						
Fort Pulaski (FPKG1) (32.03N 80.90W) (6.7 m)	07/0742	996.6	7/0012	28	34	
Other Government/ University Sites						
USGS Midville (MDVG1) (32.82N 82.24W)						5.13
USGS Savannah River (32.08N 81.00W)	07/0700	995.9				
Hydrometeorological Automated Data System (HADS) Sites (NWS)						
Sapelo Island NERRS (SAXG1) (31.42N 81.29W) (10.0 m)	07/0545	998.6	07/0545		36	
WxFlow Sites						

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
North Tybee Island (XTYB) (32.02N 80.84W)			07/0635		35	
South Tybee Island (XTYE) (31.99N 80.51W)			07/0745		35	
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Eastman 1.4SSE (GA-DG-5) (32.18N 83.17W)						5.32
Hartwell 5.6NW (GA-HT-2) (34.40N 83.00W)						5.11
Richmond Hill 3NE (GA-BR-2) (31.93N 81.30W)						5.34
Watkinsville 1.8NNE (GA-OC-1) (33.88N 83.39W)						5.05
South Carolina						
International Civil Aviation Organization (ICAO) Sites						
Beaufort MCAS (KNBC)	07/0856	997.2	07/1137	16	25	2.39
Bennettsville (KBBP)	07/1515	998.3	07/1615	21	27	
Charleston Intl Aprt. (KCHS)	07/0956	999.4	07/0956	24	34	0.60
Darlington (KUDG)	07/1415	999.0	07/1535	20	30	
Florence (KFLO)	07/1453	996.6	07/1526	21	30	1.55
Hartsville (KHVS)	07/1355	999.7	07/1455	8	19	
Hilton Head Aprt. (KHXD)	07/0815	997.6	07/0855	15	27	
Johns Island (KJZI)	07/0855	1000.0	07/0953	26	38	
Kingstree (KCKI)	07/1215	998.6	07/1255	13	23	
Myrtle Beach (KMYR)	07/1455	1001.0	07/1230	24	38	2.70
North Myrtle Beach (KCRE)	07/1453	1001.6	07/1303	28	40	3.33
Coastal-Marine Automated Network (C-MAN) Sites						

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Folly Beach (FBIS1) (32.69N 79.89W) (9.8 m)	07/1000	1000.6	07/0940	33	41	
National Ocean Service (NOS) Sites						
Charleston Tide (CHTS1) (32.78N 79.93W) (8.8 m)	07/0924	999.4	07/0954	30	39	
Springmaid Pier (MROS1) (33.66N 78.92W) (8.2 m)	07/1418	1001.4	07/1412	36	44	
South Carolina Dept. of Transportation						
Dan Holt Bridge (SC024) (32.89N 79.96W)			07/1010	27	43	
Ravenel Bridge (SC019) (32.80N 79.91W)			07/1010	37	54	
Hydrometeorological Automated Data System (HADS) Sites (NWS)						
North Inlet Winyah Bay NERRS (NIWS1) (33.35N 79.19W) (7.7 m)	07/1200	1000.5	07/1200	25	38	
WxFlow Sites						
Battery Point (XCHA) (32.76N 79.95W)			07/0930		36	
Folly Beach Pier (XFOL) (32.65N 79.94W)			07/0916		38	
Fort Sumter (XSUM) (32.75N 79.87W)			07/0730		40	
Fripp Island/Beaufort (XBUF) (32.34N 80.59W)			07/0545		36	
Isle of Palms (XIOP) (32.79N 79.80W) (10.0 m)	07/1000	998.0	07/0943	35	40	
Sullivans Island (XSUL) (32.77N 79.82W)			07/0913		42	
Weather Underground Sites						
Darlington Mechanicsville (34.30N 79.80W)	07/1444	997.6	07/1554	10	15	
Florence Farm Subdivision (34.25N 79.70W)	07/1446	997.0	07/1601	13	22	
Nichols 4E (34.24N 79.07W)	07/1533	998.3	07/1640	17	18	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Citizens Weather Observer Program (CWOP) Sites						
Kiawah Island (D8416) (32.60N 80.13W)	07/0857	998.2	07/0842	27	39	
Little River (AU245) (33.88N 78.63W)	07/1510	1000.4	07/1358		51	
Little River (AU254) (33.89N 78.63W)	07/1513	1001.1	07/1422		37	
NWS Cooperative Observer Program (COOP) Sites						
Hartsville (HARS1) (34.37N 80.07W)						4.25
McColl 3NNW (MCOS1) (34.70N 79.57W)						3.73
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Conway 8E (SC-HR-18) (33.83N 78.91W)						3.65
Cordova 3.2SSE (SC-OR-14) (33.39N 80.89W)						4.90
Myrtle Beach 5NNW (SC-HR-20) (33.75N 78.92W)						4.25
Orangeburg 3.2NW (SC-OR-17) (33.52N 80.91W)						4.02
North Carolina						
International Civil Aviation Organization (ICAO) Sites						
Beaufort Aprt. (KMRH)	07/1958	1003.2	07/1958	29	44	1.00
Bogue Air Field (KNJM)	07/1857	1002.7	07/1617	26	41	0.60
Currituck (KONX)	07/2236	998.6	08/0058	23	36	0.60
Dare County Gunnery Range (K2DP)	07/2156	1001.4	07/2246	30	44	0.10
Edenton (KEDE)	07/2155	998.3	07/1615	28	40	1.22

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Elizabeth City USCG (KECG)	07/2254	998.0	08/0054	24	38	1.25
Frisco Airport (KHSE)	07/2151	1003.4	07/2019	30	46	1.59
Greeneville Aprt. (KPGV)	07/2035	999.3	07/1815	21	31	
Jacksonville Aprt. (KOAJ)	07/1855	1000.4	07/1615	24	36	
Kenansville Duplin County Aprt. (KDPL)	07/1835	999.0	07/1955	22	30	
Kill Devil Hills First Flight Aprt. (KFFA)	07/2215	1000.0	07/2355	23	33	
Kinston Regional Aprt. (KISO)	07/1956	999.0	07/1756	20	29	
Lumberton (KLBT)	07/1632	997.6	07/1729	21	32	1.69
Moore County Arpt. (KSOP)						5.34
New Bern (KEWN)	07/1954	1000.9	07/1454	23	39	1.65
New River Air Station (KNCA)	07/1856	1001.5	07/1447	22	37	2.62
Piney Island Bombing Range (KNBT)	07/2056	1002.4	07/1956	31	46	1.67
Raleigh/Durham (KRDU)						5.56
Southport (KSUT)	07/1415	1003.0	07/0615	21	35	
Washington Aprt. (KOCW)	07/2035	998.6	07/2155	26	36	
Whiteville (KCPC)	07/1615	1000.0	07/1655	14	30	
Wilmington (KILM)	07/1753	1001.7	07/1438	29	42	5.47
Coastal-Marine Automated Network (C-MAN) Sites						
Cape Lookout (CLKN7) (34.62N 76.53W) (9.8 m)	07/1900	1003.5	07/1740	32 (10-min)	46	
National Ocean Service (NOS) Sites						
Beaufort (BFTN7) (34.72N 76.67W) (7.0 m)	07/1918	1003.0	07/1718	34	40	
Duck Pier (DUKN7) (36.18N 75.75W) (14.4 m) (incomplete)	07/1800	1002.5	07/1756	32	39	
Hatteras (HCGN7) (35.21N 75.70W) (9.0 m)	07/2154	1002.8	07/1818	28	39	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Oregon Inlet (ORIN7) (35.80N 75.55W)	07/2206	1001.3	07/2212	38	45	
Remote Automated Weather Stations (RAWS)						
Back Island (BKLN7) (34.53N 77.72W) (6.1 m)			07/1518		42	
Beaufort (BNYN7) (35.52N 76.93W)			07/1918		35	
Croatan (NPTN7) (34.76N 76.90W)			07/2005		34	
Dare Bombing Range (STCN7) (35.76N 75.87W)			07/2228		42	
Elizabeth City (ELRN7) (36.35N 76.28W)			07/1913		39	
Hoffmann Forrest (HFMN7) (34.82N 77.32W)			07/1810		34	
Nature Conservancy (NATN7) (34.08N 78.30W)			07/1518		34	2.38
Sunny Point (SUNN7) (34.00N 78.00W)			07/1718		41	2.74
Turnbull Creek (TURN7) (34.68N 78.58W) (6.1 m)			07/1918		36	1.86
Other Government/ University Sites						
Duck US Army Corps Of Engineers (36.20N 75.80W) (19.4 m)			08/0040	35	47	
CORMP Ocean Crest Pier (OCPN7) (33.91N 78.15W) (12.2m)	07/1747	1000.5	07/1317	40	46	
Hydrometeorological Automated Data System (HADS) Sites (NWS)						
Cedar Island (CITN7) (35.10N 76.30W) (10.0 m)	07/2050	1004.0	07/2100	27	38	
North Carolina NERRS (NOXN7) (34.16N 77.85W) (3.7 m)	07/1745	1001.4	07/1430		38	
Swanquarter (SWQN7) (35.39N 76.33W) (10.0 m)	07/2130	1000.0	07/2320	28	43	
WxFlow Sites						

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Alligator Bridge (X292) (35.90N 75.53W) (13.0 m)	07/2221	997.6	07/2357	35	45	
Avon Ocean Pier (XAVO) (35.35N 75.50W) (16.0 m)	07/2120	1002.8	07/2039	34	46	
Avon Sound (XAVN) (35.37N 75.51W) (7.0 m)	07/2237	1001.9	07/2337	35	43	
Buxton (XBUX) (35.26N 75.52W) (10.0 m)	07/2155	1000.3	07/1835	24	40	
Fort Macon (XMAC) (34.69N 76.70W) (10.0 m)	07/1920	1000.2	07/1740	31	43	
Frisco Hatteras High (XHAT) (35.26N 75.55W) (20.0 m)	07/2135	1000.4	07/1905	22	36	
Frisco Woods (XFRI) (35.24N 75.63W) (6.0 m)	07/2032	1003.4	07/2251	34	45	
Nags Head Jockeys Ridge (XNAG) (35.95N 75.63W) (6.0 m)	07/2326	999.0	07/1936	33	41	
Ocracoke (XOCR) (35.13N 76.00W) (7.0 m)	07/2115	1001.2	07/1835	34	45	
Oregon Inlet Jetty (X291) (35.77N 75.53W) (10.0 m)	07/2310	999.0	07/1956	38	47	
Pamlico Sound (35.42N 75.83W) (14.0 m)	07/2135	1000.0	07/2140	33	49	
Salvo Kitty Hawks Kites Resort (XRTH) (35.58N 75.47W) (18.0 m)	07/2122	1001.9	07/2311	43	51	
Waves Real Slick (XSLK) (35.56N 75.49W) (6.0 m)	07/2218	1002.4	07/2218	35	42	
Whalebone Jennettes Pier (XJNP) (35.91N 75.59W) (18.0 m)	07/2215	998.1	07/1840	35	47	
Weather Underground Sites						
Emerald Isle Bogue Inlet Pier (34.66N 77.03W) (15.0 m)	07/1913	1001.4	07/1802	36	38	
Oak Island (33.91N 78.15W)	07/1637	1001.7	07/1622		43	
Surf City (34.42N 77.55W)	07/1745	1001.4	07/0855		37	
Wilmington Kings Grant (34.26N 77.87W) (9.0 m) (incomplete)	07/1417	1002.0	07/1402	26	37	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Wilmington State Port (34.20N 78.00W)	07/1719	1003.0	07/1232	35	43	
Wrightsville Beach (34.21N 77.80W)	07/1734	1001.4	07/1433	29	39	
Citizens Weather Observer Program (CWOP) Sites						
Arapahoe (D4930) (35.02N 76.83W)	07/2039	1001.8	07/1824		36	
Atlantic Beach (C3784) (34.71N 76.75W)	07/1904	1003.7	07/1924		37	
Bald Head Island West Beach (C6445) (33.87N 78.01W)	07/1713	1001.4	07/2024	35	40	
Corolla (C4566) (36.32N 75.81W)	07/2306	998.9	07/2351		41	
Cresswell (D5342) (35.84N 76.42W)	07/2150	998.3	07/2335		37	
Frisco (D6156) (35.22N 75.63W)	07/2216	1003.1	07/1930		46	
Havelock (D8919) (34.88N 76.90W)			07/1614		37	
New Topsail Beach (C7921) (34.36N 77.64W)	07/1758	1001.0	07/1458	33	43	
Shiloh (E1280) (36.26N 76.10W)	07/2232	998.9	08/0023	30	38	
Sneads Ferry (D9023) (34.52N 77.36W)	07/1913	1001.7	07/1643		38	
Surfside Beach (C8363) (33.62N 78.96W)	07/1521	1001.0	07/1411		44	
NWS Cooperative Observer Program (COOP) Sites						
Apex (APXN7) (35.74N 78.84W)						5.00
New Hill 5SE (NHLN7) (35.68N 78.92W)						6.26
Raeford (RAFN7) (34.99N 79.23W)						5.52

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Benson 2E (NC-JH-47) (35.37N 78.51W)						5.18
Cameron 7.6E (NC-HR-17) (35.33N 79.12W)						7.41
Clayton 2.9W (NC-JH-5) (35.65N 78.51W)						7.18
Coates 0.7W (NC-HR-2) (35.40N 78.68W)						5.80
Durham 4.2S (NC-DH-21) (35.92N 78.92W)						5.79
Dunn 3.1N (NC-HR-22) (35.36N 78.61W)						6.50
Fayetteville 2.4S (NC-CM-1) (35.04N 78.91W)						5.85
Godwin 2.1SW (NC-CM-39) (35.20N 78.71W)						6.60
Hamlet 1.1SW (NC-RC-4) (34.88N)						5.37
Henrico 0.4S (NC-NR-6) (36.53N 77.83W)						6.46
Knightdale 4.7SSE (NC-WK-149) (35.73N 78.46W)						6.44
Littleton 7.2NE (NC-HL-1) (36.51N 77.82W)						7.35
Louisberg 8.2ESE (NC-FK-1) (36.06N 78.16W)						5.10
Middlesex 5.2SSW (NC-JH-22) (35.72N 78.26W)						5.02
Mt. Olive 9.6ESE (NC-DP-2) (35.14N 77.91W)						5.06
Nashville 3.2W (NC-NS-2) (35.97N 78.01W)						5.28
Pinehurst 2.1NNE (NC-MR-5) (35.21N 79.44W)						5.99
Raleigh 7NW (NC-WK-87) (35.90N 78.73W)						5.87

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Roanoke Rapids 1.2N (NC-HL-3) (36.47N 77.66W)						5.68
Rockingham 0.6WSW (NC-RC-2) (34.94N 79.77W)						5.23
Sanford (NC-LE-3) (35.38N 79.16W)						5.52
Sparta 3.5SSW (NC-AG-1) (36.46N 81.15W)						5.19
Wake Forest 7.5ESE (NC-WK-133) (35.92N 78.40W)						6.28
Whispering Pines 1.7E (NC-MR-18) (35.25N 79.35W)						6.05
Winnabow 4SE (NC-BR-12) (34.10N 78.05W)						5.47
Youngsville 4.1SE (NC-FK-2) (35.99N 78.42W)						5.85
Zebulon 0.6W (NC-WK-33) (35.83N 78.33W)						5.06
Virginia						
International Civil Aviation Organization (ICAO) Sites						
Chesapeake Aprt. (KCPK)	07/2235	998.0	07/1755	25	36	0.51
Emporia Aprt. (KEMV)	07/2055	998.5	07/2135	17	24	3.36
Fentress Naval Auxiliary Field (KNFE)	07/2256	998.2	07/1956		34	
Fort Eustis (KFAF)	07/2258	997.9	08/0058	18	28	3.09
Franklin Aprt. (KFKN)	07/2155	997.9	07/1755	20	36	1.61
James City-Williamsburg Aprt. (KJGG)	07/2235	998.6	07/1835	23	32	4.69
Langley AFB (KLFI)	07/2258	998.6	08/0230	21	32	1.61
Melfa (KMFV)	08/0116	997.9	08/0236	20	32	1.16
Newport News/Patrick Henry (KPHF)	07/2254	997.7	07/1838	20	31	1.98
Norfolk Intl. Aprt. (KORF)	07/2251	998.0	07/1524	24	39	0.74
Norfolk NAS (KNGU)	07/2259	998.3	07/1859	17	29	1.05

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Wakefield Aprt. (KAKQ)	07/2154	998.0	07/1824	12	22	5.30
Wallops Island (KWAL)	08/0154	998.5	07/2054	22	31	0.94
West Point Aprt. (KFYJ)	07/2235	999.3	08/0235	14	20	6.18
Coastal-Marine Automated Network (C-MAN) Sites						
Chesapeake Light (CHLV2) (36.91N 75.71W) (43.3 m)	08/0000	998.2	08/0200	35	40	
National Ocean Service (NOS) Sites						
Cape Henry (CHYV2) (36.93N 76.01W)	08/0024	996.5	07/1736	24	35	
Chesapeake Bay Bridge Tunnel (CBBV2) (36.97N 76.11W) (13.0 m)	08/0012	997.4	07/1824	33	41	
Money Point (MNPV2) (37.78N 78.30W) (7.6 m)	07/2248	997.5	07/1930	20	34	
South Craney Island (CRYV2) (36.89N 76.34W)	07/2236	997.4	07/1748	23	35	
Willoughby Degaussing (WDSV2) (36.98N 76.32W)	07/2242	996.8	07/1754	30	40	
York River Range Light (YRKV2) (37.25N 76.33W)	07/2300	996.9	07/1348	27	34	
Remote Automated Weather Stations (RAWS)						
Prince George 3NE (PRGV2) (37.25N 77.25W)						5.88
NWS Cooperative Observer Program (COOP) Sites						
Emporia (EPRV2) (36.70N 77.56W)						6.34
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Claremont 0.2SW (VA-SR-1) (37.23N 76.97W)						5.82

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Kilmarnock 7.1NNE (VA-ND-3) (37.80N 76.31W)						5.73
Urbana 6.2NE (VA-LN-1) (37.72N 76.52W)						6.14
Whitestone 0.8SSW (VA-MX-1) (37.54N 76.44W)						5.01
Williamsburg 4.5NW (VA-JC-23) (37.31N 76.78W)						7.73
New Jersey						
National Ocean Service (NOS) Sites						
Cape May (CMAN4) (38.97N 74.96W) (12.2 m)	08/0324	998.7	08/0548	21	36	
Robbins Reef (ROBN4) (40.66N 74.07W) (15.2 m)	08/0606	999.9	08/0312	27	34	
Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) Sites						
Bedminster Twp. (NJ-SM-11) (40.66N 74.63W)						5.53
Ocean Twp. 0.8SE (NJ-MN-5) (40.24N 74.03W)						5.15
Rumson 0.7NNE (NJ-MN-44) (40.37N 74.00W)						5.02
Toms Rover Twp. 3.1SSE (NJ-OC-9) (35.95N 74.14W)						5.72
Massachusetts						
International Civil Aviation Organization (ICAO) Sites						
Nantucket (KACK)	08/1053	1001.9	08/1008		35	0.94
Coastal-Marine Automated Network (C-MAN) Sites						
Buzzards Bay (BUZM3) (41.40N 71.03W)	08/1000	999.9	08/0622		38	

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)	
Buoys						
NOAA 41004 (32.50N 79.10W) (5.0 m)	07/1000	1002.1	07/1350	31	41	
NOAA 41008 (31.40N 80.87W) (5.0 m)	07/0550	998.3	07/0550	35	47	
NOAA 41009 (28.52N 80.18W) (5.0 m)	06/2150	1005.9	06/2000	30 (10-min)	45	
NOAA 41012 (30.04N 80.53W) (5.0 m)	07/0050	1004.2	07/0320	30 (10-min)	39	
NOAA 41013 (33.44N 77.74W) (5.0 m)	07/1350	1003.3	07/1700	32 (10-min)	43	
CaroCoops 41024 (33.85N 78.49W) (3.0 m)	07/1500	1001.6	07/1500	33	37	
CaroCoops 41029 (32.81N 79.63W) (3.0 m)	07/1000	1001.2	7/1000	30	35	
NOAA 41036 (34.21N 76.95W)	07/1820	1003.2	07/1620	33	43	
CORMP 41038 (34.14N 77.72W) (3.0 m)	07/1700	1002.0	07/1800	31	37	
NOAA 42003 (26.04N 85.61W) (5.0 m)	06/0808	1000.9	06/0750	37 (1-min)	41	
NOAA 44020 (41.44N 70.19W) (5.0 m)	08/1050	1000.2	08/0400	29 (10-min)	39	
NOAA 42036 (28.50N 84.52W) (5.0 m)	06/1650	997.0	06/1620	36 (10-min)	47	
NERACOOS 44024 (42.31N 65.93W) (4.0 m)	08/1600	1007.4	08/1700	29	36	
NOAA 44025 (40.25N 73.17W) (5.0 m)	98/0650	998.8	08/0930	24 (10-min)	35	
CBIBS 44064 (36.98N 76.04W) (3.0 m)	08/0020	1000.3	07/1850	26	36	
NOAA 44066 (39.59N 72.60W) (5.0 m)	08/0650	998.2	08/0910	28 (10-min)	35	

[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. NOS and COMPS stations report 6-minute average sustained winds.

Table 4. Selected National Ocean Service (NOS) Tide Gauges data for Tropical Storm Andrea, 5 – 7 June 2013.

Location	Storm surge (ft)[a]	Storm tide (ft)[b]	Estimated Inundation (ft)[c]
National Ocean Service (NOS) Tide Gauges			
Florida			
Pensacola (PCLF1 – 8729840) (30.40N 87.21W)	1.19	1.84	0.9
Panama City (PACF1 - 8729108) (30.15N 85.67W)	1.01	1.86	1.1
Apalachicola (APCF1 - 8728690) (29.73N 84.98W)	1.42	2.18	1.3
Cedar Key (8727520) (29.14N 83.03W)	4.55	4.09	2.6
Clearwater Beach (CWBF1 - 8726274) (27.98N 82.83W)	2.64	3.17	2.2
McKay Bay Entrance (MCYF1 - 8726667) (27.91N 82.43W)	3.34	3.39	2.4
Old Port Tampa (OPTF1 - 8726607) (42.35N 71.05W)	2.84		2.4
St. Petersburg (SAPF1 - 8726520) (27.76N 82.63W)	2.63		2.0
Port Manatee (PMAF1 - 8726384) (27.64N 82.56W)	2.33	2.47	1.8
Fort Myers (FMRF1 - 8725520) (26.65N 81.87W)	1.71	1.79	1.5
Naples (NPSF1 - 8725110) (26.13N 81.81W)	2.16	1.82	1.2
Trident Pier (TRDF1 - 8721604) (28.42N 80.59W)	1.00	1.37	0.3
Mayport (MYPF1 - 8720218) (30.40N 81.43W)	1.15	2.56	0.6
Fernandina Beach (FRDF1 - 8720030) (30.67N 81.47W)	1.29	3.36	0.6
Georgia			
Fort Pulaski (FPKG1 - 8670870) (32.03N 80.90W)	1.55	4.47	1.0
South Carolina			
Clarendon Plantation (8667633) (32.50N 80.78W)	1.83		1.0
Charleston (CHTS1 - 8665530) (32.78N 79.93W)	1.23	3.25	0.6
Oyster Landing (8662245) (33.35N 79.19W)	1.18	2.88	0.5
Springmaid Pier (SMBS1 - 8661070) (33.66N 78.82W)	1.43	3.00	0.6
North Carolina			
Wilmington (WLON7 - 8658120) (34.23N 77.95W)	2.18		0.6
Oregon Inlet (ORIN7 - 8652587) (35.80N 75.55W)	2.35	2.74	2.3
Virginia			
Money Point (MNPV2 - 8639348) (36.78N 76.30W)	1.00		0.9

Location	Storm surge (ft)[a]	Storm tide (ft)[b]	Estimated Inundation (ft)[c]
Chesapeake Bay Bridge Tunnel (CBBV2 - 8638863) (36.97N 76.11W)	1.00		0.9
Yorktown USCG Training Center (YKTV2 - 8637689) (37.23N 76.48W)	1.01		0.9
Windmill Point (8636580) (37.62N 76.29W)	1.39		1.2
Lewisetta (LWTV2 - 8635750) (38.00N 76.46W)	1.28	1.49	0.8
Kiptopeke (KPTV2 - 8632200) (37.17N 75.99W)	1.08	2.17	1.1
Wachapreague (WAHV2 - 8631044) (37.61N 75.69W)	1.24		0.8
Rhode Island			
Quonset Point (QPTR1 - 8454049) (41.59N 71.41W)	1.04		0.5
Providence (FOXR1 - 8454000) (41.81N 71.40W)	1.19	2.65	0.3
Conimicut Light (CPTR1 - 8452944) (41.72N 71.34W)	1.18		0.3
Newport (NWPR1 - 8452660) (41.51N 71.33W)	1.04	2.43	0.6
Massachusetts			
Woods Hole (BZBM3 - 8447930) (41.52N 70.67W)	1.28	1.66	0.8
Fall River (FRVM3 - 8447386) (41.70N 71.16W)	1.37		0.2
Boston (BHBM3 - 8443970) (42.35N 71.05W)	1.26	5.54	0.8

[a] Storm surge is water height above normal astronomical tide level.

[b] For most locations, storm tide is water height above the North American Vertical Datum of 1988 (NAVD88). Storm tide is water height above Mean Lower Low Water (MLLW) for NOS stations in Puerto Rico, the U.S. Virgin Islands, and Barbados.

[c] Estimated inundation is the maximum height of water above ground. For some USGS storm tide pressure sensors, inundation is estimated by subtracting the elevation of the sensor from the recorded storm tide. For other USGS storm tide sensors and USGS high-water marks, inundation is estimated by subtracting the elevation of the land derived from a Digital Elevation Model (DEM) from the recorded and measured storm tide. For NOS tide gauges, the height of the water above Mean Higher High Water (MHHW) is used as a proxy for inundation.

Table 5. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Andrea, 5 – 7 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	29.7	**38.3**	**38.9**				
OCD5	68.0	178.8	170.1				
Forecasts	6	4	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 6. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Andrea, 5 – 7 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	7.5	**1.8**	**0.0**				
OCD5	7.0	7.5	4.5				
Forecasts	6	4	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 7. Watch and warning summary for Tropical Storm Andrea, 5 – 7 June 2013.

Date/Time (UTC)	Action	Location
5 / 2200	Tropical Storm Watch issued	Flagler Beach, FL to Surf City, NC
5 / 2200	Tropical Storm Warning issued	Boca Grande, FL to Ochlockonee River, FL
6 / 0900	Tropical Storm Warning issued	Flagler Beach, FL to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
6 / 0900	Tropical Storm Warning modified to	Boca Grande, FL to Indian Pass, FL
6 / 2100	Tropical Storm Warning modified to	Boca Grande, FL to Ochlockonee River, FL
7 / 0000	Tropical Storm Warning modified to	Boca Grande, FL to Steinhatchee River, FL
7 / 0300	Tropical Storm Warning discontinued	Boca Grande, FL to Steinhatchee River, FL
7 / 0900	Tropical Storm Warning modified to	Altamaha Sound, GA to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
7 / 1200	Tropical Storm Warning modified to	Savannah River, GA to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
7 / 1500	Tropical Storm Warning modified to	South Santee River, SC to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
7 / 1800	Tropical Storm Warning modified to	Little River Inlet, SC to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
7 / 2100	Tropical Storm Warning modified to	Surf City, NC to Cape Charles Light, VA including the Pamlico and Ablemarle Sounds and Chesapeake Bay south of New Point Comfort
8 / 0300	Tropical Storm Warning discontinued	All

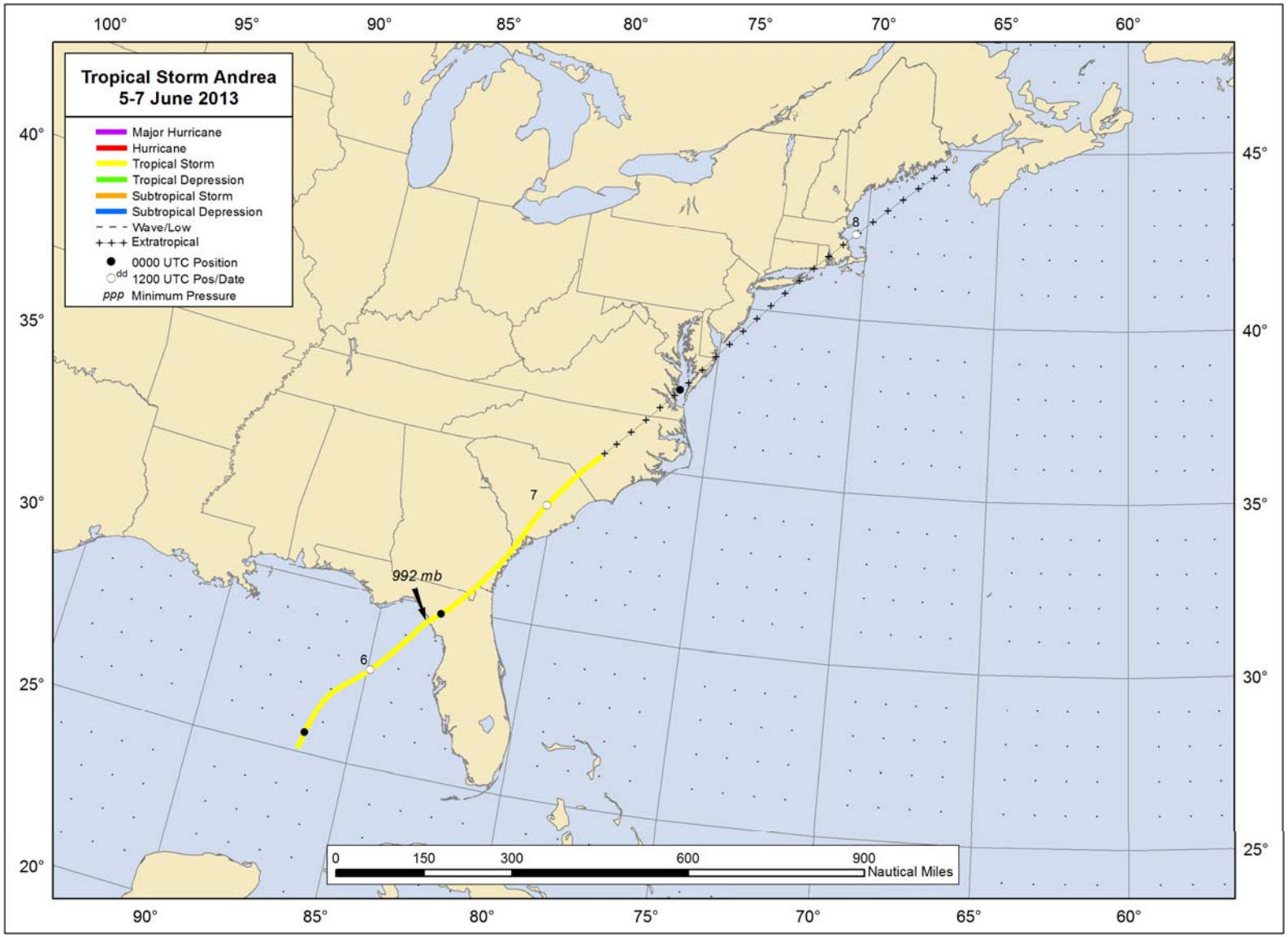


Figure 1. Best track positions for Tropical Storm Andrea, 5 – 7 June 2013.

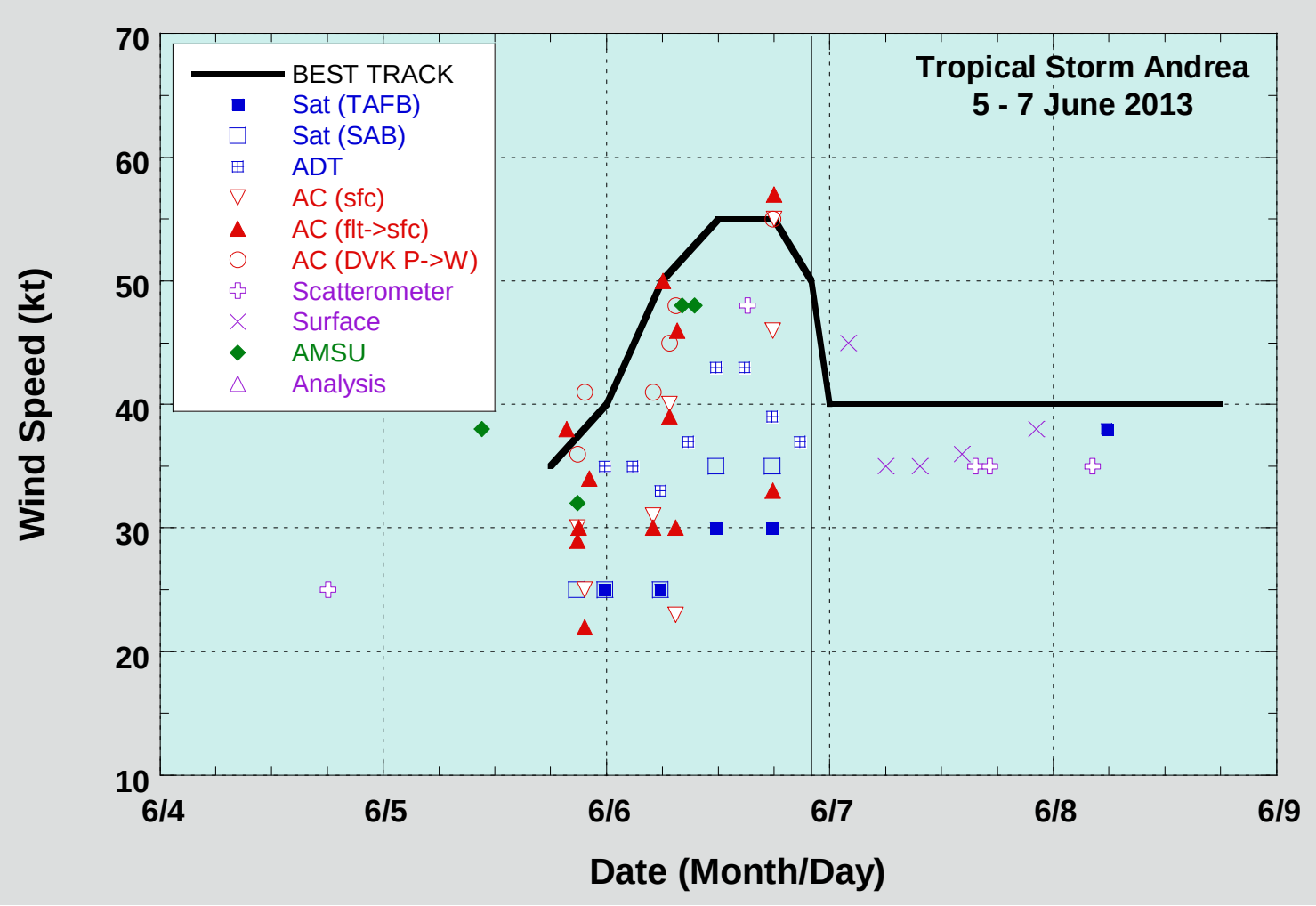


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Andrea, 5 - 7 June 2013. Aircraft observations have been adjusted for elevation using 80% adjustment factors for observations from 850 mb and 1500 ft. Advanced Dvorak Technique estimates 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 line corresponds to landfall.

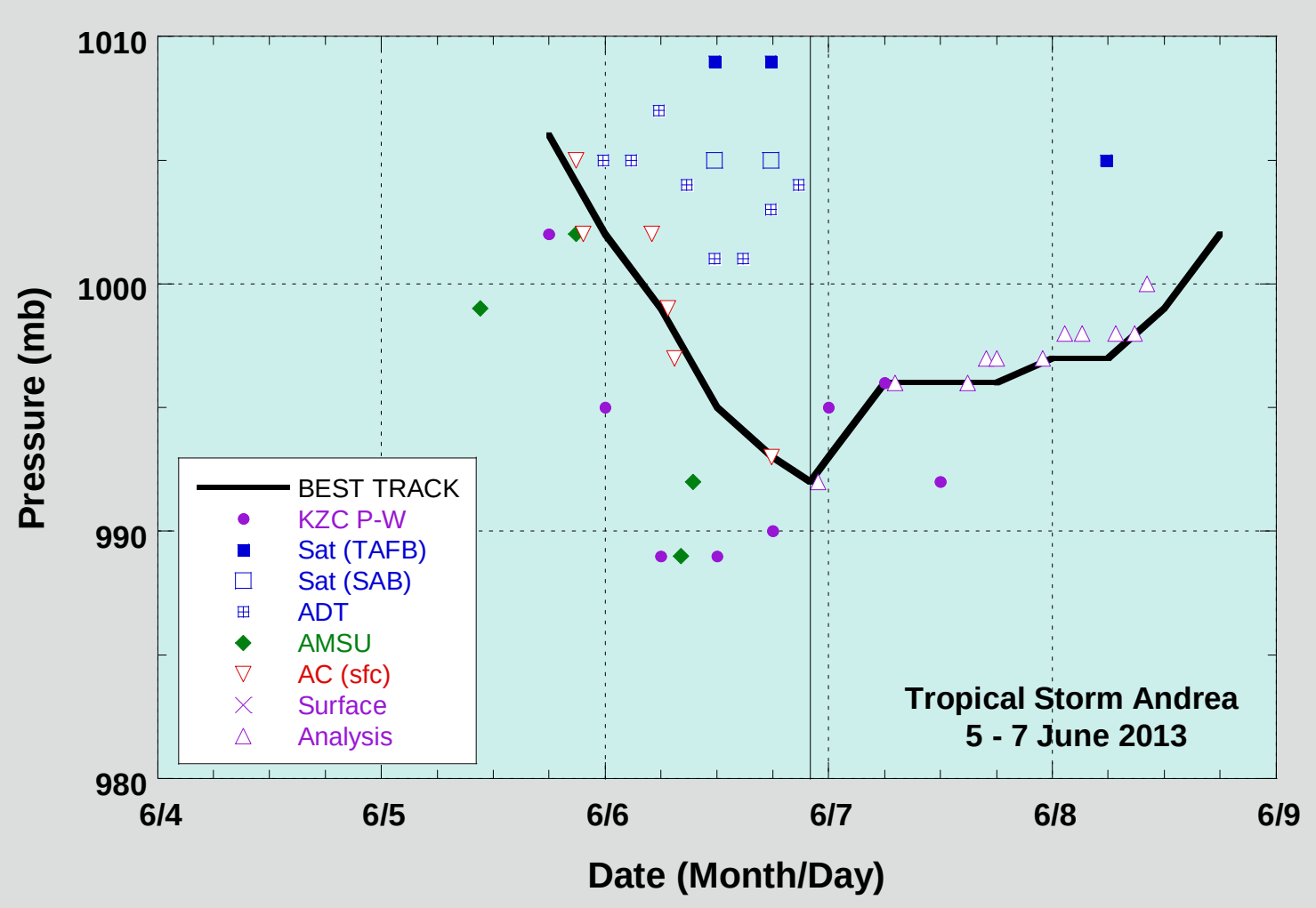


Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Andrea, 5 – 7 June 2013. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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 line correspond to landfall.