

## **Reports**

### **October 2016 Flood**

The scanned documents in this digital file were part of the original SCDOT paper files for the flood of interest. Some of these documents will have more pertinent information regarding the flood than others, but all paper documents were, generally, included for historical documentation.

#### **List of Documents**

- NOAA Report
- Peak Water Surface Report
- USGS Streamflow Report
- USGS Storm Tide Report

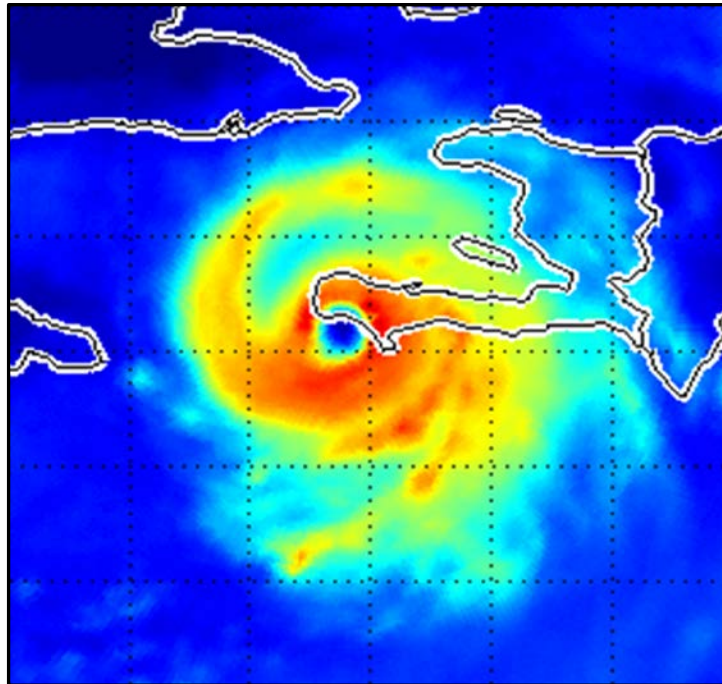


# NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

## HURRICANE MATTHEW (AL142016)

28 September – 9 October 2016

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National Hurricane Center  
7 April 2017<sup>1</sup>



MIMIC MICROWAVE SATELLITE IMAGE OF MATTHEW AS THE EYE OF THE POWERFUL HURRICANE WAS MAKING LANDFALL NEAR LES ANGLAIS, HAITI, AT 1100 UTC 4 OCTOBER 2016. IMAGE COURTESY OF UW-CIMSS WISCONSIN.

Matthew was a category 5 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that later made landfalls as a major hurricane along the coasts of southwestern Haiti, extreme eastern Cuba, and western Grand Bahama Island, and as a category 1 hurricane along the central coast of South Carolina. Matthew was responsible for 585 direct deaths, with more than 500 deaths occurring in Haiti, making it the deadliest Atlantic hurricane since Hurricane Stan in 2005. Matthew reached category 5 intensity at the lowest latitude ever recorded in the Atlantic Basin.

<sup>1</sup> Original report date 3 April 2017. Revised on 7 April 2017 to update United States and North Carolina casualties.

# Hurricane Matthew

28 SEPTEMBER – 9 OCTOBER 2016

## SYNOPTIC HISTORY

A vigorous tropical wave exited the west coast of Africa early on 23 September and moved westward across the tropical Atlantic at forward speeds of 20-25 kt for the next three days. The fast-moving, low-latitude disturbance generally remained south of 10° N latitude until 26 September, when it slowed down and turned toward the west-northwest. Over the next couple of days, the disturbance's satellite cloud pattern gradually acquired the appearance of a tropical cyclone, an indication of the system's well-defined mid- and upper-level circulations. However, scatterometer wind data indicated that the tropical wave did not possess a closed surface circulation. This open-wave wind flow pattern was confirmed on 27 September when a U.S. Air Force Reserve Unit reconnaissance aircraft was unable to close off a surface circulation during its investigative mission. However, aircraft data indicated that surface winds of near 40 kt were occurring on the north side of the wave. Early on 28 September when the system was passing just north of Barbados, radar imagery in the Lesser Antilles indicated that thunderstorm activity was becoming better organized, including pronounced curved convective bands near and to the north and northeast of the well-defined mid-level circulation center. Another Air Force Reserve Hurricane Hunter aircraft found a closed surface circulation and 50-kt surface winds around 1400 UTC that day. Based on the aircraft wind data and microwave satellite imagery (not shown), it is estimated that a tropical storm formed around 1200 UTC 28 September about 15 n mi west-northwest of Barbados. 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<sup>2</sup>.

Under the influence of a strong deep-layer ridge to its north, Matthew turned westward and moved across the Windward Islands, passing midway between St. Lucia and St. Vincent around 1800 UTC 28 September, and moved into the eastern Caribbean Sea 6 h later. The unusually large wind field on the east side of Matthew's asymmetric circulation resulted in tropical-storm-force winds occurring on Barbados as late as 0000 UTC 29 September. These conditions spread northward across most of the Lesser Antilles, with tropical-storm-force wind gusts occurring as far north as the U.S. Virgin Islands and Puerto Rico. As Matthew continued to move over the deep, warm waters of the Caribbean Sea, the tropical cyclone gradually strengthened within an environment of west-southwesterly 850–200-mb vertical wind shear of about 20 kt, and reached hurricane status by 1800 UTC 29 September about 165 n mi northeast of Curaçao.

Over the next 48 h, the ridging increased to the north and west of Matthew, forcing the hurricane towards the west-southwest. Despite moderate vertical wind shear of 15-20 kt, Matthew

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<sup>2</sup> 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 *bt*k directory, while previous years' data are located in the *archive* directory.

underwent a 24-h period of rapid intensification (RI) between 0000 UTC 30 September and 0000 UTC 1 October, during which time Matthew's eye diameter contracted from roughly 30 n mi to 5 n mi (Fig. 4). The hurricane strengthened an extraordinary 75 kt, reaching an estimated peak intensity of 145 kt at 0000 UTC 1 October when located less than 80 n mi north of Punta Gallinas, Colombia. This intensity made Matthew the southernmost category 5 hurricane in the Atlantic basin, surpassing a record previously set by Hurricane Ivan in 2004.

Almost immediately after Matthew reached its peak intensity, the powerful category 5 hurricane began a slow weakening trend. Passive microwave satellite imagery never indicated that an eyewall replacement cycle (ERC) occurred during that weakening phase, and reconnaissance aircraft wind data confirmed that a secondary wind maximum or ERC did not develop. However, upwelling was occurring beneath the hurricane as indicated by satellite-derived sea-surface temperature (SST) data and also SST data from NOAA buoy 42058. The eye of Matthew passed directly over the buoy at approximately 0747 UTC 3 October, which recorded a pressure measurement of 942.9 mb. However, the buoy's SST data (Fig. 5) indicate that upwelling and mixing reduced the SSTs beneath the hurricane by more than 3°C. Oceanic cooling occurred at the buoy more than 12 h before Matthew's eye passage, as a result of both the strength and size of the hurricane's wind field.

The western portion of the subtropical ridge across Cuba and Hispaniola weakened early on 2 October, and the hurricane made a small counter-clockwise loop and turned slowly northwestward within weak steering currents. During that time, Matthew weakened to an estimated intensity of 125 kt by 0600 UTC 2 October, when the cyclone was located about 300 n mi south-southwest of Port-au-Prince, Haiti.

It is worth noting that during Matthew's post-peak-intensity weakening phase, the innermost RMW remained fairly steady at about 5-7 n mi for more than 48 h (Fig.4). Maintenance of the small RMW may have contributed to the re-intensification phase that the hurricane underwent between 0600 UTC and 1800 UTC on 2 October when Matthew was moving northward around the western periphery of a broad deep-layer ridge located over the central subtropical Atlantic. During this time, the deep-layer vertical wind shear had decreased to less than 10 kt while mid-level humidity values had increased to more than 70 percent (Fig. 6). Now moving away from the region of upwelling and over deeper warm water containing a higher oceanic heat content, Matthew reached a secondary peak intensity of 135 kt by 1800 UTC 2 October when the powerful category 4 hurricane was located about 105 n mi south of Tiburon, Haiti. During this re-intensification phase, Matthew's central pressure decreased to its lowest value of 934 mb while the RMW increased to 10-15 n mi. Matthew moved slightly east of due north with some minor fluctuations in intensity, and was at an intensity of 130 kt when the center of the eye made landfall along the southwestern coast of Haiti near Les Anglais around 1100 UTC 4 October (Fig. 7a). Matthew was the first major hurricane, and also the first category 4 hurricane, to make landfall on Haiti since Cleo of 1964.

Matthew continued moving northward across the western end of Haiti's Tiburon Peninsula and into the western Gulf of Gonâve by 1800 UTC (Figs. 7b,c). The mountainous terrain disrupted the hurricane's low-level circulation, and Matthew's sustained winds weakened to 115 kt by the time the category 4 hurricane moved through the Windward Passage and made landfall near Juaco, Cuba, around 0000 UTC 5 October (Fig. 7d). While an upper-level trough lifted out to the northeast, the ridge to the north of Matthew built westward, forcing the hurricane on a

northwestward track across the eastern end of Cuba and into the Atlantic Ocean between Cuba and the Bahamas early on 5 October. Additional disruption by the mountainous terrain of eastern Cuba caused the hurricane to weaken to category 3 status.

Little change in intensity occurred during the next 18 h; by 1200 UTC 6 October, however, Matthew had completed a brief re-strengthening period, regaining category 4 status with an intensity of 125 kt when the hurricane was located about 25 n mi south-southwest of Nassau, Bahamas. Matthew then began a slow but steady weakening trend due to an ERC, increasing vertical wind shear, and decreasing mid-level moisture (Fig. 6) ahead of an approaching mid-latitude trough. Matthew's eyewall passed over the extreme western portion of New Providence Island, bringing hurricane-force winds and flooding rains to most of the central and northwestern Bahamas. Continuing on a northwestward track, the category 4 hurricane made landfall near West End, Grand Bahama Island, around 0000 UTC 7 October, bringing category-3 winds to that area.

A broad, eastward-moving mid-latitude trough located over the central United States gradually eroded the ridge to the north and east of Matthew, allowing the major hurricane to turn toward the north-northwest on 7 October. Over the next 24 h, Matthew completed an ERC, causing the eye diameter to increase to 30-40 n mi. Remaining about 30 n mi offshore of the Florida east coast, the western edge of Matthew's eyewall barely clipped NASA's Cape Canaveral launch facility, likely producing sustained category 2 winds at the extreme northeastern portion of the launch complex. Matthew weakened to a category 3 hurricane around 0600 UTC 7 October about 35 n mi east of Vero Beach, Florida, and became a category 2 hurricane by 0000 UTC 8 October about 50 n mi east-northeast of Jacksonville Beach, Florida.

Hurricane Matthew moved northward around the western periphery of a subtropical ridge early on 8 October, remaining about 50 n mi offshore of the Georgia coast. As Matthew gained latitude, its wind field expanded, spreading hurricane-force wind gusts across the coastal regions of southeastern Georgia and southern South Carolina, especially on the barrier islands where category 2 wind gusts occurred. The approaching mid-latitude trough eroded the subtropical ridge further, causing the category 2 hurricane to make a sharp turn toward the northeast and weaken further. The now category 1 hurricane took a track nearly parallel to the coast of South Carolina, making landfall around 1500 UTC 8 October just south of McClellanville, South Carolina, in the Cape Romain Wildlife Sanctuary. Matthew was the first hurricane since Hurricane Hazel in 1954 to make landfall in the United States north of Florida during the month of October. The center of the hurricane moved back offshore of the coast of South Carolina by 1800 UTC, and remained just offshore of the coast of North Carolina through 9 October. Baroclinic interaction associated with the mid-latitude trough caused Matthew's cloud shield and rainfall pattern to steadily shift from the southeastern to the northwestern side of the circulation, resulting in deep moisture and heavy rainfall to spread well inland over the southeastern United States.

The northwestern edge of Matthew's large eyewall extended well inland and brought hurricane-force wind gusts and heavy rains to coastal regions of the Carolinas. While Matthew was moving east-northeastward to the south of eastern North Carolina early on 9 October, a combination of the cyclone undergoing extratropical transition and an increasing pressure gradient from an approaching cold front caused sustained hurricane-force winds over the Outer Banks and significant sound-side storm-surge flooding. Matthew maintained its east-northeastward motion and lost its tropical characteristics by 1200 UTC 9 October, as southwesterly vertical wind shear in excess of 40 kt stripped away all of the deep convection near

Matthew's center. The extratropical low merged with a frontal system by 0000 UTC 10 October about 200 n mi east of Cape Hatteras, North Carolina. Still possessing hurricane-force winds, the elongated cyclone turned northeastward within the deep tropospheric southwesterly flow ahead of a mid-latitude low located over the eastern United States and moved along the frontal boundary, brushing the coast of eastern Nova Scotia late on 10 October. The broad cyclone eventually merged with a larger extratropical low pressure system near Atlantic Canada on 11 October.

## METEOROLOGICAL STATISTICS

Observations in Matthew (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 19 flights made by the 53rd Weather Reconnaissance Squadron (53WRS) of the U. S. Air Force Reserve Command and from 8 flights conducted by NOAA/AOC "Hurricane Hunter" reconnaissance aircraft; those flights yielded a total of 120 center fixes (96 from the 53WRS and 24 from the NOAA/AOC). Additional dropwindsonde observations were obtained from flights conducted by the NASA AV-6 Global Hawk unmanned aircraft as part of the Hurricane and Severe Storms Sentinel (HS3) research program. Data from Doppler weather radars located at NOAA WFOs Miami, Melbourne, Jacksonville, Charleston, Wilmington, and Morehead City, along with data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Matthew.

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

### *Winds and Pressure*

Matthew's estimated peak intensity of 145 kt at 0000 UTC 1 October is based on SFMR-measured surface winds of 143 kt at 0010 UTC. Post-storm quality control checks made by the NOAA Hurricane Research Division (HRD) suggest that was a reliable report. These peak wind speeds were observed at the end of the rapid intensification cycle, during which time Matthew's radius of maximum winds had contracted down from 30 n mi to approximately 5 n mi.

Matthew's estimated minimum central pressure of 934 mb, which was first observed at 0000 UTC 4 October, is based on a dropwindsonde surface pressure measurement of 934 mb at 2343 UTC 3 October, which was accompanied by a surface wind of 4 kt. The estimated central pressure of 942 mb at the time of Matthew's 145-kt peak intensity is based on a dropwindsonde surface pressure measurement of 944 mb at 0125 UTC 1 October, which was accompanied by a surface wind of 18 kt.

The eastern portion of Matthew's eye passed over NOAA Buoy 42058 in the central Caribbean Sea (Fig. 8) at approximately 0656 UTC 3 October, during which time a pressure of 942.9 mb and a 5-meter wind speed of 10 kt were measured. About 2 h prior to the eye's passage, a 1-minute sustained wind of 74 kt and a gust to 83 kt were measured (Table 3). However, the buoy stopped reporting 1-minute wind speed data from 0510-0650 UTC 3 October 2016, which means that the peak wind speed during Matthew's traversal of the buoy likely was missed.

In the Dominican Republic, the highest recorded wind gust was 43 kt at Las Américas International Airport (MDSD) in Santo Domingo on 3 October.

In Haiti, there were no wind reports received from the area where the category 4 hurricane made landfall along the western end of the Tiburon Peninsula. The only official wind measurement was a sustained wind of 30 kt and a gust to 45 kt at Toussaint Louverture International Airport (MTPP) in Port-au-Prince, which is protected by a mountain range about 80 n mi east-northeast of where Matthew made landfall.

Across eastern Cuba, the highest winds measured were a 1-minute sustained wind of 108 kt at Punta de Maisí (MUMA), which was accompanied by a gust of 132 kt. However, the wind equipment failed at 0156 UTC 5 October, making it possible that stronger winds might have gone undetected. A sustained wind of 103 kt and a gust of 151 kt were observed along the northeast coast in Jamal.

In the Bahamas, the highest recorded winds occurred at the Bahamas Department of Meteorology's (BDM) upper-air site located at the Nassau airport, where a sustained wind of 100 kt and a gust to 111 kt were measured. A sustained wind of 84 kt was measured at the BDM's Weather Forecast Office, which is also located on the airport complex. However, a window in the forecast office was blown-out, forcing the staff to evacuate the premises. Hence, wind records at that location were not recorded beyond 0100 UTC 7 October. Farther north, a sustained 69-kt wind and a gust to 91 kt were reported at Settlement Point on Grand Bahama Island as the eastern edge of Matthew's eyewall passed to the west of that location. Moreover, the BDM stated that their Doppler weather radar velocity data, along with surface wind observations, indicated that tropical-storm-force winds affected New Providence island, including the capital of Nassau, for approximately 19 h from 0700 UTC 6 October to 0200 UTC 7 October, and that hurricane-force winds lasted for about 8 h from 1130 UTC to 1930 UTC on 6 October.

Across the southeastern United States, sustained tropical-storm-force winds spanned a large portion of coastal regions from Palm Beach County in southeastern Florida northward to the North Carolina Outer Banks. In addition, tropical-storm-force wind gusts reached inland at least 80 n mi from the Atlantic coasts of Florida, Georgia, South Carolina, and North Carolina. Sustained gale-force winds occurred across portions of the Virginia Tidewater area, with hurricane-force wind gusts occurring well offshore. The U.S. Army Corps of Engineers' Virginia Beach buoy (44014), located about 65 n mi east-southeast of the mouth of the Chesapeake Bay, measured a 10-minute average wind of 52 kt (equivalent to a 55-kt 1-minute wind) and a peak gust of 110 kt. However, that peak gust was almost double the sustained wind values that had been measured 1 h prior to and 3 h after the occurrence of the gust, during a period in which the pressure gradient was increasing between Matthew and a high pressure system located over the Great Lakes. Since a cold front had passed over and moved south of the buoy a few hours earlier, it is possible that the wind gust was due to local accelerations behind the frontal zone in a

convection-free area offshore of the Delmarva Peninsula, and was not directly associated with Matthew's circulation.

Sustained hurricane-force/category 1 winds were confined mainly to the immediate coastal areas and barrier islands of east-central and northeastern Florida, and the barrier islands of Georgia, South Carolina, and North Carolina, including the Outer Banks. The strongest winds measured along the U.S. southeast coast are as follows: sustained winds of 64-74 kt with gusts of 91-93 kt on the Kennedy Space Center (KSC) complex at Cape Canaveral, Florida; sustained wind of 65 kt and a gust to 83 kt on Tybee Island, Georgia; sustained 58-kt wind at Beaufort, South Carolina, and a gust of 90 kt at Winyah Bay, South Carolina; sustained wind of 67 kt and a gust of 84 kt at Nags Head, North Carolina. Furthermore, an NWS damage survey indicated that category-2 sustained winds likely occurred over mostly unpopulated coastal areas of northern Brevard County, Florida, from the northernmost portion of the KSC and extending northward across Mosquito Lagoon to the Brevard/Volusia County border.

The aforementioned remarkable RI period, which has only been exceeded a few times in the Atlantic historical record, occurred during apparently unfavorable environmental conditions consisting of west-southwesterly 850–200-mb vertical wind shear of 18-22 kt. Such strong shear conditions generally result in only slow or no strengthening. However, post-storm shear recalculations of the SHIPS model by decreasing the default areal diameter of 1000 km down to 400 km, and using observed positions instead of forecast positions, did yield significantly smaller vertical wind shear values of roughly 10-15 kt during the RI period. It is also interesting to note that Matthew was unusually electrically active with numerous lightning strikes having occurred in the eyewall, especially inside of the RMW, during most of the hurricane's time over the Caribbean Sea. However, the role that this lightning played in the evolution of the hurricane, especially during the RI period, is unknown.

### ***Landfall Intensity Estimates***

Haiti: 130 kt near Les Anglais at 1100 UTC 4 October is based on a flight-level-to-surface wind conversion value of 126 kt, an SFMR surface wind of 128 kt, a Dvorak satellite intensity of T6.5/127 kt from both TAFB and SAB, and ADT satellite intensity estimates of 135-139 kt.

Cuba: 115 kt near Juaco at 0000 UTC 5 October is based on an SFMR surface wind value of 117 kt just prior to landfall, and an ADT estimates of 117 kt. A 1-minute sustained surface wind of 108 kt was measured at Punta de Maisí, which was located east of the landfall location and near or just outside the RMW. In addition, a wind gust to 132 kt was observed at Punta de Maisí at 0156 UTC 5 October, just prior to the equipment failing. A sustained wind of 103 kt and a gust to 151 kt were recorded northwest of the landfall location at Jamal. The swath of calm winds observed during eye passage was about 8-10 n mi wide (Fig. 9). Wind measurements were acquired from Dines pressure-tube anemometers.

Bahamas: 115 kt near West End, Grand Bahama Island, at 0000 UTC 7 October is based on an SFMR surface wind value of 118 kt, a Dvorak satellite intensity of T6.0/115 kt from both TAFB and SAB, and an ADT estimate of 125 kt. A sustained wind of 84 kt was observed in the capital of Nassau; a sustained wind of 69 kt and a gust of 91 kt were measured at Settlement Point as the eastern edge of Matthew's eyewall passed just west of that location.

South Carolina: 75 kt just south of McClellanville is based on a flight-level-to-surface wind conversion value of 77 kt around the time of landfall, and Dvorak satellite intensity estimates of T4.5/77 kt from TAFB and T4.0/65 kt from SAB.

## Storm Surge<sup>3</sup>

**Dominican Republic** – Specific storm surge values are not available, but media reports, along with information from the Dominican Republic government, indicate that considerable inundation occurred due to a combination of a significant storm surge and large waves along the southern coast from La Romana westward to the border with Haiti. Extremely rough surf conditions caused 8 Marines and 6 civilians to be stranded on Beata Island, which is located just south of the Barahona Peninsula.

**Haiti** – Although no specific storm surge values from the coasts of Haiti's Tiburon Peninsula are available, official and media reports indicate that considerable wave action and coastal inundation was caused by Matthew's storm surge.

**Cuba** – Reports from the Meteorological Institute of Cuba indicate that a storm surge of 10-13 ft was observed along the southern coast of Guantánamo Province, resulting in saltwater inundation that extended inland more than 300 ft, affecting the towns of Imías, San Antonio de Sur, and Maisí. The surge was also accompanied by large, battering waves of 20-26 ft all along the coast, with a maximum wave height of about 30 ft occurring at Maisí. Along the northern coast of the province, a storm surge exceeding 11 ft, accompanied by waves of 15-20 ft, resulted in inundation that penetrated 1000-1500 ft inland. Storm surge heights of 5-6 ft, along with waves up to 16 ft high, occurred along the north coast of Santiago de Cuba Province. Inundation extended more than 200 ft inland, which briefly cut off the road between the cities of Santiago de Cuba and Guantánamo. In Holguin Province, the storm surge was estimated at 3-5 ft, resulting in coastal flooding that pushed inland about 300 ft in some areas. Large waves up to 20 ft occurred on top of the surge at Cabo Lucrecia, while wave heights of 16 ft were observed at Gibara. Along the north coast of Camagüey Province, a lesser storm surge of about 3 ft occurred, along with waves of 6-13 ft. This combination resulted in minor saltwater inundation that extended up to 200 ft inland at Cayo Sabinal.

**Bahamas** – Storm surge heights up to 8 feet inundated the south coast of New Providence and Grand Bahama Island. The east coast of Andros Island also experienced large and powerful surge and wave action, causing inundation that completely destroyed many coastal structures and infrastructure.

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<sup>3</sup> 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).

### ***United States –***

The maximum storm surge measured by a tide gauge in the United States was 7.70 ft above normal tide levels at a NOS gauge at Fort Pulaski, Georgia. Matthew also produced storm surges of 6.96 ft at Fernandina Beach, Florida, 6.20 ft at Charleston, South Carolina, and 6.06 ft at Hatteras, North Carolina. Several NOS tide gauges from Mayport, Florida, to Hatteras, North Carolina, as well as along the St. Johns River, measured their highest water levels on record during Matthew.

In Florida, the combined effect of the surge and tide produced maximum inundation levels of 5 to 7 ft above ground level along the coasts of Flagler, St. Johns, and Duval Counties (Fig. 10). A United States Geological Survey (USGS) storm tide pressure sensor deployed on Fort Matanzas Beach just north of Matanzas Inlet recorded a wave-filtered storm tide water elevation of 8.39 ft above the North American Vertical Datum of 1988 (NAVD88). This measurement converts to about 6.4 ft above Mean Higher High Water (MHHW), which suggests that maximum inundation of 6-7 ft above ground level occurred in the vicinity of Matanzas Inlet. A post-storm assessment conducted by the Weather Forecast Office (WFO) in Jacksonville also suggested that inundation could have been as high as 7 ft in several locations along the immediate coastline, particularly near Matanzas Inlet and Marineland. In Duval County, a record water level of 3.28 ft above MHHW was reported by the NOS gauge at Mayport (Bar Pilots Dock), exceeding the 2.48 ft above MHHW recorded on 27 September 2004 during Hurricane Jeanne. Farther north, maximum inundation levels were 3 to 5 ft above ground level in Nassau County, where the NOS gauge at Fernandina Beach measured a storm tide of 4.17 ft above MHHW. Inundation levels decreased south of Flagler County, with 4 to 6 ft above ground level estimated in Volusia County and 3 to 4 ft above ground level estimated in Brevard County. Maximum inundation levels along the southeastern coast of Florida south of Cape Canaveral were 1 to 2 ft above ground level.

Elsewhere in Florida, inundation occurred well inland from the coast along the banks of the St. Johns River due to locally induced surge in the river and freshwater input from rainfall. Data from NOS tide gauges along the river recorded 3 to 4 ft of storm surge, with a maximum surge of 4.6 ft above normal levels reported at Racy Point. Maximum inundation levels along the river bank were 2 to 4 ft above ground level, with the Racy Point gauge reporting a storm tide of 4.6 ft above MHHW. Record water levels were reported by the NOS gauges at Red Bay Point (3.24 ft above MHHW) and Dames Point (2.77 ft above MHHW).

Maximum inundations were 3 to 5 ft above ground level along the coast of Georgia. The NOS gauge at Fort Pulaski, to the east of Savannah, recorded a peak water level of 5.05 ft above MHHW, which is a record for that site. The previous record at the gauge was 3.40 ft above MHHW, set on 15 October 1947 during the 1947 Cape Sable (Florida) Hurricane. An NHC survey team measured a high water mark of 4.9 ft above ground level on National Park Service grounds at Fort Pulaski, substantiating the report from the nearby tide gauge.

In South Carolina, maximum inundation levels were also 3 to 5 ft above ground level. In addition to the 5.05 ft above MHHW reported at the Fort Pulaski, Georgia, NOS gauge, which lies very near the Georgia-South Carolina border, the NOS station at Oyster Landing (North Inlet

Estuary) near Georgetown recorded a peak water level of 4.69 ft above MHHW. Elsewhere, the tide gauge at Charleston measured a peak water level of 3.52 ft above MHHW.

Maximum inundation levels along the coast of North Carolina varied significantly by location. For the Atlantic coast between the North Carolina-South Carolina border to Cape Hatteras, maximum inundation levels were 2 to 4 ft above ground level. The highest reported storm tide in that area was 3.53 ft above MHHW (8.21 ft above MLLW) from the NOS gauge in Wilmington along the Cape Fear River. This was a record flood level at the downtown Wilmington gauge, eclipsing the old record of 3.47 ft above MHHW (8.15 ft above MLLW) set in 1954 during Hurricane Hazel. The highest coastal water levels in the state occurred farther up the coast on the sound side of the Outer Banks, where maximum inundation levels were estimated to be 4 to 6 ft above ground level. The NOS gauge at the United States Coast Guard station on Hatteras Island, which sits on Pamlico Sound, measured a peak water level of 5.76 ft above MHHW. This value was corroborated by several high water marks surveyed by the USGS, the highest of which was a mark of 5.1 ft above ground level in Hatteras. North of Cape Hatteras, maximum inundation levels were generally 1 to 3 feet above ground level. Along that section of the coast, the highest surveyed high water mark was 3.0 ft above ground level on the sound side of Nags Head, and the highest measured water level was 2.39 ft above MHHW by the tide station at Oregon Inlet Marina.

Some coastal flooding also occurred along the coasts of Virginia, Maryland, and Delaware, but the highest inundations of 2 to 4 ft above ground level occurred primarily in the Hampton Roads area. The NOS gauge at Money Point reported a peak water level of 3.43 ft above MHHW, and the gauge at Sewells Point measured a water level of 3.10 ft above MHHW. Matthew caused severe flooding in coastal parts of southeastern Virginia, with Virginia Beach officials reporting very significant flooding and that almost every road in the city had become impassable.

### ***Rainfall and Flooding***

Matthew produced locally heavy rainfall across portions of the Lesser Antilles, but especially on Martinique (Fig. 11). That island nation received the brunt of Matthew's heavy rainfall with 8.19 inches occurring in the southern portion of the island at Rivière-Pilote Stade, while 7.94 inches of rainfall was measured in the northern portion at Fond-Denis-Cadet. Rainfall totals of 5-6 inches were common over the interior and western portions of Martinique due to the orographic lift created by the island's mountains, which also resulted in a sharp rainfall gradient along and just inland of the east coast where rainfall amounts less than 2 inches occurred.

Tremendous rainfall occurred across the central and western portions of the Tiburon Peninsula, and also over northwestern Haiti, with some locations receiving more than 20 inches. Along the north-central coast of the Tiburon Peninsula, immediately to the east of where Matthew's eye made landfall, an official rainfall total of 23.80 inches was measured at Anse-à-Veau, while 20.10 inches of rainfall was observed at Petit-Trou-de-Nippes. Elsewhere across the peninsula, rainfall totals in excess of 15 inches were common. The fury with which Matthew lashed the Sud and Grand'Anse Departments (regions) resulted in the collapse of the rainfall monitoring system in almost all areas along or near the path of Matthew's eye. For this reason, no rainfall

data for these departments (regions) are available due to the instruments either having been damaged, washed away, or simply destroyed.

In the adjacent Dominican Republic, rainfall amounts of 6-10 inches were common across the southern third of the country, with several areas receiving more than 12 inches. A peak rainfall total of 16.92 inches was measured at the María Montez International Airport in Barahona along the south-central coast of the Dominican Republic. Over the central third of the country, lesser rainfall amounts of 2-5 inches occurred. A distinct 'rain shadow' of an inch or less of rainfall occurred over the northern third of the Dominican Republic due to the east-west oriented mountain ranges blocking the northward transport of significant moisture and rain showers in the eastern portion of Matthew's circulation.

Jamaica, being located in the drier western portion of Mathew's circulation, received very little rainfall. However, the eastern portions of Cuba felt the brunt of the hurricane's heavy rains, even after Matthew had weakened due to traversing the mountainous terrain of southwestern Haiti. Rainfall amounts exceeding 10 inches were common across Guantanamo Province, with Punta de Maisí airport (MUMA) receiving 26.04 inches of rain.

Across the Bahamas, a sharp west-to-east rainfall gradient was evident, with amounts near 20 inches measured from Inagua to Bimini in the western portion of the archipelago to less than 3 inches in the easternmost portion of the country from Long Island to eastern Grand Bahama Island. A maximum storm total amount of 19.70 inches was measured in Matthew Town, Inagua, and 16.82 inches was reported on South Bimini.

In the United States, torrential rains occurred over much of east-central and northeastern Florida, extending northward across coastal sections of Georgia, much of eastern South Carolina, central and eastern North Carolina, and the Virginia Tidewater. Rainfall amounts exceeding 10 inches were common in this region (Fig. 12). The heaviest rain in eastern North Carolina resulted from a contribution of Matthew's tropical moisture, the ongoing extratropical transition that caused the cyclone's rains to favor the northwestern quadrant, and a pre-existing frontal boundary over the far eastern portions of the state. The maximum reported storm-total rainfall was near Evergreen in Columbus County, North Carolina, where 18.95 inches was measured on 8-9 October. Other notable rainfall amounts measured were 17.48 inches at Hunter Army Air Field in Savannah, Georgia, 17.05 inches at Hope Mills in southeastern North Carolina, 17.01 inches at Cape Canaveral Air Station in east-central Florida, 16.90 inches on Edisto Island in southern South Carolina, and 14.21 inches at Chesapeake in extreme southeastern Virginia.

During Matthew's extratropical stage, rainfall amounts were generally less than 3 inches from the northern Delmarva to Massachusetts due to the large cyclone moving away from the U.S. east coast.

## **Tornadoes**

Because the right-front quadrant of the hurricane's circulation remained mostly offshore, atmospheric conditions conducive for the generation of tornadoes did not extend very far inland

over of the southeastern United States. Only two weak tornadoes were reported – an EF0 tornado occurred in Horry County, South Carolina, when a waterspout moved on shore in North Myrtle Beach and another EF0 tornado occurred in Wayne County, North Carolina, near Walnut Creek.

## CASUALTY AND DAMAGE STATISTICS

Matthew was responsible for 585 direct deaths<sup>4</sup>: 546 in Haiti, 34 in the United States, 4 in the Dominican Republic, and 1 in St. Vincent and the Grenadines. An additional 18 indirect deaths occurred in the United States, and 128 persons are missing and 439 persons were injured in Haiti. More than 3 million residents in the United States were evacuated from coastal areas, at least 380,000 people were evacuated in Cuba, 340,000 people evacuated in Haiti, and more than 8,500 persons evacuated from the southern regions of the Dominican Republic.

**Lesser Antilles** – No official damage estimates have been received. On St. Vincent, media reports indicate that a 16-year-old boy died in the town of Layou during a rain-induced mudslide as he was cleaning a drain behind his house. On St. Lucia, tropical-storm-force winds downed trees and power lines, leaving about 70% of the island’s residents without power. Floods and mudslides damaged many homes and roads, and the country’s banana crop suffered significant damage; at least 85% of the island’s farms incurred losses. Two homes were destroyed, one each in Bisée and Gros Islet; several other homes on the island were damaged. On the north end of St. Lucia, mudslides and other debris rendered many roads impassable from Castries and Gros-Islet. On Dominica, some minor damage was reported, which temporarily left many people without water and electricity. Heavy rains in Grenada disrupted the water supply on that island. On Martinique, strong wind gusts of more than 75 kt knocked down numerous trees and powerlines, resulting in more than 55,000 people temporarily losing power. Rain-induced flooding forced closure of the main road connecting Fort-de-France to the southern portion of the island and also caused 4,000 people to lose their water supply.

**Dominican Republic** – No official damage estimates have been received. Tropical-storm-force winds occurred over the southwestern and south-central portion of the country, causing trees and power lines to be blown down in several communities. In the capital city of Santo Domingo, severe flooding caused by the heavy rainfall caused the wall of a building to collapse and fall on four people, killing two adults and two children. At least 8,500 people were evacuated from southwestern portions of the country.

Widespread flash floods, mudslides, and river floods were common across the southern third of the country, rendering many roads impassable for several days and even affecting some of the country’s prisons. Floodwaters adversely affected at least 50% of the aqueducts supplying water to Santo Domingo and also contaminated water wells in many outlying communities. Fast-moving floodwaters destroyed 26 homes, and also damaged an additional 16 homes and 2

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<sup>4</sup> 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.

bridges. The southern slope of the central mountain range and the southwestern portion of the country experienced very heavy rains, which generated severe floods and mudslides, causing damage to many roads and making them impassable, collapsing bridges, and severely damaging agriculture.

**Haiti** – Widespread damage to beachfront structures occurred from Tiburon eastward to Saint-Louis-du-Sud in Sud Department (region). Media reports indicate that numerous well-constructed structures were knocked down by the pounding surf and then swept out to sea. However, in Les Cayes on the southern coast of the Tiburon Peninsula, the Haitian Government estimated that more than 10 h of hurricane-force winds and heavy rains blasted all the crops in the community's fields. At least 80% of crops were lost in some areas, according to the United Nations Office for the Coordination of Humanitarian Affairs. Grand'Anse Department (region), located in the northern portion of the peninsula, was hit particularly hard, with hundreds of poorly constructed homes having been completely destroyed by Matthew's category 4 winds. In the city of Jérémie, nearly all of the corrugated-metal homes were destroyed, with only a few concrete buildings left standing. Thousands of large coconut, breadfruit, and plantain trees were blown down by the intense winds.

Official reports from the Government of Haiti and the United States Agency for International Development (USAID) indicated that heavy rainfall across most of the country resulted in widespread flash flooding, river floods, and mudslides. Travelling west of Les Cayes in the Sud Department, roads were impassable for several days after Matthew made landfall due to flooding and resultant severe damage to roads and bridges throughout the region. Some communities in Grand'Anse Department were completely cut off due to flood waters. Destruction of the La Digue Bridge in Petit Goave complicated transportation of relief supplies to the hardest-hit areas. The flooding ravaged large swaths of farmland and also drowned livestock.

Haitian officials indicated that at least 29,000 houses had been destroyed or heavily damaged in Grand'Anse and Sud Departments, and 17 schools were also damaged. The downing of power and telephone lines by the high winds was widespread throughout the aforementioned regions. The effects of Matthew's intense winds and rainfall-induced flooding and mudslides resulted in the deaths of at least 546 persons.

At least 210,000 homes were either destroyed or severely damaged, with about 90% of the houses along the southern coast of the Tiburon Peninsula having been destroyed. In the same general location, about 90% of coconut trees were knocked down by Matthew's category-4 winds, and entire coffee and cocoa plantations were destroyed. More than 350,000 animals in the area were also killed. Matthew's intense winds knocked down power lines across most of the Tiburon Peninsula, leaving about 80% of residents without power. Cell phone towers were also knocked down by the high winds, which interrupted communications and inhibited rescue efforts in the days following the storm. According to the Haitian government, more than 85% of buildings suffered serious damage in this region, with some having been completely destroyed. More than 80% of sheet metal roofs were damaged. More specifically, in rural areas, traditional buildings constructed of timber framing and roofing made of sheet metal or hemp were completely destroyed. In urban areas, numerous mixed houses (i.e., concrete, chipboard, and sheet metal roofing construction) were partially destroyed.

During the aftermath, an outbreak of cholera developed due to the significant damage that Haiti's life support infrastructure incurred, resulting in nearly 10,000 cases according to the Pan American Health Organization (PAHO). The PAHO also reported that more than 2.4 million Haitians were directly affected by Hurricane Matthew. According to the Caribbean Disaster Emergency Management Agency (CDEMA), at least 120,000 families had their homes destroyed by Matthew.

The World Bank and the Inter-American Development Bank estimated total damage in Haiti to be about \$1.9 billion USD. According to RMS, a catastrophe risk management company, those losses are equal to more than 10 percent of the country's GDP.

**Cuba** – No direct deaths were reported. The most significant damage occurred in the easternmost province of Guantánamo, which was primarily confined to buildings along the immediate coastal areas due to storm surge flooding. In the city of Baracoa, which was traversed by Matthew's western eyewall, widespread structural damage to homes and other buildings resulted from the category 3 winds and storm surge. According to media reports, hundreds of homes were damaged across eastern Cuba, especially in Guantánamo Province, which received the brunt of Matthew's winds. In Baracoa, 90% of the homes there were damaged or completely destroyed. Extensive damage to trees and utility poles occurred across much of Guantánamo Province, and the eastern portion of Holguin Province. Strong winds also knocked down a communication tower in Majayara, and a bridge spanning the Toa River was destroyed by flood waters, leaving several communities isolated.

The combination of high storm surge and wave action destroyed a guard post building at the Boca de Jauco Bridge. Media reports from Baracoa also indicate that hundreds of homes were damaged or destroyed by the storm surge flooding, including more than 30 houses washed away, and that the coastal highway on the south side of the city was completely eroded and made impassable in large stretches. Some flooding of streets occurred in the town of Malecón due to saltwater inundation. Media reports quoting government officials indicate that damages in Cuba are estimated be around \$2.58 billion USD, with the majority of the damage having occurred in Guantánamo Province.

**Bahamas** – Tropical-storm-force winds affected all of the Bahamas, with hurricane-force winds occurring over the western portion of the country from the Exumas and Andros northward to western Grand Bahama Island. Category 3 winds barely missed New Providence and Andros islands, but damage surveys by the Government of the Bahamas suggested that at least category 3 winds occurred on Berry Islands and western Grand Bahama Island. Numerous trees and power lines were knocked down, rendering many roads impassable. Storm surge-induced flooding occurring on the backside of the storm affected much of the western half of the island. Matthew's long-duration winds down trees along with utility poles and lines throughout most of the country, and also caused severe structural damages to many homes and buildings. On New Providence, North and Central Andros, and Grand Bahama islands, the primary wind effects were to roofs, with damage ranging from pealed shingles to total destruction. Severe damage to vegetation occurred in the Northwest Bahamas. On western Grand Bahama Island, it is estimated that 95% of the homes in the townships of Eight Mile Rock and Holmes Rock sustained severe damage. By the time Matthew's circulation had cleared the Bahamas on 8 October, some portion of the country had been affected by tropical-storm-force winds for three days.

The narrow swath of torrential rainfall across the westernmost Bahamas island chain caused severe flooding in many low-lying communities of Exuma, Andros, New Providence and western Grand Bahama Island. In Nassau, roads near and surrounding the airport were flooded to a depth of about 2 feet.

Media reports quoting government officials indicate that damage in the Bahamas is estimated to be at least \$600 million USD.

**United States** – A breakdown of the 34 direct deaths by state is as follows: Florida – 2, Georgia – 2, South Carolina – 4, North Carolina – 25, and Virginia – 1. Although the southeastern U.S. was spared the full brunt of Matthew’s strongest winds as the core of the powerful hurricane remained just offshore, widespread wind damage to roofs, along with downed trees and utilities lines, still occurred from the Florida peninsula northward through the Carolinas. Matthew’s wind field caused some structural damage to homes and businesses, and widespread downing of trees, utility lines, and poles, which caused massive power outages. However, most of the structural damage caused by Matthew’s wind was described as minor, which is a stark contrast to the moderate to severe structural damage that was associated with the storm surge.

The combination of storm surge inundation and inland freshwater flooding caused by excessive rainfall resulted in more than 1 million structures having been impaired or damaged by Hurricane Matthew, forcing businesses from Florida to North Carolina to close, and temporarily putting thousands out of work. More than 3.5 million customers from Florida to Virginia lost electrical power due to Hurricane Matthew’s effects.

The NOAA National Centers for Environmental Information (NCEI) estimates that wind and water damage caused by Matthew totaled approximately \$10.0 billion, with a 90% confidence interval of  $\pm$ \$2.0 billion. This makes Matthew the tenth-most-destructive hurricane to affect the United States.

Loss of life and specific damage by state are as follows:

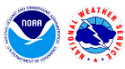
**Florida:** Direct fatalities (2) – one woman was killed in Crescent City in Putnam County when a tree fell on the camper where she was residing, and a 63-year-old woman was killed in the city of DeLand in Volusia County when a tree fell on her while she was outside feeding her animals. There were also nine indirect deaths, which included two persons succumbing to carbon monoxide poisoning caused by operating gas-powered electrical generators in their homes and two deaths due to cessation of medical devices when electrical power was lost. More than 1.2 million customers lost electrical power across the state.

Much of Florida east of Interstate 75 and highway US27, and north of Lake Okeechobee and West Palm Beach experienced downed trees, trees falling onto homes, roof damage, and downed powerlines, along with stripped off awnings, siding, and other non-structural building features such as billboards and facades. The combination of high storm surge and wave action eroded beaches along coastal areas of east-central and northeastern Florida, and washed away boats and automobiles. Beach erosion was described as moderate from Palm Beach County northward to Indian River County, and was moderate to severe in many locations from Brevard County to the St. Mary’s River. Damage to beaches and dunes are estimated to be \$29 million in Palm Beach County.

In Brevard County, which was the portion of Florida closest to Matthew's center, 11 homes were destroyed, 140 sustained major damage, 549 experienced minor damage, and 939 additional homes were adversely affected in some way. High water levels, wave run-up, and large breaking waves caused major beach erosion, extensive escarpment of sand dunes, and damage to numerous pedestrian crossovers along the coastline. Foundations of several beachfront properties between Satellite Beach and Melbourne Beach were compromised and weakened due to the damaged dunes and berms. Damage to the beaches is estimated to be \$25 million. Saltwater intrusion also affected NASA's rocket launch facility at the Kennedy Space Center, Cape Canaveral, causing several million dollars-worth of damage. The roof of NASA's Operations Support Building II (OSB-II) broke and rainwater damaged the interior of the structure. Air conditioning was lost throughout Launch Complex 39 as well. NASA had to deploy its Damage Assessment and Recovery Team (DART) to KSC to quickly effect repairs to the roof in order to prevent further damage to the OSB-II. Portable chillers mounted on trailers had to be brought in to provide cooling and ventilation to buildings that had lost air conditioning, including the Launch Control Center. Many other facilities also had roof damage, broken windows or lost power. Almost every stoplight on the KSC had been blown over or broken, and water intrusion also was a common occurrence. Ironically, the damage that Matthew inflicted on the facility delayed the scheduled launch of NOAA's GOES-R advanced geostationary weather satellite that will be used to monitor future tropical cyclones.

Significant damage occurred in Volusia County where 69 homes were destroyed, 467 homes sustained major damage, 1,494 incurred minor damage, and additional 10,041 experienced some sort of adverse effects. Structural damage to homes and businesses due to wind were mainly confined to the barrier islands, as well as those properties exposed to larger bodies of water. High water levels, wave run-up, and large breaking waves caused major beach erosion, extensive escarpment of sand dunes, and damage to numerous pedestrian crossovers along the entire coastline. In Ormond-By-The-Sea, surging waters eroded much of the protective barrier along highway A1A, resulting in the collapse of several sections of the highway.

Farther north along the northeast Florida coast, major to extreme beach erosion occurred from Flagler Beach to Micklers Landing in St. Johns County. In many areas, the dune lines were cut back 30-40 ft, leaving vertical cliffs that were 12-16 ft high. Large rocks that were uncovered on the beach were forced backward 150 ft to highway A1A, and the highway was washed out in numerous locations up and down the Flagler County coastline. The rough surf conditions also knocked down the end of the Flagler Beach pier and produced significant sand overwash on roads in Marinaland, Summerhaven, Vilano, and Ponte Vedra. Severe storm surge flooding produced inundation of 6-7 ft above ground level, causing a new inlet to be cut in the barrier island between Marineland and Matanzas Inlet. Severe damage was reported in Summerhaven and Matanzas Inlet, with many houses and businesses inundated by saltwater that was at least 3 ft high. Storm surge flooding was reported at the sea walls in St. Augustine Beach and at the Castillo de San Marcos National Monument. Water heights up to 4 ft above ground level occurred in the city of St. Augustine, especially near the bayfront and the San Sebastian River. More than 2 ft of saltwater intrusion occurred on Anastasia Island. In Ponte Vedra Beach, storm surge inundation moved the sand dune line back 30-40 ft, carved out 12-16 ft cliffs, and undermined numerous structures along the beachfront.



In Duval County, several communities in the east side of the Jacksonville metropolitan area incurred extensive damage due to water and numerous massive oak trees having been knocked down. Major to locally extreme beach erosion occurred in Jacksonville Beach, resulting in some sand dunes being completely swept away. Battering waves knocked down and washed away part of the Jacksonville Beach Pier. The combination of storm surge and freshwater flooding of the St. Johns River destroyed many properties and knocked out electrical power for nearly 250,000 customers in the Jacksonville metropolitan area.

Moderate beach erosion occurred in Nassau County, resulting in several washouts along Ocean Boulevard. Hurricane-force wind gusts caused widespread tree and powerline damage, along with some structural damage, mainly across the eastern portion of the county.

Georgia: Direct fatalities (2) – two males, ages 68 and 41 were killed in Statesboro and Savannah, respectively, after trees fell on their homes and crashed through the roofs. One indirect death resulted when a man in Statesboro drove his car into a tree that had fallen across Burkhalter Road.

More than 12 inches of rainfall in many locations across southeastern portions of the state left roads, homes, and businesses inundated by freshwater flooding more than 4 ft deep at times. Downed trees and powerlines were common throughout the coastal areas of the state. On Sapelo Island in McIntosh County, several thousand trees were reported knocked down by category 1 wind gusts. At least 300,000 customers in the state were left without electrical power.

Chatham County received the brunt of Matthew's storm surge effects in the state. On Tybee Island, where record storm surge was recorded at the Ft. Pulaski National Monument, a dune escarpment 7-10 ft high was noted on 19<sup>th</sup> Street. Storm surge inundation also penetrated as far inland as Lovell Avenue and points south, with minor erosion occurring from near the Tybee Island Pier to Center Street. Debris lines also indicated that highway US80 on the north side of the island had been inundated by saltwater in a few locations, resulting in 3 ft of water in a few homes located several blocks inland from the shoreline. In Savannah, storm surge inundation flooded the parking lot of the Hyatt Regency Hotel and also flooded a ballroom with up to 18 inches of saltwater. Floodwaters from the Savannah River inundated a restaurant on the east end of River Street and there were eyewitness reports of the hulls of boats tied up at the River Street Bridge rising to the level of the railings along the river. Storm surge pushed into river inlets and low-lying areas near Savannah, causing saltwater damage to many estuaries and bird refuges in and around the Savannah National Wildlife Refuge. Wind gusts in Savannah, especially in residential neighborhoods, knocked down large majestic oak trees, most dating back more than a century.

In Liberty County, storm surge caused some property damage on St. Catherine Island, including the destruction of three docks. Sand overwash was evident in several locations on the island and dunes were breached or completely destroyed in many spots. Saltwater inundation was noted along St. Catherine's Sound Margin and some creeks were partially flooded by transported sand. At least 10% of the sea turtle nesting habitat was destroyed due to the beach erosion. In the southeastern part of the county, freshwater flooding forced Interstate 95 to be closed between exits 58-67.



Although Glynn County escaped major storm surge damage, significant flooding of all roads around Brunswick still occurred, rendering them impassable to St. Simons Island. Hurricane-force wind gusts along the coastal areas and tropical-storm-force wind gusts extending at least 60 n mi inland knocked down trees and powerlines, and caused damage to the roofs of homes and businesses.

South Carolina: Direct fatalities (4) – In Florence County, 2 females were drowned when their car was swept away by rain-induced floodwaters. In Marion County, a 40-year old male was drowned in his flooded home; in Richland County, a 66-year old male was found pinned face-down in floodwaters outside his home. One indirect death occurred in Dillon County when a 70-year old man was struck by a cable while cleaning up tree debris. The combination of strong wind gusts and freshwater floods downed trees and powerlines more than 50 n mi inland from the coast, forcing the closure of many roads. In the town of Nichols in Marion County, more than 100 people spent the night on the third floor of the town hall due to rising floodwaters. However, the bulk of the damage associated with Matthew occurred in the counties of Beaufort, Berkeley, Charleston, Dorchester, Georgetown, and Horry. At least 800,000 homes and businesses lost power across the state.

In Beaufort County, significant storm surge caused inundation at several locations along highway US21 and eight boats were driven aground along the north side of the highway. An additional four boats were driven aground onto the Beaufort County Airport runway. An NWS site survey indicated extensive tree damage had occurred on Dataw Island, including trees knocked down onto several homes, which was consistent with wind gusts of at least 85 kt. Storm surge inundation on the island destroyed several boats and washed out the northbound lane of the Harbor Island Bridge. The survey further confirmed that some of the structural damage on Harbor Island was consistent with wind gusts of 85-95 kt. The combination of the strong winds and high surge badly damaged several waterfront homes along North Harbor Drive, and Hunting Island State Park was rendered inaccessible due to large number of trees that were knocked down. Sand overwash occurred in many locations on Hunting Island, and a pier was damaged on the south end of the island. Saltwater inundation was also evident on Fripp Island, including the deposition of boulders and large amounts of sand across roads located on the northeastern side of the island. Two waterfront homes on the eastern end of the island near Fripp Inlet incurred major structural damage. Damage to roofs of homes elsewhere on the island was consistent with wind gusts of at least 85 kt. On Hilton Head Island, an NWS site survey indicated that storm surge inundation reached the Harbour Town Golf Course, which is located more than 500 ft inland from the small harbor and more than 1000 ft from the coast. Several marinas on the island were also damaged by the combination of storm surge and wave action.

The downing of trees and powerlines by category 1 wind gusts was widespread throughout much of Charleston County. Storm surge inundation occurred along the entire coast, including much of downtown Charleston where many roads were closed during the storm due to high water. Several communities and many businesses near the Cooper River also experienced saltwater inundation more than 10 n mi inland from the coast. The combination of the high surge and wave action sunk one boat and drove another one aground on Ashley River just north of the I-526/Westmoreland Bridge. Another large boat was driven aground along a tree line just west of the Intracoastal Waterway near Isle of Palms. Significant escarpment of more than 6 ft was noted along the sand dune line north of the Isle of Palms Pier.



Farther south in Colleton County, numerous trees and powerlines were knocked down throughout the area. Flooding occurred along the Edisto River well inland, with a height of 14.90 ft measured near Givhans Ferry, which was the 12<sup>th</sup>-highest flood stage ever recorded. Edisto Island was hit particularly hard by Hurricane Matthew. A majestic oak tree 90 ft tall and 3 ft in diameter was uprooted and one home was completely destroyed. For a while, there was no electricity or water on the island, and all roads were impassable; Main Road was flooded and closed at the intersection with highway US17. An NWS survey team reported that the combination of surge and wave action damaged at least 70 beachfront homes along a 1.5-mile stretch of Palmetto Boulevard on Edisto Beach. The most significant damage occurred along the northern end of the beach, with most concrete home foundations and driveways severely undercut by as much as 6 ft or completely destroyed by the rushing waters. Complete destruction of wooden decks up to 15 ft tall was common. Up to 5 ft of saltwater inundation occurred on parts of the island, and sand up to 5-ft deep was pushed onshore and covered more than a 1-n-mi stretch of Palmetto Boulevard near the beach. Widespread debris was mixed with the sand, including gas tanks, refrigerators, and HVAC units. It is estimated that the beachfront of Edisto Beach moved inland as much as two city blocks.

Up the coast in Georgetown County, moderate flooding occurred on the Black River and Pee Dee River, which spread into parts of the city of Georgetown. Two boats were run aground in the city, and several other boats were washed out to sea. Numerous roads were closed across Georgetown due to floodwaters and downed trees and powerlines. Inland freshwater flooding resulted in numerous evacuations throughout the county.

In Horry County, the combination of storm surge and large waves caused significant beach erosion in beachfront communities along most of the coastal areas, including Myrtle Beach. Heavy rainfall, combined with storm surge moving upstream, caused major flooding of the Waccamaw and Little Pee Dee Rivers. The Waccamaw River reached a record crest of 17.90 ft in Conway, toppling the old record set in 1928 that was caused by Hurricane Okeechobee, which is listed as one of the state's "storms of the century" by the South Carolina Department of Natural Resources. Most of Socastee was inundated by knee-deep water caused by the convergence of floodwaters where the Intracoastal Waterway meets the Waccamaw River just west of the city. Small rivers and creeks surrounding the Conway-Horry County Airport overflowed their banks, flooding portions of the runway complex. High water rendered roads, bridges, and railways impassible, and more than 1,000 people had to seek shelter to escape the floodwaters. More than 170 roads were closed in the county due to freshwater flooding, including highway US501, a main line of communication leading out of Myrtle Beach. The combination of storm surge and wave action tore away 900 ft of the 1,000-ft Springmaid Pier in Myrtle Beach, according to city officials, leaving splintered, weather-beaten boards scattered across the beach where the pier once stood. In addition, the pier in Surfside Beach suffered substantial damage due to significant storm surge, and city officials shut down all roads from Dogwood Drive to the ocean due to the flooding. An EF0 tornado in North Myrtle Beach damaged a couple of businesses and also caused minor damage to a few homes.

In upland portions of the state, widespread freshwater flooding of streets, highways, streams, and rivers occurred across the counties of Darlington, Dillon, Florence, Marion, and Marlboro. Fast-moving floodwaters completely destroyed a bridge in Scranton and numerous water rescues were required across Florence County. In Marlboro County, floodwaters caused a

CSX Railroad train derailment in Wallace. One locomotive and four cars came off the track in a washed-out area just north of the large overpass on Highway 9. The South Carolina Department of Health and Environmental Control responded and found no evidence of any hazardous materials cargo or any fuel leakage that might have posed a threat to surrounding areas.

In Dillon County, major flooding resulted in the closure of Interstate 95 between mile-markers 181 and 193. Moderate flooding of the Lumber and Pee Dee Rivers in the southern part of the county forced closure of Highway 9 from Dillon to Lakeview. Both the Squires Lake Dam and Little Pee Dee State Park Dam failed due to flooding. An unregulated dam in Lexington County also failed.

North Carolina: Direct fatalities (25) – Of the direct deaths reported, 24 of them were flood related. Unfortunately, 19 of those drowning deaths occurred when people drove their vehicles or walked into hazardous floodwaters and were swept away by the swift currents. Some of the victims encountered flood waters after driving around posted barricades. None of the flood-related deaths were associated with storm surge.

Two males, ages 44 and 22, drowned when their vehicle plunged into floodwaters covering a washed-out road in Bladen County. A 70-year-old male was found drowned about 50 yards from his abandoned vehicle. In Cumberland County, a male (age 54) was found drowned near his abandoned vehicle, and a female driver was drowned when her car plunged into rushing flood waters across highway US301. In Gates County, a 75-year old male was found in his car after floodwaters had receded. A 74-year old man was drowned after he drove his car around barriers and into a rain-swollen creek in Harnett County. Four deaths occurred in Johnston County; a driver's car was swept away after attempting to cross a flood-covered bridge, a female driver's car was swept away in floodwaters near I-95 mile-marker 85, a 51-year-old male was swept away while walking through floodwaters, and another driver was found submerged car in a car in Cleveland. Three people were killed in Lenoir County when a 71-year-old male was drowned while attempting to rescue a horse, a female drowned after driving her car around barricades and into floodwaters near LaGrange, and a 55-year-old man was found drowned in a shed in Kinston. A female driver drowned in Pitt County when her car was swept away by rushing floodwaters. Four flood-related deaths occurred in Robeson County when a man's car was washed away by floodwaters near highway NC130, a man relying on oxygen drowned while attempting to escape floodwaters in his home in Fairmont, a 76-year-old man in Lumberton fell into water in his flooded home and drowned, and a female passenger drowned after her husband drove their car into floodwaters. Two people were killed in Wayne County when a male (age 54) had his car swept away by rushing floodwaters, and a 47-year-old female was found in her car after floodwaters had receded. In Wilson County, two people drowned after their cars were swept away submerged by freshwater floods. In Robeson County, a man fell into a large hole caused by an uprooted tree and was unable to climb out of the hole as it filled with floodwaters, resulting in an apparent drowning death.

One additional direct death that was not flood related occurred when a man in Wake County was killed after a tree fell on the truck that he was driving.

There were also six indirect deaths in North Carolina associated with Matthew. A 63-year-old male collapsed from apparent heart failure after getting out of his vehicle in Cumberland County, a person died from apparent heart failure in Lenoir County while walking around after the

hurricane had passed, a female was killed in a fire in Rowan County, a 30-year-old male was killed when his car hydroplaned and crashed on a wet road in Sampson County, two evacuees died in shelters due to health-related issues.

Wind damage was limited primarily to the immediate coastal areas, but flood-producing rainfall exceeding 10 inches was widespread, occurring along and well inland from the coast. Freshwater flooding of major rivers, low-lying areas, roads, and several municipalities was common. Flooding forced closure of Interstate 95 at exit 73 (US421) through exit 58 (NC295) and at exit 31 (NC20) through exit 13 (I-74). In addition, Interstate 40 was closed westbound from exit 341 (NC55) to exit 334 (NC96) between Newton Grove and Benson.

In New Hanover County, at least 4 ft of storm surge produced a record flood level at the downtown Wilmington gauge along the Lower Cape Fear River. The storm surge flooding not only pushed northward up the Cape Fear River, but also spread eastward, producing saltwater inundation in Carolina Beach and low-lying dune areas elsewhere along the immediate coast.

Flooding of the Black River Basin in the western part of Pender County resulted in evacuation and rescues of several neighborhoods in the days following Matthew.

In Brunswick County, major flooding occurred near the confluence of the Black River and the Cape Fear River in the days following Matthew's passage. This caused water to back up into the Lockwood Folly River in Shallotte, forcing several water rescues by local emergency responders.

Major freshwater flooding occurred in the western part of Columbus County along the Lumber River, especially in the town of Fair Bluff where 85% of the town was submerged under water, resulting in massive evacuations. Highways 701 and 74, as well as highway NC130, experienced lengthy closures due to freshwater inundation.

Several of the highest rainfall amounts occurred in Bladen County, resulting in major freshwater flooding along the Cape Fear River at Lock #1 near the town of Kelly. Major flooding was reported in Clarkton, Elizabethtown, White Oak, and Tar Heel, forcing evacuations and water rescues in the latter two municipalities. Floodwaters inundated much of downtown Bladenboro and caused the closure of numerous roads, including major state highways NC210, NC242, NC41, NC53, and NC87. Gauges on the Cape Fear River at the William O. Huske Dam and Lock #1 near East Arcadia recorded their highest flood stages since 1945.

In Robeson County, major and record-breaking flood levels were observed along the Lumber River at Lumberton. Devastating floods occurred in and around Lumberton and Pembroke, causing significant monetary damage and loss of property, and forcing the closure of many roads. Offices in the *Robesonian Newspaper* in Lumberton were also flooded. A levee was believed to have broken in Lumberton, forcing the emergency evacuation of nearly 1,500 people stranded by the rising waters. On 10 October, two days after Matthew had passed, those people were still stranded and awaiting rescue. Most of them were in knee-deep water, but some fled to rooftops to escape the floodwaters. Numerous water rescues were required at many locations along the Lumber River. This was one of the hardest hit counties in the state due to the historic flooding that occurred.



Heavy rainfall and resultant freshwater flooding extended well inland from the state capital of Raleigh eastward to the Outer Banks, resulting in numerous evacuations and water rescues. One notable evacuation included the removal of nearly 800 inmates at the minimum-security Neuse Correctional Institute in Goldsboro in order to escape rising water from the Neuse and Little rivers. More than 700 swiftwater rescues were required in Cumberland County alone. Extensive flooding along the Tar, Cape Fear, Neuse and Lumber rivers produced dangerous conditions beyond drowning – the waters were toxic from sewage, chemicals, and dead animals that were caught up in the floods.

Although Matthew remained well offshore of the Outer Banks, winds coming out of a high pressure system located over the Great Lakes were accelerated into Matthew's circulation, resulting in widespread tree and powerline damage in Currituck, Dare, Hyde, and Tyrrell Counties. These winds also drove water onshore on the sound side of the barrier islands that combined with storm surge coming in from the Atlantic, producing significant saltwater inundation across much of the Outer Banks. Portions of Highway NC12 were closed or impassable. The section of highway NC12 from Kitty Hawk Road to Lillian Street was once again hit hard by overwash, causing new damage to the dunes and pavement. That area was closed and repaired in 2015 after Hurricane Arthur caused damage to the road in 2014. According to the North Carolina Department of Transportation, the barrier island highway was also closed from Old Oregon Inlet Road in Nags Head southward to Hatteras Village due to "very high standing water throughout the area, especially in Hatteras and Avon, with deep standing water covering much of NC12 for the entire length of Hatteras Island."

Elsewhere on the Outer Banks, a large volume of tree debris in Southern Shores had to be removed from the town's streets to allow for emergency vehicles to reach residents. However, overall damage to structures was limited. The town of Kitty Hawk experienced freshwater flooding from the heavy rains between highways US158 and NC12, and pumps had to be invoked in an effort to relieve the standing water. Beach Road (NC12) received damage in front of the Sea Dunes condominiums and had to be closed, while the eastern portion of highway was eroded away by the ocean. Although some homes were damaged from flooding and high winds, property damage overall was described as minor by city officials. The town of Duck's damage estimate indicated that a total of 543 properties were affected. City officials reported that, although many properties were damaged, the damage was relatively minor in nearly all cases. The most common types of damage identified were missing or damaged roof shingles and damaged siding, fascia, and soffits. Storm-surge flooding damaged dozens of additional residences throughout Duck. However, most of the flooded areas were enclosed storage areas, not finished rooms. Several beach structures, such as stairways and decks, were damaged by wave action caused by Matthew. Nags Head officials indicated the town experienced significant flooding on Beach Road (NC12) and between the highways on the north end of Nags Head. Significant flooding also occurred in some of the west side neighborhoods such as Nags Head Pond and Nags Head Acres.

An EF0 tornado touched down near Walnut Creek in Wayne County, uprooting numerous trees, causing minor roof damage to several buildings, and destroying at least one billboard. In addition, a camper was uplifted and rotated around an adjacent building, and subsequently sustained damage. Several privacy fences were also knocked down and blown away. No injuries or deaths resulted from the tornado.

Across the southeastern and eastern portions of the state, Matthew caused at least \$1.5 billion in property damage to 100,000 buildings, left 900,000 people without electrical power, and caused environmental problems.

Virginia: Direct fatalities (1) – A 53-year-old man was swept out to sea and drowned; his body was later found near Constant's Wharf Park & Marina in Suffolk. One indirect death occurred when a 38-year-old male rear-ended a semi-tractor trailer that had stopped at a downed tree across the road.

Strong northerly winds accelerating down the Chesapeake Bay caused widespread power outages across much of the Virginia Tidewater area, especially in the cities of Chesapeake, Hampton Roads, Virginia Beach, and Norfolk. Numerous traffic lights were knocked out, causing confusion and frustration on area roadways. Many streets were rendered impassable either due to floodwaters, downed trees, or downed power lines. In Virginia Beach, flooding and power outages stressed the sewer system so much that city officials asked residents to cut back on unnecessary water use due to the system's inability to handle excessive wastewater flows. Furthermore, city officials indicated that saltwater inundation from storm surge flooding likely got into a 30-inch pressurized line, adding stress to it and exposing a weak spot, which caused a break in a major sewer line along Laskin Road. This resulted in about 2 million gallons of raw sewage spilling into a tributary of Linkhorn Bay. In Suffolk, Matthew's winds and rains damaged some City Hall offices, forcing them to be moved elsewhere within the building.

Many roads were flooded and rendered impassable, especially in Chesapeake, Elmwood Landing, Mill Creek, and Culpepper Landing neighborhoods, and pumps had to be installed to help increase the drainage. More than 100 road closures were reported throughout southeastern Virginia due to freshwater flooding.

Although Matthew's center passed more than 100 n mi southeast of Virginia, the hurricane's effects still caused nearly 350,000 households to lose electrical power. The Virginia Department of Transportation estimated that damage from Hurricane Matthew to state-maintained roads and bridges, along with debris cleanup, was at least \$2 million.

Mid-Atlantic and Northeast: Matthew lost its tropical characteristics early on 9 October as it moved eastward and then northeastward away from the United States. However, the large circulation of the extratropical low pressure system still managed to produce some flooding rains across the Delmarva Peninsula, along with minor beach erosion from Delaware to Long Island. In Snow Hill, Maryland, located in the east-central portion of the Delmarva, freshwater flooding led to a water rescue, but no injuries were reported.

## FORECAST AND WARNING CRITIQUE

The genesis of Matthew was forecast extremely well. Table 4 provides the number of hours in advance of formation associated with the first NHC Tropical Weather Outlook (TWO) forecast in each likelihood category. The precursor disturbance was introduced in the TWO and given a low (<40%) chance of genesis during the next five days 138 hours before Matthew formed.

It was given a medium (40-60%) chance 96 h before genesis occurred, followed 12 h later by a high chance (>60%) of formation. For the shorter term 48-h forecasts, the disturbance was given low, medium, and high chance of genesis 96 h, 54 h, and 42 h, respectively, before formation occurred.

A verification of NHC official track forecasts (OFCL) for Matthew is given in Table 5a. Official forecast track errors were significantly lower than the mean official errors for the previous 5-yr period at all forecast times, especially at 12 h and 24 h where OFCL forecasts were about 40% better than average. At 72-120 h, the climatology and persistence model (OCD5) errors were larger than their 5-yr averages, which suggests that Matthew was a more difficult hurricane to forecast at those longer time periods. Figure 13 shows OFCL forecasts plotted against the best track for Matthew for 0-72 h and 0-120 h. The NHC 72-h forecasts verified exceptionally well with very little bias. The OFCL 120-h forecasts verified quite well over the Caribbean Sea and the Bahamas. However, once Matthew emerged over the southwestern Atlantic north of the Greater Antilles, there was a sharp right-of-track bias due to expectations that Matthew would turn southward around a ridge that was expected to build over the southeastern United States instead of recurving into the mid-latitude westerlies.

A homogeneous comparison of the official track errors with selected guidance models during Matthew's tropical and post-tropical phases is given in Table 5b. Overall, the European Centre for Medium-Range Weather Forecasting model (EMXI) and the United Kingdom Met Office model (EGRI) had the lowest errors, which were mostly lower than the NHC official forecast errors. Many of the model consensus aids also had lower errors than the official forecasts, especially between 12 h and 96 h, including the new NOAA HFIP Corrected Consensus Approach (HCCA) model.

A verification of NHC official intensity forecasts (OFCL) for Matthew is given in Table 6a. OFCL intensity errors were greater than the mean official errors for the previous 5-yr period at all forecast times and contained a pronounced low bias. The early OFCL forecasts missed Matthew's 24-h period of significant strengthening that occurred from 30 September to 1 October, resulting in the low bias. However, after Matthew completed that RI period, OFCL intensity forecast were quite good. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 6b. Overall, the NOAA Hurricane Weather Research and Forecasting model (HWFI) had the best statistics, but only narrowly outperforming the NHC official intensity forecasts at 36-96 h. However, none of the available intensity models, including the consensus model IVCN and its individual members – HWFI, GHMI, CTCL, DSHP, and LGEM – predicted Matthew's RI period either before or during the episode (Fig. 14).

In addition to Hermine earlier in the season, Matthew provided another opportunity for the National Weather Service to issue the Prototype Storm Surge Watch/Warning Graphic (Fig. 17), a depiction of areas that would qualify for inclusion under a storm surge watch or warning under development by the agency. Once operational, the storm surge watch and warning will be issued to delineate areas in which there is a possibility and danger, respectively, of life-threatening inundation of normally dry areas near the coast due the combination of storm surge and the tides. Prototype Storm Surge Watch/Warning Graphics were issued for Matthew beginning at 2100 UTC 4 October, with a possibility of life-threatening inundation within the next 48 hours indicated for the east coast of Florida from North Palm Beach to the Volusia/Brevard County line. A danger of life-threatening inundation within the next 36 h was first conveyed at 0300 UTC 5 October from

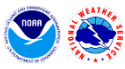
North Palm Beach to Sebastian Inlet, Florida. The Prototype Storm Surge Warning was then extended northward on successive advisories.

Storm surge observations and analyses indicate that at least 3 ft of inundation (the current threshold for the prototype watch/warning) occurred from the east-central coast of Florida northward to North Carolina and the Hampton Roads area of Virginia within most of the Prototype Storm Surge Warning areas (Figs. 10 and 15). In general, locations within the southern portion of the warning area (south of Cape Canaveral) did not experience at least 3 ft of inundation, but only a slight westward shift in Matthew's track would have caused worse storm surge flooding in that area. Conversely, a Prototype Storm Surge Warning was not depicted north of Duck, North Carolina, yet some locations in the Hampton Roads area of Virginia may have experienced 3 ft of inundation. NHC's highest explicit storm surge inundation forecasts indicated that 7 to 11 ft above ground level was expected somewhere between Sebastian Inlet, Florida, and Edisto Beach, South Carolina. Inundation heights that were observed along the coasts of Flagler, St. Johns, and Duval Counties in Florida appear to have been very close to the 7-ft threshold.

Coastal watches and warnings associated with Matthew are given in Table 7. A hurricane watch was first issued for the southeastern and east-central coasts of Florida from Deerfield Beach to the Volusia/Brevard County line at 1500 UTC 4 October. Since sustained tropical-storm-force winds first reached the southeast Florida coast within the hurricane watch area in Palm Beach County around 1800 UTC 6 October, a lead time of 51 h was provided. A hurricane warning was issued for the southeastern and east-central Florida coastal areas from Golden Beach to Sebastian Inlet at 0300 UTC 5 October, and was subsequently extended northward to the Flagler/Volusia County line at 1500 UTC 5 October. Sustained hurricane-force winds first reached the northern portion of the hurricane warning area at Cape Canaveral, Florida, around 0900 UTC 7 October, resulting in a lead time of 42 h. However, the southern portion of the hurricane warning south of Sebastian, Florida, did not verify. Tropical storm and hurricane watches and warnings were subsequently issued at various times for the remainder of the southeastern coast of the United States from the Volusia/Brevard County border northward to Duck, North Carolina. However, the segment of the North Carolina Outer Banks from Surf City to Duck was only covered by a tropical storm warning and a hurricane watch. Surface observations indicate that sustained hurricane-force winds occurred near Nags Head, North Carolina, on the morning of 9 October, an area that was not covered by a hurricane warning.

NHC does not issue warnings for inland flooding, but coordinates with the Weather Prediction Center (WPC) on hazard statements for inclusion in NHC public products. The risk of flooding and flash flooding from central Florida to eastern North Carolina was first mentioned in the NHC Public Advisory at 5 AM Friday 7 October, when Matthew's center was east of Cape Canaveral. The threat of inland flooding was included as a "Key Message" in NHC's Tropical Cyclone Discussion beginning at 11 AM that day, and Public Advisories began describing the anticipated flooding as "life-threatening" beginning at 5 PM.

## ACKNOWLEDGMENTS



Data in Table 3 were compiled from Post-Tropical Cyclone Reports issued by the NWS Forecast Offices (WFOs) in Miami, Melbourne, Tampa Bay/Ruskin, Jacksonville, Charleston, Wilmington, and Newport/Morehead City. Data from the Weather Prediction Center, National Data Buoy Center, NOS Center for Operational Oceanographic Products and Services, United States Geological Survey, the Cuban Meteorological Service (INSMET), the Bahamas Department of Meteorology, the Dominican Republic National Meteorological Office, and Meteo-France were also used in this report. Situation Reports (SITREP) from the Government of Haiti and USAID, along with reports from the St. Vincent and the Grenadines National Emergency Management Office were used to compile casualty and damage information for their respective countries. Mark Sudduth of *HurricaneTrack.com* contributed detailed wind and pressure observations, along with eyewitness accounts of conditions in New Smyrna Beach, Florida, during Matthew's passage. Special thanks to Hurricane Specialist Robbie Berg and the NHC Storm Surge Unit for providing valuable analysis and figures concerning U.S. coastal flooding caused by Matthew's storm surge. Brad Klotz of the NOAA/AOML Hurricane Research Division (HRD) provided the post-storm quality control checks of SFMR surface wind speed data.



Table 1. Best track for Hurricane Matthew, 28 September – 9 October 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
28 / 1200	13.4	59.8	1009	50	tropical storm
28 / 1800	13.6	61.2	1008	50	"
29 / 0000	13.9	62.6	1004	55	"
29 / 0600	14.0	64.0	1002	55	"
29 / 1200	14.1	65.5	995	60	"
29 / 1800	14.2	66.9	993	65	hurricane
30 / 0000	14.2	68.1	987	70	"
30 / 0600	14.0	69.3	979	85	"
30 / 1200	13.8	70.4	968	100	"
30 / 1800	13.5	71.2	955	120	"
01 / 0000	13.4	71.9	942	145	"
01 / 0600	13.4	72.5	942	140	"
01 / 1200	13.4	73.1	944	135	"
01 / 1800	13.4	73.3	942	130	"
02 / 0000	13.5	73.5	940	130	"
02 / 0600	13.7	73.9	941	125	"
02 / 1200	14.0	74.3	947	130	"
02 / 1800	14.2	74.7	945	135	"
03 / 0000	14.5	75.0	944	130	"
03 / 0600	14.9	75.0	942	125	"
03 / 1200	15.4	75.0	941	125	"
03 / 1800	15.9	74.9	938	125	"
04 / 0000	16.6	74.6	934	130	"
04 / 0600	17.5	74.4	934	130	"
04 / 1100	18.3	74.3	935	130	"
04 / 1200	18.4	74.3	937	125	"



Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
04 / 1800	19.3	74.3	947	120	"
05 / 0000	20.1	74.3	949	115	"
05 / 0600	20.7	74.4	960	110	"
05 / 1200	21.4	74.8	962	105	"
05 / 1800	22.2	75.4	963	105	"
06 / 0000	23.0	76.0	960	105	"
06 / 0600	23.8	76.7	952	110	"
06 / 1200	24.7	77.5	937	120	"
06 / 1800	25.7	78.3	937	120	"
07 / 0000	26.7	79.0	937	115	"
07 / 0600	27.7	79.7	939	110	"
07 / 1200	28.9	80.3	944	105	"
07 / 1800	29.7	80.7	946	100	"
08 / 0000	30.7	80.6	949	95	"
08 / 0600	31.6	80.6	953	85	"
08 / 0900	32.1	80.5	957	85	"
08 / 1200	32.5	79.9	963	80	"
08 / 1500	33.0	79.5	967	75	"
08 / 1800	33.5	79.0	973	70	"
09 / 0000	33.9	77.3	981	70	"
09 / 0600	34.7	76.0	983	70	"
09 / 1200	35.0	74.5	984	65	extratropical
09 / 1800	35.2	72.8	987	60	"
10 / 0000	35.3	71.1	990	55	"
01 / 0000	13.4	71.9	942	145	maximum winds
04 / 0000	16.6	74.6	934	130	minimum pressure

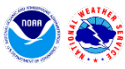


<b>Date/Time (UTC)</b>	<b>Latitude (°N)</b>	<b>Longitude (°W)</b>	<b>Pressure (mb)</b>	<b>Wind Speed (kt)</b>	<b>Stage</b>
04 / 1100	18.3	74.3	934	130	landfall near Les Anglais, Haiti
05 / 0000	20.1	74.3	949	115	landfall near Juaco, Cuba
07 / 0000	26.7	79.0	937	115	landfall near West End, Grand Bahama Island
08 / 1500	33.0	79.5	963	75	landfall 5 n mi south of McClellanville, South Carolina

Table 2. Selected ship reports with winds of at least 34 kt for Hurricane Matthew, 28 September – 10 October 2016, while it was a tropical and extratropical cyclone.

Date/Time (UTC)	Ship call sign	Latitude (°N)	Longitude (°W)	Wind dir/speed (kt)	Pressure (mb)
29 / 0100	3ETA8	19.2	67.1	070 / 35	1014.0
05 / 0000	J8PE4	20.1	71.2	170 / 40	1006.0
07 / 1000	WMKA	31.6	77.8	080 / 40	1007.0
07 / 1800	DFDG2	29.8	76.0	130 / 36	1007.2
08 / 1100	3FFL8	25.8	79.5	230 / 38	1009.9
08 / 1354	WTER	32.8	79.9	330 / 40	980.2
09 / 0000	WAIU	37.0	70.9	140 / 37	1007.0
09 / 0700	H3GR	30.3	80.3	020 / 35	1012.0
09 / 1600	C6VV8	40.4	69.3	050 / 52	1011.0
09 / 1800	D5FR8	37.6	73.1	350 / 60	999.0
09 / 1800	BUZM3	41.4	71.0	020 / 35	1011.9
09 / 2100	WCE506	41.0	70.9	030 / 45	1010.3
10 / 0000	3EFD9	40.5	71.5	020 / 45	1011.9
10 / 0000	BUZM3	41.4	71.0	010 / 37	1011.4
10 / 0100	BATFR2	41.3	69.3	020 / 55	1005.4
10 / 0600	A8XY2	39.7	69.5	360 / 56	1009.0





Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Nassau Upper-Air Station (MYNN) (25.05N 77.46W)			06/1400	100	111				
Paradise Island (25.08N 77.30W)			06/1139	57 (10 min)					
Ragged Island (22.18N 75.73W)	05/0000	989.0	05/1800	40 (10 min)					
Stella Maris, Long Island (23.58N 75.27W)									2.82
West End 1.1 ESE (BHS-WG-1) (26.68N 78.96W)									1.01
<b>Barbados</b>									
<b>ICAO Sites</b>									
Grantley-Adams IAP (TBPB) (13.07N 59.49W)	28/0800	1007.8	28/2200	37 (10 min)	53				2.69
<b>Cuba</b>									
<b>ICAO Sites</b>									
Frank País/Holguin Arpt (MUHG/78372) (20.79N 76.32W)	05/1800	1002.2	05/1700	17 (1 min/10 m)	27				2.51
Hermanos Ameijeiras/Las Tunas Arpt (MUVT/78357) (20.99N 76.94W)	05/2100	1003.1	04/1740	24 (1 min/10 m)	30				2.51
Mariana Grajales/Guantánamo Arpt (MUGT/78368) (20.09N 75.16W)	04/2010	991.6	04/1950	9 (1 min/10 m)	---				4.67
Punta de Maisí Arpt (MUMA/78369) (20.24N 71.50W)	05/0150	968.8	05/0120	108 (1 min/10 m)	132				26.04
Sierra Maestra/Manazillo Arpt (MUMZ/78359) (20.29N 77.09)	05/0800	1004.3	05/2215	22 (1 min/10 m)	29				1.00
U.S. Naval Station, Guantánamo Bay (MUGM) (19.90N 75.21W)	04/2156	996.9	04/1356	24 (1 min/10 m)	34 <sup>F</sup>				3.16



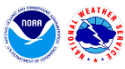




Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Bombardopolis/ Nord-Ouest Dep't (19.70N 73.33W)									15.74
Carrefour/ Ouest Department (18.53N 72.40W)									6.30
Fonds-Parisien/ Ouest Department (18.52N 71.98W)									4.13
Gros-Morne/ Artibonite Department (19.67N 72.68W)									3.94
Jean-Rabel/ Nord-Ouest Dep't (19.85N 73.20W)									17.72
La Vallée-de-Jacmel/ Sud-Est Department (18.27N 72.67W)									15.83
Mombin-Crochu/ Nord-Est Department (19.37N 71.98W)									1.20
Petit-Trou-de-Nippes/ Nippes Department (18.45N 73.35W)									20.10
Plaisance/ Nord Department (19.60N 72.47W)									3.74
Verrettes/ Artibonite Department (19.05N 72.47W)									3.93
<b>Martinique</b>									
<b>ICAO Sites</b>									
Martinique Aimé Césaire IAP (TFFF) (14.59N 60.99W)	28/1900	1007.9 <sup>F</sup>	28/2107	38 (10 min)	61				
<b>Other</b>									
Daimant (elev. 366 m) (14.48N 61.00W)			28/2107	44 (10 min)	66				
Fond-Denis-Cadet (elev. 493 m) (14.73N 61.14W)			28/1856	39 (10 min)	87				7.94



Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Fort De Frances Desaix (elev. 143 m) (14.63N 60.07W)			28/2023	35 (10 min)	60				
Lorrain Vallon (elev. 83 m) (14.81N 61.07W)			28/2213	32 (10 min)	63				
Rivière-Pilote Stade (elev. 80 m) (14.48N 60.91W)									8.19
Sainte-Anne (elev. 22 m) (14.44N 60.87W)			28/1927	32 (10 min)	61				5.65
Sainte-Luce (elev. 44 m) (14.59N 60.99W)			28/1935	32 (10 min)	60				
Sainte-Pierre (elev. 27 m) (14.74N 61.18W)			28/1917	31 (10 min)	60				
Trinite Caravel (elev. 26 m) (14.71N 60.97W)			28/2201	52 (10 min)	75				
Vauclin (elev. 12 m) (14.54N 60.84W)			28/2113	51 (10 min)	68				4.96
<b>Montserrat</b>									
<b>ICAO Sites</b>									
John A. Osborne IAP (TRPG) (16.79N 62.19W)	28/2100	1012.0 <sup>F</sup>	28/1807	31 <sup>F</sup> (10 min)	42				
<b>Puerto Rico</b>									
<b>ICAO Sites</b>									
Luis Muñoz Marín (San Juan) IAP (TJSJ) (18.44N 66.00W)	29/0756	1013.5	29/1109	25 (2 min/10 m)	36 <sup>F</sup>				
<b>St. Croix</b>									
<b>ICAO Sites</b>									
Henry E. Rohlsen IAP (TISX) (17.70N 64.80W)	28/1935	1013.5	28/2153	27 <sup>F</sup> (10 min)	43				
<b>St. Lucia</b>									



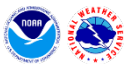
Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
<b>ICAO Sites</b>									
George F. L. Charles IAP (TLPC) (14.02N 60.99W)	28/1900	1006.0	29/0000	19 (10 min)	43				
Hewanorra IAP (TLPL) (13.73N 60.95W)	28/2100	1007.0	29/0000	31 <sup>F</sup> (10 min)	41				
<b>St. Maarten &amp; St. Martin</b>									
<b>ICAO Sites</b>									
Princess Juliana IAP (TNCM) (18.04N 63.11W)	28/1942	1012.8 <sup>F</sup>	28/2200	21 (10 min)	33				
<b>United States</b>									
<b>Florida</b>									
<b>International Civil Aviation Organization (ICAO) Sites</b>									
Brooksville-Tampa Bay Reg. Arprt (KFHB) (28.47N 82.45W)	07/1053	1001.8	07/1853	22 (2 min, 10 m)	34				
Cape Canaveral Air Force Station (KXMR) (28.50N 80.75W)									17.01
Daytona Beach IAP (KDAB) (29.18N 81.05W)	07/1537	974.3	07/1045	45 (2 min, 10 m)	62				5.06
Deland Municipal Airport (KDED) (29.06N 81.28W)	07/1655	984.7	07/1415	36 (2 min, 10 m)	54				
Fernandina Beach Muni. Airport (KFHB) (30.61N 81.46W)	07/2235	984.6	08/0155	38 (2 min, 10 m)	52				
Ft. Lauderdale Exec. Arprt (KFYE) (26.20N 80.17W)	07/0053	996.9	07/0126	26 (2 min, 10 m)	38				1.61
Ft. Lauderdale-Hollywood IAP (KFLL) (26.07N 80.15W)	06/2305	996.7	07/0453	21 (2 min, 10 m)	29				1.19
Ft. Myers-Page Field Airport (KFMY) (26.58N 81.97W)	07/0753	1001.9	06/1907	21 (2 min, 10 m)	41				



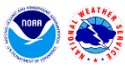
Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Gainesville Regional Airport (KGNV) (29.69N 82.27W)	07/1953	996.5	07/1917	29 (2 min, 10 m)	42				1.49
Jacksonville-Cecil Field Airport (KVQQ) (30.22N 81.88W)			07/2215	32 (2 min, 10 m)	48				8.91
Jacksonville Exec./Craig (KCRG) (30.34N 81.51W)	07/2053	986.1	07/2006	41 (2 min, 10 m)	60				8.91
Jacksonville IAP (KJAX) (30.48N 81.70W)	07/2156	989.8	07/1920	39 (2 min, 10 m)	56				8.32
Jacksonville Naval Air Station (KNIP) (30.22N 81.67W)	07/2053	988.5	07/1909	42 (2 min, 10 m)	59				6.71
Keystone Heights Airpark (K42J) (29.85N 82.05W)	07/1535	999.3	07/1535	24 (2 min, 10 m)	36				
Lake City Gateway Airport (KLCQ) (30.18N 82.58W)	07/2135	999.3	07/2015	24 (2 min, 10 m)	36				
Leesburg IAP (KLEE) (28.82N 81.81W)	07/1550	995.9	07/1825	27 (2 min, 10 m)	42				1.69
Mayport Naval Station/ Jacksonville (KNRB) (30.40N 81.43W)									1.47
Northeast Florida Reg. Airport/St. Augustine (KSGJ) (28.78N 81.24W)	07/1858	982.1	07/1721	44 (2 min, 10 m)	59				8.81
North Perry-Hollywood Airport (KHWO) (26.00N 82.24W)	06/2253	998.0	07/0353	23 (2 min, 10 m)	36				
Ocala IAP (KOCF) (29.18N 82.22W)	07/1850	997.6	07/1650	20 (2 min, 10 m)	34				3.00
Okeechobee County Airport (KOBK) (27.27N 80.85W)	07/0615	994.2	07/1115	27 (2 min, 10 m)	34				
Opa Locka-Miami Exec. Aprt (KOPF) (25.91N 80.28W)	06/2300	998.5	07/0045	24 (2 min, 10 m)	35				
Orlando-Melbourne IAP (KMLB) (28.10N 80.65W)	07/0937	980.0	07/0646	46 (2 min, 10 m)	61				6.17



Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Orlando IAP (KMCO) (28.42N 81.33W)	07/1058	991.5	07/1444	40 (2 min, 10 m)	53				2.48
Orlando Exec. Airport (KORL) (28.55N 81.33W)	07/1229	991.5	07/1521	36 (2 min, 10 m)	50				3.01
Orlando-Sanford IAP (KSFB) (28.78N 81.24W)	07/1508	987.1	07/1512	41 (2 min, 10 m)	55				8.22
Palm Beach IAP (KPBI) (26.68N 80.09W)	07/0353	992.8	06/2253	29 (2 min/10 m)	44				
Pompano Beach Airpark (KPMP) (26.25N 80.12W)	07/0200	996.0	07/0322	33 (2 min/10 m)	41				
Sarasota-Bradenton IAP (KSRQ) (27.40N 82.55W)	07/0853	1002.8	07/1153	24 (2 min/10 m)	34				
St. Pete.-Clearwater IAP (KPIE) (27.91N 82.69W)	07/0853	1002.2	07/0953	21 (2 min/10 m)	35				
The Villages Airport (KVVG) (28.96N 81.97W)	07/1815	993.0	07/1815	26	35				
Treasure Coast IAP/ Ft. Pierce (KFPR) (27.49N 80.37W)	07/0711	982.7	07/0715	29 (2 min, 10 m)	59				4.18
Vero Beach Regional Airport (KVRB) (27.65N 80.42W)	07/0725	980.7	07/0650	48 (2 min/10 m)	64				3.55
Williston Municipal Airport (KX60) (27.35N 82.47W)	07/1835	999.0	07/1935	28	39				
Witham Field Airport/ Stuart (KSUA) (27.18N 80.22W)	07/0615	985.1	07/0615	36 (2 min/10 m)	53				2.45
<b>United States Geological Survey (USGS) Storm Tide Pressure Sensors</b>									
Fort Matanzas Beach (FLSTJ03126) (29.72N 81.23W)							8.39	6.4	
<b>Everglades National Park Water Quality Stations</b>									
Blackwater Sound Key (BWSF1) (25.18N 80.44W)							2.03 (MLLW)		



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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Butternut Key (BNKF1) (25.09N 80.52W)							2.06 (MLLW)		
Duck Key (DKKF1) (25.18N 80.49W)							2.19 (MLLW)		
Little Blackwater Sound (LSBF1) (25.21N 80.43W)							2.16 (MLLW)		
<b>Coastal-Marine Automated Network (C-MAN) Sites</b>									
Blount Island Command (BLIF1) (30.39N 81.52W)	07/2124	986.4	07/2000	36 (10 min, 17 m)	56				
Cedar Key (CDRF1) (29.14N 83.03W)	07/1854	1002.4	06/1624	29 (10 min, 10 m)	45				
Fowey Rocks (FWYF1) (25.59N 80.10W)	06/2200	999.0	06/2250	38 (6 min, 4.4 m)	49				
Molasses Reef (MLRF1) (25.01N 80.38W)			06/1109		37 (16 m)				
St. Augustine (SAUF1) (29.86N 81.27W)	07/1900	978.9	07/1730	57 (10 min, 17 m)	75				
<b>National Ocean Service (NOS) Sites</b>									
Clearwater Beach (8726724) (27.98N 82.83W)	07/0918	1003.2	07/1154	33 (6 min, 7 m)	39				
Dames Point (8720219) (30.39N 81.56W)						3.68	4.18 <sup>I</sup>	2.8	
Fernandina Beach (8720030) (30.67N 81.47W)	08/0012	987.4 <sup>F</sup>	08/0318	34 (6 min, 7 m)	51	6.91	6.96	4.2	
Lake Worth Pier (8722670) (26.61N 80.03W)			06/2130	40 (6 min, 6 m)	52	1.69	1.97	1.4	
Mayport-Bar Pilots Dock (8720218) (30.40N 81.43W)	07/2112	985.3	07/2006	46 (6 m)	65	4.69	5.22 <sup>I</sup>	3.3	
I-295 Bridge, St. Johns River (8720357) (30.19N 81.69W)	07/2036	988.3	07/1800	28 (10 m)	42	3.08	3.44	3.1	
Racy Point, St. Johns River (8720625) (29.80N 81.55W)						4.58	5.19	4.6	
Red Bay Point, St. <sup>J</sup> Johns River (8720503) (29.98N 81.64W)	07/2012	986.9	07/1824	44 (10 m)	60	3.38	3.66 <sup>I</sup>	3.2	



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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
South Bank Riverwalk, St. Johns River (8720226) (30.32N 81.66W)						3.37	2.76	2.1	
Trident Pier (8721604) (28.42N 80.59W)	07/1100	973.5	07/0948	45 (6 min, 7 m)	64	4.09	2.82	1.8	
Vaca Key (8723970) (24.71N 81.10W)	06/1930	1003.5	06/2230	26 (7 m)	30	0.98	0.60	1.0	
Virginia Key (8723214) (25.73N 80.16W)	06/2206	998.4	07/0506	26 (10 m)	33	1.01	1.30	1.1	
<b>Weatherflow Sites</b>									
Altamonte Springs-Spring Lake (XSPR) (28.66N 81.41W)			07/1221	33	41				
Anna Maria Island 6 NNW (XEGM) (27.61N 82.76W)			07/1116	32	38				
Boca Grande 2 S (XBCG) (26.72N 82.26W)			06/2010	23	36				
Buck Island - Jacksonville (XJAK) (30.39N 81.48W)	07/2048	979.4	07/1943	51 (2 min, 10 m)	71				
Carysfort Reef Light-Key Largo (KCFL) (25.23N 80.21W)	06/1955	997.3	06/2230	33	42				
Cocoa Beach Club (XCOA) (28.31N 80.63W)			07/1245	43	56				
Cocoa Beach Pier (XCCO) (28.37N 80.60W)			07/0845	52	67				
Crescent Beach - Summerhouse (XHSE) (29.71N 81.23W)	07/1815	977.6	07/1725	49 (2 min, 5 m)	67				
Hobe Sound (XHOB) (27.05N 80.17W)			07/0529	37	50				
Horizon West-Reedy Lake (XRDY) (28.44N 81.63W)			07/1326	31	39				
Huguenot Park - Jacksonville (XHUP) (30.42N 81.41W)	07/2048	979.4	07/1943	51 (2 min, 10 m)	71				



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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Jacksonville Beach Pier (XJAX) (30.29N 81.39W)	07/2105	983.6	07/1735	53 (2 min, 12 m)	66				
Jensen Beach (XJEN) (27.22N 80.20W)			07/0400	45	63				
Jensen Beach-St. Lucie Pwr Plnt (XSTL) (27.35N 80.24W)			07/0207	50	58				
Jupiter (XJUP) (26.89N 80.06W)			06/2315	49 (6 m, 5 min)	58				
Lewis - St. Johns (XLWS) (29.91N 81.33W)	07/1929	976.9	07/1659	39 (2 min, 15 m)	58				
Malabar-Rocky Point (XRPT) (27.98N 80.55W)			07/0648	52	63				
Melbourne-Dairy Road (XDAI) (28.04N 80.64W)			07/0747	38	62				
Melbourne Beach-Aquarina R&D Lab (XDAI) (27.94N 80.49W)			07/0749	35	53				
Merritt Island-Banana River at SR520 (XCCB) (28.36N 80.65W)			07/0919	55	70				
Merritt Island-Banana River at SR528 (XMER) (28.40N 80.66W)			07/1130	37	60				
New Smyrna Beach (XNSB) (29.04N 80.90W)			07/1202	61	72				
Palmetto 7 NW (XSKY) (27.60N 82.65W)			07/1532	30	36				
Sarasota 1 WNW (XSRB) (27.34N 82.56W)			06/2002	28	36				
Tamarac (XCVN) (26.19N 80.30W)			07/0038		37 (10 m)				
Titusville-Parrish Park North (XPAR) (28.63N 80.81W)			07/1110	50	65				











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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Vero Beach 4 W (VRGF1) (27.69N 80.44W)									4.53
<b>Other Sites</b>									
AP837 - 3 SW Eagle Lake (27.95N 81.79W)			07/0748	24	38				
AR664 - 2 WNW Frostproof (27.76N 81.57W)			07/1929		36				
AR666 - 1 ESE Dundee (28.01N 81.60W)			07/0734	22	37				
Broad Key (Weatherstem) (25.35N 80.25W)			06/1043		36				
D1496 - 1 N Beverly Hills (28.93N 82.46W)			07/202		40				
D9045 - 1 NW Port Charlotte (26.99N 82.11W)			06/1935		37				
E6508 – Belleair (27.95N 82.81W)			07/0935	30	43				
Kennedy Space Center (KSC0021) – USAF Tower 2 (28.44N 80.56W)			07/1020	59 (1 min, 16.5 m)	88				
Kennedy Space Center (KSC0003) – USAF Tower 3 (28.46N 80.53W)			07/1026	74 (1 min, 16.5 m)	93				
Kennedy Space Center (KSC1102) – USAF Tower 110 (28.57N 80.59W)			07/1121	65 (1 min, 16.5 m)	91				
Kennedy Space Center (KSC3132) – USAF Tower 313 (28.62N 80.66W)			07/1130	60 (1 min, 16.5 m)	86				
Kennedy Space Center (KSC0020) – USAF Tower 108 (28.44N 80.56W)			07/1020	58 (1 min, 16.5 m)	85				



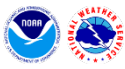
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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Kennedy Space Center (KSC0108) – USAF Tower 2 (28.54N 80.57W)			07/1046	64 <small>(1 min, 16.5 m)</small>	83				
Kennedy Space Center (KSC0061) – USAF Tower 6 (28.51N 80.56W)			07/1127	53 <small>(1 min, 16.5 m)</small>	81				
Kennedy Space Center (KSC0303) – USAF Tower 303 (28.46N 80.57W)			07/1037	60 <small>(1 min, 16.5 m)</small>	80				
Kennedy Space Center (KSC1101) – USAF Tower 1101 (28.57N 80.59W)			07/1230	70 <small>(1 min, 16.5 m)</small>	80				
Kennedy Space Center (KSC3131) – USAF Tower 3131 (28.63N 80.66W)			07/1130	58 <small>(1 min, 16.5 m)</small>	80				
Kennedy Space Center (KSC0403) – USAF Tower 403 (28.46N 80.59W)			07/1050	60 <small>(1 min, 16.5 m)</small>	80				
Kennedy Space Center (KSC0001) – USAF Tower 1 (28.43N 80.57W)			07/1129	59 <small>(1 min, 16.5 m)</small>	77				
Kennedy Space Center (KSC0415) – USAF Tower 415 (28.66N 80.70W)			07/1104	56 <small>(1 min, 16.5 m)</small>	73				
KFLDAYTONA014- Daytona Beach (Embry Riddle) Weatherstem (29.19N 81.05W)			07/1527	62	73				
New Smyrna Beach <i>HurricaneTrack.com</i> (29.02N 80.91W)	07/1457	969.9	07/1440	56 <small>(26 m, 1 min)</small>	82				
Ortega 1 SSE (C0639) (30.26N 81.70W)			07/1948		34				6.87







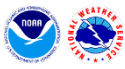




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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Millhaven 9 ENE (BFYG1) (32.93N 81.50W)									5.28
Oliver 1 SW (OLVG1) (32.49N 81.56W)									6.49
Port Wentworth (PWNG1) (32.17N 81.15W)									9.02
Port Wentworth 6 N (PTWG1) (32.24N 81.15W)									9.18
Rincon 5 SE (ACRG1) (32.25N 81.18W)									12.81
Rincon 6 NE (HBNG1) (32.34N 81.15W)									13.17
Rincon 6 SE (ACMG1) (32.24N 81.15W)									12.26
Sapelo Island (SPIG1) (31.40N 81.28W)									12.96
Sapelo Island Reserve (SAXG1) (31.42N 81.30W)	08/0430	982.6	08/0530	50 (10 m)	65				10.94
Springfield 2 W (SRFG1) (32.35N 81.34W)									11.23
Sterling 3 SW (STRG1) (31.21N 81.61W)									9.65
Tybee Island 4 NW (FTBG1) (32.03N 80.90W)									8.24
<b>South Carolina</b>									
<b>ICAO Sites</b>									
Allendale County Airport (KAQX) (32.99N 81.27W)			08/0915	31 (10 m, 2 min)	47				
Beaufort County Airport (KARW) (32.41N 80.63W)			08/0835	45 (10 m, 2 min)	60				



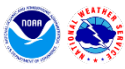
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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Beaufort MCAS (KNBC) (32.49N 80.70W)	08/0456	980.6	08/0845	40 (10 m, 2 min)	62				13.97
Charleston Downtown Airport (KCXM) (32.70N 80.01W)			08/0335	32 (10 m, 2 min)	50				
Charleston Executive Airport (KJZI) (32.78N 79.93W)	08/1300	974.6	08/1300	36 (10 m, 2 min)	46				
Charleston IAP (KCHS) (32.90N 80.04W)	08/1316	981.7	08/1655	42 (10 m, 2 min)	60				10.48
Columbia Metropolitan Airport (KCAE) (33.95N 81.12W)									4.45
Curtis L. Brown Field/Elizabethtown (KEYF) (34.60N 78.58W)	08/1920	993.9	08/2105	18 (10 m, 2 min)	37				
Florence Regional Airport (KFLO) (34.19N 79.72W)	08/1153	1011.5	08/1029	29 (10 m, 2 min)	38				6.75
Georgetown County Airport (KGGE) (33.31N 79.32W)	08/1335	990.5	08/0515	27 (10 m, 2 min)	41				
Hartsville Regional Airport (KHVS) (34.40N 80.12W)	08/1155	1002.0	08/1135	25 (10 m, 2 min)	35				
Hilton Head Island Airport (KHXD) (32.23N 80.69W)			08/0855	53 (10 m, 2 min)	76				
Marlboro County Jetport (KBBP) (34.62N 79.73W)	08/1155	1002.4	08/1155	24 (10 m, 2 min)	37				
McEntire JNG Base/Columbia (KMMT) (33.92N 80.78W)									6.83
Mount Pleasant Reg. Airport (KLRO) (32.90N 79.78W)			08/1435	37 (10 m, 2 min)	48				
Berkeley Co. Arpt/Moncks Crnr (KMKS) (33.19N 80.04W)			08/0555	23 (10 m, 2 min)	38				11.69
Grand Strand/N Myrtle Beach Airport (KCRE) (33.81N 78.72W)	08/1900	980.7	08/2114	33 (10 m, 2 min)	61				



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	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Low Country Reg. Arpt /Walterboro (KRBW) (32.93N 80.64W)			08/1135	29 (10 m, 2 min)	43				
Myrtle Beach IAP (KMYR) (33.69N 78.93W)	08/1815	998.0	08/2115	42 (10 m, 2 min)	64				3.34
Williamsburg Regional Arpt/Kingstree (KCKI) (33.71N 79.86W)	08/1435	992.9	08/1435	18 (10 m, 2 min)	31				
<b>C-MAN Sites</b>									
Folly Island (FBIS1) (32.69N 79.89W)	08/1300	971.3	08/1120	45 (7 m, 10 min)	59				
<b>NOS Sites</b>									
Cooper River Entrance, Charleston (8665530) (32.78N 79.93W)	08/1248	975.6	08/0018	37 (9 m, 6 min)	51	6.20	6.15	3.5	
Oyster Landing (North Inlet Estuary) (8662245) (33.35N 79.19W)						5.51	7.11 <sup>I</sup>	4.7	
Springmaid Pier <sup>J</sup> (8661070) (33.66N 78.92W)	08/1618	985.0	08/0700	41 (7 m, 6 min)	53	4.43	5.20	2.8	
<b>National Estuarine Research Reserve System (NERRS) Sites</b>									
Winyah Bay-S. Jetty (TEC2929) (33.18N 79.20W)			08/1950	56 (7 m, 6 min)	90				
<b>Coastal Ocean Research and Monitoring Program (CORMP) Sites</b>									
Fripp Nearshore – FRP2 (41033) (32.28N 80.41W)			08/1108	48 (3 m)	73				
Capers Nearshore – CAP2 (41029) (32.81N 79.63W)	08/1308	962.8	08/1308	41 (3 m)	57				
<b>Weatherflow Sites</b>									
Charleston-Battery Point (XCHA) (32.76N 79.95W)	08/1316	972.0	08/1401	46 (9 m)	63				
Beaufort (XBUF) (32.34N 80.59W)	08/0841	966.0	08/0841	58 (10 m)	72				







Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
<b>HADS Sites</b>									
Bennett's Point, Ace Basin Res. (ACXS1) (34.04N 78.94W)	08/1045	979.5	08/1300	19 (10 m)	36				11.36
Elba Island (ELBS1) (32.12N 81.05W)									12.45
Galivant's Ferry (GALS1) (34.06N 79.25W)									11.88
Pinopolis-Lake Moultrie (PNOS1) (33.25N 80.03W)	08/1330	985.4	08/1700	43 (10 m)	56				
<b>Remote Automated Weather Stations (RAWS)</b>									
Adams Run/Ace Basin (ABRS1) (32.66N 80.40W)			08/1255	27 (6 m)	63				10.58
Huger 3 NNE (HUGS1) (33.13N 79.78W)									11.50
Jamestown 2 NE-Santee River (JAMS1) (33.30N 79.67W)									11.00
Limehouse 4 SW-Little Black River (FWDS1) (32.17N 81.12W)									12.70
Mullins (MULS1) (34.19N 79.25W)									15.57
Savannah/Hardeeville NWR (SVNS1) (32.10N 81.08W)			08/0923	34 (6 m)	54				12.78
Walterboro (WTBS1) (32.92N 80.63W)			08/1407	15 (6 m)	37				9.62
<b>Others</b>									
Chadbourne 1.1 WNW (34.51N 79.42W)									12.90
Edisto Island Middleton (EDSS1) (32.60N 80.33W)									16.90
Florence 5 E (34.19N 79.67W)									11.95
Georgetown 1 ENE (33.37N 79.29W)			08/2000	39	65				



Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Marion (34.17N 79.40W)									14.52
Marion 4 E (34.18N 79.34W)									15.02
Quinby 5 N (34.30N 79.73W)									12.69
Wedgfield Plantation 5 SE (33.37N 79.18W)									14.36
<b>North Carolina</b>									
<b>ICAO Sites</b>									
Albert J. Ellis-Jacksonville Airport (KOAJ) (34.83N 77.62W)	08/2156	994.5	09/0156	26 (10 m, 2 min)	50				
Billy Mitchell-Hatteras Airport (KHSE) (35.22N 75.62W)	09/0258	989.0	09/0019	41 (10 m, 2 min)	54				
Bouge Field MCAF-Bouge Sound (KNJM) (34.69N 77.03W)	08/2357	992.8	06/1632	29 (10 m, 2 min)	50				
Burlington-Alamance Regional Arpt (KBUY) (35.05N 79.48W)									3.96
Cape Fear Regional Airport (KSUT) (33.93N 78.07W)	08/2105	984.0	09/0025	35 (10 m, 2 min)	51				
Charlotte Douglas IAP (KCLT) (35.21N 80.94W)									2.78
Cherry Point MCAS (KNKT) (34.90N 76.90W)	09/0054	993.4	09/0454	41 (10 m, 2 min)	54				
Coastal Carolina Reg. Arpt/New Bern (KEWN) (35.07N 77.04W)	08/2354	995.2	09/0513	33 (10 m, 2 min)	49				5.30
Columbus County Municipal Arpt (KCPC) (35.27N 78.72W)	08/1945	998.1	08/2045	20 (10 m, 2 min)	33				
Dare County Gunnery Range Airport (K2DP) (35.67N 75.90W)	09/0521	995.6	09/0051	28 (10 m, 2 min)	48				
Dare County Reg. Airport-Manteo (KMQI) (35.90N 75.70W)	09/0710	995.9	09/0910	43 (10 m, 2 min)	61				



Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Duplin County Airport-Kenansville (KDPL) (34.99N 77.98W)	08/2205	996.6	08/2220	28 (10 m, 2 min)	43				
Elizabeth City Regional Arpt (KECG) (36.26N 76.17W)									9.99
Fayetteville Regional Airport (KFAY) (34.99N 78.88W)									14.99
First Flight Airport-Kill Devil Hills (KFFA) (36.02N 75.67W)	09/0725	996.3	09/0945	31 (10 m, 2 min)	52				
Kingston Regional Jetport (KISO) (35.33N 77.62W)	08/2156	995.9	08/2256	32 (10 m, 2 min)	44				
Lumberton Municipal Airport (KLBT) (34.61N 79.06W)	08/1901	995.9	08/1929	35 (10 m, 2 min)	58				10.47
Michael J. Smith-Beaufort Arpt (KMBH) (34.72N 76.65W)	09/0258	992.1	09/0629	40 (10 m, 2 min)	61				
New River MCAS/Jacksonville (KNCA) (34.72N 77.43W)	08/2256	992.7	09/0256	42 (10 m, 2 min)	63				5.35
Pitt-Greenville Airport (KPGV) (35.64N 77.38W)	08/2345	100.7	08/2345	39 (10 m, 2 min)	51				
Raleigh-Durham IAP (KRDU) (35.88N 78.79W)									6.96
Rocky Mount-Wilson Regional Arpt (KRWI) (35.85N 77.89W)									6.79
Washington-Warren Airport (KOCW) (35.57N 77.05W)	09/0015	998.3	09/0015	33 (10 m, 2 min)	39				
Wilmington IAP (KILM) (34.28N 77.92W)	08/2353	991.2	09/0017	39 (10 m, 2 min)	61				6.59
<b>C-MAN Sites</b>									
Cape Lookout (CLKN7) (34.62N 76.53W)	09/0400	989.8	09/0900	49 (10 m, 10 min)	66				
<b>NOS Sites</b>									















Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Naval Station -Norfolk (KNGU) (36.83N 76.33W)									10.11
Richmond IAP (KRIC) (37.51N 77.32W)									4.14
Roanoke-Blacksburg Reg. Airport (KRIC) (37.33N 79.98W)									4.30
Wakefield Municipal Airport (KAKQ) (36.98N 77.01W)									5.39
Wallops Flight Facility Airport (KWAL) (37.93N 75.48W)									6.28
<b>NOS Sites</b>									
Chesapeake Bay Bridge Tunnel (8638863) (36.97N 76.11W)	09/0506	1002.7	09/0442	50 (6 m, 6 min)	58	3.40		2.8	
Kiptopeke (8632200) (37.17N 75.99W)			09/1542	38 (7 m, 6 min)	50	2.82	3.25	2.2	
Lewisetta (8635750) (38.00N 76.47W)	09/0624	1009.4	09/1300	26 (6 m, 6 min)	39	1.77	2.08	1.4	
Money Point (8639348) (36.78N 76.30W)	09/0454	1003.2	09/1000	27 (6 m, 6 min)	46	4.16		3.4	
Sewells Point (8638610) (36.94N 76.33W)	09/0448	1004.6				3.61	4.25	3.1	
Yorktown USCG Training Center (8637689) (37.23N 76.48W)	09/0518	1005.4	09/0524	32 (10 m, 6 min)	48	2.75		2.3	
Wachapreague (8631044) (37.61N 75.69W)	09/0706	1005.5	09/0136	31 (7 m, 6 min)	39	2.77	3.60	1.7	
<b>Weatherflow Sites</b>									
Virginia Beach - Chesapeake Light Tower (XCLT) (36.90N 75.71W)	09/0519	994.0	09/0529	63 (41 m, 1 min)	76				
Wachapreague (XWAC) (37.60N 75.69W)	09/0719	1002.0	09/0709	23 (10 m, 1 min)	37				









Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Princess Anne 4.4 WSW (MD-SS-4) (38.18N 75.77W)									4.09
Salisbury 2.5 WSW (MD-WC-2) (38.36N 75.63W)									3.73
Snow Hill 0.4 S (MD-WR-14) (38.17N 75.39W)									4.72
Westover 2.6 WNW (MD-SS-6) (38.14N 75.75W)									3.62
<b>NWS COOP Sites</b>									
Assateague Island (ASTM2) (38.24N 75.75W)									5.91
<b>Weatherflow Sites</b>									
Ocean City (XOCN) (38.33N 75.08W)	09/0828	1005.0	09/0527	37 (10 m, 1 min)	42				
Point Lookout (XPTL) (38.04N 76.32W)	09/0631	1007.0	09/0541	26 (11 m, 1 min)	40				
<b>Delaware</b>									
<b>ICAO Sites</b>									
Delaware Coastal Airport/Georgetown (KGED) (38.69N 75.36W)									2.90
Wilmington-New Castle Airport (KILG) (39.68N 75.61W)									1.26
<b>NOS Sites</b>									
Lewes (8557380) (38.78N 75.12W)	09/0836	1009.5	09/1700	40 (10 m, 6 min)	48	2.30	3.21	1.2	
<b>Offshore</b>									
<b>NOAA Buoys</b>									
E. Caribbean (42059) (15.25N 67.21W)	29/1850	1004.8	29/1850	53 (5 m, 10 min)					
C. Caribbean (42058) (14.92N 74.92W)	03/0656	942.9	03/0503	74 <sup>g</sup> (5 m, 10 min)	86				
Canaveral (42058) (28.52N 80.19W)	07/0820	975.4	08/0820	56 (5 m, 10 min)	68				



Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>C</sup>	Storm tide (ft) <sup>D</sup>	Estimated Inundation (ft) <sup>E</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>A</sup>	Sustained (kt) <sup>B</sup>	Gust (kt)				
Diamond Shoals (41025) (35.01N 75.40W)	09/0750	984.9	09/0750	53 (54m, 10 min)	66				
Frying Pan Shoals, NC (41013) (33.43N 77.74W)	08/2220	982.4	09/0110	45 (4 m, 10 min)	63				
Onslow Bay Outer, NC (41064) (34.21N 76.95W)	09/0200	982.8	09/0400	45 (3 m, 60 min)	64				
Sunset Nearshore, NC (41024) (33.83N 78.48W)	08/2008	977.8	09/2008	41 (3 m, 60 min)	58				
Wrightsville Beach Offshore, NC (41037) (33.99N 77.36W)	08/2308	984.4	09/0308	43 (53m, 60 min)	64				
Wrightsville Beach Nearshore, NC (41038) (34.14N 77.72W)	08/2208	985.3	09/0308	43 (53m, 60 min)	62				
Virginia Beach (44014) (36.61N 74.84W)	09/1050	995.8	09/1210	52 (5 m, 10 min)	110				
South Hatteras (41002) (31.76N 74.84W)	08/2050	1004.8	09/0440	31 (5 m, 10 min)	41				
Edisto (41004) (32.50N 79.10W)	08/1350	981.7	08/1320	50 (5 m, 10 min)	64				
Grays Reef (41008) (31.40N 80.87W)	08/0350	957.6	08/0250	54 (5 m, 10 min)	68				
Canaveral 20 E (41009) (28.52N 80.19W)	07/0820	975.4	07/0820	56 (5 m, 10 min)	68				

- <sup>A</sup> Date/time is for sustained wind when both sustained and gust are listed.
- <sup>B</sup> Except as noted, sustained wind averaging periods for C-MAN and land-based reports are 2 min; buoy averaging periods are 8 min.
- <sup>C</sup> Storm surge is water height above normal astronomical tide level.
- <sup>D</sup> For most locations, storm tide is water height above the North American Vertical Datum of 1988 (NAVD88).
- <sup>E</sup> Estimated inundation is the maximum height of water above ground. For NOS tide gauges, the height of the water above Mean Higher High Water (MHHW) is used as a proxy for inundation.
- <sup>F</sup> Last of several occurrences.
- <sup>G</sup> Wind speed data missing 0510-0650 UTC 3 October 2016.
- <sup>H</sup> All wind data missing 0800-1000 UTC 6 October 2016.
- <sup>I</sup> Record water level.
- <sup>J</sup> Sensor damaged or destroyed and likely did not record maximum water level.
- <sup>K</sup> All wind data missing 1300 UTC 9 October – 0200 10 October 2016.

Table 4. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the “Low” category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	120-Hour Outlook
Low (<40%)	96	138
Medium (40%-60%)	54	96
High (>60%)	42	84

Table 5a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for forecasts issued on Hurricane Matthew, 28 September – 9 October 2016. 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	<b>17.6</b>	<b>27.6</b>	<b>42.4</b>	<b>58.8</b>	<b>87.2</b>	<b>135.1</b>	<b>170.8</b>
OCD5	34.6	82.1	141.3	202.8	343.7	451.5	486.4
Forecasts	42	40	38	36	32	28	24
OFCL (2011-15)	28.4	45.0	60.4	77.1	113.1	157.8	210.0
OCD5 (2011-15)	48.3	101.5	161.5	222.6	329.8	412.6	483.9

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for forecasts issued on Hurricane Matthew, 28 September – 9 October 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	17.8	29.1	44.2	63.8	92.7	137.3	165.9
OCD5	34.7	82.1	139.8	199.6	351.4	459.7	472.6
GFSI	18.1	33.0	48.5	66.2	105.3	145.0	201.2
EMXI	<b>17.4</b>	29.2	<b>37.9</b>	<b>48.5</b>	<b>76.3</b>	<b>111.0</b>	<b>128.2</b>
EGRI	19.2	31.3	<b>36.2</b>	<b>47.3</b>	<b>67.4</b>	<b>100.8</b>	<b>120.8</b>
NVGI	25.6	44.7	70.1	110.9	187.3	262.4	348.2
CMCI	29.1	53.4	77.4	109.5	196.0	326.9	523.0
GHMI	21.2	40.6	63.6	88.9	148.4	226.3	334.5
HWFI	20.3	36.5	58.6	90.4	162.8	263.2	381.9
CTCI	18.8	36.6	59.8	89.5	144.6	200.9	237.1
GFNI	21.7	45.4	75.4	110.4	180.2	284.1	448.2
TCON	<b>16.7</b>	29.5	44.9	66.0	106.0	158.7	232.9
TVCA	<b>16.4</b>	<b>29.0</b>	44.7	63.9	100.2	149.0	203.9
TVCX	<b>16.1</b>	<b>28.9</b>	<b>42.9</b>	<b>60.5</b>	93.7	139.2	186.6
GFEX	<b>16.9</b>	29.4	<b>40.8</b>	<b>51.9</b>	<b>78.7</b>	<b>113.7</b>	<b>140.4</b>
HCCA	<b>15.3</b>	<b>26.8</b>	<b>34.9</b>	<b>47.4</b>	<b>78.2</b>	<b>119.0</b>	193.2
AEMI	18.7	32.9	49.6	69.0	113.6	159.5	228.4
BAMS	63.7	113.1	150.3	171.5	154.0	<b>121.9</b>	167.7
BAMM	35.9	68.3	102.2	127.3	146.9	<b>120.5</b>	<b>158.3</b>
BAMD	32.5	61.6	87.8	114.4	170.3	204.2	226.0
Forecasts	35	33	31	29	25	22	19



Table 6a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for forecasts issued on Hurricane Matthew, 28 September – 9 October 2016. 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.

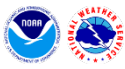
	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	7.7	12.5	16.8	19.6	21.1	22.5	22.1
OCD5	11.6	15.8	16.6	18.4	22.0	27.9	55.5
Forecasts	42	40	38	36	32	28	24
OFCL (2011-15)	6.2	9.4	11.5	13.3	14.6	14.6	15.8
OCD5 (2011-15)	7.3	10.8	13.3	15.3	17.7	17.8	17.6

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for forecasts issued on Hurricane Matthew, 28 September – 9 October 2016. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 6a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	8.0	12.7	14.2	14.0	15.0	18.2	17.1
OCD5	12.6	16.4	<b>13.7</b>	<b>13.5</b>	18.5	24.5	55.7
DSHP	12.6	17.2	17.9	18.5	22.6	27.3	24.3
LGEM	13.0	17.5	19.9	19.2	17.6	19.0	<b>14.6</b>
GHMI	14.9	22.5	25.0	19.3	18.6	20.4	19.8
HWFI	11.7	13.8	<b>14.0</b>	<b>13.1</b>	15.1	18.9	<b>12.1</b>
CTCI	12.6	19.5	21.7	20.1	23.8	25.4	20.2
GFNI	14.0	21.8	24.3	21.4	16.0	<b>15.1</b>	<b>13.7</b>
ICON	12.3	16.7	16.9	15.3	16.4	<b>16.2</b>	<b>14.5</b>
IVCN	12.2	16.7	17.1	15.4	17.3	<b>17.1</b>	<b>15.0</b>
HCCA	12.4	17.4	18.7	15.8	18.2	19.3	<b>16.7</b>
GFSI	12.2	17.4	17.6	17.8	20.0	27.7	29.6
EMXI	9.8	15.6	17.1	18.0	19.5	25.5	30.2
Forecasts	35	33	31	29	25	22	19

Table 7. Watch and warning summary for Hurricane Matthew, 28 September – 9 October 2016.

<b>Date/Time (UTC)</b>	<b>Action</b>	<b>Location</b>
28 / 1500	Tropical Storm Warning issued	Guadeloupe and Martinique
28 / 1500	Tropical Storm Warning issued	St. Lucia
28 / 1500	Tropical Storm Warning issued	Barbados, Dominica, St. Vincent, and Grenadine Islands
28 / 2100	Tropical Storm Watch issued	Aruba, Bonaire, and Curacao
29 / 0300	Tropical Storm Warning discontinued	Barbados, Dominica, St. Vincent, and Grenadine Islands
29 / 0300	Tropical Storm Warning issued	Dominica, St. Vincent, and Grenadine Islands
29 / 0900	Tropical Storm Warning discontinued	Guadeloupe and Martinique
29 / 0900	Tropical Storm Warning discontinued	St. Lucia
29 / 0900	Tropical Storm Warning discontinued	Dominica, St. Vincent, and Grenadine Islands
29 / 0900	Tropical Storm Warning issued	St. Vincent and Grenadine Islands
29 / 1200	Tropical Storm Warning discontinued	All
29 / 2100	Tropical Storm Watch issued	Colombia/Venezuela border to Riohacha
30 / 0600	Tropical Storm Watch discontinued	Aruba, Bonaire, and Curacao
30 / 0600	Tropical Storm Watch issued	Aruba and Curacao
30 / 1200	Tropical Storm Watch discontinued	Aruba and Curacao
30 / 1200	Tropical Storm Watch issued	Aruba
30 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Colombia/Venezuela border to Riohacha
30 / 1500	Tropical Storm Watch discontinued	All
30 / 2100	Tropical Storm Watch issued	Southern border Haiti/Dominican Republic to Port-au-Prince
30 / 2100	Hurricane Watch issued	Jamaica
1 / 1500	Tropical Storm Watch discontinued	All
1 / 1500	Tropical Storm Warning discontinued	All
1 / 1500	Hurricane Watch issued	Southern border Haiti/Dominican Republic to Le Môle-St. Nicholas
1 / 2100	Hurricane Watch changed to Hurricane Warning	Jamaica
1 / 2100	Hurricane Watch changed to Hurricane Warning	Southern border Haiti/Dominican Republic to Le Môle-St. Nicholas



<b>Date/Time (UTC)</b>	<b>Action</b>	<b>Location</b>
1 / 2100	Hurricane Watch issued	Le Môle-St. Nicholas to northern border Haiti/Dominican Republic
1 / 2100	Hurricane Watch issued	Camagüey to Guantánamo
2 / 0600	Tropical Storm Watch issued	Puerto Plata to northern border Haiti/Dominican Republic
2 / 0600	Tropical Storm Warning issued	southern border Haiti/Dominican Republic to Barahona
2 / 0900	Hurricane Watch discontinued	Le Môle-St. Nicholas to northern border Haiti/Dominican Republic
2 / 0900	Hurricane Watch issued	Turks & Caicos and Southeastern Bahamas
2 / 0900	Hurricane Warning discontinued	southern border Haiti/Dominican Republic to Le Môle-St. Nicholas
2 / 0900	Hurricane Warning issued	Haiti
2 / 0900	Hurricane Warning issued	Las Tunas to Guantánamo
3 / 0300	Hurricane Watch changed to Hurricane Warning	Southeastern Bahamas
3 / 0300	Hurricane Watch issued	Turks & Caicos and Central Bahamas
3 / 2100	Hurricane Warning changed to Tropical Storm Warning	Jamaica
3 / 2100	Hurricane Watch discontinued	Turks & Caicos and Central Bahamas
3 / 2100	Hurricane Watch issued	Turks & Caicos
3 / 2100	Hurricane Watch issued	Northwestern Bahamas
4 / 0900	Hurricane Watch changed to Tropical Storm Warning	Turks & Caicos
4 / 0900	Hurricane Watch changed to Hurricane Warning	Southeastern Bahamas to Northwestern Bahamas
4 / 0900	Hurricane Warning modified to	Southeastern Bahamas to Northwestern Bahamas
4 / 1500	Tropical Storm Watch issued	Seven Mile Bridge to Deerfield Beach
4 / 1500	Tropical Storm Warning discontinued	Jamaica
4 / 1500	Hurricane Watch issued	Deerfield Beach to Volusia/Brevard County Line
4 / 2100	Tropical Storm Watch modified to	Seven Mile Bridge to Golden Beach
4 / 2100	Hurricane Watch modified to	Golden Beach to Volusia/Brevard County Line
5 / 0300	Tropical Storm Watch changed to Tropical Storm Warning	Seven Mile Bridge to Golden Beach
5 / 0300	Tropical Storm Warning issued	Chokoloskee to Ocean Reef



Date/Time (UTC)	Action	Location
5 / 0300	Hurricane Watch discontinued	Golden Beach to Volusia/Brevard County Line
5 / 0300	Hurricane Watch issued	Sebastian Inlet to Flagler/Volusia County Line
5 / 0300	Hurricane Warning issued	Golden Beach to Sebastian Inlet
5 / 0900	Hurricane Watch modified to	Sebastian Inlet to Fernandina Beach
5 / 1500	Hurricane Warning changed to Tropical Storm Warning	Haiti
5 / 1500	Tropical Storm Watch discontinued	All
5 / 1500	Tropical Storm Warning discontinued	southern border Haiti/Dominican Republic to Barahona
5 / 1500	Hurricane Watch modified to	Flager/Volusia County Line to Fernandina Beach
5 / 1500	Hurricane Warning modified to	Golden Beach to Flager/Volusia County Line
5 / 1800	Tropical Storm Warning discontinued	Turks & Caicos
5 / 2100	Tropical Storm Watch issued	Chokoloskee to Suwannee River
5 / 2100	Tropical Storm Warning discontinued	Haiti
5 / 2100	Hurricane Watch discontinued	Cuba
5 / 2100	Hurricane Warning discontinued	Cuba
5 / 2100	Hurricane Watch modified to	Flager/Volusia County Line to Savannah River
6 / 0300	Hurricane Watch discontinued	Flager/Volusia County Line to Savannah River
6 / 0300	Hurricane Watch issued	Fernandina Beach to Edisto Beach
6 / 0300	Hurricane Warning modified to	Golden Beach to Fernandina Beach
6 / 0900	Hurricane Watch discontinued	Fernandina Beach to Edisto Beach
6 / 0900	Hurricane Watch issued	Altamaha Sound to South Santee River
6 / 0900	Hurricane Warning modified to	Golden Beach to Altamaha Sound
6 / 1200	Hurricane Warning modified to	Central Bahamas to Northwestern Bahamas
6 / 1500	Tropical Storm Watch modified to	Chokoloskee to Anclote River
6 / 1500	Tropical Storm Warning issued	Anclote River to Suwannee River
6 / 1500	Hurricane Watch modified to	Edisto Beach to South Santee River
6 / 1500	Hurricane Warning modified to	Golden Beach to Edisto Beach
6 / 2100	Tropical Storm Warning issued	South Santee River to Surf City
6 / 2100	Hurricane Watch discontinued	All
6 / 2100	Hurricane Warning modified to	Golden Beach to South Santee River



Date/Time (UTC)	Action	Location
7 / 0000	Tropical Storm Watch modified to	Englewood to Anclote River
7 / 0000	Tropical Storm Warning discontinued	Chokoloskee to Ocean Reef
7 / 0000	Tropical Storm Warning modified to	Seven Mile Bridge to Boca Raton
7 / 0000	Hurricane Warning modified to	Boca Raton to South Santee River
7 / 0300	Tropical Storm Warning modified to	Ocean Reef to Boca Raton
7 / 0900	Tropical Storm Watch modified to	Anna Maria Island to Anclote River
7 / 0900	Tropical Storm Warning modified to	Boca Raton to Jupiter Inlet
7 / 0900	Hurricane Warning modified to	Jupiter Inlet to South Santee River
7 / 1200	Tropical Storm Warning modified to	Jupiter Inlet to Sebastian Inlet
7 / 1200	Hurricane Warning discontinued	Northwestern Bahamas
7 / 1200	Hurricane Warning modified to	Sebastian Inlet to South Santee River
7 / 1500	Tropical Storm Watch discontinued	All
7 / 1500	Tropical Storm Warning modified to	Surf City to Duck
7 / 1500	Tropical Storm Warning modified to	Sebastian Inlet to Cocoa Beach
7 / 1500	Tropical Storm Warning discontinued	Anna Maria Island to Anclote River
7 / 1500	Hurricane Watch issued	Surf City to Cape Lookout
7 / 1500	Hurricane Warning discontinued	Sebastian Inlet to South Santee River
7 / 1500	Hurricane Warning issued	Cocoa Beach to Surf City
7 / 2100	Tropical Storm Warning discontinued	Sebastian Inlet to Cocoa Beach
7 / 2100	Tropical Storm Warning issued	Volusia/Brevard County Line to Flagler/Volusia County Line
7 / 2100	Hurricane Warning modified to	Flagler/Volusia County Line to Surf City
8 / 0000	Tropical Storm Warning discontinued	Volusia/Brevard County Line to Flagler/Volusia County Line
8 / 0300	Tropical Storm Warning issued	Flagler/Volusia County Line to Fernandina Beach
8 / 0300	Hurricane Warning modified to	Fernandina Beach to Surf City
8 / 0900	Tropical Storm Warning discontinued	Flagler/Volusia County Line to Fernandina Beach
8 / 0900	Hurricane Warning modified to	Altamaha Sound to Surf City
8 / 1800	Hurricane Warning modified to	Edisto Beach to Surf City
8 / 2100	Hurricane Warning modified to	South Santee River to Surf City
9 / 0300	Hurricane Watch modified to	Surf City to Duck
9 / 0300	Hurricane Warning modified to	Little River Inlet to Surf City
9 / 0900	Tropical Storm Warning modified to	Cape Fear to Duck



<b>Date/Time (UTC)</b>	<b>Action</b>	<b>Location</b>
9 / 0900	Hurricane Warning discontinued	All
9 / 1500	Hurricane Watch discontinued	All
9 / 1800	Tropical Storm Warning modified to	Surf City to Duck
9 / 2100	Tropical Storm Warning discontinued	All

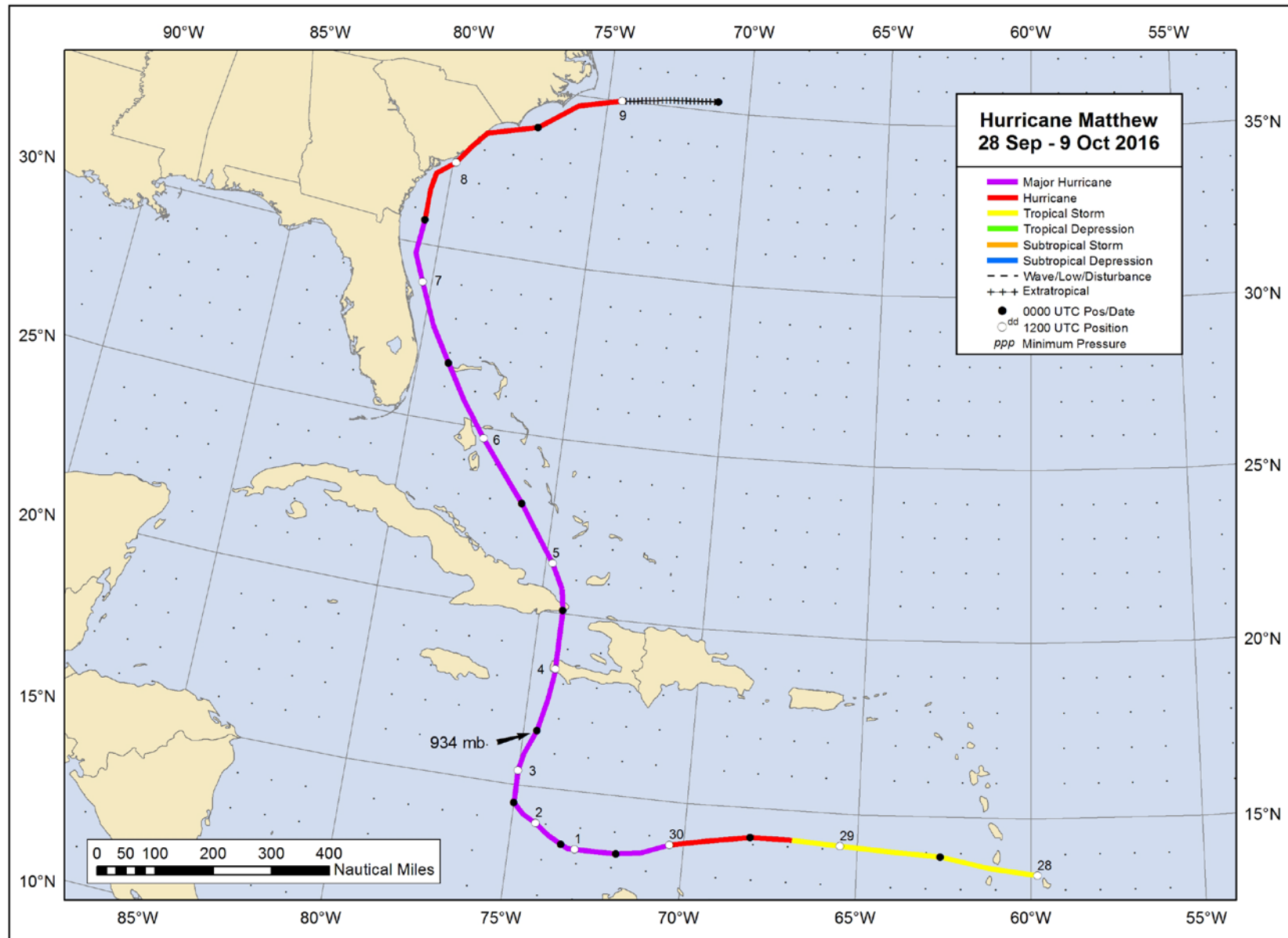


Figure 1. Best track positions for Hurricane Matthew, 28 September – 9 October 2016.

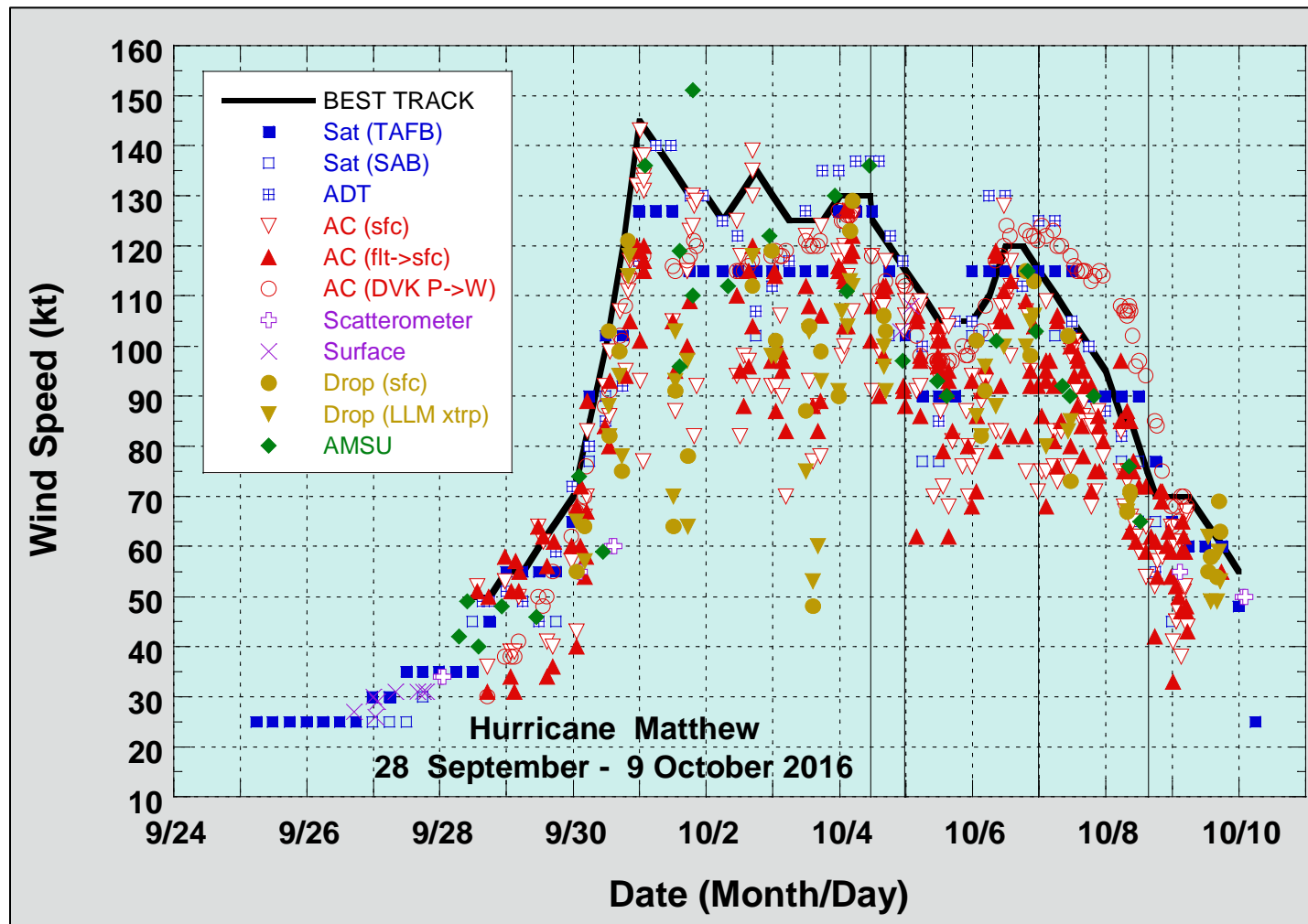


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Matthew, 28 September – 9 October 2016. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM). Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

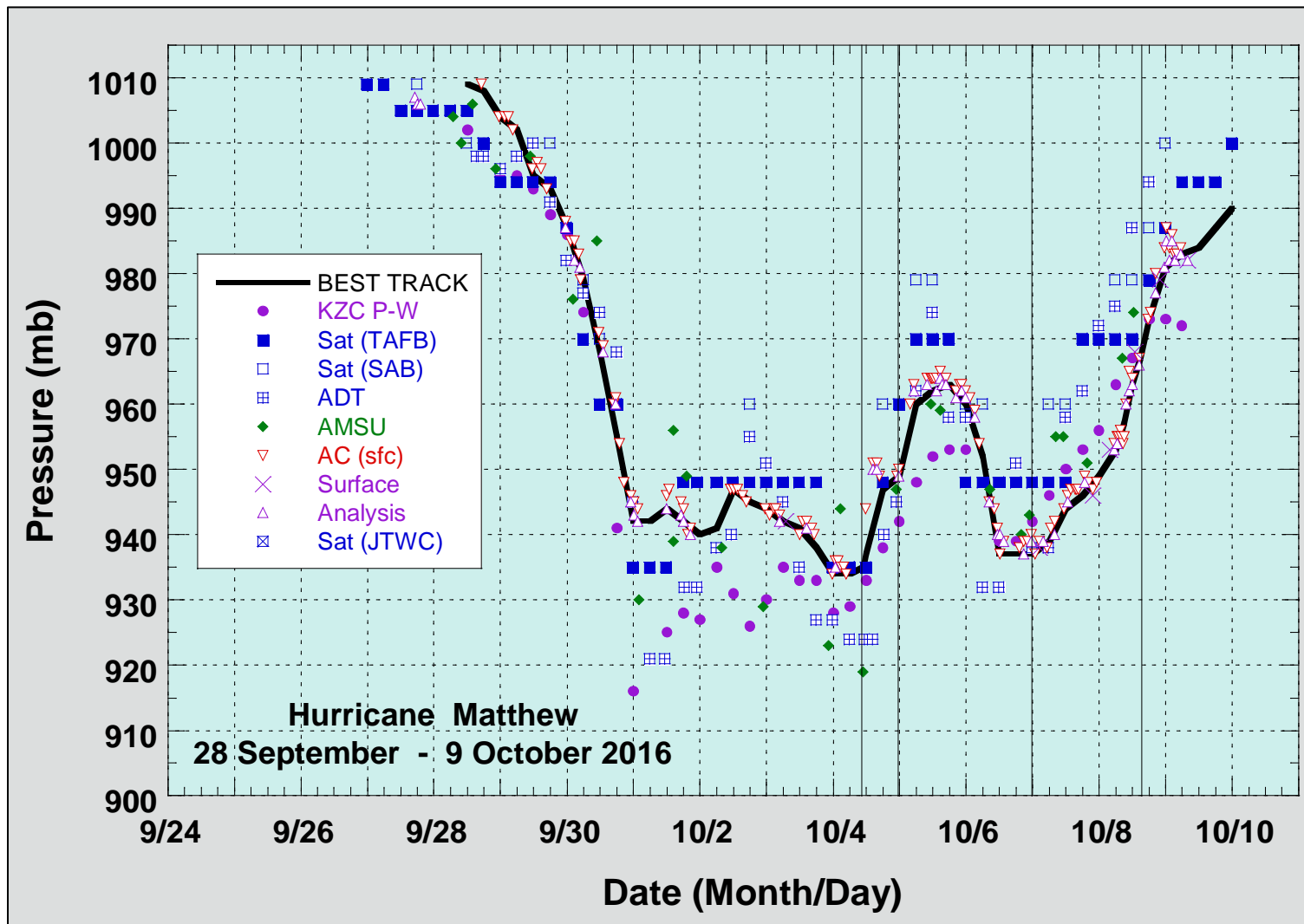


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Matthew, 28 September – 9 October 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

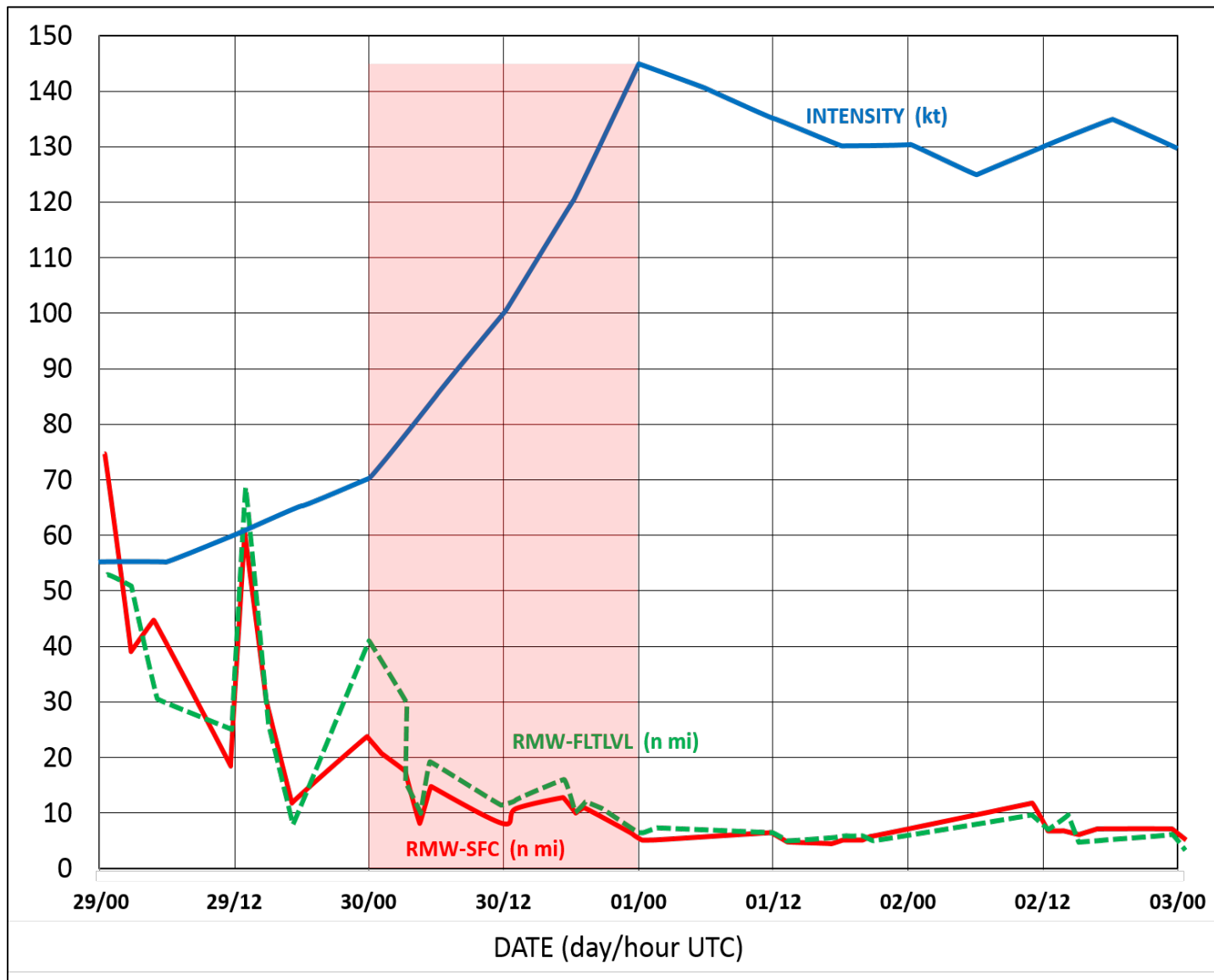


Figure 4. Plot of Hurricane Matthew's intensity versus SFMR-based surface (RMW-SFC) and 700-mb flight-level (RMW-FLTLVL) radius of maximum winds (RMW). Time period covered is from 0000 UTC 29 September to 0000 UTC 3 October 2016, which includes Matthew's rapid intensification period (red shading).

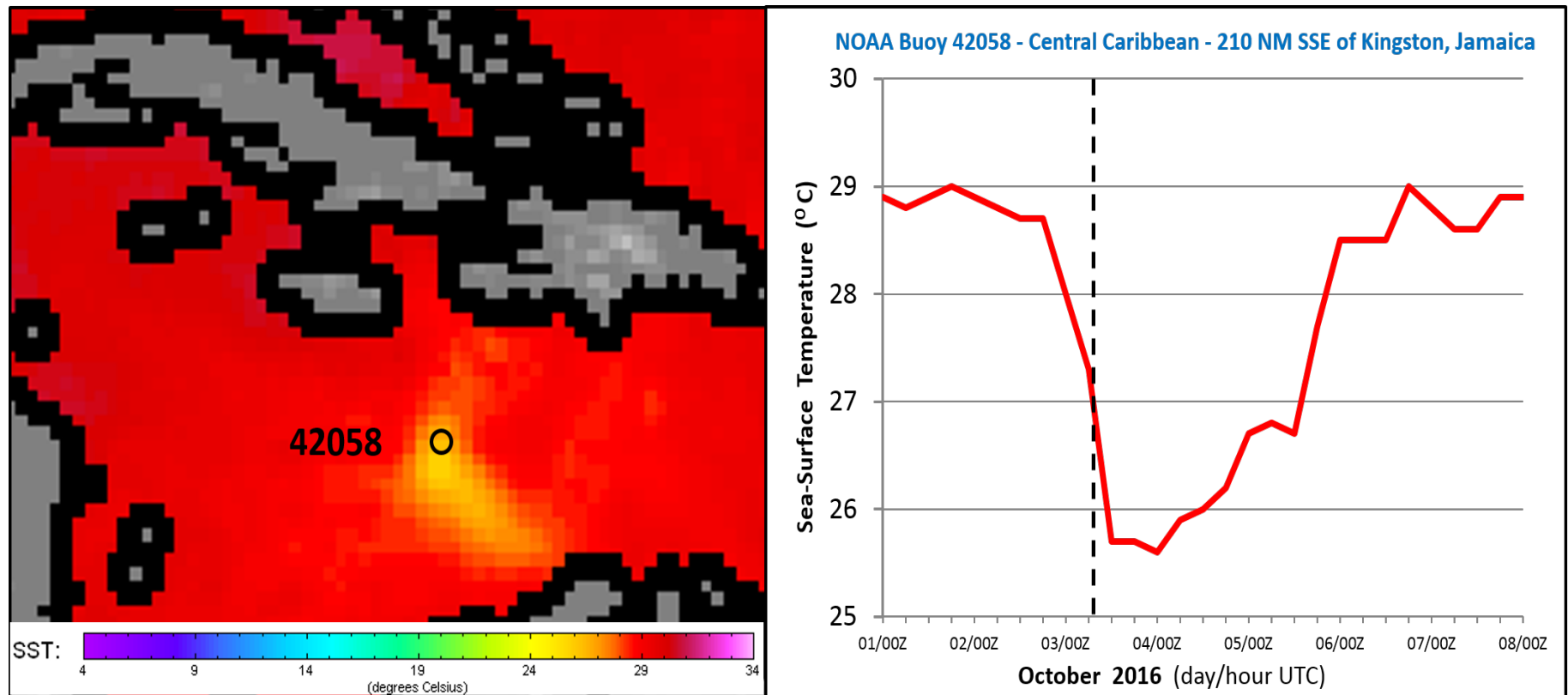


Figure 5. Satellite-derived sea-surface temperature analysis valid 1200 UTC 4 October showing cold wake (yellow shading) created by Hurricane Matthew. Buoy 42058 location is indicated by black circle (*left panel*). Time series plot of SST data (red line) recorded by NOAA Buoy 42058 during the period 1 - 8 October 2016 (*right panel*). The time of Hurricane Matthew's eye passage over the buoy is indicated by the black vertical dashed line. Upwelling began more than 12 h before eye passage and continued for almost 24 h after passage. Satellite-derived SST image courtesy Remote Sensing Systems (RSS), Santa Rosa, CA.

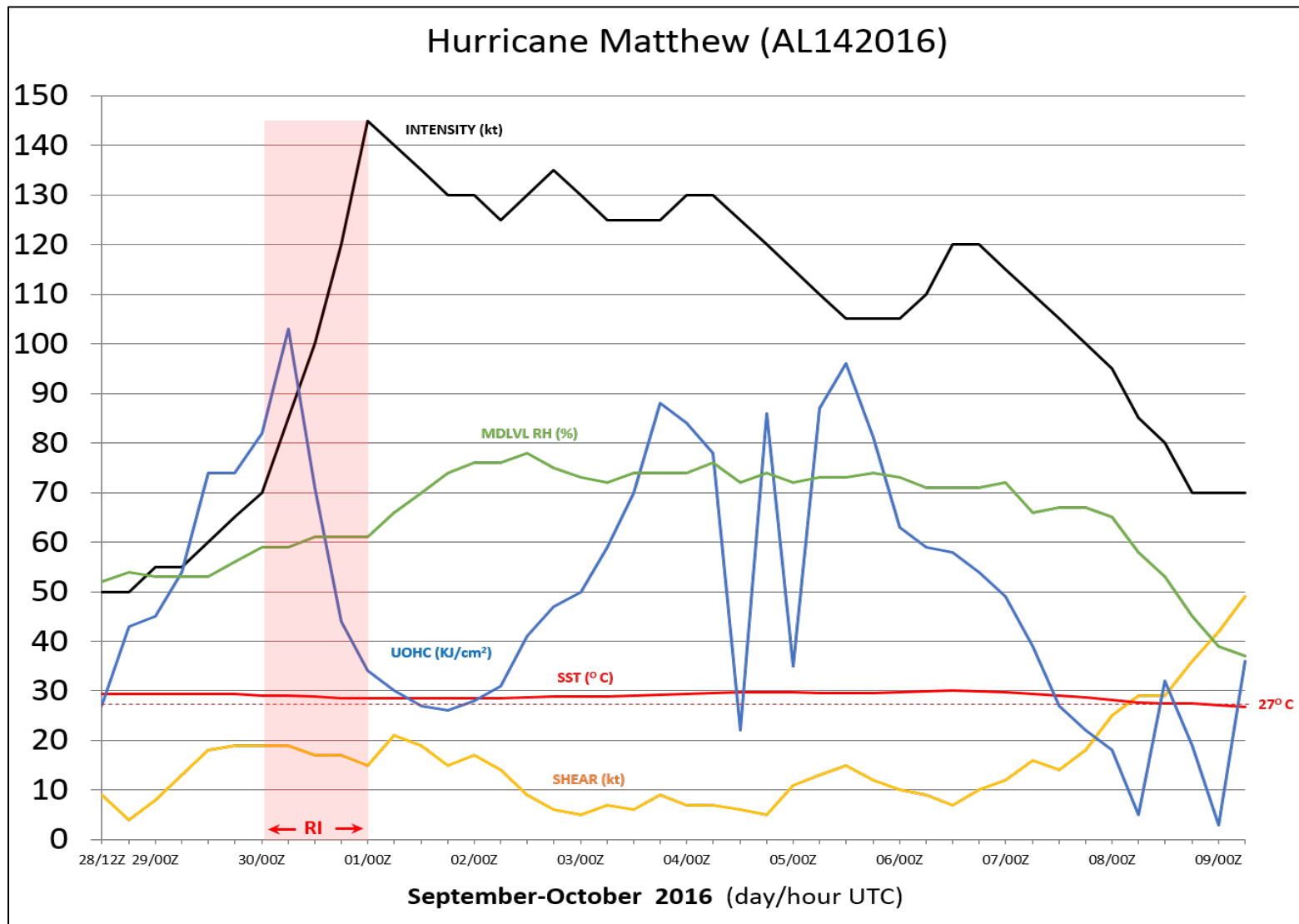


Figure 6. Plot of Hurricane Matthew’s intensity versus GFS-based SHIPS model analyzed environmental parameters: 850–200-mb vertical wind shear (**SHEAR**), sea-surface temperature (**SST**), upper-ocean heat content (**UOHC**), and 700–500-mb average relative humidity (**MDLVL RH**). Time period covered is from 1200 UTC 28 September to 0600 UTC 9 October 2016, which includes the rapid intensification (**RI**/red shading) cycle.

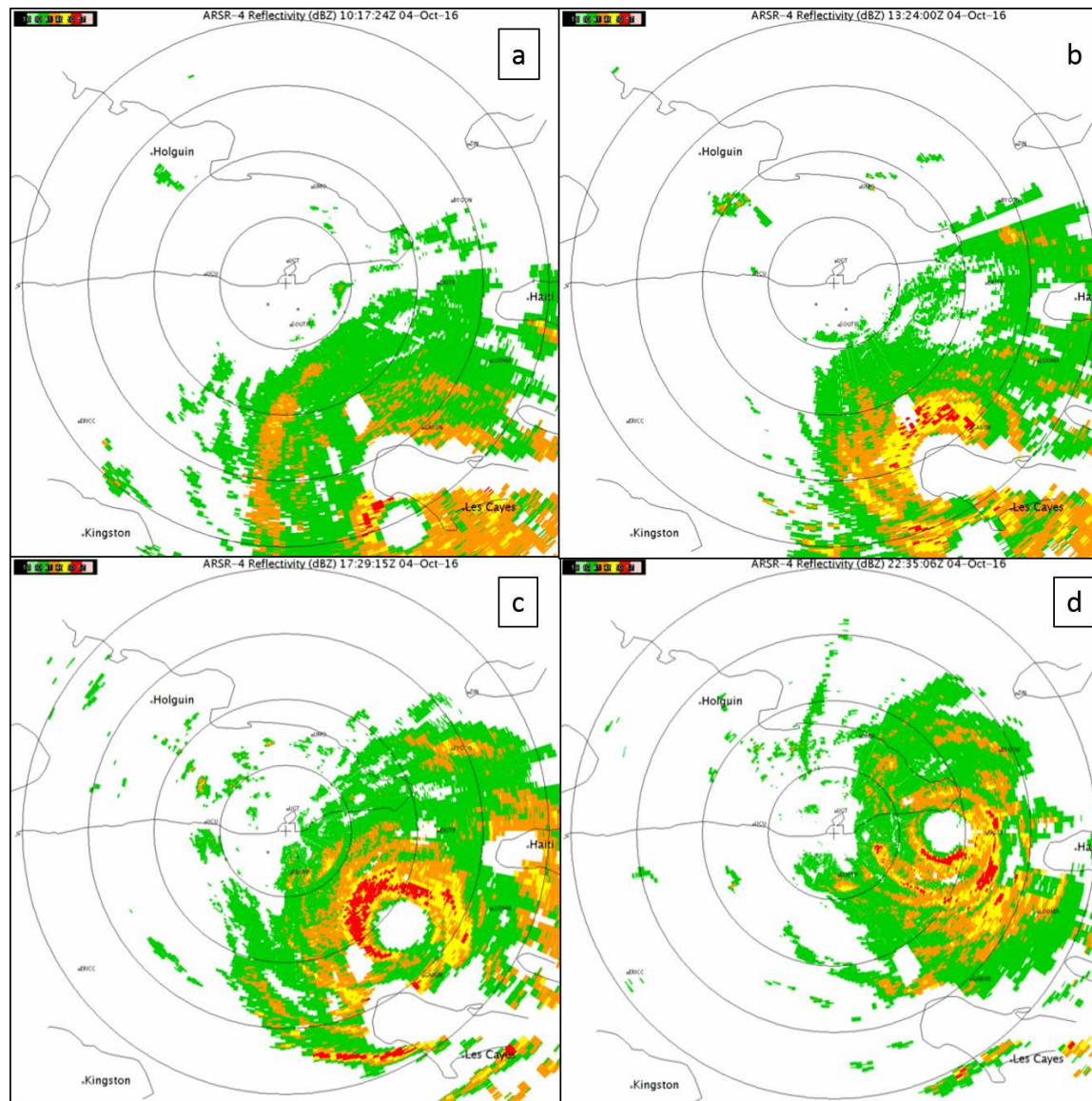


Figure 7. U.S. Federal Aviation Administration ARSR-4 radar reflectivity data (dBZ) from Guantanamo Bay, Cuba, on 4 October 2016 when Matthew's eye was (a) approaching Les Anglais, Haiti, at 1017 UTC, (b) over the western Tiburon peninsula at 1324 UTC, (c) over the western Gulf of Gonâve at 1729 UTC, and (d) approaching Juaco, Cuba, at 2235 UTC. Range rings are 30 n mi.

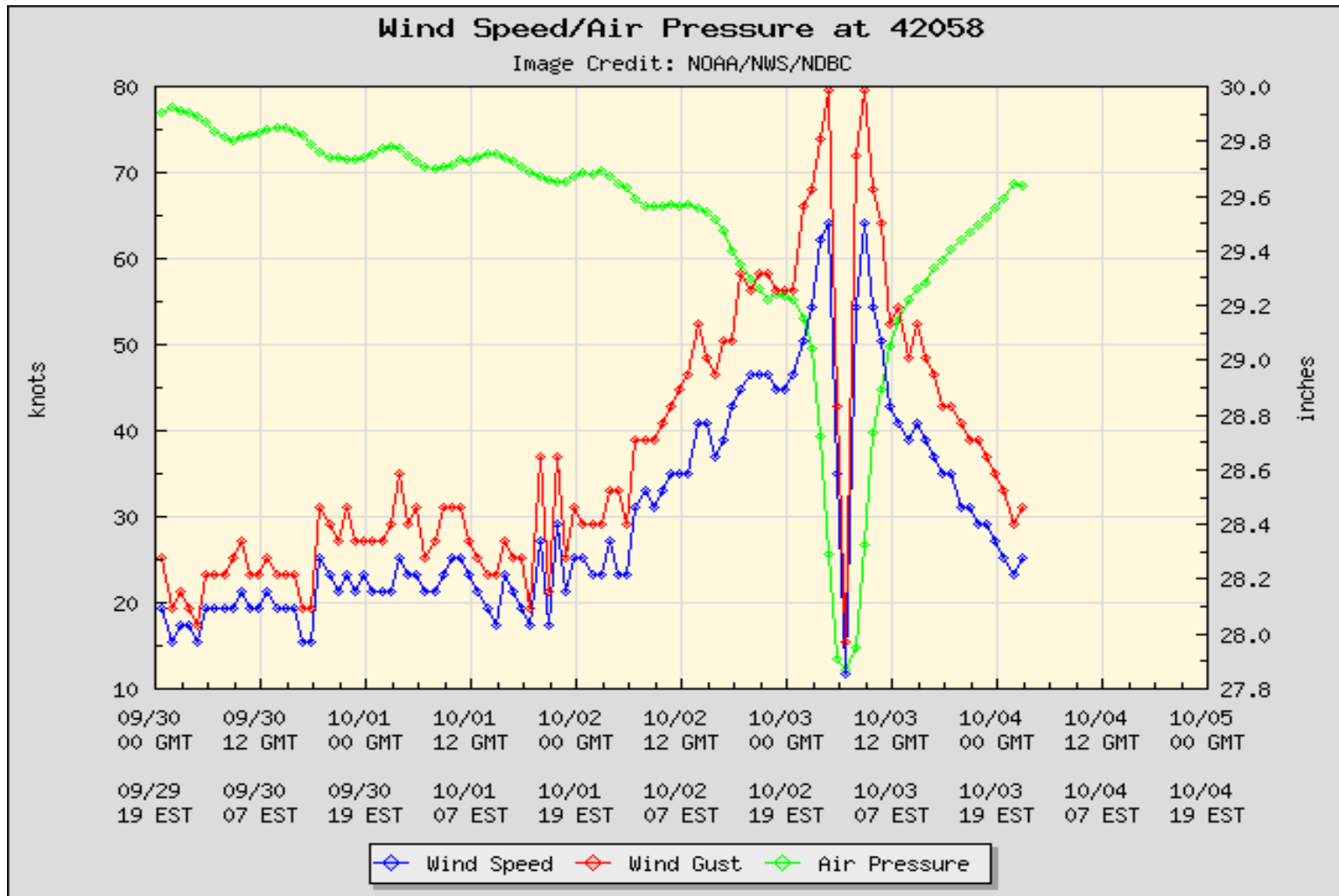


Figure 8. Times series plot of surface pressure (in Hg), 10-minute average wind speed (kt), and wind gusts (kt) associated with Hurricane Matthew's passage over NOAA Buoy 42058, located over the central Caribbean Sea about 220 n mi southeast of Kingston, Jamaica. Time plot is in Coordinated Universal Time/UTC (GMT) and Eastern Standard Time (EST). The minimum pressure of 27.84 inches measured during eye passage equals 942.9 mb.

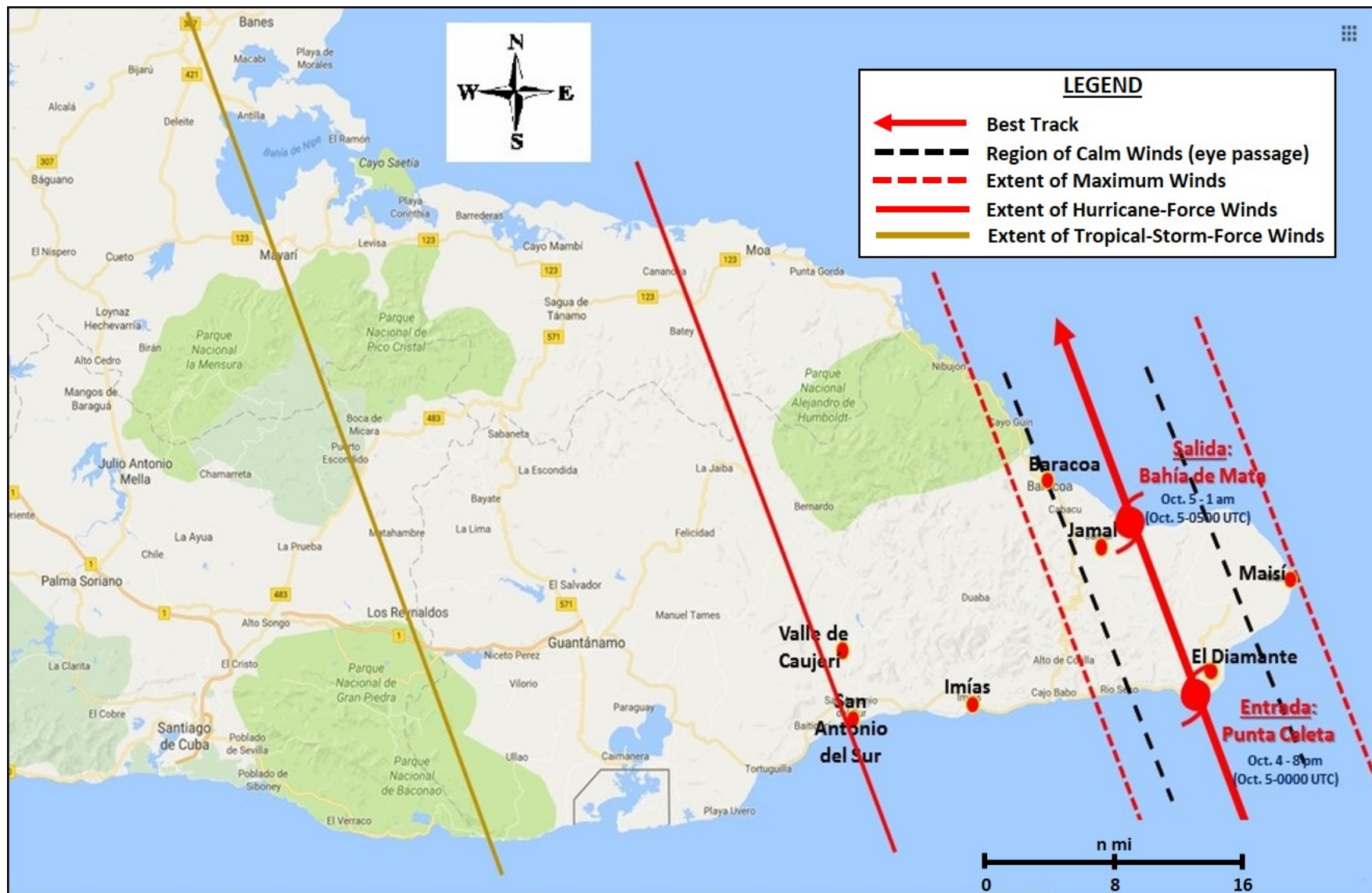


Figure 9. Matthew's track and wind fields during the hurricane's passage over eastern Cuba on 5 October 2016. Graphic is courtesy of the Instituto de Meteorología de Cuba/INSMET (Meteorological Institute of Cuba).

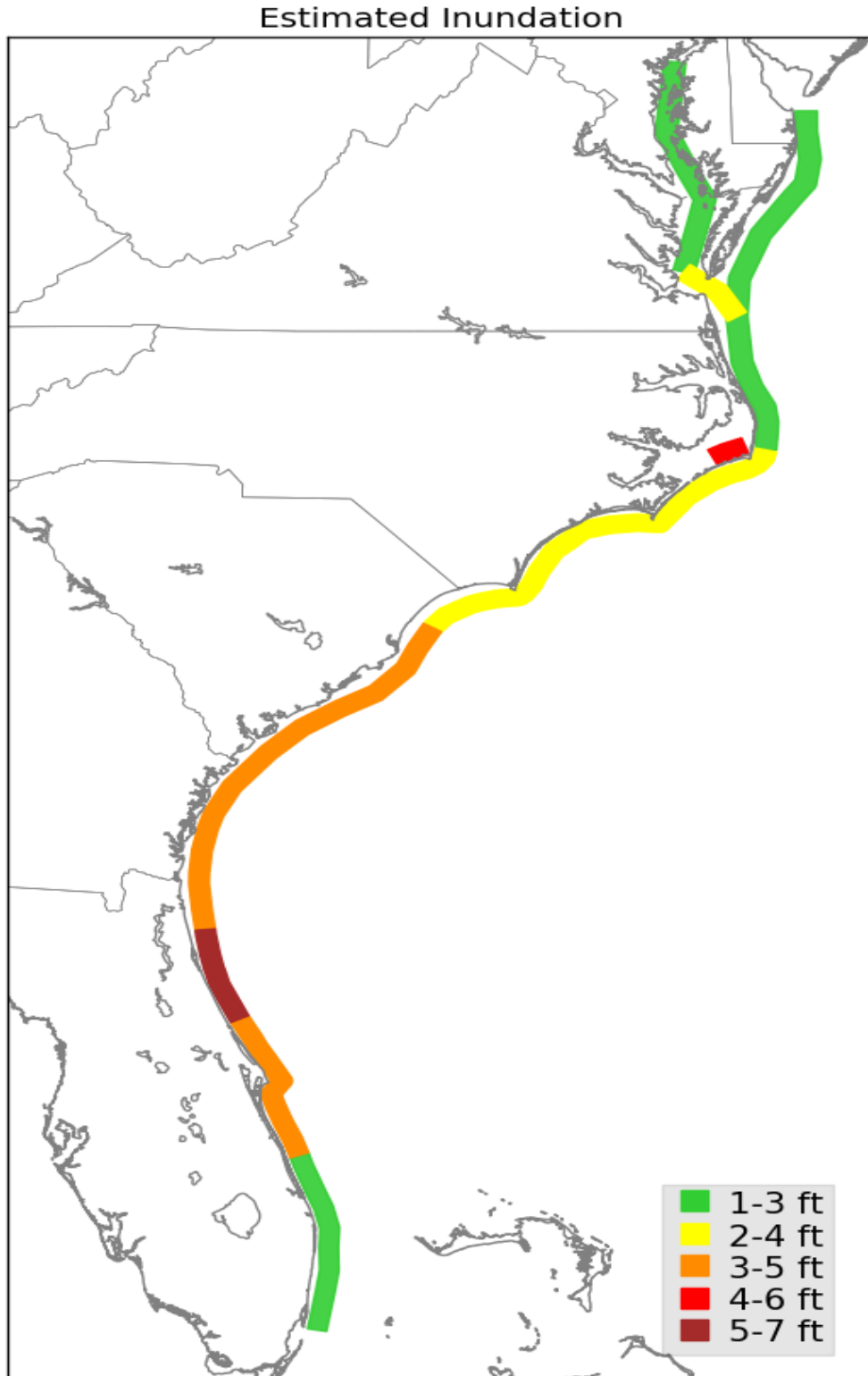


Figure 10. Estimated maximum storm surge inundation levels (ft above ground level) along the southeastern and mid-Atlantic coasts of the United States due to Hurricane Matthew. Estimates are based on USGS and NWS high water mark observations, NOS tide station observations above MHHW, and USGS storm tide pressure sensors. Image courtesy of the NHC Storm Surge Unit.

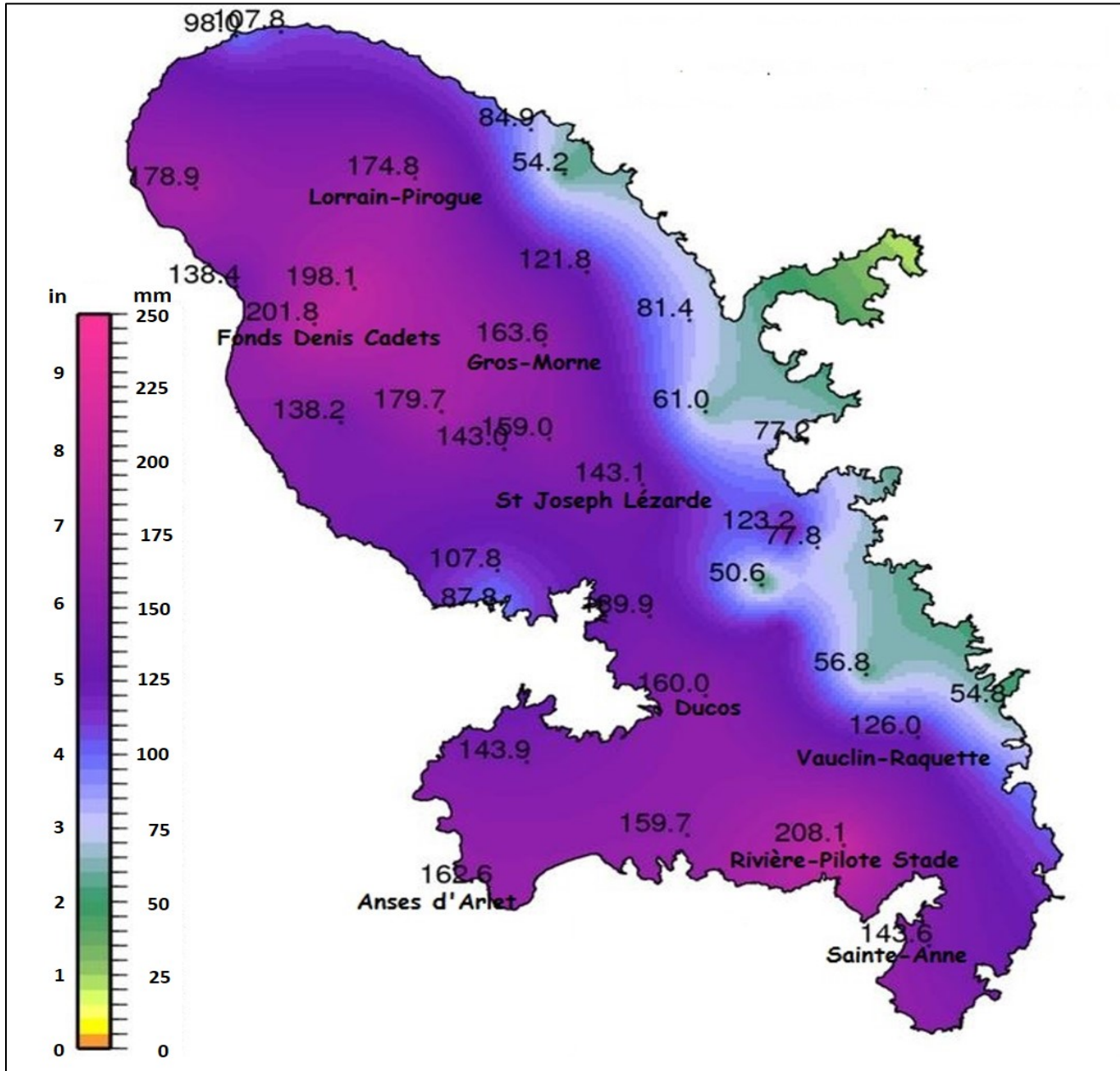


Figure 11. Total rainfall amounts in inches (in) and millimeters (mm) for Matthew during its passage over Martinique as a tropical storm during the period 28-29 October 2016. Graphic courtesy of Météo-France.

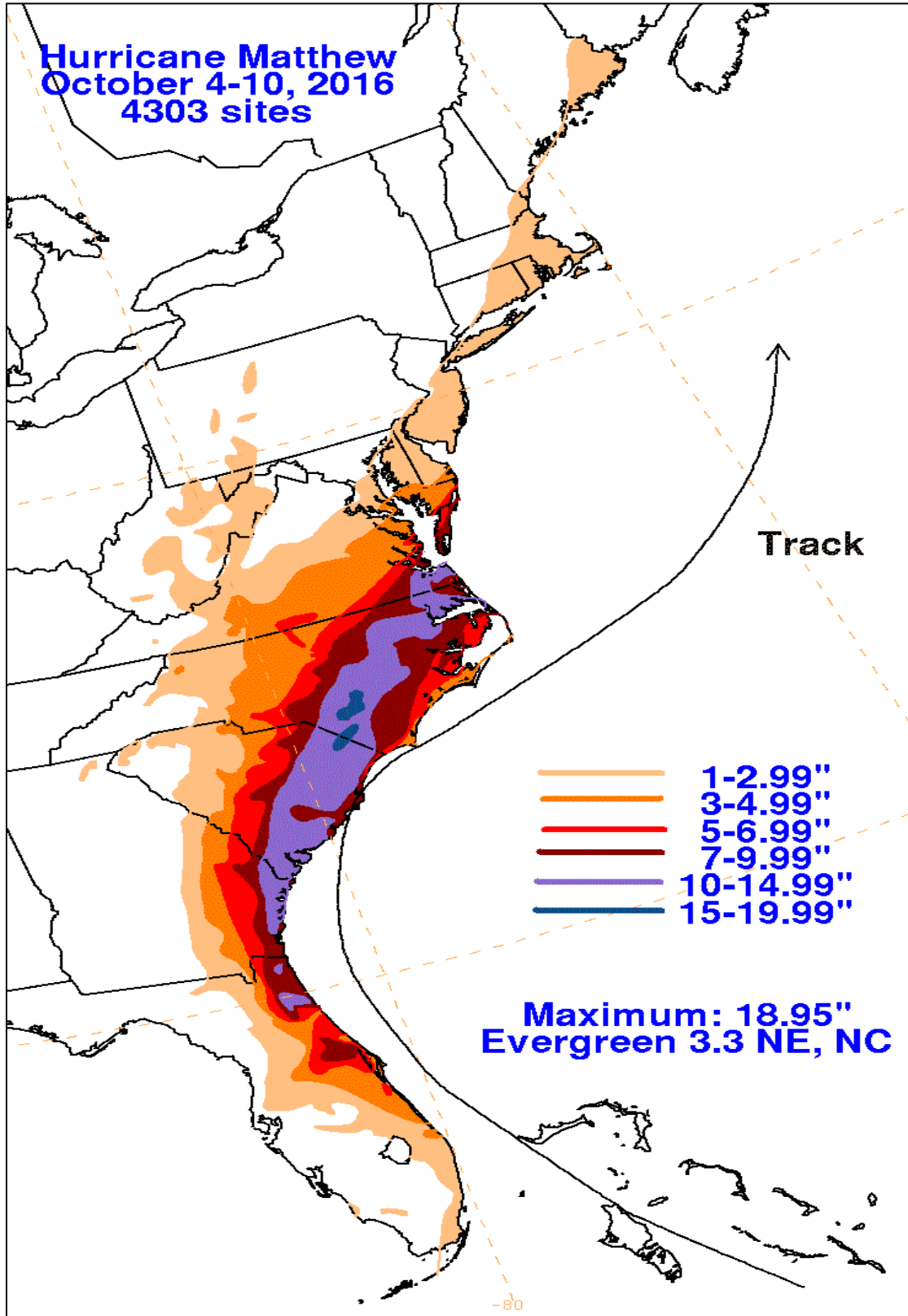


Figure 12. U.S. rainfall amounts (inches) for Hurricane Matthew during its tropical and post-tropical phases, which has been compiled from 4,303 sites during the period 4–10 October 2016. Graphic courtesy of David Roth at the NOAA/NWS Weather Prediction Center.

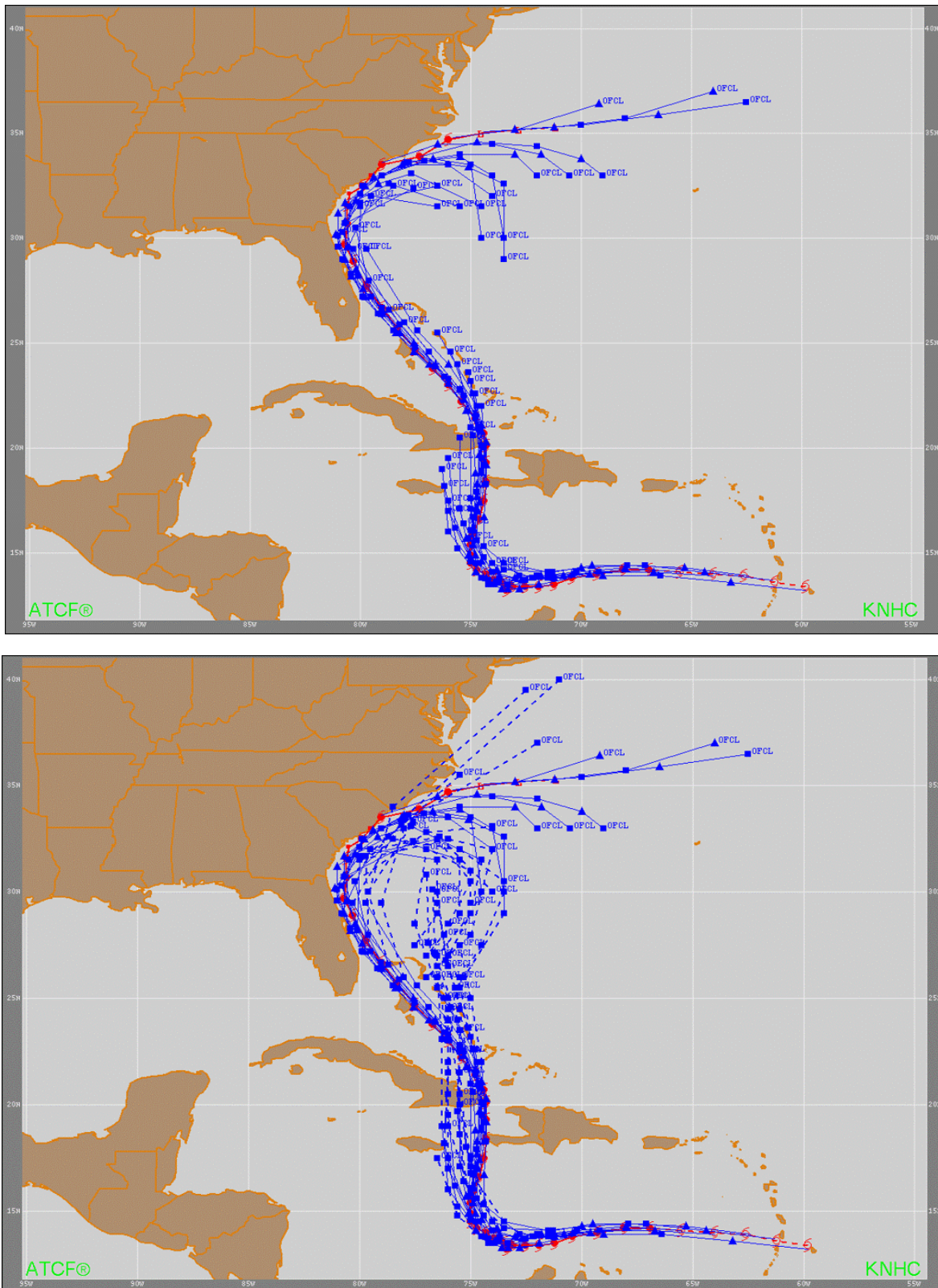


Figure 13. Selected official track forecasts with 0, 12, 24, 36, 48, and 72 h positions indicated (dashed blue lines, *top panel*) and 0, 12, 24, 36, 48, 72, 96, and 120 h positions indicated (dashed blue lines, *bottom panel*) for Hurricane Matthew, 28 September – 9 October 2016. The best track is given by the thick solid red line with positions given at 6 h intervals.

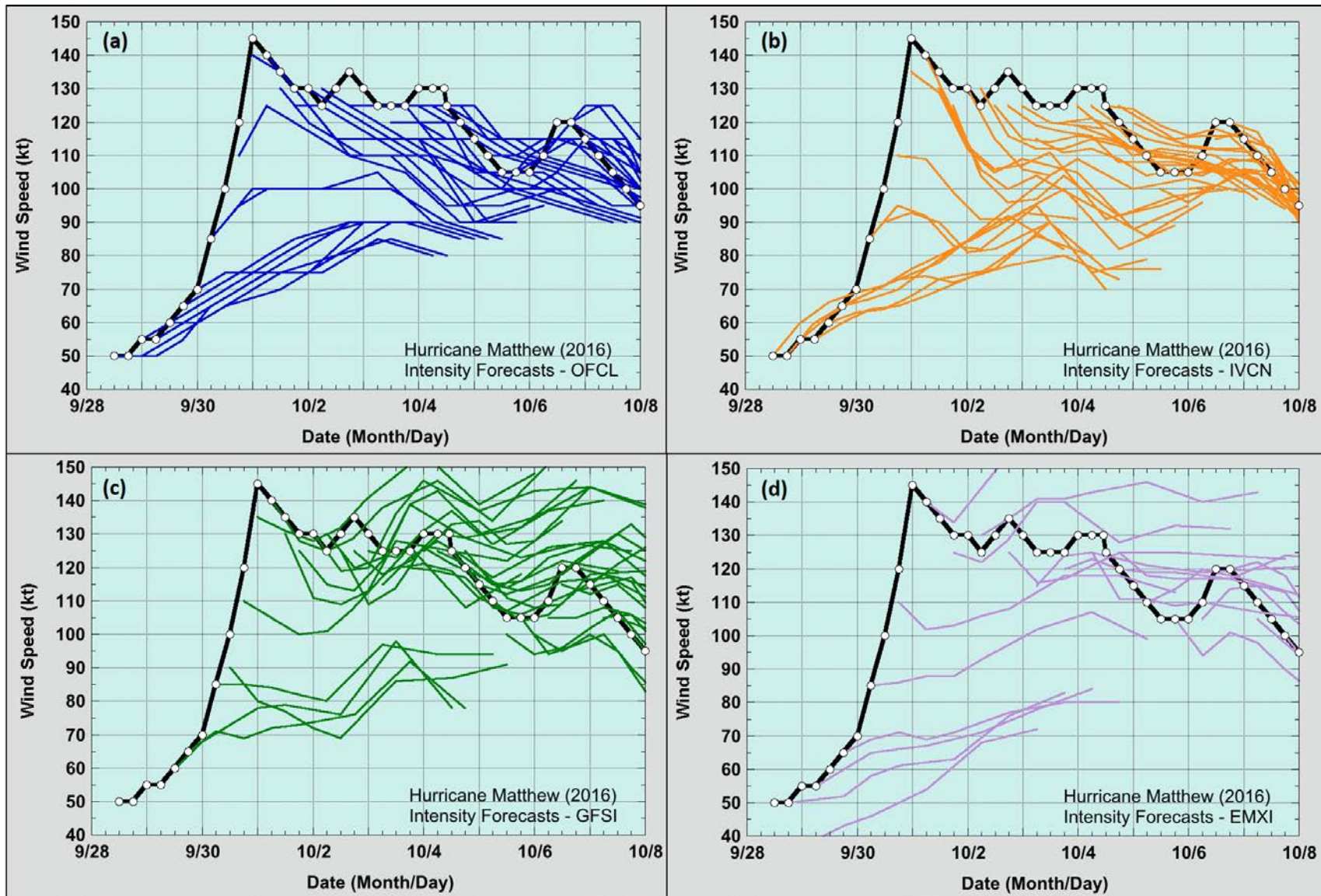


Figure 14. Hurricane Matthew 120-h intensity forecasts during the period 1200 UTC 28 September – 0000 UTC 8 October 2016 for (a) OFCL [blue lines], (b) the 5-member consensus model IVCN [orange lines], (c) the NOAA GFS model [green lines], and (d) the ECMWF model [purple lines]. The intensity best track is denoted by the solid black line at 6-h intervals (white dots).

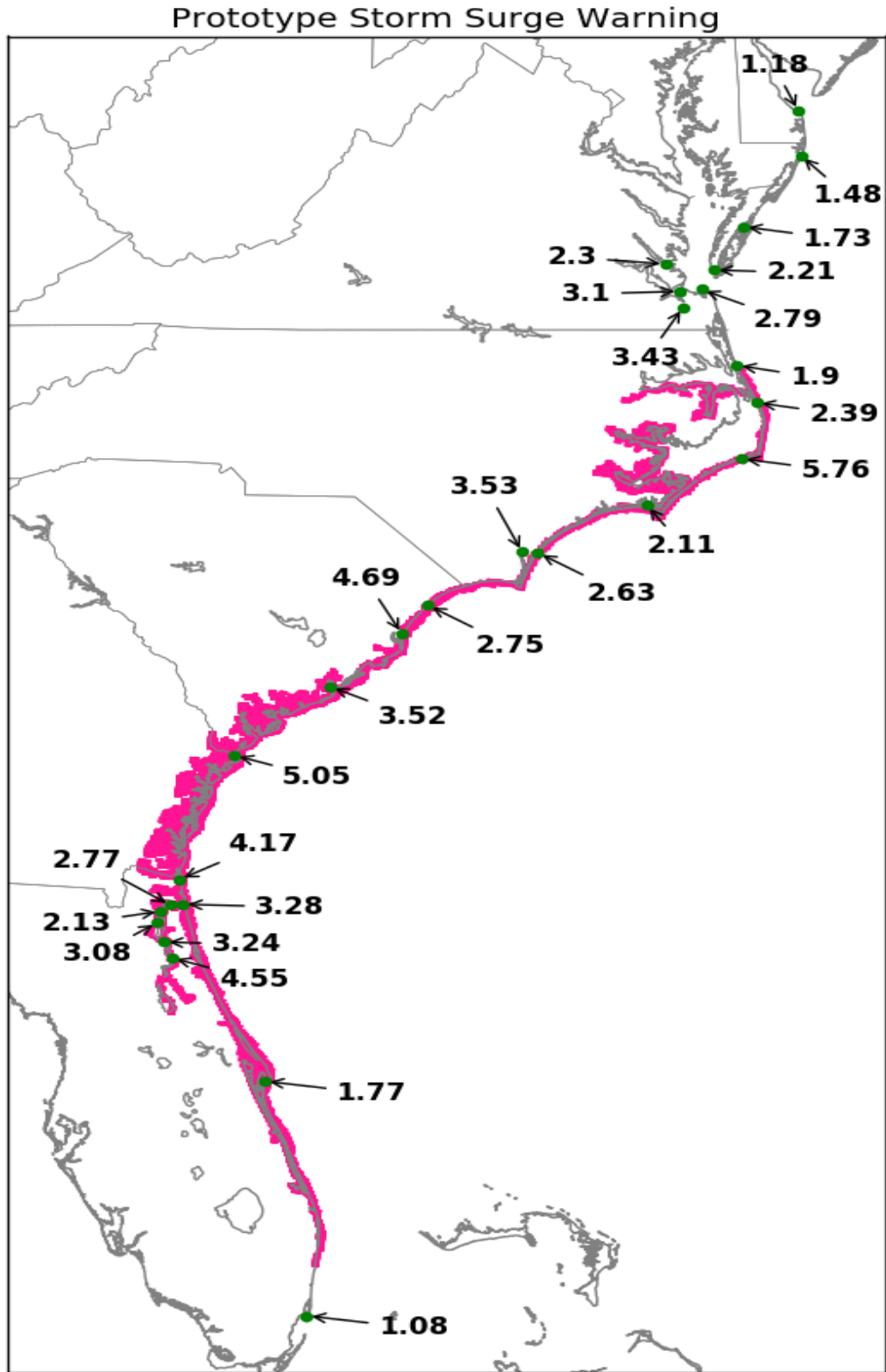


Figure 15. Areas along the East Coast of the United States that were depicted within a Prototype Storm Surge Warning (magenta) at any time during Hurricane Matthew, along with maximum NOS tide station observations (ft) above MHHW. Image courtesy of the NHC Storm Surge Unit.

## ESTIMATE OF PEAK WATER SURFACE US 378 CROSSING LITTLE PEE DEE RIVER

1928 HWM from road plans 26.231/34.218      75      ft  
 Datum tie from plans:                              49.26      ft      (72.94-23.684)  
 1928 HW with corrected datum:                25.74  
 Assumed increase above 1928 HWM:        1      ft  
 Projected Peak Elevation:                        26.74      ft

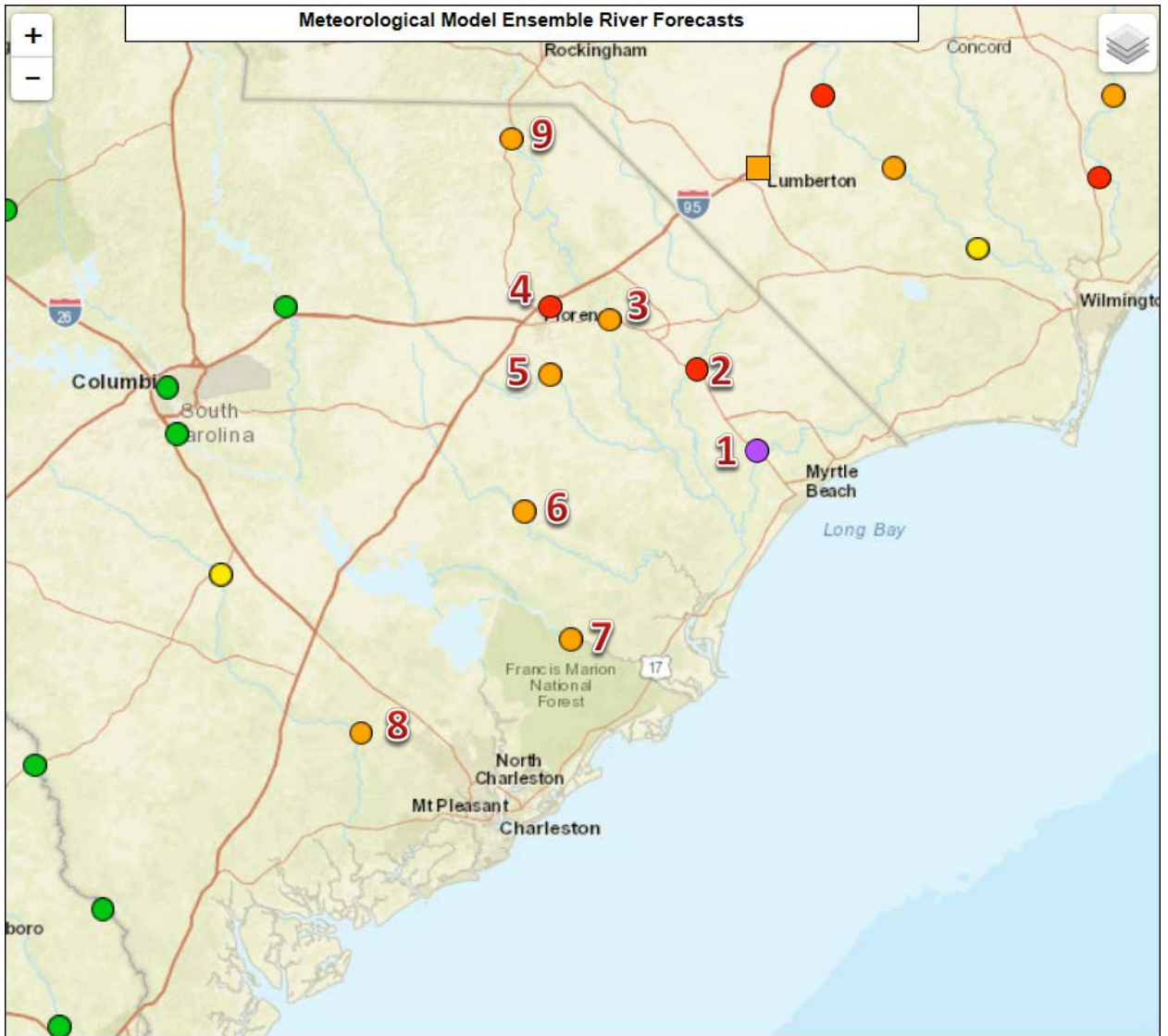
**Based on gage at US 501, assume peak is 1 ft above 1928 High Water Mark**

Bridge Data		Road Data		Peak Flow Data		
Bridge #	Low Chord Elev.	Br FG Elev.	FG Low Point Elev on Road	Shoulder Low Point Elev.	Projected Peak at Gage	Gage adjusted to MSL
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
1	26.4	30.7	29.5	28.25	26.74	26.74
2	26.4	30.7	29.26	28.01	26.74	26.74
3	26.4	30.7	29.15	27.9	26.74	26.74
4	25.672	29.95	28.8	27.55	26.74	26.74
5	26.4	30.7	29.34	28.09	26.74	26.74
6	28.7	36.57	31.5	30.25	26.74	26.74

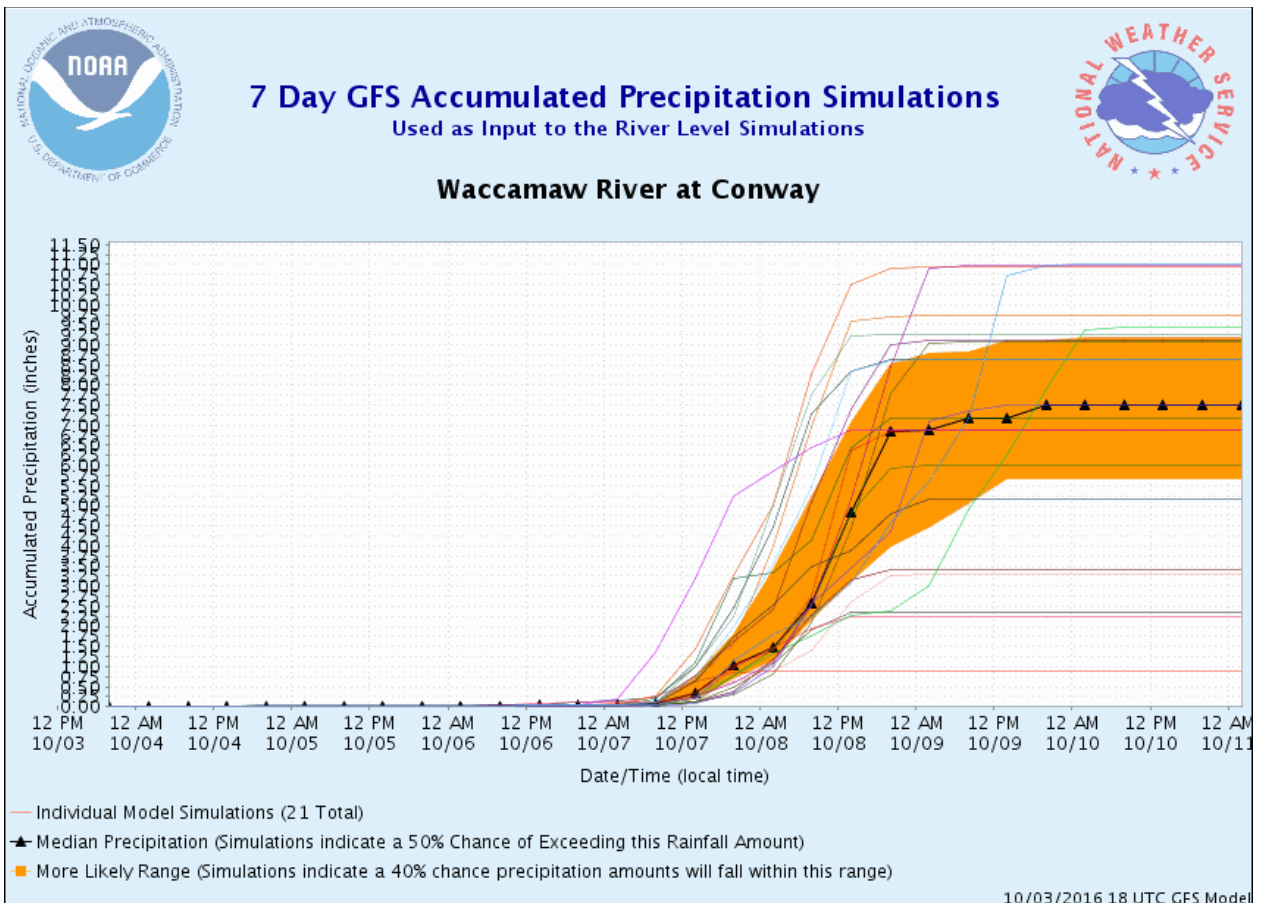
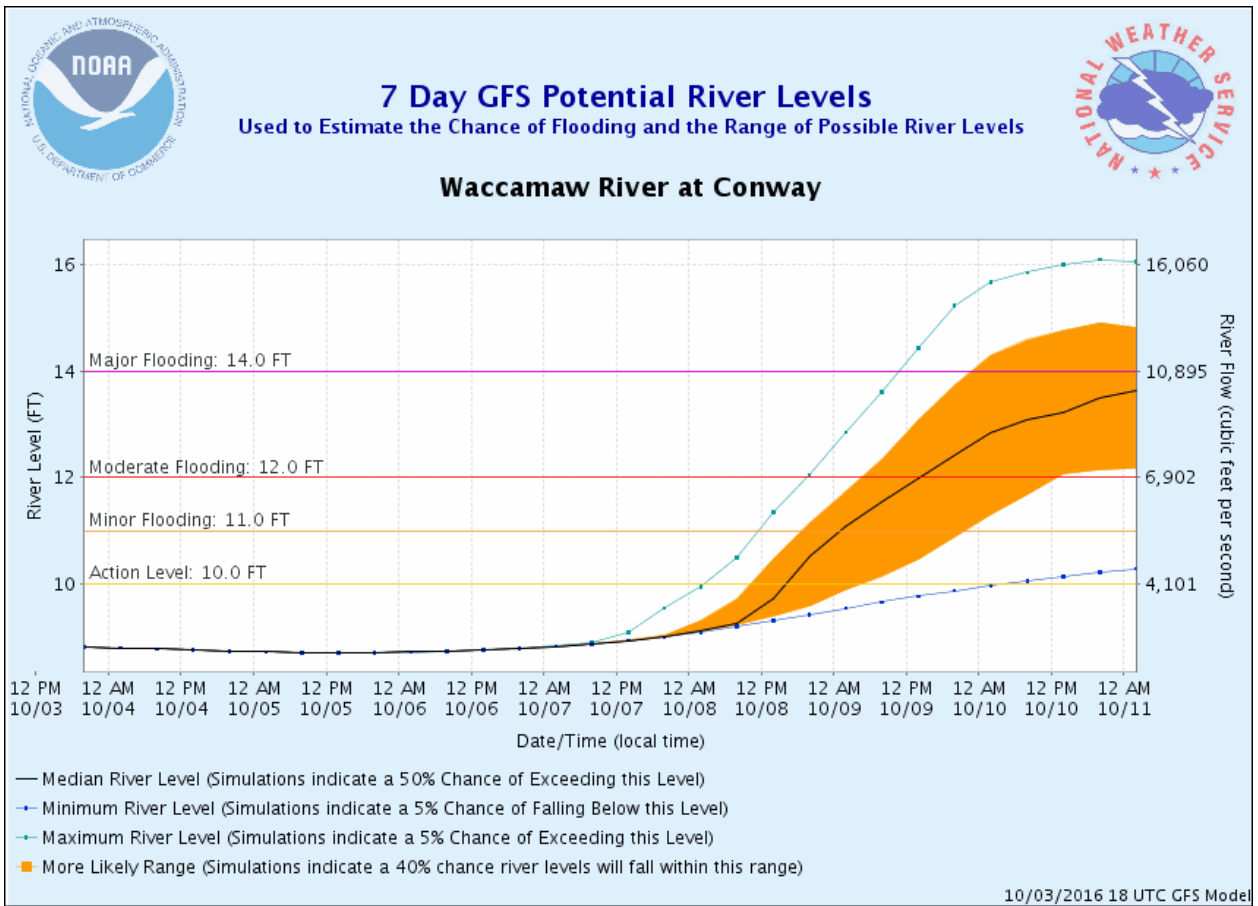
Plot Data						
Arbitrary Sta	Lowest Low Chord	Lowest Road FG	Lowest Shoulder Elev	Projected Gage Elev	Projection of FEMA Limited Study	Measured Data by Maintenance (10/11/2016 at approx. 10:00 AM)
(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
0	25.7	28.8	27.55	26.74	24.5	0
10	25.7	28.8	27.55	26.74	24.5	0

Shoulder differential from FG 1.25 ft

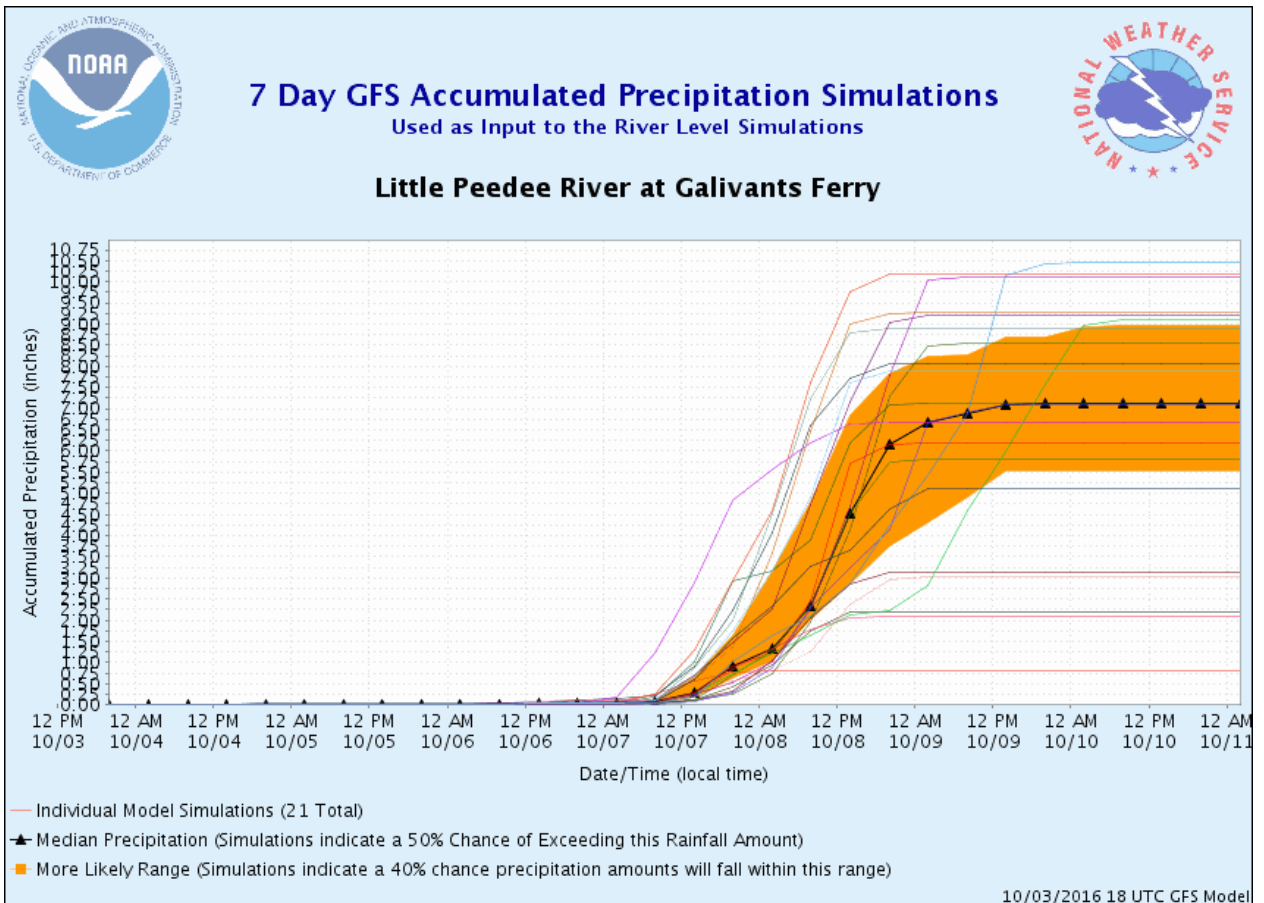
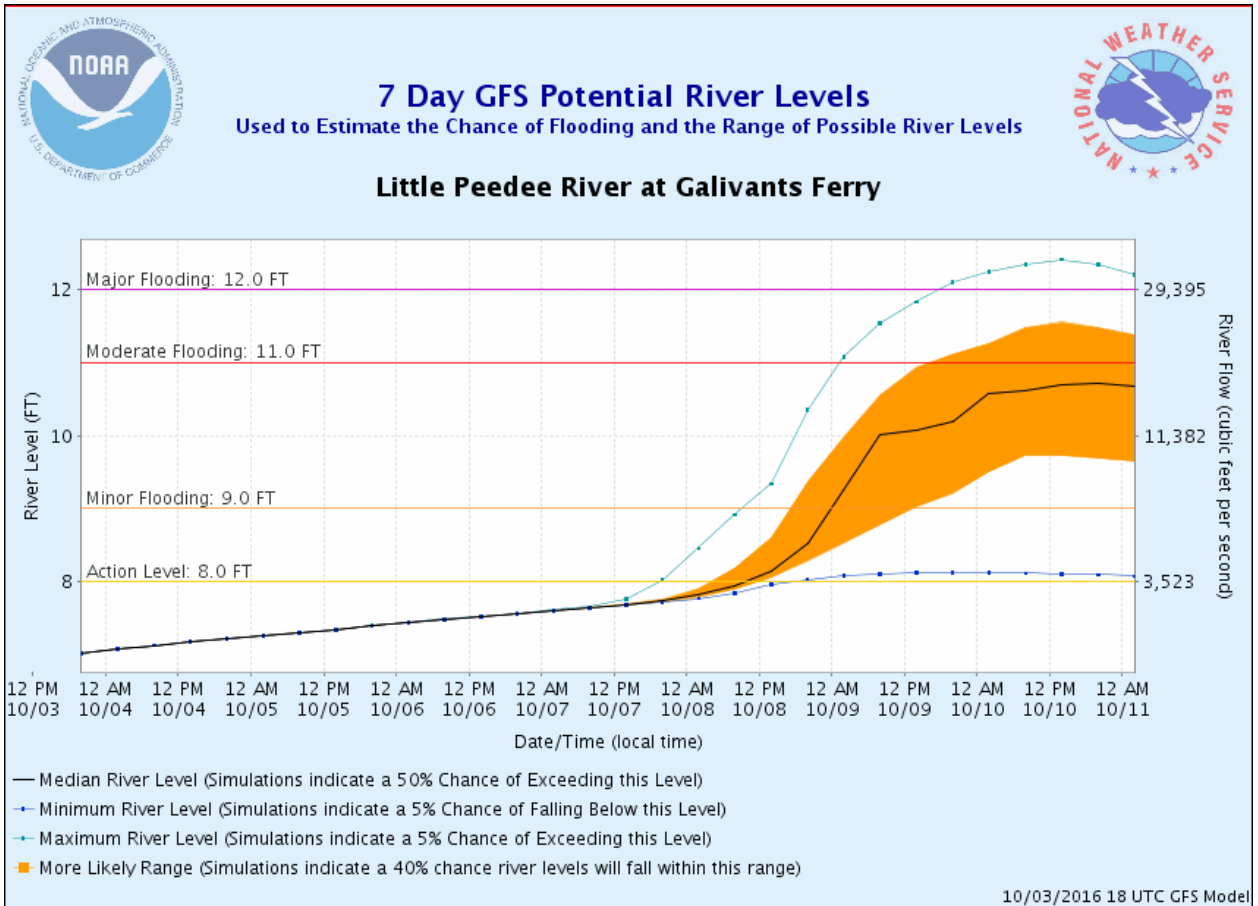




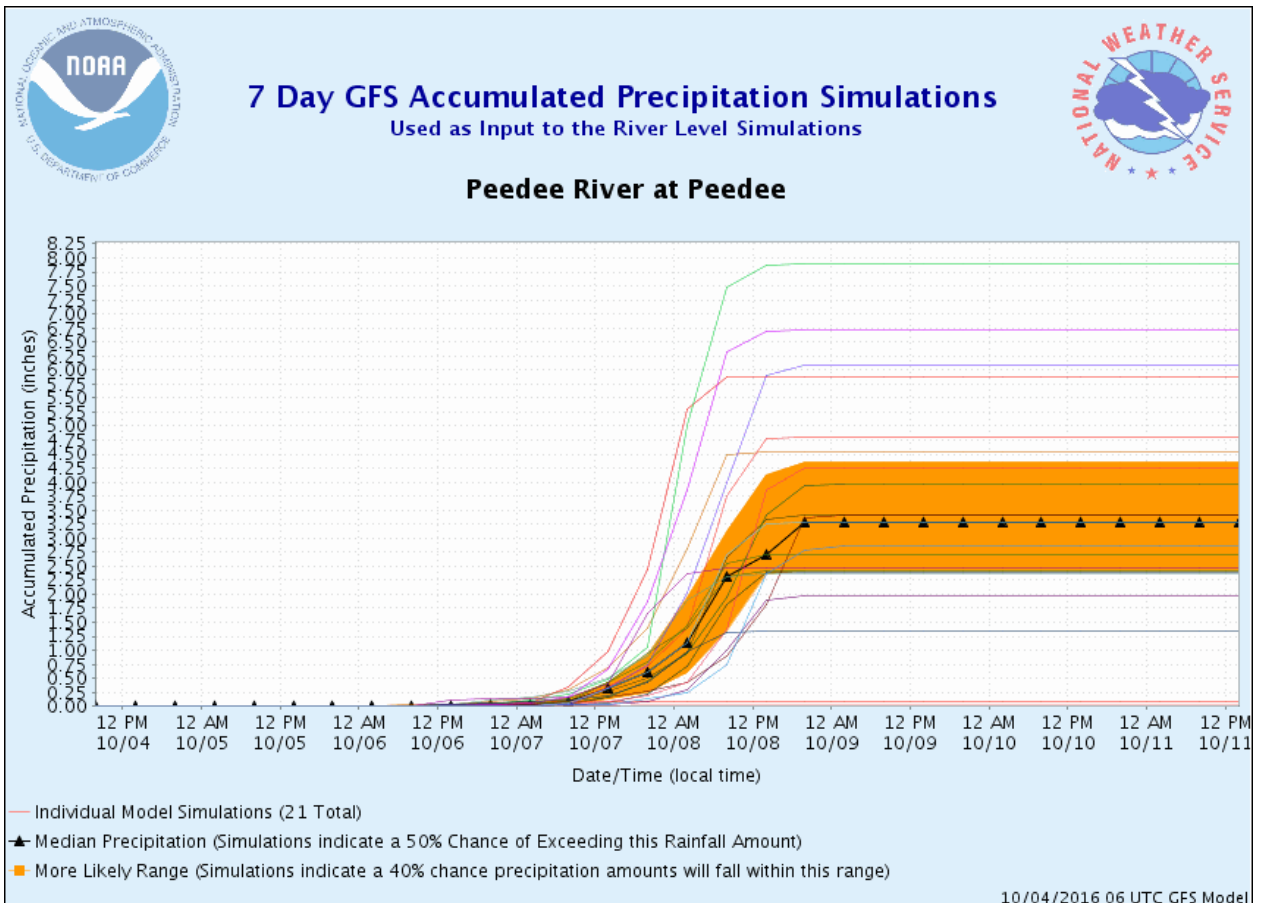
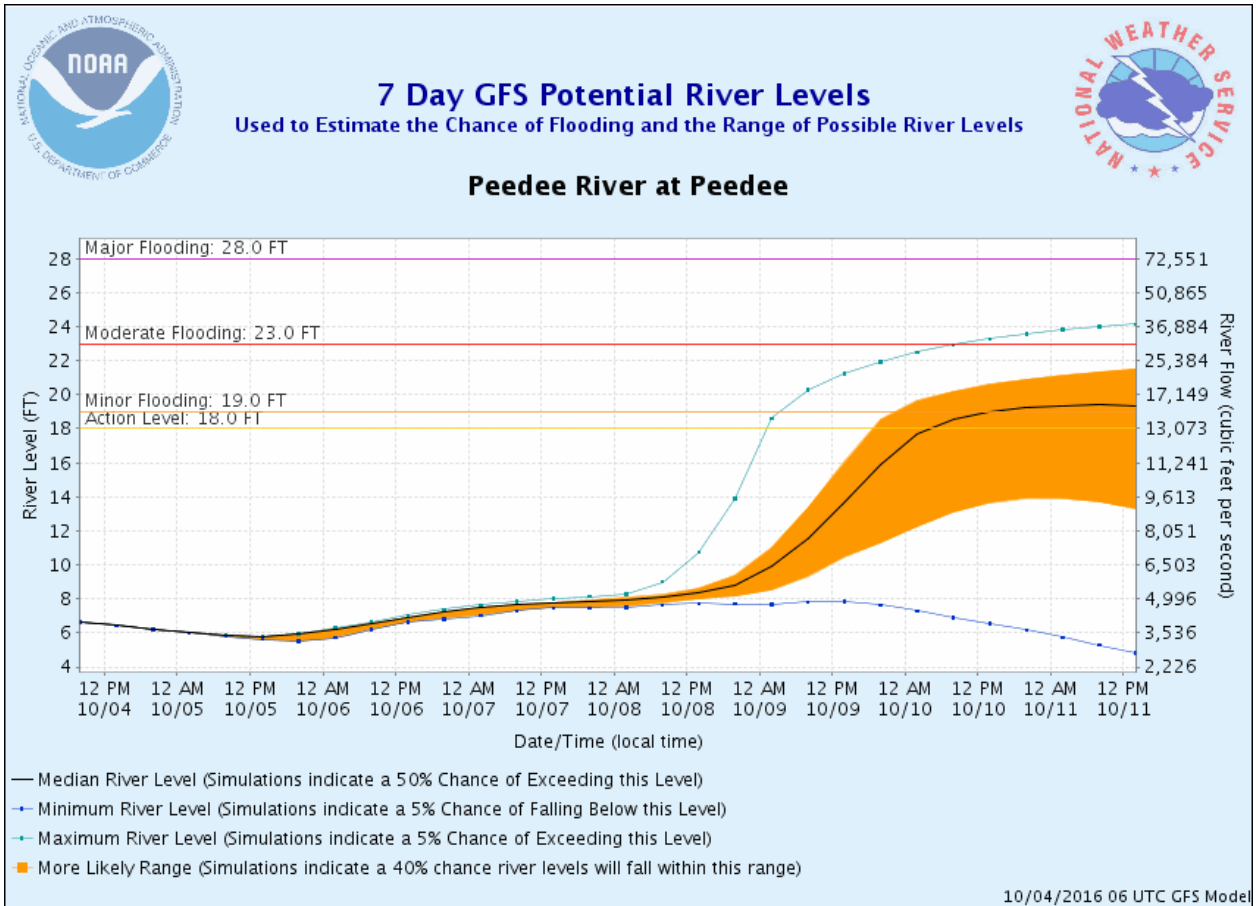
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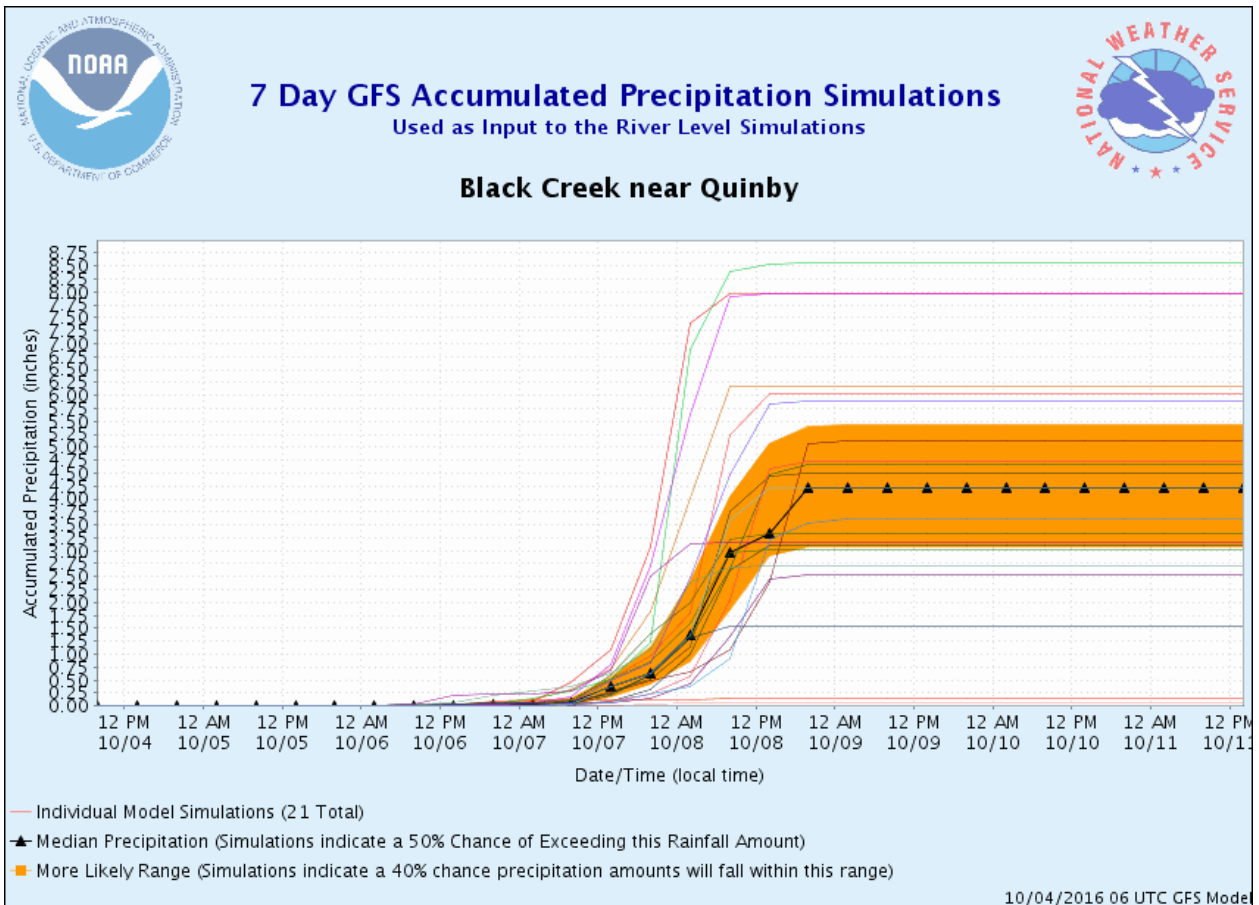
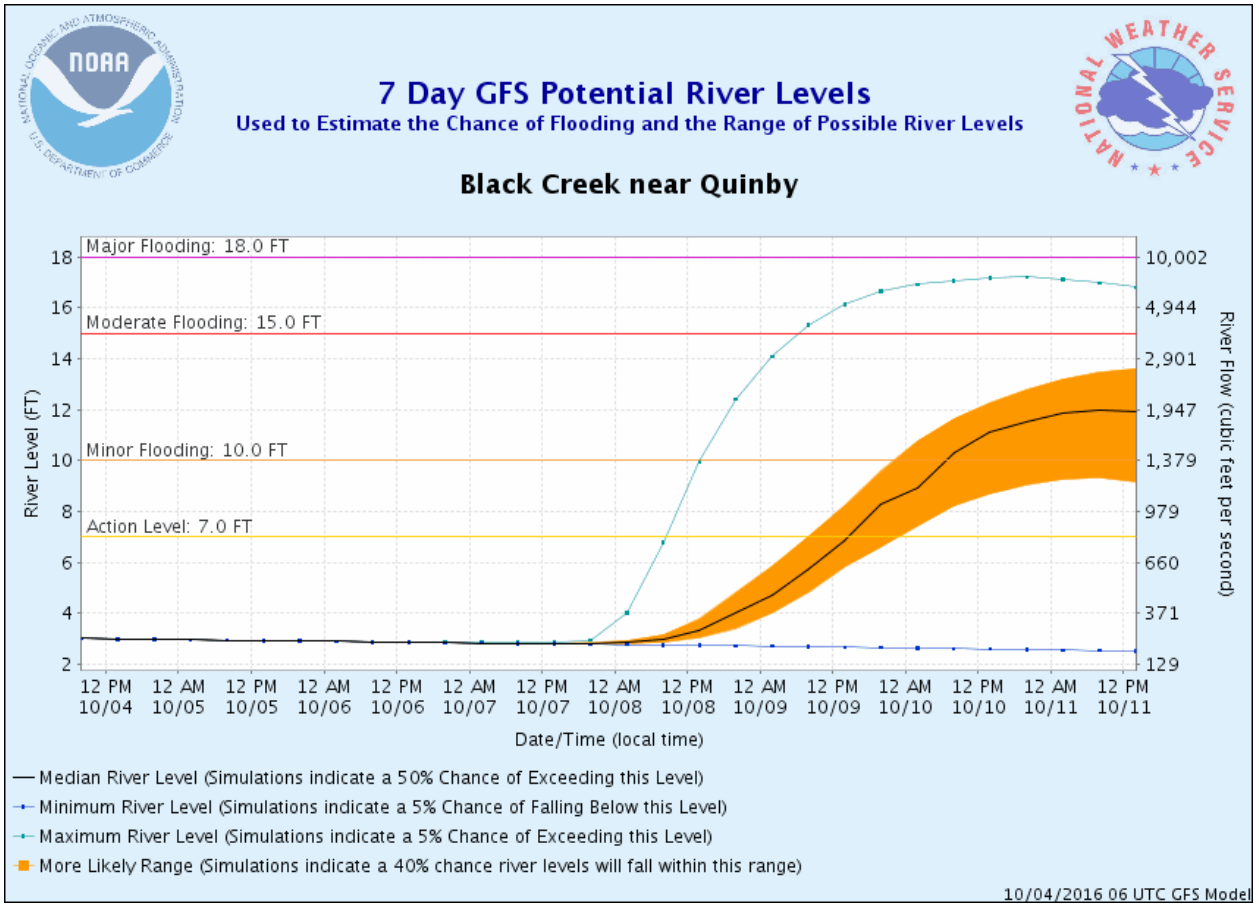
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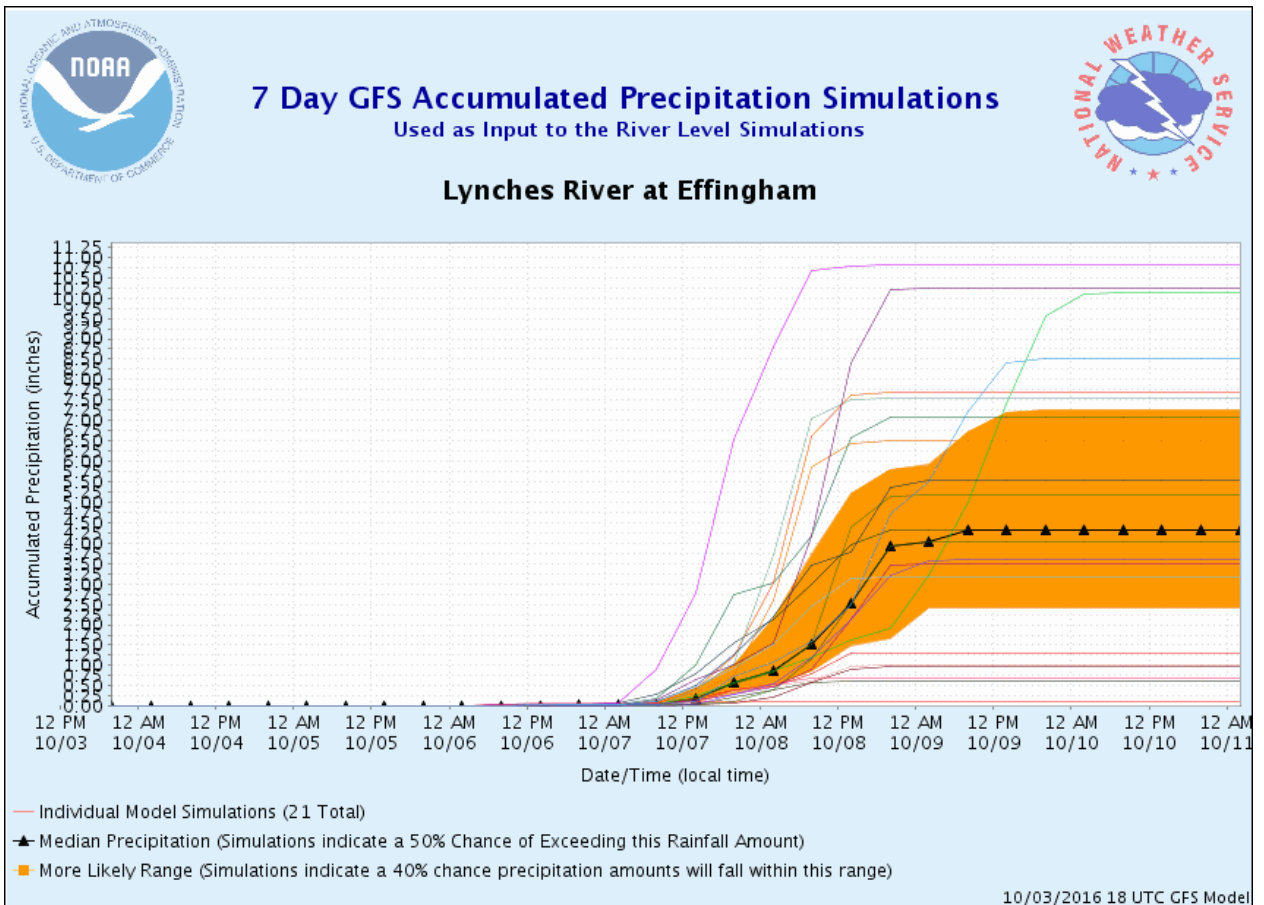
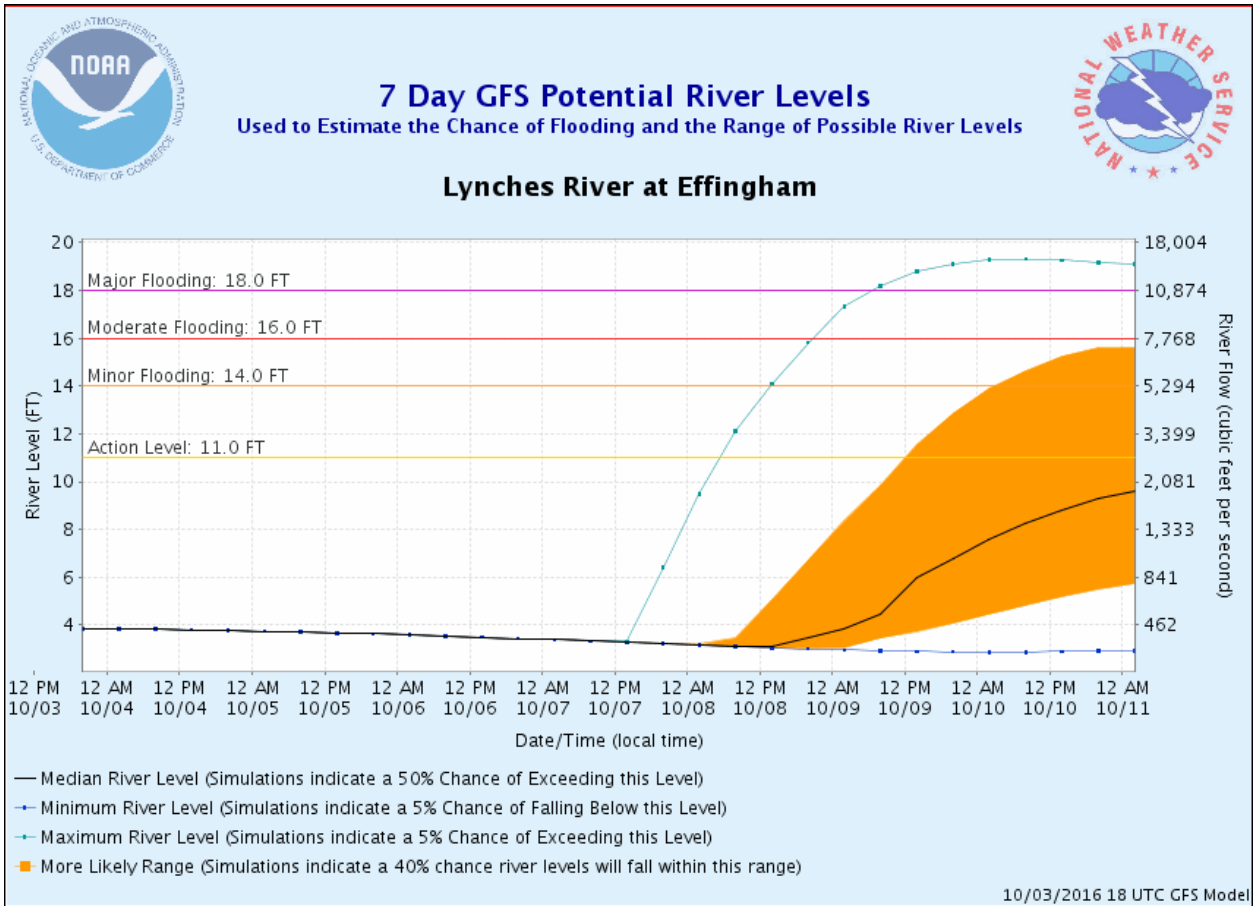


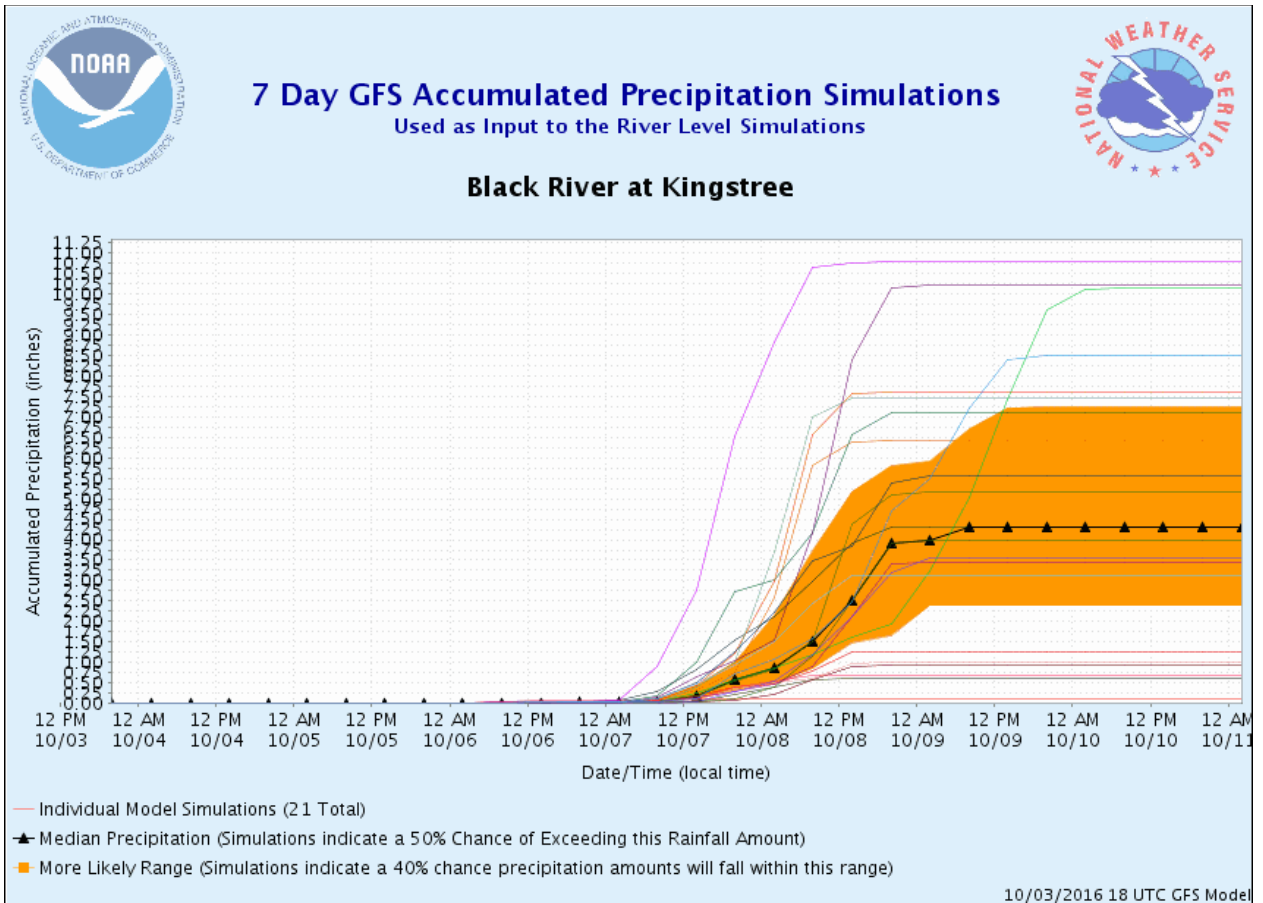
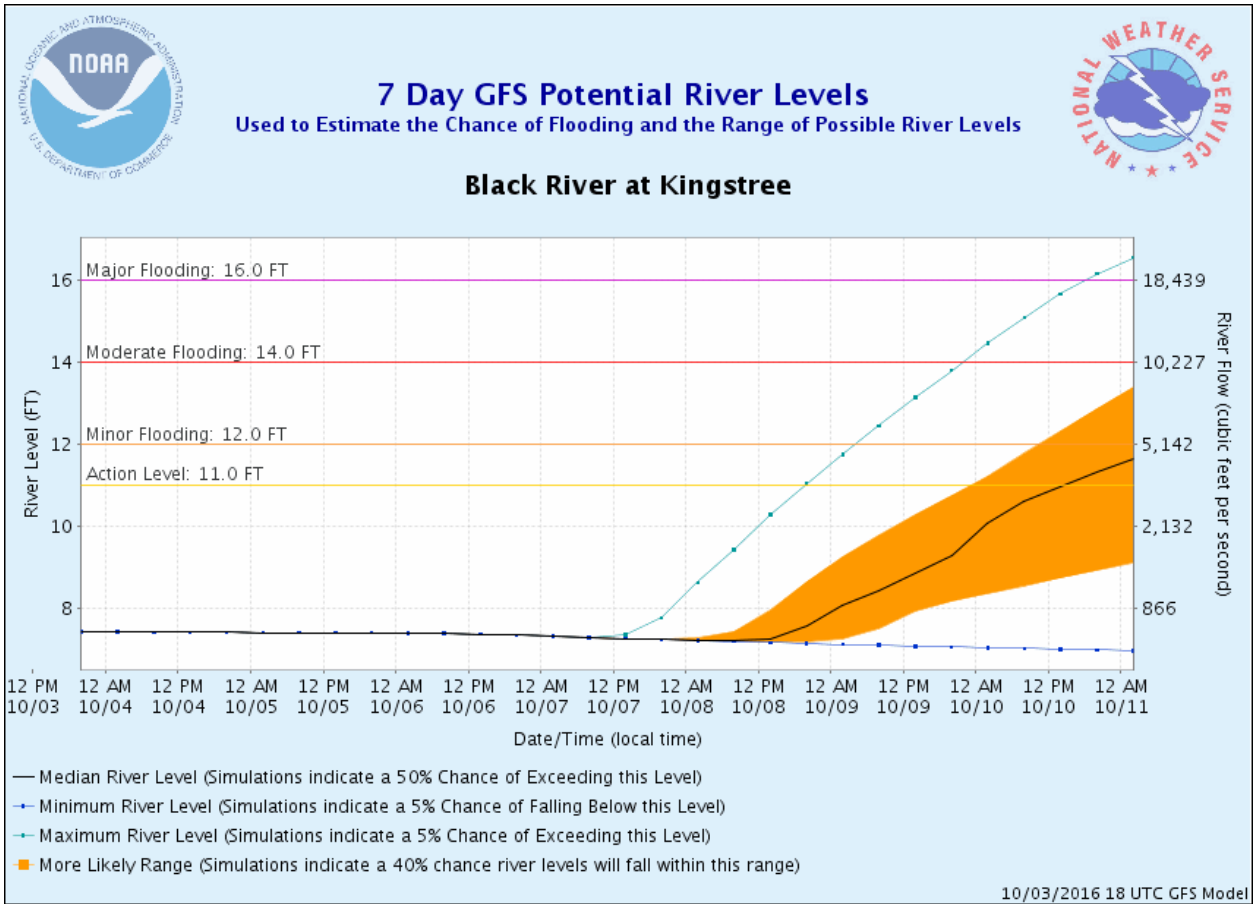
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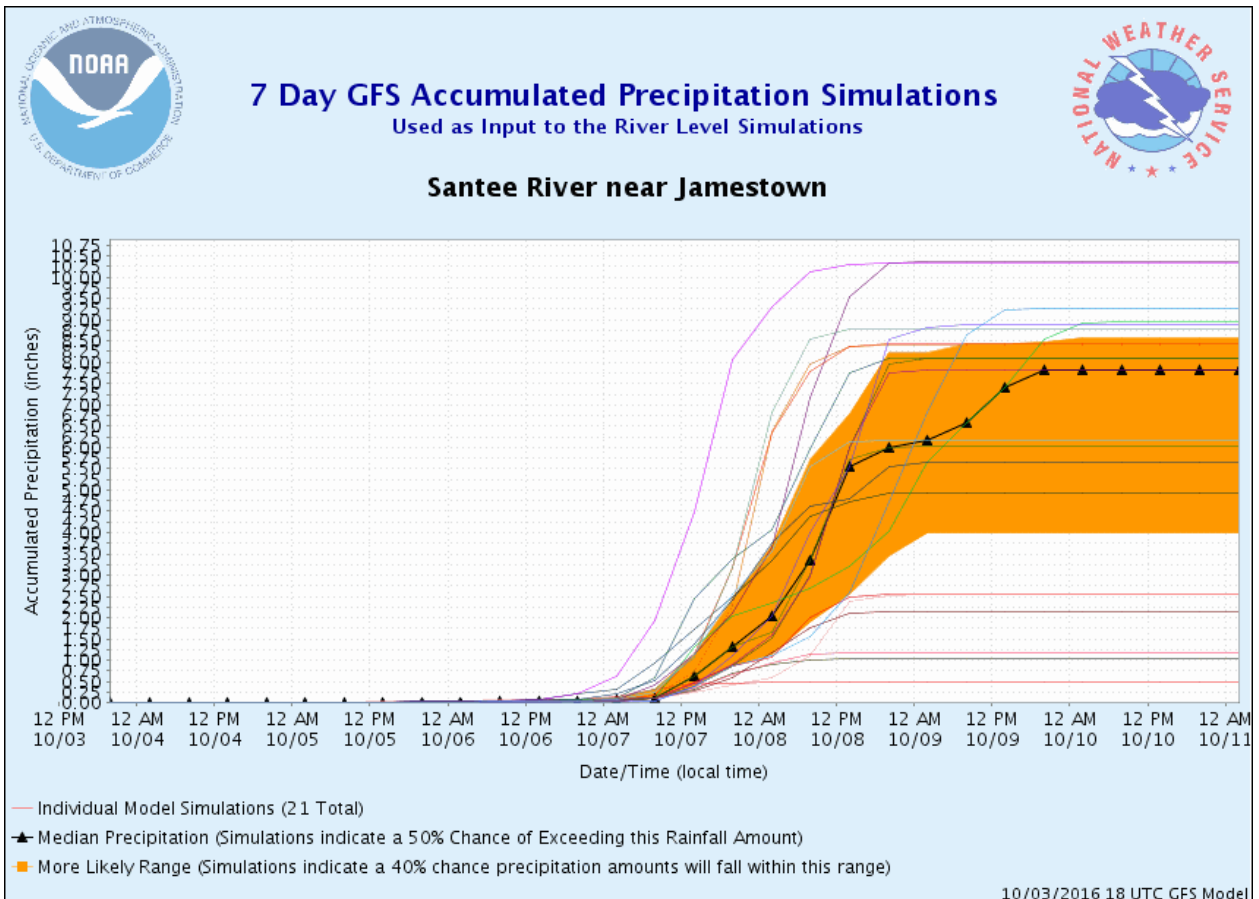
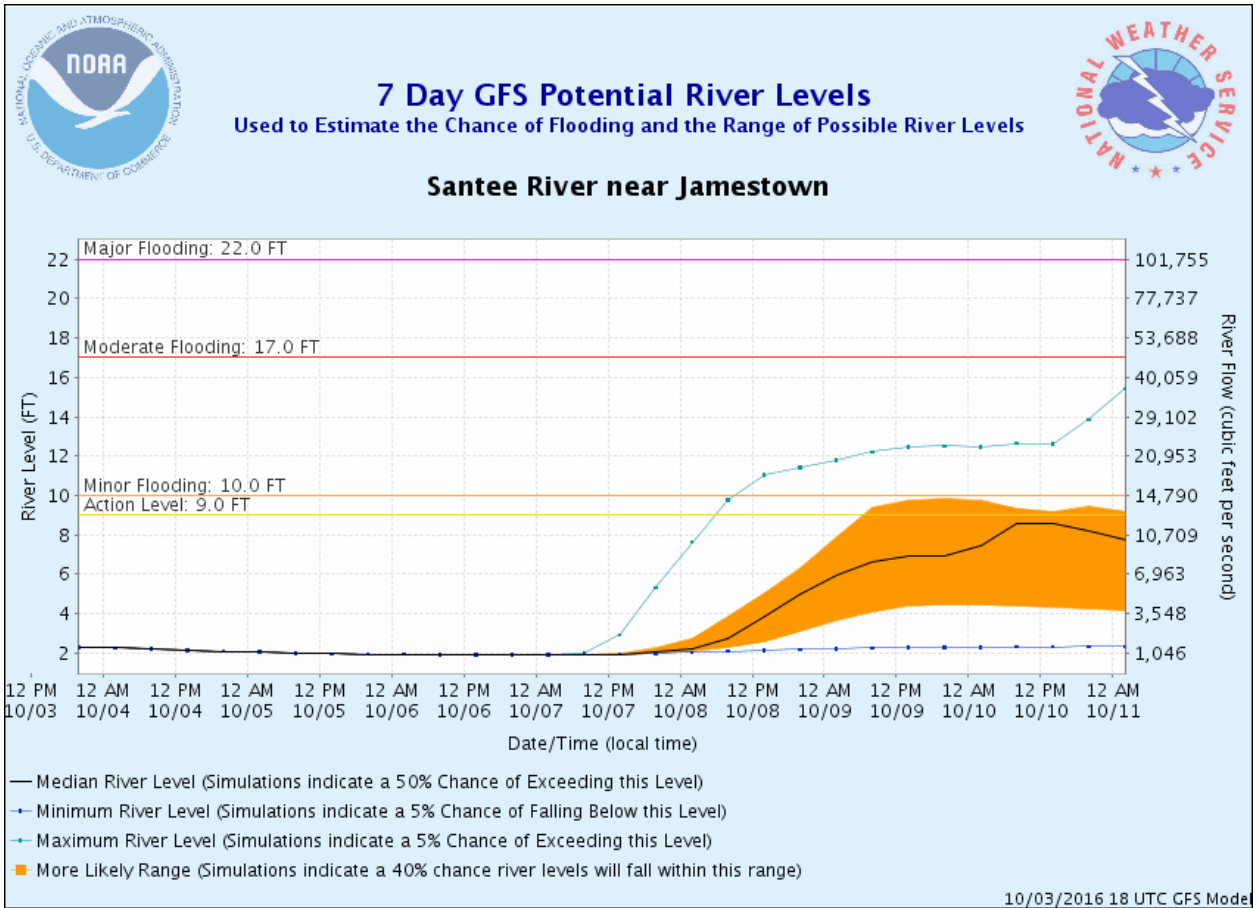


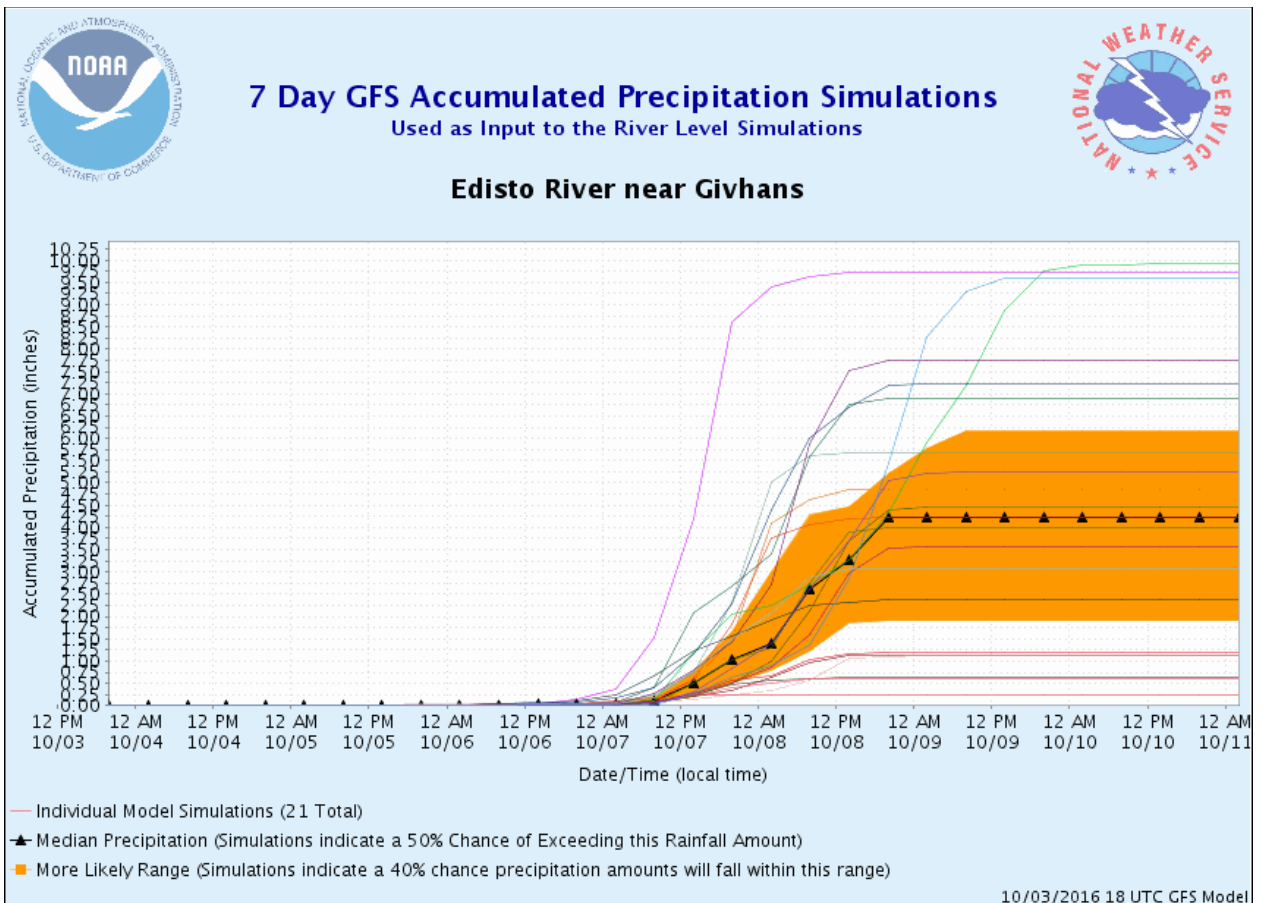
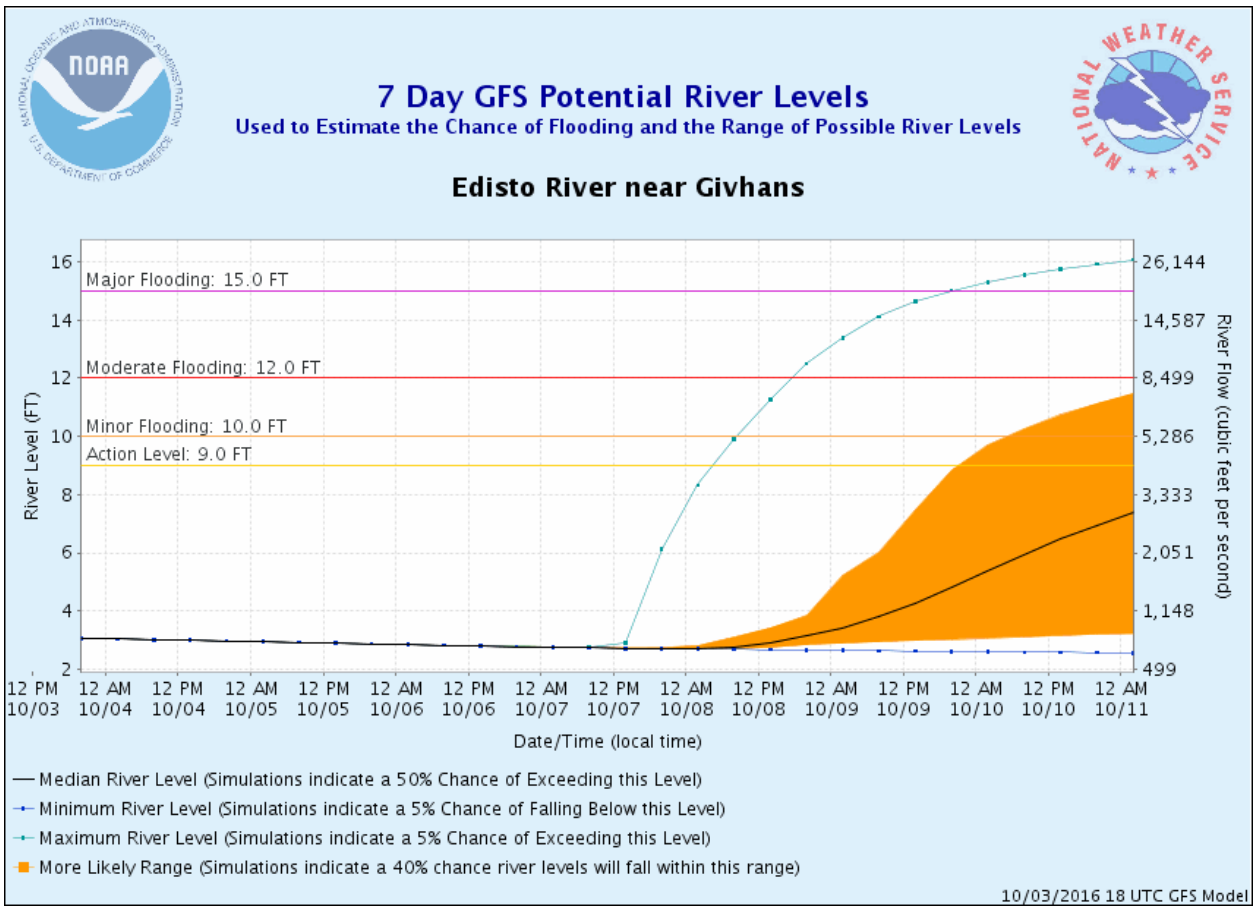
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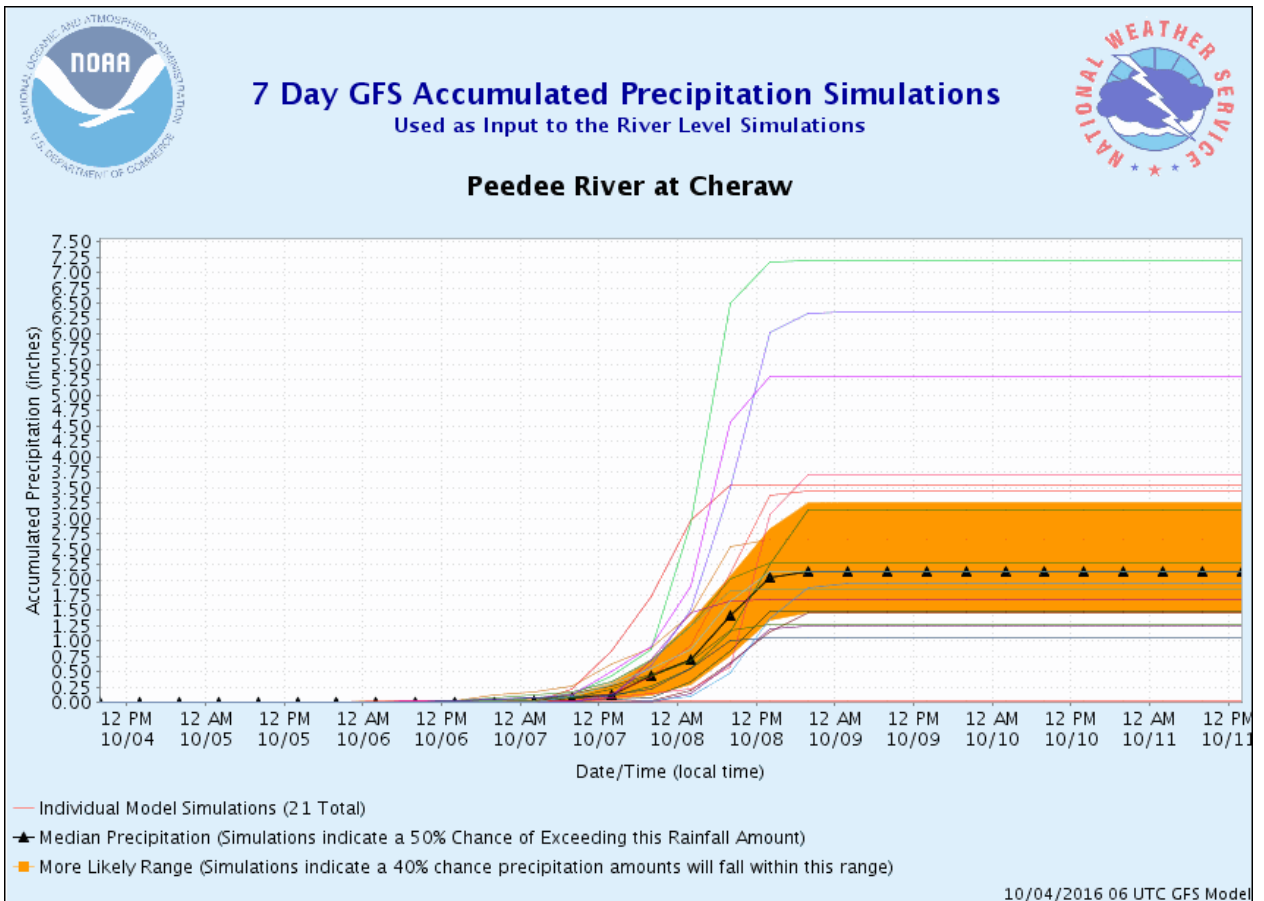
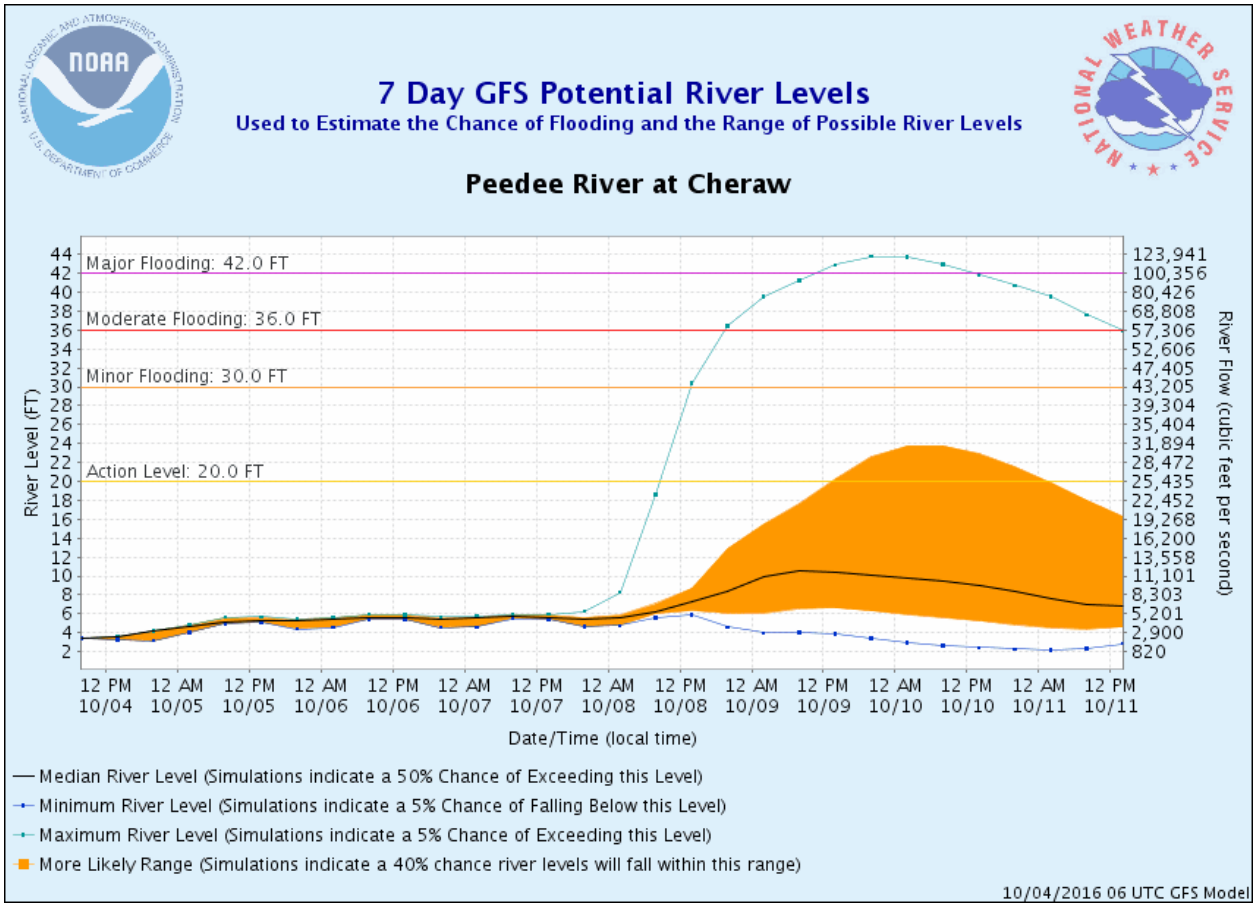




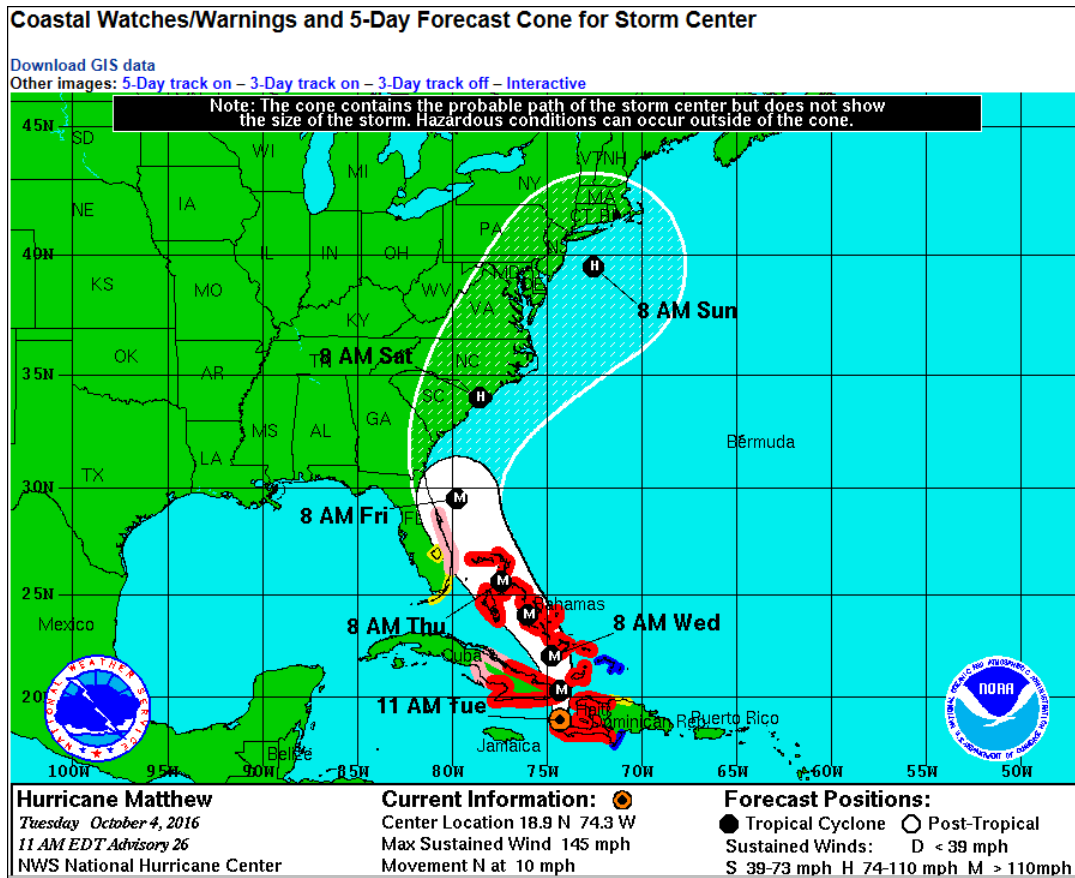








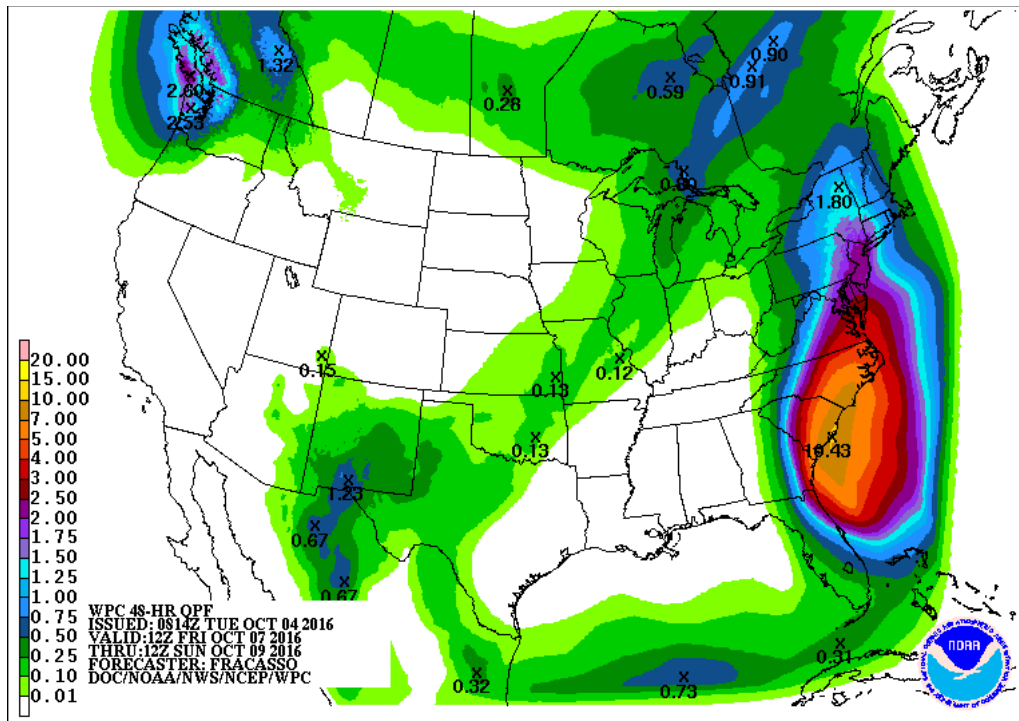
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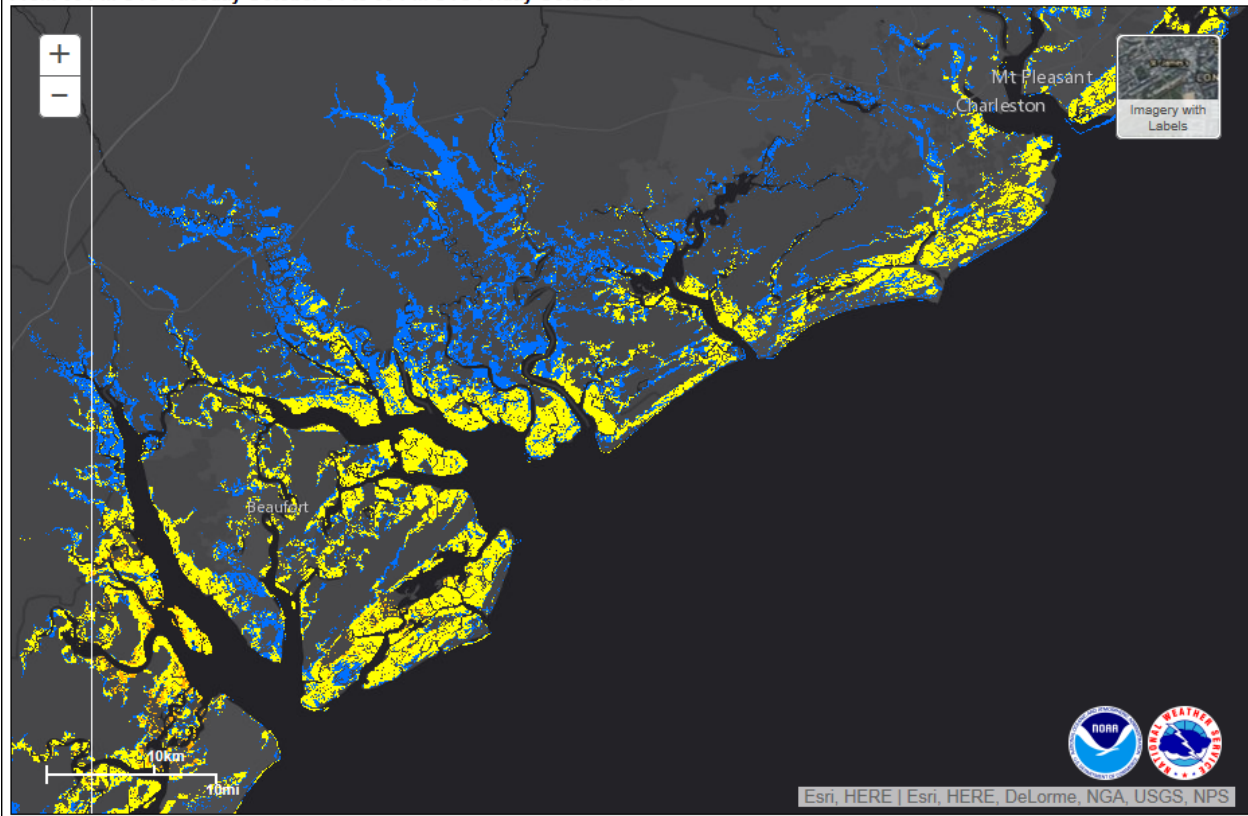
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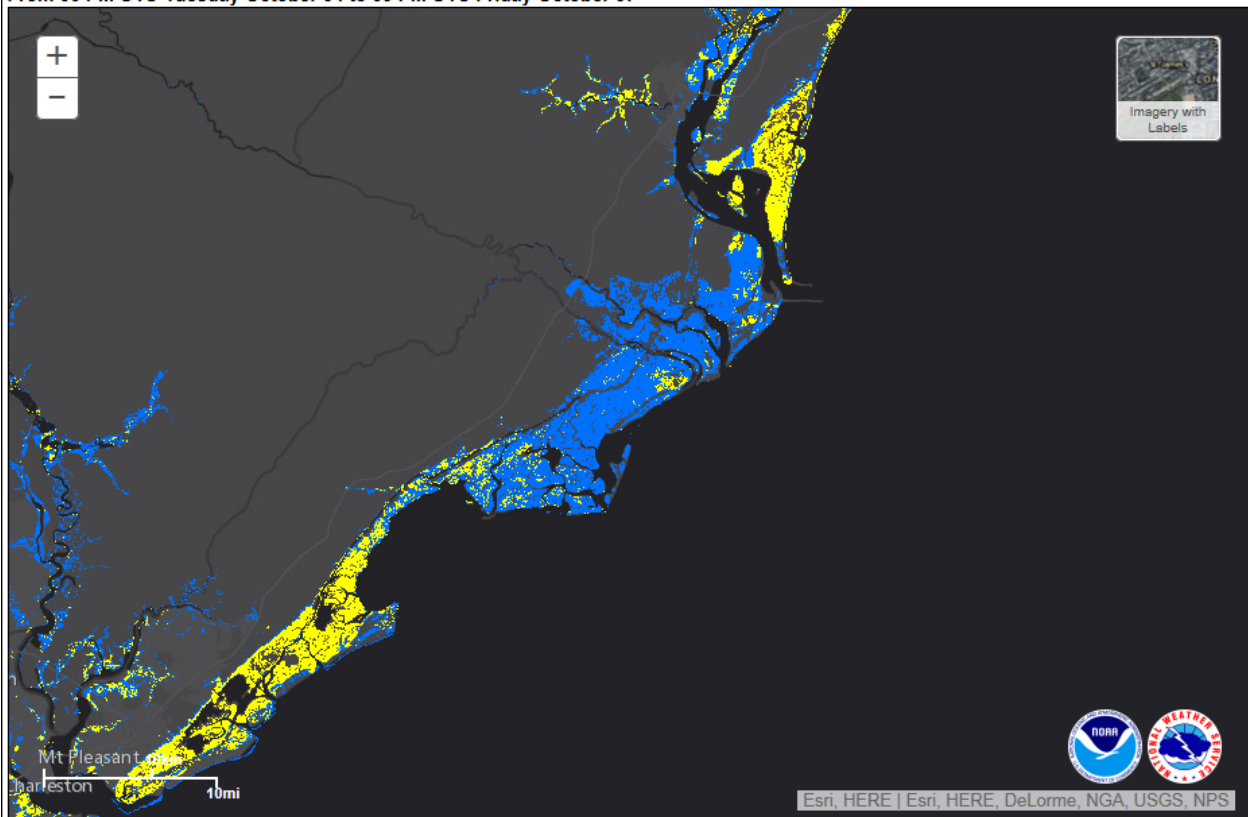
### 5 Day Rain Forecast



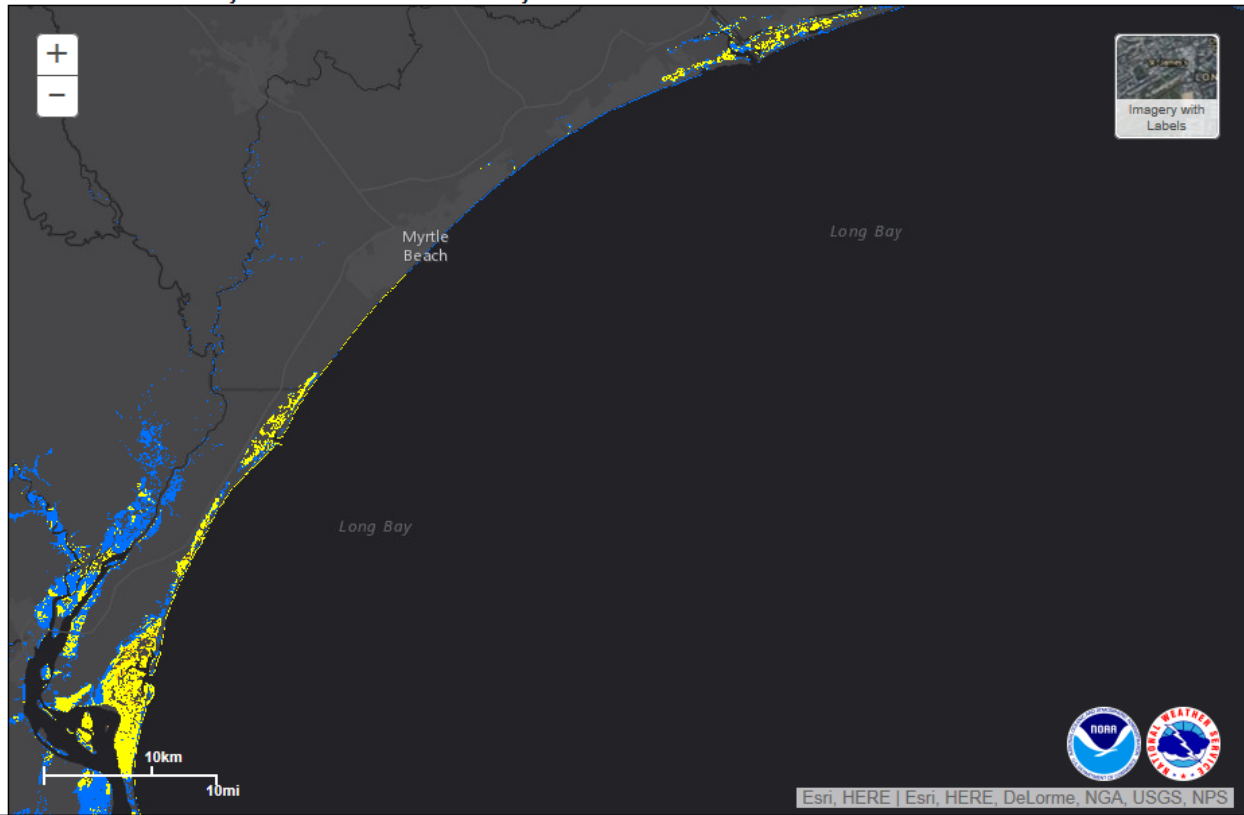
**NHC Potential Storm Surge Flooding Map**  
Hurricane MATTHEW (2016) Advisory 26  
From 03 PM UTC Tuesday October 04 to 09 PM UTC Friday October 07



**NHC Potential Storm Surge Flooding Map**  
Hurricane MATTHEW (2016) Advisory 26  
From 03 PM UTC Tuesday October 04 to 09 PM UTC Friday October 07



**NHC Potential Storm Surge Flooding Map**  
**Hurricane MATTHEW (2016) Advisory 26**  
**From 03 PM UTC Tuesday October 04 to 09 PM UTC Friday October 07**



**Potential Storm Surge Flooding\***

- Intertidal Zone/Estuarine Wetland
- Greater than 1 foot above ground
- Greater than 3 feet above ground
- Greater than 6 feet above ground
- Greater than 9 feet above ground

**Map Layer Options:**

Inundation Layer Only

Inundation with Intertidal Layer

Map Opacity Slider

[Download GIS data](#)  
*(Instructions)*

[Inundation Layer Only](#)

[Inundation with Intertidal Layer](#)

Displayed flooding values indicate the water height that has about a 1-in-10 (10%) chance of being exceeded.

## HYDROLOGIC REPORT 10/14/2016 – Noon

### Little Pee Dee:

- Peak was on Wednesday, October 12<sup>th</sup> at Galivants Ferry
- Confirmed with district that US-378 and overflow bridges currently have over 3' of freeboard. Water should continue to rise throughout the day and hopefully peak by tomorrow at this location. Recommend close monitoring to ensure no pressure flow. USGS is installing a temporary gage to assist with monitoring.
- Still approx. 8' above flood stage
- Rate of decline is less than 1' per day

### Waccamaw River:

- Approaching estimated peak of 16.9', currently 16.3' in Conway.
- Expect the peak in Conway on Sunday, and at Bucksport by Thursday.

### Pee Dee

- At US-701 – Still rising, gage is being repositioned by USGS.
- Expect 1'-4' more rise at 701. Expected to have plenty of freeboard (>3') and no road approach issues.
- City of Georgetown – Thanks to Mapping for providing the KML files from last year's flooding. The highwater mark from last year was elevation 4.6, and we did not close any roads in the City of Georgetown. US-17 approaches are at 7.9' and 10.3' on either end of the bridge, so we do not expect any overtopping. .

### Black River

- At Kingstree – Peaked Monday; -3' since then
- At Andrews – Peaked Thursday. -0.3' since then
- At Browns Ferry – Slowly rising, approx. 0.5' per day

### Santee River

- At Jamestown – Below flood stage on Thursday 10/13
- At McClennanville – Slowly dropping / returning toward normal.

### Edisto River

- Near Givhans Ferry – Peaked Wednesday night, -0.5' since then

Ashley River at Charleston – Remains steady

Cooper at N. Charleston – Still 1' higher than normal, holding steady

Cooper at Ports Authority – Slowly dropping / returning toward normal.

Wando at Wando – Still 0.5' higher than normal

Wando at US-526 – Gage is out

Charleston Harbor Tide Gage – NWS projections show moderate to major flooding at high tide over the weekend and through Monday.

### Roads

US-501 – Good

US-378 – Monitor closely

US-701 – Good at this time

SC-22 – Good

SC-9 – Closed

US-17(G'town) – Good at this time

## HYDROLOGIC REPORT 10/15/2016 – 8 am

### Little Pee Dee:

- Peak was on Wednesday, October 12<sup>th</sup> at Galivants Ferry
- Still approx. 7' above flood stage
- Rate of decline was 4.5 inches from 10am Friday to 5am Saturday.
- Projection from NWS shows decline from Major to Moderate flood stage by Thursday, October 20<sup>th</sup>.
- US-378 - recommend close monitoring to ensure no pressure flow.

### Waccamaw River:

- Reached peak of 16.95' near Longs on Friday, October 14<sup>th</sup> at 12:45pm.
- Still rising in Conway. Up 6 inches since yesterday.
- Expect the peak in Conway by Sunday, and at Bucksport by Thursday.
- NWS projections show the Waccamaw will maintain peak level through Thursday, October 20<sup>th</sup>.

### Pee Dee

- At US-701 – Still rising, over 6" since yesterday.
- Expect 1'-4' more rise at 701. Expected to have plenty of freeboard (>3') and no road approach issues.
- City of Georgetown – Thanks to Mapping for providing the KML files from last year's flooding. The highwater mark from last year was elevation 4.6, and we did not close any roads in the City of Georgetown. US-17 approaches are at 7.9' and 10.3' on either end of the bridge, so we do not expect any overtopping. .

### Black River

- At Kingstree – Peaked Monday; -3' since then
- At Andrews – Peaked Thursday. -0.3' since then
- At Browns Ferry – Appears to have reached peak

### Santee River

- At Jamestown – Below flood stage on Thursday 10/13
- At McClennanville – Slowly dropping / returning toward normal.

### Edisto River

- Near Givhans Ferry – Peaked Wednesday night, -0.5' since then

Ashley River at Charleston – Remains steady

Cooper at N. Charleston – Still 1' higher than normal, holding steady

Cooper at Ports Authority – Slowly dropping / returning toward normal.

Wando at Wando – Still 0.5' higher than normal

Wando at US-526 – Gage is out

Charleston Harbor Tide Gage – NWS projections show moderate to major flooding at high tide over the weekend and through Monday.

## Roads

US-501 Galivants Ferry – Good, river has peaked.

US-501 Conway – Waccamaw is near peak, and will remain at peak levels through Thursday.

US-378 – Monitor closely - Little Pee Dee River is nearing peak

US-701 – Good at this time, Pee Dee River is rising, expect to have plenty of freeboard

SC-22 – Good

SC-9 – Closed at Waccamaw bridge, near pressure flow, road approaches overtopped.

US-17(G'town) – Good at this time

## HYDROLOGIC REPORT 10/15/2016 – 8 pm

### Little Pee Dee:

- Peak was on Wednesday, October 12<sup>th</sup> at Galivants Ferry.
- Still approx. 6.75' above flood stage.
- Rate of decline was 4 inches from 8am to 8pm Saturday.
- Projection from NWS shows decline from Major to Moderate flood stage by Thursday, October 20<sup>th</sup>.
- US-378 Appears to have peaked today.

### Waccamaw River:

- Reached peak of 16.95' near Longs on Friday, October 14<sup>th</sup> at 12:45pm.
- Still rising in Conway. Up 9.5 inches since yesterday.
- Expect the peak in Conway by Sunday, and at Bucksport by Thursday.
- NWS projections show the Waccamaw in Conway will recede about 1' by Thursday, October 20<sup>th</sup>.

### Pee Dee

- At US-701 – Still rising, over 8" since yesterday.
- Expect 1'-4' more rise at 701. Expected to have plenty of freeboard (>3') and no road approach issues.
- City of Georgetown – Gage at US-17 is averaging about 0.5' higher than normal at peaks. The highwater mark from last year was elevation 4.6, and we did not close any roads in the City of Georgetown. US-17 approaches are at 7.9' and 10.3' on either end of the bridge, so we do not expect any overtopping.

### Black River

- At Kingstree – Peaked Monday; -3.5' since then.
- At Andrews – Peaked Thursday. -0.9' since then.
- At Browns Ferry – Appears to have reached peak.

### Santee River

- At Jamestown – Below flood stage on Thursday 10/13.
- At McClennanville – Slowly dropping / returning toward normal.

### Edisto River

- Near Givhans Ferry – Peaked Wednesday night, 3.5' above flood stage.

Ashley River at Charleston – Normal.

Cooper at N. Charleston – Slightly higher than normal.

Cooper at Ports Authority – Normal.

Wando at Wando – Normal.

Charleston Harbor Tide Gage – NWS projections show moderate to major flooding at high tide over the weekend and through Tuesday.

Roads:

US-501 Galivants Ferry – Good, river has peaked.

US-378 – Monitor closely - Little Pee Dee River appears to have reached peak

SC-9 – Closed at Waccamaw bridge, near pressure flow, road approaches overtopped.

SC-22 – Good

US-501 Conway – Waccamaw is near peak, and will remain near peak levels through Thursday.

US-701 – Good at this time, Pee Dee River is rising, expect to have plenty of freeboard

US-17(G'town) – Good at this time

## HYDROLOGIC REPORT 10/16/2016 – 8 am

### Little Pee Dee:

- Peak was on Wednesday, October 12<sup>th</sup> at Galivants Ferry.
- Still approx. 6.5' above flood stage.
- Rate of decline was 3 inches from 8pm Saturday to 8am Sunday.
- Projection from NWS shows decline from Major to Moderate flood stage by Thursday, October 20<sup>th</sup>.
- US-378 peaked Saturday. Down 0.1' over last 12 hours.

### Waccamaw River:

- Reached peak of 16.95' near Longs on Friday, October 14<sup>th</sup> at 12:45pm.
- Still rising in Conway. Up 9.5 inches since yesterday.
- Expect the peak in Conway by Sunday, and at Bucksport by Thursday.
- NWS projections show the Waccamaw in Conway will recede about 1' by Friday, October 21<sup>st</sup>.

### Pee Dee

- At US-701 – Still rising, over 9" since yesterday.
- Expect less than 2' more rise at 701. Expected to have plenty of freeboard (>3') and no road approach issues.
- City of Georgetown – Gage at US-17 is averaging about 0.5' higher than normal at peaks. The highwater mark from last year was elevation 4.6, and we did not close any roads in the City of Georgetown. US-17 approaches are at 7.9' and 10.3' on either end of the bridge, so we do not expect any overtopping.

### Black River

- At Kingstree – Peaked Monday; -3.7' since then.
- At Andrews – Peaked Thursday. -1.0' since then.
- At Browns Ferry – Peaked on Saturday. -0.15' since then.

### Santee River

- At Jamestown – Below flood stage on Thursday 10/13.
- At McClennanville – Peaked on Wednesday. -0.25 since then.

### Edisto River

- Near Givhans Ferry – Peaked Wednesday night, 3.22' above flood stage.

Ashley River at Charleston – Normal.

Cooper at N. Charleston – Slightly higher than normal.

Cooper at Ports Authority – Normal.

Wando at Wando – Normal.

Charleston Harbor Tide Gage – NWS projections show moderate to major flooding at high tide over the weekend and through Tuesday.

Roads:

US-501 Galivants Ferry – Good, river has peaked.

US-378 – Monitor closely - Little Pee Dee River peaked.

SC-9 – Closed at Waccamaw bridge, near pressure flow, road approaches overtopped.

SC-22 – Good

US-501 Conway – Waccamaw is near peak, and will remain near peak levels through Friday.

US-701 – Good at this time, Pee Dee River is rising, expect to have plenty of freeboard

US-17(G'town) – Good at this time

# Preliminary Peak Stage and Streamflow Data at Selected Streamgaging Stations in North Carolina and South Carolina for Flooding Following Hurricane Matthew, October 2016



Open-File Report 2016–1205

U.S. Department of the Interior  
U.S. Geological Survey

**Front cover.** USGS hydrographer standing on flooded West 5th Street in Lumberton, North Carolina, on October 13, 2016, preparing to make a discharge measurement of the Lumber River at Lumberton (USGS station 02134170). Photograph by Jeffrey Moss, USGS.

# **Preliminary Peak Stage and Streamflow Data at Selected Streamgaging Stations in North Carolina and South Carolina for Flooding Following Hurricane Matthew, October 2016**

By J. Curtis Weaver, Toby D. Feaster, and Jeanne C. Robbins

Open-File Report 2016–1205

**U.S. Department of the Interior  
U.S. Geological Survey**

**U.S. Department of the Interior**  
SALLY JEWELL, Secretary

**U.S. Geological Survey**  
Suzette M. Kimball, Director

U.S. Geological Survey, Reston, Virginia: 2016

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Suggested citation:

Weaver, J.C., Feaster, T.D., and Robbins, J.C., 2016, Preliminary peak stage and streamflow data at selected stream-gaging stations in North Carolina and South Carolina for flooding following Hurricane Matthew, October 2016: U.S. Geological Survey Open-File Report 2016–1205, 38 p., <https://doi.org/10.3133/ofr20161205>.

ISSN 2331-1258 (online)

## Contents

Abstract .....	1
Introduction.....	1
Purpose and Scope .....	3
Study Area.....	6
General Weather Conditions and Precipitation Causing the October 2016 Flooding.....	6
Methods Used to Collect Streamflow Data .....	8
Peak Streamflow and Stage .....	10
Comparison of the October 2016 Flood to Past Floods .....	11
Summary.....	14
References Cited.....	15

## Figures

1. Map showing Hurricane Matthew storm total rainfall, October 4–10, 2016.....	2
2. Graph showing cumulative storm rainfall total and running totals for various time increments on October 7–9, 2016, at the Cape Fear River at William O. Huske Lock near Tarheel in Bladen County, North Carolina .....	3
3. Image showing flooding in Lumberton in Robeson County, North Carolina, on October 11, 2016, just south and east of the I-95 crossing over the Lumber River.....	4
4. Image showing flooding in and near Princeville in Edgecombe County, North Carolina, on October 13, 2016, near the U.S. Highway 64 crossing over the Tar River.....	4
5. Map showing selected U.S. Geological Survey real-time streamgages in North and South Carolina .....	5
6. Map showing the track of Hurricane Matthew through the Atlantic basin from September 29 through October 9, 2016.....	7
7. Photograph of U.S. Geological Survey personnel using an acoustic Doppler current profiler to make a streamflow measurement at USGS station 02089000, Neuse River near Goldsboro in Wayne County, North Carolina, October 10, 2015 .....	8
8. Graph showing rating curves developed for use before and after the October 2016 flood for Lumber River at Boardman near the border between Robeson and Columbus Counties, North Carolina, showing streamflow measurements made during the event .....	9
9. Photograph of U.S. Geological Survey field crews conducting surveys of high-water marks to document the elevation of flood waters in Robeson County North Carolina, for the October 2016 flood.....	9

10. Graphs showing cumulative rainfall and stage and streamflow at Flat Creek near Inverness in Hoke County, North Carolina, for September 1 through October 31, 2016 .....	10
11. Graph showing stage and streamflow at Black River near Tomahawk in Sampson County, North Carolina, and stage at Black River near Currie in Pender County, North Carolina, for October 1–31, 2016 .....	11
12. Graphs showing observed stage before, during, and after Hurricane Matthew for Falls Lake and six USGS streamgages on the Neuse River downstream from Falls Lake, October 1–November 10, 2016.....	12
13. Graphs showing observed streamflow before, during, and after Hurricane Matthew for Falls Lake and six USGS streamgages on the Neuse River downstream from Falls Lake, October 1–November 10, 2016 .....	13

## Tables

1. Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew .....	18
2. Chronology of major floods in North Carolina since 1876.....	36
3. Chronology of major floods in South Carolina since 1893 .....	38

## Conversion Factors

U.S. customary units to International System of Units

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
<b>Length</b>		
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<b>Area</b>		
square mile (mi <sup>2</sup> )	259.0	hectare (ha)
square mile (mi <sup>2</sup> )	2.590	square kilometer (km <sup>2</sup> )
<b>Flow rate</b>		
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft <sup>3</sup> /s)	0.02832	cubic meter per second (m <sup>3</sup> /s)
mile per hour (mi/h)	1.609	kilometer per hour (km/h)

## Datums

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to either the North American Datum of 1927 (NAD 27) or the North American Datum of 1983 (NAD 83).



# Preliminary Peak Stage and Streamflow Data at Selected Streamgaging Stations in North Carolina and South Carolina for Flooding Following Hurricane Matthew, October 2016

By J. Curtis Weaver, Toby D. Feaster, and Jeanne C. Robbins

## Abstract

The passage of Hurricane Matthew across the central and eastern regions of North Carolina and South Carolina during October 7–9, 2016, resulted in heavy rainfall that caused major flooding in parts of the eastern Piedmont in North Carolina and coastal regions of both States. Rainfall totals of 3 to 8 inches and 8 to more than 15 inches were widespread throughout the central and eastern regions, respectively. U.S. Geological Survey streamgages recorded peaks of record at 26 locations, including 11 sites with long-term periods of 30 or more years of record. A total of 44 additional locations had peak streamflows that ranked in the top 5 for the period of record. Additionally, among 23 U.S. Geological Survey streamgages within the affected basins in North Carolina where stage-only data are collected, new peak stages were recorded at 5 locations during the flooding. U.S. Geological Survey personnel made 102 streamflow measurements at 60 locations in both States to verify, update, or extend existing rating curves (which are used to determine stage-discharge relations) during the October 2016 flood event.

## Introduction

Hurricane Matthew brought tropical moisture to parts of the Southeastern United States, including North Carolina and South Carolina, during October 7–9, 2016, resulting in heavy rainfall across the region (fig. 1). The heavy rainfall across the Carolinas resulted in major flooding from the Albemarle-Chowan River Basin in northeastern North Carolina to the Little Pee Dee River Basin in northeastern South Carolina. Rainfall totals of 3 to 8 inches and 8 to more than 15 inches were widespread throughout the central and eastern regions of both States, respectively, (fig. 1; Southeast Regional Climate Center, 2016). One U.S. Geological Survey

(USGS) raingage at the Cape Fear River at William O. Huske Lock near Tarheel in Bladen County, North Carolina (USGS station 02105500), recorded 16.87 inches of rain for the period October 7–9, 2016 (fig. 2). The National Weather Service reported that an observer affiliated with the Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network reported 17.00 inches of rain on October 7–9 near Hope Mills in Cumberland County, North Carolina, while a second CoCoRaHS observer reported 18.38 inches of rain for the same period near Elizabethtown in Bladen County in North Carolina (Nicholas Petro, National Oceanic and Atmospheric Administration [NOAA] National Weather Service, written commun., November 9, 2016).

In South Carolina, rainfall totals in the Coastal Plain region for October 7–9, 2016, ranged from about 3 inches to as high as 17.22 inches near Dillion, South Carolina (fig. 1; Hope Mizzell, South Carolina Department of Natural Resources, written commun., November 4, 2016). For that same period, 16.9 inches of rain also was recorded on Edisto Island, S.C., which is located southwest of Charleston. Because of damages and losses that resulted from the high winds, storm surges, and flooding in South Carolina, the U.S. Department of Agriculture designated Beaufort, Cherokee, Jasper, and Union Counties as primary natural disaster areas (AgFax Media, 2016).

By the end of October, the passage of Hurricane Matthew had resulted in 28 fatalities in North Carolina, of which 17 were associated with vehicles that were swept off flooded roadways (Stradling, 2016). Five fatalities in South Carolina were attributed to flooding from Hurricane Matthew (M.C. Lamm, South Carolina Department of Natural Resources, written commun., November 15, 2016). At the height of the event more than 600 roads had to be closed in North Carolina, including portions of Interstates 40 and 95, resulting in more than 2,100 required road repairs that included shoulder washouts and damage to drainage structures such as pipes, reinforced concrete box culverts, and bridges

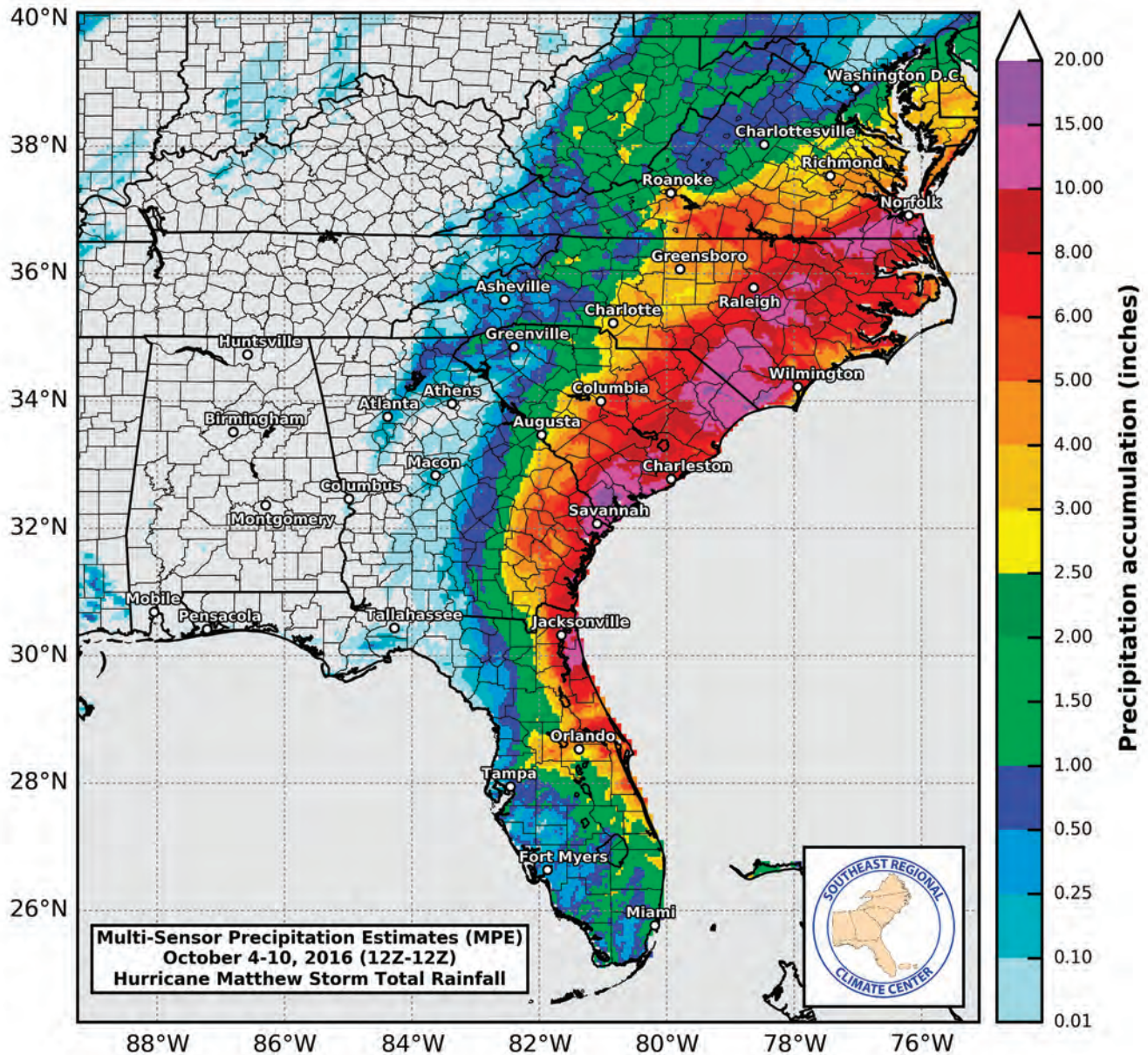
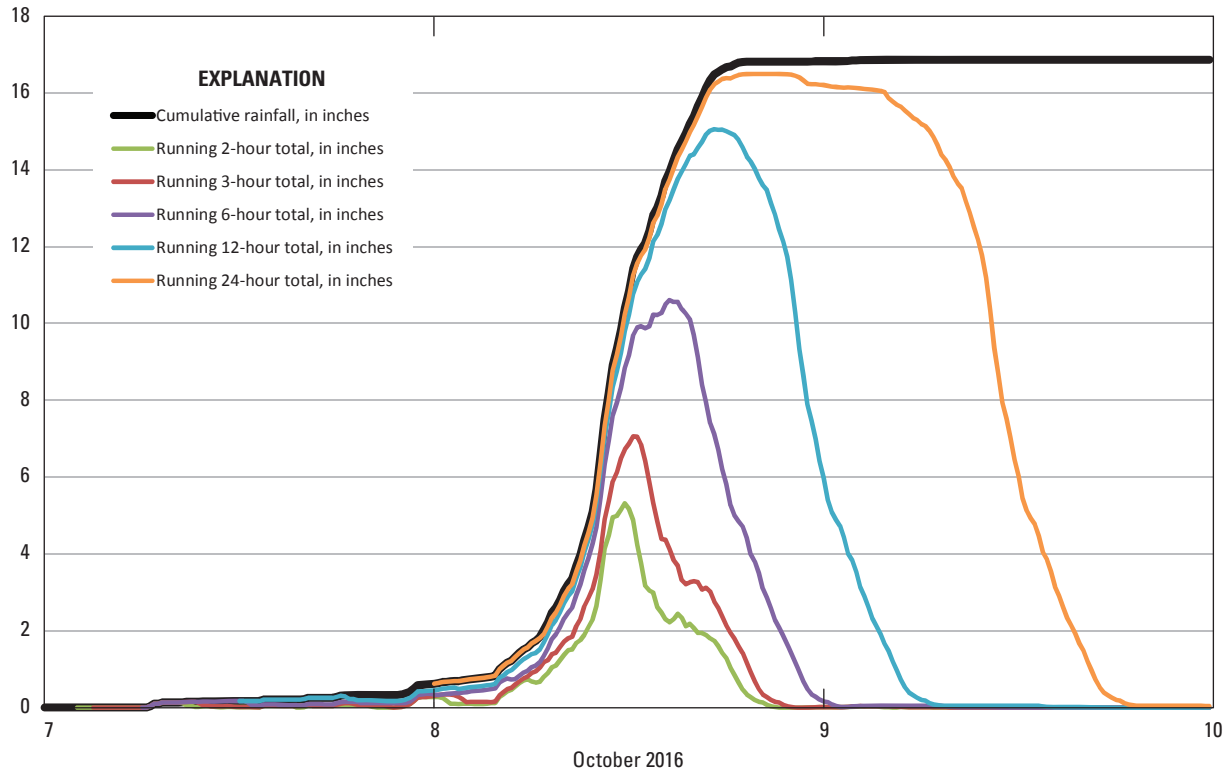


Figure 1. Hurricane Matthew storm total rainfall, October 4–10, 2016 (Southeast Regional Climate Center, 2016).

(Matthew Lauffer, N.C. Department of Transportation, written commun., November 30, 2016). The N.C. Department of Environmental Quality, Division of Energy, Mineral and Land Resources, reported that 20 dams across southeastern North Carolina were breached or partially breached as a result of runoff from Hurricane Matthew (Shane Cook, N.C. Department of Environmental Quality, Division of Energy, Mineral and Land Resources, Dam Safety Program, written commun., December 16, 2016). In South Carolina, 797 highway structures had to be closed during the event (721 roads and

76 bridges), including 167 roads that were reopened the same day they were closed (J. Feda, S.C. Department of Transportation, written commun., October 31, 2016). The S.C. Department of Health and Environmental Control reports that 25 dams in the State were breached as a result of the runoff from Hurricane Matthew (S.C. Department of Health and Environmental Control, 2016).

In North Carolina, nearly 1.6 million customers lost power as a result of winds that downed trees and power lines (Nicholas Petro, NOAA National Weather Service, written



**Figure 2.** Cumulative storm rainfall total and running totals for various time increments on October 7–9, 2016, at the Cape Fear River at William O. Huske Lock near Tarheel in Bladen County, North Carolina (USGS station 02105500).

commun., November 9, 2016). The N.C. Department of Public Safety's Floodplain Mapping Program reported that nearly 99,000 structures across the State were inundated with water when portions of towns, such as Lumberton in Robeson County (fig. 3) and Princeville in Edgecombe County (fig. 4), were flooded. Emergency management officials have estimated the damage in North Carolina from the storm at approximately \$1.5 billion, not including damage to the State infrastructure or the agriculture industry (Nicholas Petro, NOAA National Weather Service, written commun., November 9, 2016). On the basis of historical information compiled by the State Climate Office of North Carolina, Hurricane Matthew was the fourth costliest and fifth deadliest tropical cyclone on record in North Carolina (State Climate Office of North Carolina, 2015). In South Carolina, Hurricane Matthew caused nearly \$341 million in damage to public property, including about \$100 million in damage to State-owned roads (Wilks, 2016).

The USGS computes and disseminates streamflow data collected at more than 9,900 streamgaging stations nationwide. In North and South Carolina, the USGS operates approximately 260 and 160 real-time streamgages, respectively, in cooperation with numerous local, State, and Federal agencies, monitoring gage height, streamflow, reservoir elevations, and tidal flow. Streamflow data collection serves a

variety of purposes, including providing information for flood forecasts and documenting flood extent and levels. Leading up to and during flooding, streamflow data are vital for flood warning, forecasting, and emergency management. The long-term, systematic streamflow data are used to assess risk and to mitigate flooding through flood-plain management and in the design or repair of infrastructure (for example, roads, bridges, reservoirs, and pipelines), houses, and buildings.

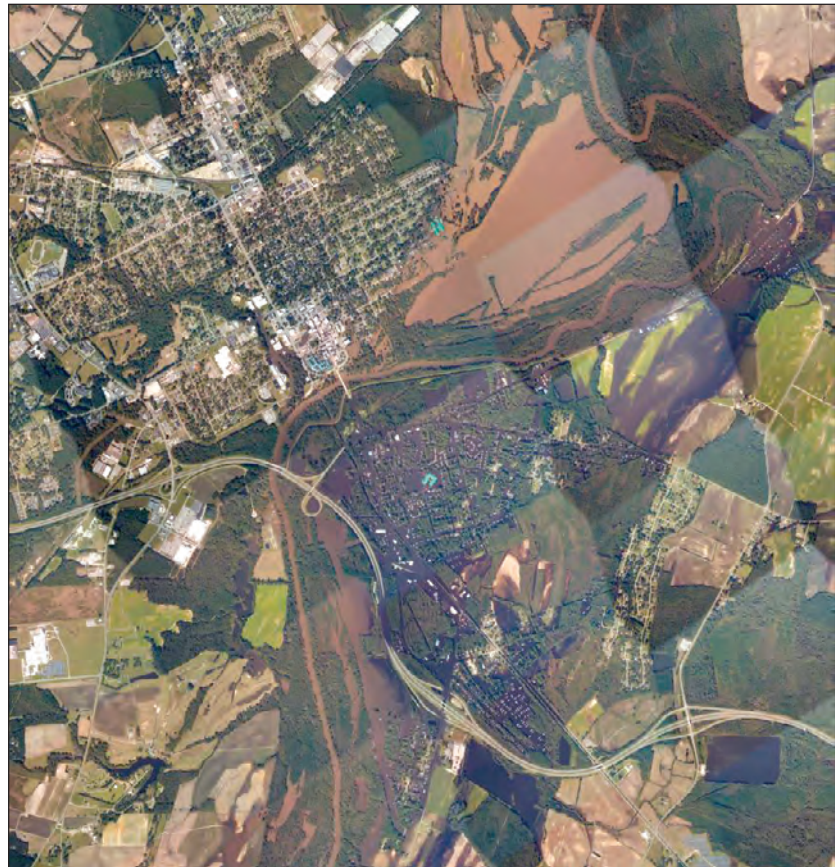
## Purpose and Scope

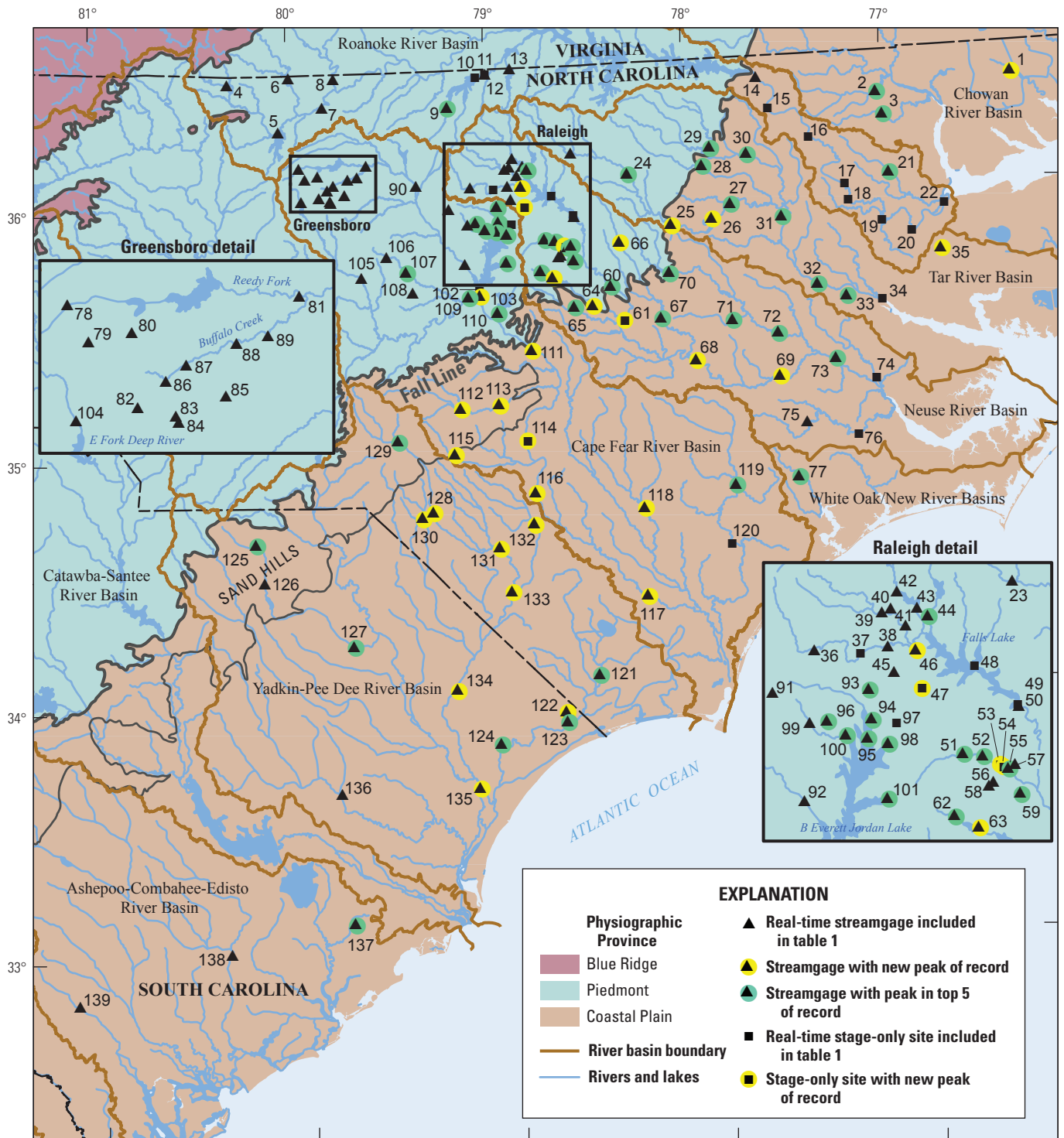
The purpose of this report is to provide preliminary data documenting the peak streamflows and stages for rivers and streams in North Carolina and South Carolina that are part of the USGS Real-Time Data Network and that were impacted by the catastrophic flooding following the passage of Hurricane Matthew on October 7–9, 2016 (fig. 5). The 2016 peak streamflows are placed into context by ranking the October 2016 flood peaks with other annual flood peaks for the period of record at each streamgage as well as with historic floods that precede USGS systematic records. National Weather Service (NWS) flood stage information is also provided for sites where a NWS flood stage has been defined (table 1 at the end of the report).



**Figure 3.** Flooding in Lumberton in Robeson County, North Carolina, on October 11, 2016, just south and east of the I-95 crossing over the Lumber River (National Oceanic and Atmospheric Administration National Geodetic Survey Remote Sensing Division, 2016).

**Figure 4.** Flooding in and near Princeville in Edgecombe County, North Carolina, on October 13, 2016, near the U.S. Highway 64 crossing over the Tar River (National Oceanic and Atmospheric Administration National Geodetic Survey Remote Sensing Division, 2016).





River basins from the 1:100,000-scale NHD Watershed Boundary Dataset  
 Streams and Lakes from the 1:2,000,000-scale National Hydrography Dataset  
 State boundaries from the U.S. Census Tiger-Line files  
 Ecoregions from the U.S. Environmental Protection Agency 1:7,500,000-scale digital data (Omernik, 1987, revised 2002)

Figure 5. Selected U.S. Geological Survey real-time streamgages in North and South Carolina.

## Study Area

The streamgage data (peak stage and streamflow) documented in this report are part of the USGS Real-Time Data Network for North Carolina and South Carolina, which have areas of 53,819 and 32,020 square miles, respectively. Both States are located on the South Atlantic slope adjacent to the Atlantic Ocean and are generally divided into three major physiographic provinces: Blue Ridge, Piedmont, and Coastal Plain (Cooke, 1936; fig. 5).

The Blue Ridge is a mountainous region of steep terrain with some stream gradients greater than 250 feet (ft) per mile (Bloxham, 1979). Land-surface elevations range from 1,000 to more than 3,500 ft above sea level in South Carolina and more than 6,000 ft above sea level in North Carolina. The Piedmont is characterized by rolling hills, elongated ridges, and moderately deep to shallow valleys. Piedmont land-surface elevations range from about 1,000 ft above sea level at the Blue Ridge foothills to about 300–400 ft above sea level at the Fall Line, which is the name given to the boundary between the Piedmont and Coastal Plain regions (fig. 5).

About two-thirds of South Carolina is in the Coastal Plain region where bedrock is overlain by sediments that thicken from just a few feet near the Fall Line to about 3,800 ft near Hilton Head Island near the southernmost corner of the State (Badr and others, 2004). The Coastal Plain in North Carolina comprises about one-third of the State's total area and is overlain by a sedimentary wedge that thickens from a featheredge at the Fall Line to more than 10,000 ft at Cape Hatteras at the Outer Banks (Giese and Mason, 1993; Winner and Coble, 1996). At the Fall Line, a narrow, hilly region, known as the Sand Hills, is located where the Piedmont descends to the Coastal Plain (National Oceanic and Atmospheric Administration, 2015b; fig. 5). The Sand Hills region is about 30 to 40 miles wide with elevations ranging from about 200 to more than 500 ft. The lower part of the Coastal Plain consists of low-elevation, flat plains with many swamps, marshes, dunes, barrier islands, and beaches, which typically are lower, flatter, and more poorly drained than the upper part of the Coastal Plain (Omernik, 1987).

In both States, precipitation is principally delivered by storms that move inward from the Gulf of Mexico, the Caribbean Sea, and the Atlantic Ocean (U.S. Geological Survey, 1985). Additionally, local and upwind land surfaces, as well as lakes and reservoirs, provide moisture to the atmosphere by evaporation. In a normal year, monthly precipitation is highest in the winter, reaching a maximum in early March and then decreasing sharply in April and May. Fall is typically a dry season (except in rare instances when tropical storms or hurricanes occur) with minimal statewide precipitation during October and November.

Annual rainfall in South Carolina averages as much as 80 inches in the highest elevations of the Blue Ridge to less than 45 inches in parts of the upper portion of the Coastal Plain and Sand Hills regions (National Oceanic and Atmospheric Administration, 2015b). In general, the Blue Ridge region

receives an average of about 56 inches or more of annual rainfall, the upper portion of the Piedmont about 47 to 55 inches, the lower portion of the Piedmont about 45 to 48 inches, the upper portion of the Coastal Plain about 44 to 49 inches, and the lower portion of the Coastal Plain about 46 to 53 inches.

In the Blue Ridge of North Carolina, the annual average precipitation ranges from more than 90 inches in the southwestern part of the State (the rainiest region in the Eastern United States) to only 37 inches just less than 50 miles to the north in the valley of the French Broad River (National Oceanic and Atmospheric Administration, 2015a). The average annual precipitation in the Piedmont ranges from about 40 inches in the west to about 50 inches in the east in the vicinity of the Fall Line (State Climate Office of North Carolina, 2016a). Average annual precipitation in the Coastal Plain generally ranges from 50 to 55 inches, with higher values near 60 inches that have been attributed to past tropical storms that have affected parts of the southern coastal region of North Carolina.

## General Weather Conditions and Precipitation Causing the October 2016 Flooding

Hurricane Matthew began as a tropical wave off the coast of Africa in late September 2016, identified by forecasters as Invest 97L just southwest of the Cape Verde Islands on September 25 (State Climate Office of North Carolina, 2016b; The Weather Channel, 2016). The system was named Tropical Storm Matthew on September 28 as it moved westward across the Atlantic Ocean just north of the coast of South America. The tropical system strengthened to hurricane status on September 29 and reached its peak intensity with maximum sustained winds of 161 miles per hour on October 1 as a Category 5 storm on the Saffir-Simpson scale (State Climate Office of North Carolina, 2016d). The storm made a hard right turn near the border between Columbia and Venezuela under the steering influence of a high-pressure ridge near Bermuda and began a northward track that would take it through the Caribbean and the Bahamas and eventually toward the Southeastern United States (State Climate Office of North Carolina, 2016d; fig. 6).

Along its northward track, Hurricane Matthew maintained Category 4 strength through the Caribbean Sea, making landfall in eastern Cuba and western Haiti on October 4 (State Climate Office of North Carolina, 2016b). After moving through the Bahamas on October 5–6 at Category 3 and 4 strength, the hurricane skirted the coasts of Florida and Georgia on October 7 as a Category 3 and 2 storm, bringing heavy storm surge and high winds into the coastal regions. Hurricane Matthew officially made landfall as a Category 1 storm southeast of McClellanville, South Carolina, in the early morning hours of October 8 (State Climate Office of North Carolina, 2016b; fig. 6).



**Figure 6.** The track of Hurricane Matthew through the Atlantic basin from September 29 through October 9, 2016. (State Climate Office of North Carolina, 2016b).

Forecast tracks in early October suggested a landfall near the North Carolina/South Carolina border followed by a path through the Coastal Plain of North Carolina. But just several days prior to anticipated landfall, a stationary front located off the east coast led forecasters to believe the storm would make another hard right turn toward the east off the northern South Carolina coast followed by a loop back toward the Bahamas. The front moved back inland, however, allowing Hurricane Matthew to come further north toward North Carolina before making the anticipated turn (State Climate Office of North Carolina, 2016d). The hurricane moved toward the north and east just off the southern North Carolina coast, bringing hurricane force winds to parts of the southern Outer Banks before heading out to sea on October 9 (fig. 6). Large storm systems making sharp turns along their pathways may slow down in forward speed, which is regarded as a primary factor in what resulted in the heavy precipitation over eastern parts of both North Carolina and South Carolina for almost 2 days (Mike Money Penny, National Weather Service, oral commun., October 27, 2016).

The heavy rainfall across both States during October 7–9 resulted in all-time record 1-day amounts for a number of locations across the region with periods of climatic record ranging from 18 to 146 years (commonly 50+ years) (Nicholas Petro, NOAA National Weather Service, written commun., November 9, 2016). The 1-day records were set in four locations in North Carolina and at least two locations in South Carolina, with records exceeding 100 years at two

locations: Dillon, South Carolina (17.22 inches, surpassing 7.65 inches previously set on September 5, 1979; records back to 1904) and Tarboro, North Carolina (9.50 inches, tying previous record set on October 25, 1872; records back to 1870). Other notable rainfall totals in North Carolina included areas where some of the worst flooding in recorded history occurred during the October 2016 event: Fayetteville (14.00 inches, surpassing 5.13 inches previously set just 10 days prior on September 29, 2016; records traced back to 1910) and Lumberton (12.53 inches, surpassing 7.62 inches set on September 15, 1999; records back to 1948). The other two locations where all-time 1-day rainfall records were set were Raleigh, North Carolina (6.45 inches), and Florence, South Carolina (11.74 inches). In addition to the 1-day record rainfall in Dillon, South Carolina, a total of 16.9 inches of rain also was recorded on Edisto Island, South Carolina, which is located southwest of Charleston, (Hope Mizzell, South Carolina Department of Natural Resources, written commun., November 4, 2016).

In addition to locations where 1-day records were set, there were also seven locations in North Carolina and one location in South Carolina where all-time 2-day rainfall records were set during the event. These locations included Wilson (9.22 inches), Elizabeth City (8.22 inches), Edenton (8.50 inches), Plymouth (9.10 inches), Williamston (9.07 inches), Washington (8.00 inches), and Greenville (9.07 inches) in North Carolina and North Myrtle Beach (8.90 inches) in South Carolina.

Although rainfall records were set during the passage of Hurricane Matthew through the central and eastern Carolinas, rainfall rates reached levels representing return periods exceeding 200 years. At the USGS raingage at Cape Fear River at William O. Huske Lock near Tarheel in Bladen County, North Carolina (USGS station 02105500), a total of 16.87 inches was recorded during October 7–9 (fig. 2). Because rainfall data at this site are recorded using a 15-minute interval, the record can be used to compute running totals for varying time increments as each interval is recorded. At the USGS raingage near Tarheel, the observed maximum total rainfall during October 7–9 was computed for the following time increments: 2 hours (5.32 inches), 3 hours (7.06 inches), 6 hours (10.61 inches), 12 hours (15.06), and 24 hours (16.50 inches), all of which were observed on October 8 (fig. 2). On the basis of the NOAA rainfall-frequency statistics developed for this location, these maximum rainfall totals correspond to intensities with return periods at or exceeding 200 years: 2 hours (at 200 years), 3 hours (between 500 and 1,000 years), 6 hours (>1,000 years), 12 hours (>1,000 years), and 24 hours (>1,000 years) (National Oceanic and Atmospheric Administration, 2014). These rainfall totals are consistent with information received from the National Weather Service indicating that rainfall for 3-hour time increments during the storm corresponded to intensities with return periods exceeding 200 years as the heaviest rainfall moved through North Carolina along and adjacent to the Interstate 95 corridor (Mike Money Penny, National Weather Service, written commun., December 1, 2016).

## Methods Used to Collect Streamflow Data

In this report, streamgage data refer to both stage or gage height (in feet) and volumetric streamflow rates (in cubic feet per second). These data were collected systematically at continuous record streamgaging stations or determined from field measurements of stage in cases where the gage structure or equipment was damaged by flood waters.

U.S. Geological Survey streamgages operate autonomously by collecting data at regular time intervals (typically either 5 or 15 minutes) depending on watershed size and “flashiness” of the stream (that is, how quickly streamflow levels respond to rainfall). Typically, streamgages automatically record stage data. The stage data are collected using a variety of methods (float and tape, submersible pressure transducer, non-submersible pressure transducer, or non-contact radar). More information about how USGS streamgages operate is available in Lurry (2011). Although stage data are important, streamflow data are often more important for such purposes as streamflow forecasting for flood warning, water-quality loading, flood-frequency analysis, and flood-mitigation planning. Computation of streamflow at a streamgaging station requires periodic measurements of streamflow over a range of stage. The relation defined between stage and measured streamflow is used to convert the stage data to streamflow data. Physical observations of stream velocity and stream depth are made onsite by USGS personnel (fig. 7) to determine near-instantaneous streamflow (Turnipseed and Sauer, 2010).



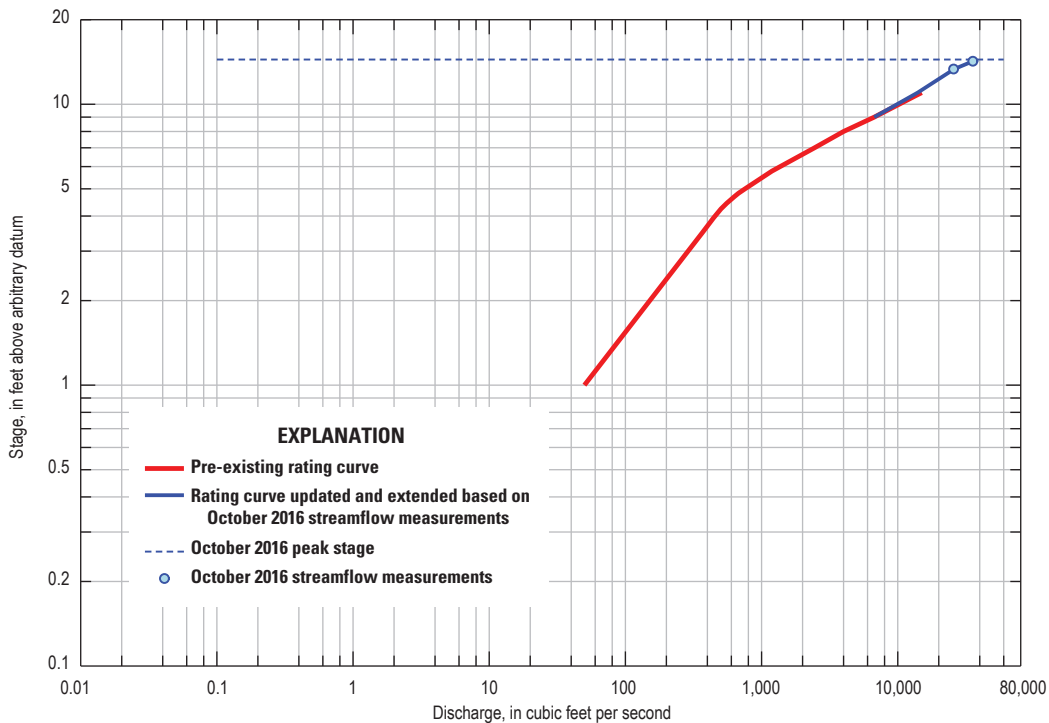
**Figure 7.** U.S. Geological Survey personnel using an acoustic Doppler current profiler to make a streamflow measurement at USGS station 02089000, Neuse River near Goldsboro in Wayne County, North Carolina, October 10, 2016. Photograph by John Mazurek, USGS.

In most cases, the relation is a simple stage-streamflow relation or rating curve. After construction of the rating curve, continued periodic measurements of streamflow are required at various stages to verify or support changes to a station rating curve (fig. 8). From October 9 to 14, 2016, USGS personnel made 76 streamflow measurements at 46 sites in North Carolina and 26 streamflow measurements at 14 sites in South Carolina to verify, update, or extend existing rating curves.

In some cases, direct measurements of streamflow during a flood are not possible or are impractical. In those instances, indirect measurement methods can be used (Benson and Dalrymple, 1967), whereby water-surface profiles determined by high-water marks and roughness and geometry of the channel and flood plains are used in hydraulic equations based on the principles of conservation of energy, conservation of momentum, and continuity to compute the peak streamflow for that particular flood. The high-water marks and channel geometry are determined by field survey. Roughness is subjectively determined on the basis of bed material, cross-section irregularities, depth of flow, vegetation, and channel alignment. The USGS assigns uncertainty/accuracy estimates to each indirect measurement on the basis of the hydraulic and geometric conditions found at each field site (Benson and Dalrymple, 1967; Dalrymple and Benson, 1967; Hulsing, 1967; Matthai, 1967; Bodhaine, 1968). In other cases, high-water marks are documented for the purpose of recording the elevation of the flood peak (fig. 9).



**Figure 9.** U.S. Geological Survey field crews conducting surveys of high-water marks to document the elevation of flood waters in Robeson County, North Carolina, for the October 2016 flood. This high-water mark identified on October 19, 2016, at a residence off LaClaire Road near Lumberton was measured at nearly 7 feet above the ground. Photograph by Jonathan J. Graham, USGS.



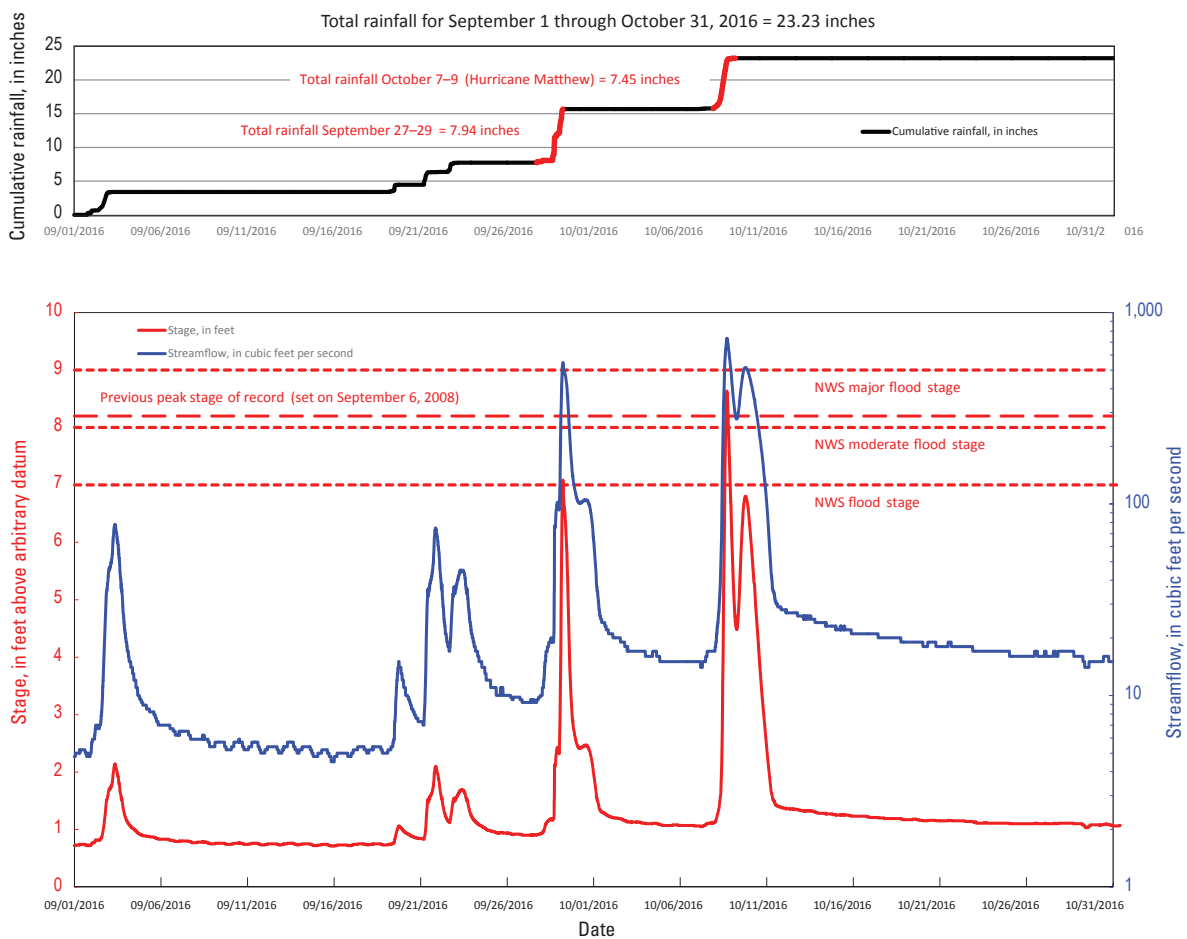
**Figure 8.** Rating curves developed for use before (red) and after (blue) the October 2016 flood for Lumber River at Boardman near the border between Robeson and Columbus Counties, North Carolina (USGS station 02134500), showing streamflow measurements made during the event.

## Peak Streamflow and Stage

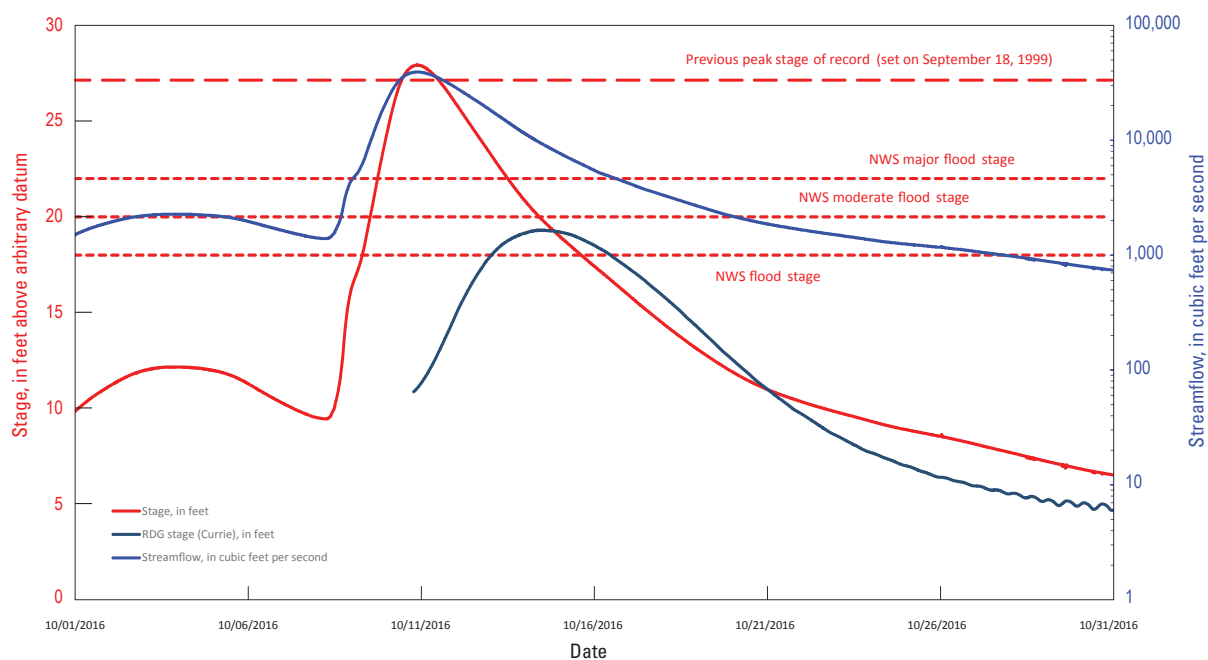
Peak streamflow and stage data collected during the October 2016 flood for 139 streamgages (127 in North Carolina and 12 in South Carolina) are listed in table 1 (at the end of the report); site locations are shown in figure 5. The streamgages listed in table 1 were selected because (1) both peak stage and (or) peak streamflow for the October 2016 flood event were monitored at the site, and (2) historic streamflow and (or) stage data were available for comparison. A subset of 23 of the 127 streamgages in North Carolina have stage-only records, leaving 104 streamgages where both stage and streamflow were monitored during the flood. For South Carolina, only streamgages for which the peak was ranked in the top 10 for the period of record were included. Feaster and others (2015) provide additional historic peak information for other streamgages in the USGS Real-Time Data Network in South Carolina. Stage and streamflow were monitored during the flood at all 12 South Carolina streamgages listed in table 1.

The ranking for the October 2016 streamflow peaks at selected streamgages for the period of record are presented in table 1. Twenty-three of 104 streamgages in North Carolina and 3 of 12 streamgages in South Carolina had new peaks of record for streamflow. Of the 67 stations with long-term records<sup>1</sup> of 30 or more years, 11 had new peaks of record: 02084557, Van Swamp near Hoke, NC (40 years); 02089000, Neuse River near Goldsboro, NC (34 years); 02089500, Neuse River at Kinston, NC (34 years); 02102500, Cape Fear River at Lillington, NC (35 years); 02102908, Flat Creek near Inverness, NC (49 years) (fig. 10); 02105500, Cape Fear River at William O. Huske Lock near Tarheel, NC (33 years); 02105769, Cape Fear River at Lock #1 near Kelly, NC (36 years); 02106500, Black River near Tomahawk, NC (69 years) (fig. 11); 02134480, Big Swamp near Tar Heel, NC (32 years); 02134500, Lumber River at Boardman, NC (95 years); 02135000, Little Pee Dee River at Galivants Ferry, SC (76 years).

<sup>1</sup>The USGS uses a 30-year criterion to identify those streamgages having long-term periods of streamflow record (U.S. Geological Survey, 2014).



**Figure 10.** Cumulative rainfall and stage and streamflow at Flat Creek near Inverness in Hoke County, North Carolina (USGS station 02102908), for September 1 through October 31, 2016. [NWS, National Weather Service]



**Figure 11.** Stage and streamflow at Black River near Tomahawk in Sampson County, North Carolina (USGS station 02106500), and stage at Black River near Currie in Pender County, North Carolina (USGS rapid deployment gage [RDG] 02107544), for October 1–31, 2016. [NWS, National Weather Service]

In addition to the 26 streamgaging stations that had new peaks of record, 44 streamgages recorded new peaks that ranked in the top 5 for the period of record. For streamgaging stations with at least 30 years of record, 27 streamgages recorded peaks that ranked in the top 5 for the period of record.

Among the 23 streamgages in North Carolina with stage-only records, 5 recorded new peak stages. Two of those five sites had at least 30-year periods of record. At Neuse River at Smithfield (USGS station 02087570), the peak stage during the October 2016 flood (29.09 ft; table 1) exceeded the previous record stage set in September 1999, the highest since the 1984 water year<sup>2</sup> when regulated flow from Falls Lake began. Inspection of the annual peak stages in the peak-flow record, however, indicate the stage recorded in the October 2016 flood may be the highest since August 1908. Similarly, at the Cape Fear River at Fayetteville (USGS station 02104000), the peak stage during the October 2016 flood (58.94 ft; table 1) exceeded the previous record stage set in September 1996, the highest since the 1982 water year when regulated flow from B. Everett Jordan Lake began. Inspection of the annual peak stages in the peak-flow record, however, indicate the stage recorded at this streamgage in the October 2016 flood may be the highest since a peak stage of 68.8 ft was recorded in September 1945 and the fourth highest since a peak stage of 58.5 ft was recorded in May 1901.

<sup>2</sup>The annual period from October 1 through September 30, designated by the year in which the period ends.

## Comparison of the October 2016 Flood to Past Floods

In the Yadkin-Pee Dee River Basin, a new period of record peak occurred on October 12, 2016, for USGS station 02135000, Little Pee Dee River at Galivants Ferry, SC, with a peak stage of 17.1 ft and corresponding peak streamflow of 59,100 cubic feet per second (ft<sup>3</sup>/s) (table 1). This was the largest peak streamflow for the record that began in 1942 with the previous maximum streamflow of 27,600 ft<sup>3</sup>/s occurring on October 9, 1964. On the basis of a historic flood mark, the October 2016 flood is likely the largest since at least 1928.

Annual peak stage and streamflow data have been collected at USGS station 02110500, Waccamaw River near Longs, SC, in the Yadkin-Pee Dee River Basin since 1951. For the 2016 flood, the peak occurred on October 14 and was the second largest peak in 66 years (table 1). The maximum peak of record occurred on September 22, 1999, and was associated with rainfall from Hurricane Floyd.

New records during October 2016 at 7 of the 10 streamgages in North Carolina with long-term periods of record exceeded records previously set in two historical flood events within the past 20 years: Hurricane Fran in 1996 and Hurricane Floyd in 1999. The previous records occurred partly because of the tracks each of these storms took across the State. The track taken by Hurricane Fran was further inland over the eastern Piedmont than the track taken by Hurricane Floyd, which crossed over the Coastal Plain. As such, the previous records at the three streamgages on the

12 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016

Cape Fear River downstream from Jordan Lake were set in 1996, whereas previous records at the two streamgages on the Neuse River near Goldsboro and at Kinston (downstream from Falls Lake) were set in 1999.

Flow releases from Falls Lake and B. Everett Jordan Lake in the Neuse and Cape Fear River Basins, respectively, were managed during the days immediately following the storm passage to allow flooding from the intervening basins downstream to subside before lake releases were increased. The management of the Falls Lake elevation and flow releases from the dam are shown in figures 12 and 13 along with the stage and streamflow hydrographs for the six downstream

streamgages on the Neuse River (stage-only records collected at the Smithfield streamgage [USGS station 02087570]). The hydrographs show the initial flood peaks from the intervening basins below the reservoir moving downstream along the Neuse River while minimum flow releases (approximately 100 ft<sup>3</sup>/s based on minimum 4-inch gate opening) were made from the dam on October 8–21 to prevent dewatering the channel immediately downstream from the dam. During this period, the lake elevation rose about 7 ft (fig. 12), using about 50 percent of the flood storage pool available in Falls Lake (Michael A. Young, U.S. Army Corps of Engineers Wilmington District, written commun., December 5, 2016).

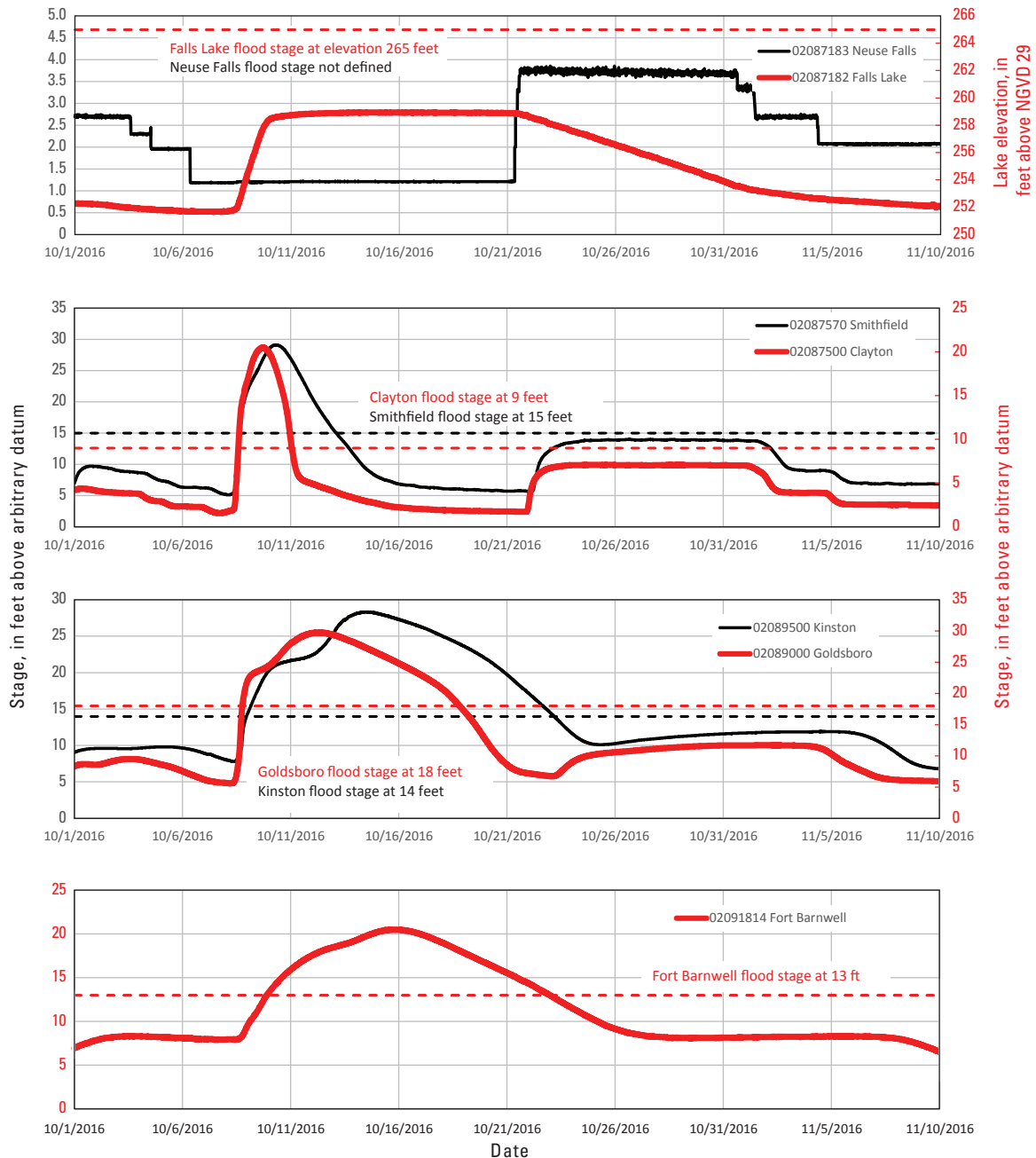
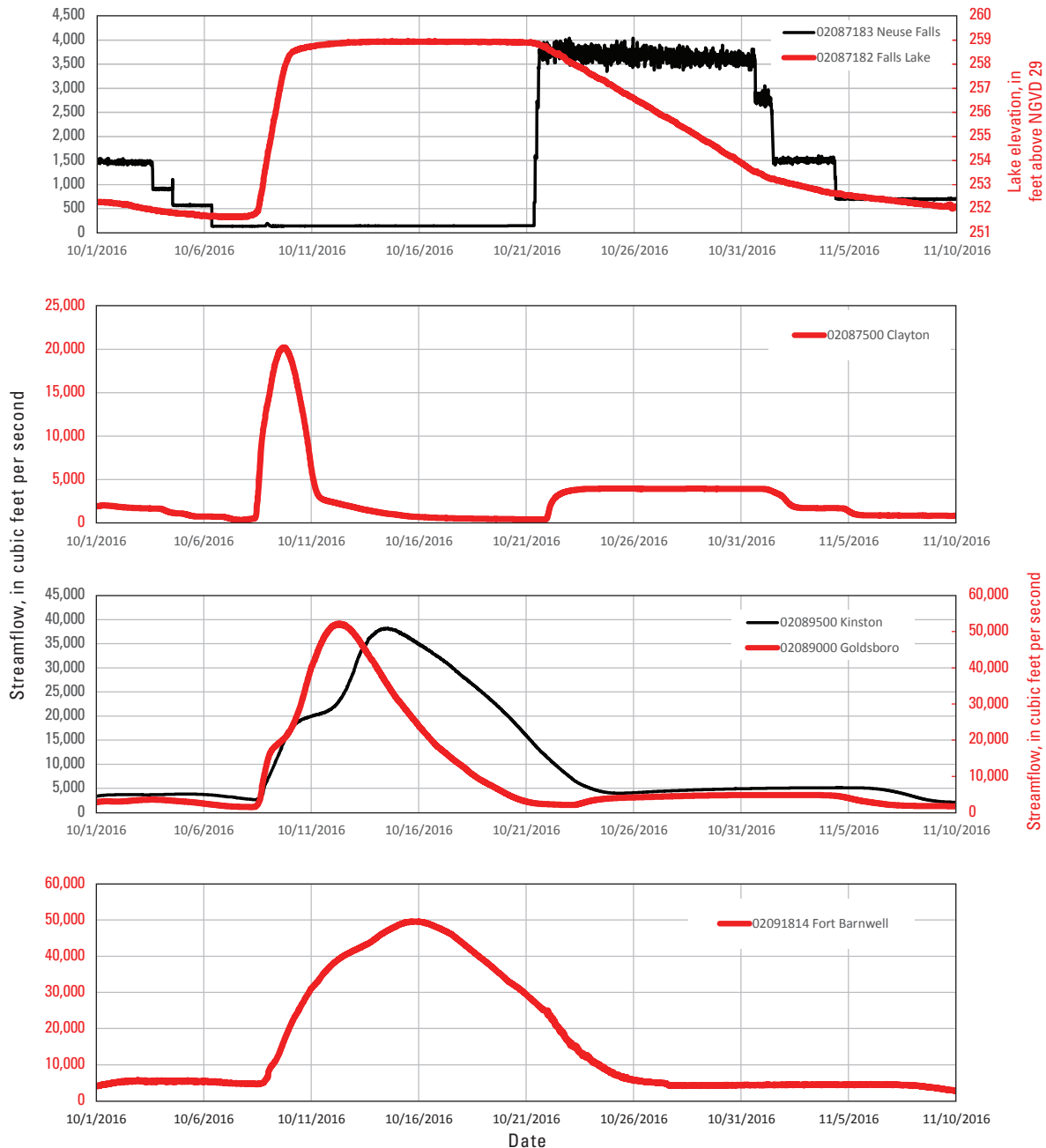


Figure 12. Observed stage hydrographs before, during, and after Hurricane Matthew (October 8–9, 2016) for Falls Lake and six USGS streamgages on the Neuse River downstream from Falls Lake, October 1–November 10, 2016.

The peak stage and streamflow at the Clayton streamgauge (USGS station 02087500) were observed at 20.48 ft and 20,200 ft<sup>3</sup>/s, respectively, on October 9 (figs. 12 and 13). These peaks were the second highest in the period of regulated record since the 1984 water year, behind the peak records set in 1999 during the flood from Hurricane Floyd. Farther downstream, the peak stage and streamflows at the Goldsboro and Kinston streamgages were new records for the period since 1984, superseding the peak records set in 1999. At the Goldsboro streamgauge (USGS station 02089000), the new record peak stage and streamflow were set at 29.74 ft and 52,600 ft<sup>3</sup>/s, respectively, on October 12 (figs. 12 and 13).

At the Kinston streamgauge (USGS station 02089500), the new record peak stage and streamflow were set at 28.31 ft and 38,200 ft<sup>3</sup>/s, respectively, on October 14 (figs. 12 and 13). Of note, the peak streamflow at Kinston was substantially less than the peak observed upstream at Goldsboro and likely is indicative of storage within the intervening drainage basin (analogous to a detention pond) between the two streamgages.

When flow releases from Falls Lake were increased to about 4,000 ft<sup>3</sup>/s on October 21 to lower the lake level in the flood storage pool, secondary but much smaller peak streamflows began to move downstream through the Neuse River (fig. 12). However, at all six Neuse River



**Figure 13.** Observed streamflow hydrographs before, during, and after Hurricane Matthew (October 8–9, 2016) for Falls Lake and six USGS streamgages on the Neuse River downstream from Falls Lake, October 1–November 10, 2016.

streamgages downstream from Falls Lake, the observed stages during the flow releases on October 21–31 remained below the NWS flood stages, where defined (fig. 12). Flood releases from the reservoir were intentionally delayed longer than normal and also were not as high as allowed under the water control plan due to the record flooding that had just occurred downstream in the river reaches near Goldsboro and Kinston (Michael A. Young, U.S. Army Corps of Engineers Wilmington District, written commun., December 5, 2016). The stage increases at the Clayton streamgage from the flow releases were substantially less than the observed flood peak, which occurred almost 2 weeks prior. Figure 12 also confirms that the effects of regulated flow were less pronounced at the Goldsboro, Kinston, and Fort Barnwell streamgages where the stage increases after the start of releases were substantially attenuated in the downstream direction. The streamflow levels at the downstream-most streamgage at Fort Barnwell finally began to recede on November 7, almost a month after Hurricane Matthew began to cross into North Carolina (fig. 12).

The flooding from Hurricane Matthew was exacerbated by wet antecedent conditions. Monthly rainfall totals for September typically were 150 to 300 percent or more above normal across the Coastal Plain (State Climate Office of North Carolina, 2016c). At a streamgage with a small upstream basin on Flat Creek near Inverness, NC (USGS station 02102908), a new record peak stage and streamflow were set at 8.63 ft and 733 ft<sup>3</sup>/s, respectively, on October 8 (fig. 10; table 1). The new record peaks supersede previous peaks set on September 6, 2008, and are the highest in the 47-year systematic period of record (through the 2015 water year) since data collection began in 1968. On September 29 about 9 days prior to Hurricane Matthew's arrival, the streamflow peaked at 547 ft<sup>3</sup>/s following rainfall amounts of 7.94 inches from September 27 to 29 as recorded by an onsite raingage. At the end of September, the monthly total rainfall was 15.69 inches. The passage of Hurricane Matthew brought an additional 7.45 inches to the basin, which resulted in the new record peak streamflow on October 8.

The above-normal rainfall during late September also resulted in new record peak stage and streamflow observed on September 29 at a nearby streamgage on the Little River at Manchester, NC (USGS station 02103000; table 1). The peak stage and streamflow at 31.18 ft and 9,440 ft<sup>3</sup>/s on September 29 were the highest for the period of record, superseding the previous record set on September 19, 1945 (peak stage at 29.0 ft, peak discharge undetermined). But the passage of Hurricane Matthew resulted in yet another peak stage and streamflow for the period of record at 32.19 ft and 10,600 ft<sup>3</sup>/s recorded a little more than a week later on October 10 (table 1).

The time of travel associated with a flood peak moving downstream in a large, unregulated river is depicted in figure 11, which shows the peak stage and streamflow that occurred at upstream station 02106500 Black River near Tomahawk, NC. A new record peak stage of 27.92 ft and streamflow of 39,100 ft<sup>3</sup>/s for the period of record were set at

the Tomahawk gage on October 10 (table 1), exceeding the previous record set in September 1999 following Hurricane Floyd. Historical peak streamflow records for this streamgage indicate that the October 2016 peak is the highest since at least 1928 (a period of 98 years).

Figure 11 also depicts the stage hydrograph for a downstream site on the Black River near Currie in Pender County, North Carolina (USGS station 02107544), that was temporarily established as a rapid deployment gage (RDG) to document peak stages resulting from Hurricane Matthew. The USGS uses RDGs to collect stage records at ungaged sites or when existing streamgages may be threatened by rising flood levels that could potentially inundate recording equipment. The RDG is designed as a portable "streamgage in a box" that can quickly be installed on a bridge or other structure crossing a stream. The peak stage recorded at the Currie RDG site occurred on October 14, which was 4 days after the record peaks occurred at the Tomahawk streamgage. Of note, the hydrograph for the Currie RDG site also indicates the return of tidal influences beginning on or about October 26 as the stage levels continued to recede following the flood (fig. 11). The Currie RDG site was installed at the request of the National Weather Service and Pender County Emergency Management when it became apparent that flooding along the Black River was likely to exceed the peak set by Hurricane Floyd. During the October 2016 flood, a total of 13 RDGs were quickly installed across eastern North Carolina, and the sites were monitored to collect additional stage records during the event (<http://waterdata.usgs.gov/nc/nwis/current/?type=tide>, accessed November 16, 2016).

In the Lumber River Basin, new period of record peak stage and streamflow values occurred on October 11, 2016, at station 02134500 Lumber River at Boardman, NC. The new record peak stage was 14.43 ft with a corresponding record peak streamflow of 38,200 ft<sup>3</sup>/s (table 1). This new record peak streamflow is the largest for the systematic period of record dating back to the 1930 water year and is almost three times the previous maximum streamflow of 13,400 ft<sup>3</sup>/s that occurred on September 24, 1945. Further, on the basis of historical information, the October 2016 peak was the highest since July 1901, which at the time was considered the highest since 1896 (a period of 121 years).

For a historical perspective on the floods caused by the heavy rainfall during October 7–9, 2016, chronologies of major floods in North Carolina and South Carolina since 1876 and 1893, respectively, are presented in tables 2 and 3 at the end of the report (U.S. Geological Survey, 1985).

## Summary

Hurricane Matthew brought heavy rainfall across central and eastern parts of North Carolina and South Carolina during October 7–9, 2016. Rainfall totals ranging from 3 to more than 15 inches were widespread in these regions of both States, resulting in major flooding. One U.S. Geological Survey

(USGS) raingage at Cape Fear River at William O. Huske Lock near Tarheel in Bladen County, North Carolina, recorded 16.87 inches of rain during the period. Thirty-three fatalities occurred in North Carolina and South Carolina in the days following the storm. At the height of the flood event, nearly 1,400 road and bridge closures occurred in the two States. Emergency management officials have estimated the damage in North Carolina from the storm at approximately \$1.5 billion, not including damage to the State infrastructure or the agriculture industry.

From October 9 to 14, USGS personnel made 76 streamflow measurements at 46 sites in North Carolina and 26 streamflow measurements at 14 sites in South Carolina to verify, update, or extend existing rating curves, which are used to determine peak streamflows. Peak streamflow and stage data, collected by the USGS, are documented in this report. Twenty-three of 104 streamgages in North Carolina and 3 of 12 streamgages in South Carolina had new peaks of record for streamflow. An additional 44 streamgages recorded new peaks that ranked in the top 5 for the period of record. Of the 67 stations with long-term records of 30 or more years, 11 had new peaks of record, and 27 recorded peaks that ranked in the top 5 for the period of record. Among the 23 streamgages in North Carolina with stage-only records, 5 recorded new peak stages, with 2 of the 5 sites having at least 30-year periods of record.

In South Carolina, 2 of the 12 streamgages monitored during the flood have periods of record of 30 years or more. A new period of record peak occurred on October 12 at Little Pee Dee River at Galivants Ferry, SC, not only the largest peak streamflow for the record that began in 1942, but also the largest flood since at least 1928 based on a historic flood mark. The second largest peak in 66 years of record was set on October 14 at Waccamaw River near Longs, SC, superseding the previous maximum peak of record that occurred in 1999 following the passage of Hurricane Floyd.

Among the 10 streamgages in North Carolina with long-term periods of record where new record peak streamflows were set during the October 2016 flood, the new records at 7 of the 10 sites exceeded records previously set following Hurricane Fran in 1996 and Hurricane Floyd in 1999. Flow releases from Falls Lake and B. Everett Jordan Lake in the Neuse and Cape Fear River Basins, respectively, were managed during the days immediately following the storm passage to allow flooding from the intervening basins downstream to subside before the releases were increased. The flooding from Hurricane Matthew was exacerbated by wet antecedent conditions as evidenced by September rainfall totals from 150 to more than 300 percent or more above normal at many locations across the Coastal Plain. Additional rainfall from Hurricane Matthew in early October thus resulted in new record or near-record peaks twice within a 2-week period at Flat Creek near Inverness, NC, and Little River near Manchester, NC.

A new record peak stage and streamflow were set on October 10 at Black River near Tomahawk, NC, exceeding the previous record set in September 1999 following Hurricane Floyd. Historical peak streamflow records for this streamgage

indicate that the October 2016 peak was the highest since at least 1928 (a period of 98 years). A new period of record peak stage and streamflow occurred on October 11 at Lumber River at Boardman, NC, the largest for the systematic period of record dating back to the 1930 water year and almost three times the previous maximum streamflow that occurred in 1945. Historical streamflow peaks for this streamgage indicate that the October 2016 peak is the highest since the historic peak of July 1901, which at the time was considered the highest since 1896 (a period of 121 years).

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## **Tables 1–3**

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**18 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016**

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Albemarle-Chowan River Basin						
1	0204382800	PASQUOTANK RIVER NEAR SOUTH MILLS, NC	36°25'17"	76°20'33"	NAD 83	64.0
2	02053200	POTECASI CREEK NEAR UNION, NC	36°22'15"	77°01'32"	NAD 83	225.0
3	02053500	AHOSKIE CREEK AT AHOSKIE, NC	36°16'49"	76°59'58"	NAD 83	63.3
Roanoke River Basin						
4	02068500	DAN RIVER NEAR FRANCISCO, NC	36°30'54"	80°18'11"	NAD 83	129.0
5	02069000	DAN RIVER AT PINE HALL, NC	36°19'09"	80°03'01"	NAD 27	501.0
6	02070500	MAYO RIVER NEAR PRICE, NC	36°32'02"	79°59'29"	NAD 83	242.0
7	02071000	DAN RIVER NEAR WENTWORTH, NC	36°24'45"	79°49'34"	NAD 83	1,053.0
8	02074000	SMITH RIVER AT EDEN, NC	36°31'32"	79°45'56"	NAD 83	538.0
9	02077200	HYCO CREEK NEAR LEASBURG, NC	36°23'52"	79°11'48"	NAD 83	45.9
10	02077280	HYCO LAKE AT DAM NR ROXBORO, NC	36°30'42"	79°02'50"	NAD 83	189.0
11	0207730290	AFTERBAY RESERVOIR AT DAM NR MCGEHEES MILL, NC	36°31'21"	78°59'51"	NAD 83	202.0
12	02077303	HYCO R BL ABAY D NR MCGEHEES MILL, NC	36°31'21"	78°59'51"	NAD 83	202.0
13	02077670	MAYO CR NR BETHEL HILL, NC	36°32'27"	78°52'19"	NAD 83	53.5
14	02080500	ROANOKE RIVER AT ROANOKE RAPIDS, NC	36°27'36"	77°38'01"	NAD 83	8,384.0
15	0208062765	ROANOKE RIVER AT HALIFAX, NC	36°19'52"	77°34'49"	NAD 83	8,450.0
16	02081000	ROANOKE RIVER NEAR SCOTLAND NECK, NC	36°12'33"	77°23'02"	NAD 83	8,671.0
17	02081022	ROANOKE RIVER NEAR OAK CITY, NC	36°00'49"	77°12'55"	NAD 83	8,810.0
18	02081028	ROANOKE RIVER AT HAMILTON, NC	35°56'51"	77°12'09"	NAD 83	8,890.0
19	02081054	ROANOKE RIVER AT WILLIAMSTON, NC	35°51'35"	77°02'25"	NAD 83	9,070.0
20	02081094	ROANOKE RIVER AT JAMESVILLE, NC	35°48'47"	76°53'34"	NAD 83	9,250.0
21	0208111310	CASHIE RIVER AT SR1257 NEAR WINDSOR, NC	36°02'52"	76°59'03"	NAD 83	108.0
22	0208114150	ROANOKE RIVER AT NC 45 NR WESTOVER, NC	35°54'54"	76°43'22"	NAD 83	9,660.0

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data								National Weather Service flood stage (ft)	Remarks
Previous maximum			Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)	Period of record for annual peak flows	Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		
Albemarle-Chowan River Basin									
9/19/1999	9.85	1,330	1996–2015	1/22	10/10/2016	11.39	2,670	—	Tidally influenced
9/17/1999	28.90	17,000	1929, 1940, 1958–2003, 2005–15	2/61	10/10/2016	26.98	11,400	—	Peak determined from a high water mark identified at site after event
9/17/1999	17.32	8,570	1951–2015	2/67	10/10/2016	15.74	5,630	—	
Roanoke River Basin									
8/17/1985	19.50	21,200	1916, 1925–26, 1928–87, 1992–2015	89/89	10/8/2016	1.59	140	13	
1/25/2010	25.77	27,800	1987–89, 2009–15	12/12	10/8/2016	6.88	2,730	—	
8/17/1985	15.49	38,000	1930–71, 1985, 1994–2015	67/67	10/8/2016	3.28	1,270	8	Previous maximum peak stage and streamflow are historic records determined in the 1985 water year.
6/22/1972	31.60	54,200	1940–2015	74/78	10/8/2016	9.27	6,540	19	
6/21/1972	16.24	24,800	1940–2015	76/78	10/8/2016	5.9	3,620	11	
8/27/1995	48.53	—	1965–92, 1994, 1996–97, 1999–2015	3/50	10/9/2016	38.42	5,880	—	Maximum peak flow for period of record not determined
9/6/1996	13.68	n/a	n/a	n/a	10/9/2016	13.05	n/a	—	Stage-only records available for site
9/7/1996	391.11	n/a	n/a	n/a	10/9/2016	386.25	n/a	—	Stage-only records available for site
7/14/1975	24.40	11,300	1974–2006, 2008–15	10/43	10/10/2016	20.04	6,630	—	Peak stage verified from a reading of the high water mark on crest stage gage
9/4/1974	11.11	4,300	1974, 1978–2011, 2013–15	20/40	10/9/2016	5.54	421	8	Previous maximum peak stage and streamflow are historic records determined in the 1974 water year.
4/16/1993	11.87	37,700	1878, 1889, 1912–2015	63/108	10/19/2016	9.26	25,900	9	
3/31/1998	47.24	n/a	n/a	n/a	10/7/2016	41.63	n/a	—	Stage-only records available for site
8/19/1940	41.98	n/a	n/a	n/a	10/7/2016	28.91	n/a	—	Stage-only records available for site, POR maximum stage occurred during pre-regulation period of record
1/27/2007	22.07	n/a	n/a	n/a	10/7/2016	21.18	n/a	23	Stage-only records available for site
9/19/1999	18.17	n/a	n/a	n/a	10/7/2016	17.56	n/a	19	Stage-only records available for site
4/27/2003	11.91	n/a	n/a	n/a	10/7/2016	11.61	n/a	12	Stage-only records available for site
9/18/1999	5.87	n/a	n/a	n/a	10/7/2016	4.96	n/a	—	Tidally influenced, stage-only records available for site
9/16/1999	18.52	15,700	1988–2015	2/30	10/9/2016	16.63	12,900	—	
8/27/2011	6.49	n/a	n/a	n/a	10/7/2016	4.97	n/a	—	Tidally influenced, stage-only records available for site

20 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Tar-Pamlico River Basin						
23	02081500	TAR RIVER NEAR TAR RIVER, NC	36°11'39"	78°34'59"	NAD 83	167.0
24	02081747	TAR R AT US 401 AT LOUISBURG, NC	36°05'35"	78°17'46"	NAD 83	427.0
25	02081942	TAR RIVER AT NC-581 NEAR SPRING HOPE, NC	35°52'55"	78°05'22"	NAD 83	670.7
26	0208250410	TAR RIVER BELOW DAM NEAR LANGLEY CROSSROADS, NC	35°53'59"	77°53'04"	NAD 27	775.0
27	02082585	TAR RIVER AT NC 97 AT ROCKY MOUNT, NC	35°57'17"	77°47'14"	NAD 83	925.0
28	02082770	SWIFT CREEK AT HILLIARDSTON, NC	36°06'44"	77°55'12"	NAD 83	166.0
29	02082950	LITTLE FISHING CREEK NEAR WHITE OAK, NC	36°11'00"	77°52'34"	NAD 83	177.0
30	02083000	FISHING CREEK NEAR ENFIELD, NC	36°09'02"	77°41'35"	NAD 83	526.0
31	02083500	TAR RIVER AT TARBORO, NC	35°53'40"	77°31'59"	NAD 83	2,183.0
32	02084000	TAR RIVER AT GREENVILLE, NC	35°37'00"	77°22'22"	NAD 83	2,660.0
33	02084160	CHICOD CR AT SR1760 NEAR SIMPSON, NC	35°33'42"	77°13'51"	NAD 83	45.0
34	02084472	PAMLICO RIVER AT WASHINGTON, NC	35°32'36"	77°03'43"	NAD 83	3,200.0
35	02084557	VAN SWAMP NEAR HOKE, NC	35°43'51"	76°44'46"	NAD 83	23.0
Neuse River Basin						
36	02085000	ENO RIVER AT HILLSBOROUGH, NC	36°04'16"	79°05'44"	NAD 83	66.0
37	02085039	ENO RIVER AT COLE MILL RD NR HUCKLEBERRY SPRING	36°03'33"	78°58'41"	NAD 83	120.8
38	02085070	ENO RIVER NEAR DURHAM, NC	36°04'20"	78°54'28"	NAD 83	141.0
39	0208521324	LITTLE RIVER AT SR1461 NEAR ORANGE FACTORY, NC	36°08'30"	78°55'09"	NAD 83	78.2
40	0208524090	MOUNTAIN CREEK AT SR1617 NR BAHAMA, NC	36°08'59"	78°53'48"	NAD 83	8.0
41	0208524975	LITTLE R BL LITTLE R TRIB AT FAIRNTOSH, NC	36°06'48"	78°51'35"	NAD 83	98.9
42	02085500	FLAT RIVER AT BAHAMA, NC	36°10'58"	78°52'44"	NAD 83	149.0

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)			
Tar-Pamlico River Basin										
9/6/1996	24.06	19,900	1940–2015	6/78	10/9/2016	17.56	11,500	16		
9/17/1999	26.05	23,700	1964–2015	4/54	10/10/2016	23.25	14,200	20		
5/19/2014	18.11	7,220	2012–15	1/6	10/10/2016	23.88	14,500	—		
5/20/2014	12.81	9,010	2012–15	1/6	10/9/2016	19.58	15,500	—		
9/17/1999	31.66	34,100	1977–2015	2/41	10/10/2016	28.73	23,200	21		
9/17/1999	21.30	23,000	1964–2015	3/54	10/9/2016	15.34	6,900	—		
9/16/1999	30.80	31,000	1960–2015	3/58	10/9/2016	24.72	13,300	16		
9/18/1999	21.65	30,100	1915–2015	3/103	10/11/2016	19.73	15,000	16		
9/19/1999	41.51	70,600	1897–1900, 1906–2015	3/116	10/13/2016	36.29	41,800	19		
9/21/1999	29.72	73,000	1919, 1940, 1997–2009, 2011–15	3/22	10/14/2016	24.46	44,500	13		
9/18/1999	21.46	—	1976–87, 1992–2004, 2006–15	2/37	10/8/2016	18.43	>7,900	10	Peak determined from a high water mark identified at site after event, rank based on stage due to undetermined annual peak streamflow for previous maximum annual peak stage of record	
8/27/2011	7.53	n/a	n/a	n/a	10/8/2016	5.18	n/a	5	Tidally influenced, stage-only records available for site	
11/6/1977	7.43	409	1978–2015	1/40	10/10/2016	8.02	793	—		
Neuse River Basin										
9/6/1996	21.13	10,800	1928, 1930–71, 1986–2015	10/75	10/8/2016	16.64	4,860	—		
9/6/2008	15.34	n/a	n/a	n/a	10/8/2016	13.34	n/a	—	Stage-only records available for site	
9/6/1996	23.58	14,700	1964–2015	11/54	10/8/2016	18.02	8,220	20		
9/6/1996	13.26	11,600	1962–2015	7/56	10/8/2016	8.96	6,310	—	Period of record for annual peak flows represents combined streamflow records for this site and discontinued streamgage USGS station 02085220 Little River near Orange Factory (drainage area 80.4 mi <sup>2</sup> )	
9/6/1996	12.56	—	1995, 1997–2015	8/22	10/8/2016	9.83	1,320	—	Maximum peak flow for period of record not determined	
9/6/1996	17.27	16,600	1996–2015	6/22	10/8/2016	14.68	7,590	—	Flow regulated by releases from the Little River Reservoir	
9/6/1996	17.26	33,800	1926–2015	10/92	10/9/2016	11.4	13,700	12		

22 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Neuse River Basin—Continued						
43	02086500	FLAT RIVER AT DAM NEAR BAHAMA, NC	36°08'55"	78°49'44"	NAD 83	168.0
44	02086624	KNAP OF REEDS CREEK NEAR BUTNER, NC	36°07'40"	78°47'55"	NAD 27	43.0
45	0208675010	ELLERBE CREEK AT CLUB BOULEVARD AT DURHAM, NC	36°01'09"	78°53'41"	NAD 83	6.0
46	02086849	ELLERBE CREEK NEAR GORMAN, NC	36°03'33"	78°49'58"	NAD 27	21.9
47	0208700550	LITTLE LICK CREEK AT NC HWY 98 AT OAK GROVE, NC	35°58'56"	78°49'28"	NAD 83	4.1
48	0208706575	BEAVERDAM CREEK AT DAM NEAR CREEDMOOR, NC	36°01'25"	78°41'21"	NAD 83	52.5
49	02087182	FALLS LAKE ABOVE DAM NR FALLS, NC	35°56'28"	78°35'00"	NAD 83	771.0
50	02087183	NEUSE RIVER NEAR FALLS, NC	35°56'24"	78°34'51"	NAD 83	771.0
51	0208726005	CRABTREE CR AT EBENEZER CHURCH RD NR RALEIGH, NC	35°50'43"	78°43'28"	NAD 83	76.0
52	02087275	CRABTREE CREEK AT HWY 70 AT RALEIGH, NC	35°50'17"	78°40'27"	NAD 83	97.6
53	0208731190	CRABTREE CREEK AT ANDERSON DRIVE AT RALEIGH, NC	35°49'16"	78°38'03"	NAD 83	111.0
54	02087322	CRABTREE CR AT OLD WAKE FOREST RD AT RALEIGH, NC	35°48'57"	78°37'34"	NAD 83	119.0
55	02087324	CRABTREE CREEK AT US 1 AT RALEIGH, NC	35°48'40"	78°36'39"	NAD 83	121.0
56	0208732534	PIGEON HOUSE CR AT CAMERON VILLAGE AT RALEIGH, NC	35°47'15"	78°39'17"	NAD 83	0.3
57	0208732885	MARSH CREEK NEAR NEW HOPE, NC	35°49'01"	78°35'35"	NAD 83	6.8
58	0208735012	ROCKY BRANCH BELOW PULLEN DRIVE AT RALEIGH, NC	35°46'48"	78°39'59"	NAD 83	1.2

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	'Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)			
Neuse River Basin—Continued										
7/26/1938	19.50	19,700	1928–59, 1962–66, 1983–93, 1996, 2001–15	8/66	10/9/2016	17.73	12,800	—	Flow regulated by Lake Michie	
3/4/1993	8.31	5,800	1983–95, 2006–15	3/25	10/8/2016	8.09	5,140	—		
9/6/2008	11.09	1,910	2008, 2013–15	—	10/8/2016	7.42	1,010	—	Annual peak flows not determined for 2009–12 water years	
9/6/2008	12.13	—	1983–88, 1992–94, 2006–07, 2010–15	1/20	10/8/2016	12.95	3,130	—	Previous maximum peak flow for period of record not determined	
5/16/2014	9.65	n/a	n/a	n/a	10/8/2016	9.72	n/a	—	Stage-only records available for site	
2/10/2010	259.89	n/a	n/a	n/a	10/8/2016	258.93	n/a	—	Stage-only records available for site	
10/1/1999	264.34	n/a	n/a	n/a	10/14/2016	258.94	n/a	265	Stage-only records available for site	
9/16/1996	8.05	7,650	1984–2015	16/34	10/21/2016	3.85	4,040	—	Flow regulated since December 1983 by Falls Lake, annual peak discharge and stage not determined for the 2009 water year, maximum peak stage and stream flow was associated with 4,000 ft <sup>3</sup> /s flow release on October 21–31, 2016, from Falls Lake to lower lake level after downstream flooding had abated.	
9/6/1996	22.40	8,200	1989–92, 1996, 1998–99, 2000, 2002–15	3/24	10/8/2016	19.96	5,740	—		
6/29/1973	27.69	11,700	1973, 1996, 1997–2015	5/23	10/8/2016	22.7	6,350	18		
6/14/2006	21.22	n/a	n/a	n/a	10/8/2016	21.3	n/a	—	Stage-only records available for site	
9/16/1999	19.93	n/a	n/a	n/a	10/8/2016	20.12	n/a	12	Stage-only records available for site	
9/6/1996	18.23	12,700	1973, 1991–2008, 2010–15	3/27	10/8/2016	17.49	9,650	18		
5/12/2007	8.65	—	1997–2003, 2005–06, 2008, 2011–15	17/20	10/8/2016	4.91	156	—	Maximum peak flow for period of record not determined, annual peak flows not determined for 2007, 2009–10 water years	
9/6/1996	13.33	3,900	1984–2015	6/34	10/8/2016	11.68	2,040	—		
7/24/1997	9.23	2,590	1997–2015	20/21	10/8/2016	9.07	511	—		

24 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Neuse River Basin—Continued						
59	02087359	WALNUT CREEK AT SUNNYBROOK DRIVE NR RALEIGH, NC	35°45'30"	78°34'59"	NAD 83	29.8
60	02087500	NEUSE RIVER NEAR CLAYTON, NC	35°38'50"	78°24'19"	NAD 83	1,150.0
61	02087570	NEUSE RIVER AT SMITHFIELD, NC	35°30'45"	78°20'58"	NAD 83	1,206.0
62	02087580	SWIFT CREEK NEAR APEX, NC	35°43'08"	78°45'08"	NAD 83	21.0
63	0208758850	SWIFT CREEK NEAR MCCULLARS CROSSROADS, NC	35°41'37"	78°41'32"	NAD 83	35.8
64	0208773375	SWIFT CREEK AT SR1555 NEAR CLAYTON, NC	35°34'30"	78°29'55"	NAD 83	113.7
65	02088000	MIDDLE CREEK NEAR CLAYTON, NC	35°34'15"	78°35'26"	NAD 83	83.5
66	02088383	LITTLE RIVER NEAR ZEBULON, NC	35°49'19"	78°21'08"	NAD 83	55.0
67	02088500	LITTLE RIVER NEAR PRINCETON, NC	35°30'41"	78°09'37"	NAD 83	232.0
68	02089000	NEUSE RIVER NEAR GOLDSBORO, NC	35°20'15"	77°59'51"	NAD 83	2,399.0
69	02089500	NEUSE RIVER AT KINSTON, NC	35°15'28"	77°35'08"	NAD 83	2,692.0
70	02090380	CONTENTNEA CREEK NEAR LUCAMA, NC	35°41'28"	78°06'35"	NAD 83	161.0
71	02091000	NAHUNTA SWAMP NEAR SHINE, NC	35°29'20"	77°48'22"	NAD 83	80.4
72	02091500	CONTENTNEA CREEK AT HOOKERTON, NC	35°25'44"	77°34'57"	NAD 83	733.0
73	02091814	NEUSE RIVER NEAR FORT BARNWELL, NC	35°18'50"	77°18'10"	NAD 83	3,900.0
74	0209205053	SWIFT CREEK AT HWY 43 NR STREETS FERRY, NC	35°13'51"	77°06'50"	NAD 83	269.0
75	02092500	TRENT RIVER NEAR TRENTON, NC	35°03'51"	77°27'41"	NAD 83	168.0
76	02092554	TRENT R AT POLLOCKSVILLE, NC	35°00'36"	77°13'08"	NAD 83	370.0

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	'Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)			
Neuse River Basin—Continued										
9/6/1996	17.03	6,760	1996–2011, 2013–15	2/21	10/8/2016	16.1	5,960	—		
9/17/1999	20.67	20,500	1984–2015	2/34	10/9/2016	20.48	20,200	9	Flow regulated since December 1983 by Falls Lake	
9/18/1999	26.72	n/a	n/a	n/a	10/9/2016	29.09	n/a	15	Stage-only records available for site since October 1998, flow regulated since December 1983 by Falls Lake	
6/14/2006	13.86	5,260	1954–71, 2002–15	2/34	10/8/2016	12.22	3,220	11		
9/6/1996	14.15	6,790	1989–2015	1/29	10/8/2016	14.31	7,060	—	Flow affected by regulation from Lake Wheeler	
9/9/2014	14.34	2,900	2009–15	1/9	10/9/2016	21.09	9,640	—		
9/6/1996	14.88	11,900	1940–2015	3/78	10/9/2016	16.18	20,600	—	Peak determined from a high water mark identified at site after event	
6/8/2013	3.62	1,820	2009–15	1/9	10/8/2016	5.47	>2,480	—	Peak stage determined from a reading of the high water mark on crest stage gage and is above current stage-discharge rating, indirect discharge measurement will be needed to estimate peak streamflow	
9/17/1999	16.58	20,700	1931–2015	2/87	10/10/2016	14.72	9,650	11		
9/20/1999	28.85	38,500	1984–2015	1/34	10/12/2016	29.74	52,600	18	Flow regulated since December 1983 by Falls Lake, annual peak discharge and stage not determined for the 2009 water year	
9/22/1999	27.71	36,300	1984–2015	1/34	10/14/2016	28.31	38,200	14	Flow regulated since December 1983 by Falls Lake	
9/17/1999	24.82	24,000	1999–2015	2/19	10/9/2016	19.46	11,200	—	Peak determined from a high water mark identified at site after event; regulated since 1976 by Buckhorn Reservoir 1 mile upstream, but new dam complete in 1999	
9/17/1999	21.00	23,000	1955–2006, 2008–15	2/62	10/9/2016	17.92	13,200	17	Annual peak discharge and stage not determined for the 2007 water year	
9/18/1999	28.28	31,900	1929–2015	2/90	10/11/2016	24.15	26,600	13		
9/20/1999	22.75	57,200	1997–2015	2/21	10/15/2016	20.51	49,600	13	Flow regulated since December 1983 by Falls Lake; tidally influenced, which is overcome by basin runoff at high flows	
9/21/1999	12.28	10,900	1997–99, 2001–05	n/a	10/16/2016	8.67	n/a	—	Stage-only records available for site since July 2008; tidally influenced, which is overcome by basin runoff at high flows	
9/17/1999	22.33	15,000	1928, 1952–2015	6/67	10/10/2016	18.48	6,760	—		
9/19/1999	16.29	18,600	1996–2005	n/a	10/10/2016	8.5	n/a	5	Stage-only records available for site since July 2008; tidally influenced, which is overcome by basin runoff at high flows	

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Cape Fear River Basin						
77	02093000	NEW RIVER NEAR GUM BRANCH, NC	34°50'57"	77°31'10"	NAD 83	94.0
78	02093800	REEDY FORK NEAR OAK RIDGE, NC	36°10'21"	79°57'10"	NAD 83	20.6
79	02093877	BRUSH CREEK AT MUIRFIELD RD AT GREENSBORO, NC	36°07'41"	79°55'26"	NAD 83	5.3
80	0209399200	HORSEPEN CREEK AT US 220 NR GREENSBORO, NC	36°08'16"	79°51'36"	NAD 83	15.9
81	02094500	REEDY FORK NEAR GIBSONVILLE, NC	36°10'23"	79°36'51"	NAD 83	131.0
82	02094659	SOUTH BUFFALO CREEK NR POMONA, NC	36°02'58"	79°51'19"	NAD 83	7.3
83	02094770	SOUTH BUFFALO CREEK AT US 220 AT GREENSBORO, NC	36°02'17"	79°47'59"	NAD 83	15.4
84	02094775	RYAN CREEK BELOW US 220 AT GREENSBORO, NC	36°01'52"	79°47'46"	NAD 83	4.1
85	02095000	SOUTH BUFFALO CR NEAR GREENSBORO, NC	36°03'36"	79°43'33"	NAD 83	34.0
86	02095181	N BUFFALO CR AT WESTOVER TERRACE AT GREENSBORO, NC	36°04'45"	79°48'46"	NAD 83	9.6
87	02095271	NORTH BUFFALO CREEK AT CHURCH ST AT GREENSBORO, NC	36°05'52"	79°46'57"	NAD 83	14.2
88	02095500	NORTH BUFFALO CREEK NEAR GREENSBORO, NC	36°07'14"	79°42'29"	NAD 83	37.1
89	0209553650	BUFFALO CREEK AT SR2819 NR MCLEANSVILLE, NC	36°07'41"	79°39'42"	NAD 83	88.5
90	02096500	HAW RIVER AT HAW RIVER, NC	36°05'14"	79°21'58"	NAD 83	606.0
91	02096846	CANE CREEK NEAR ORANGE GROVE, NC	35°59'14"	79°12'22"	NAD 83	7.5
92	02096960	HAW RIVER NEAR BYNUM, NC	35°45'55"	79°08'09"	NAD 83	1,275.0
93	0209722970	SANDY CREEK AT CORNWALLIS RD NEAR DURHAM, NC	35°58'59"	78°57'24"	NAD 83	4.7
94	02097280	THIRD FORK CR AT WOODCROFT PARKWAY NR BLANDS, NC	35°55'21"	78°57'08"	NAD 83	14.8
95	02097314	NEW HOPE CREEK NEAR BLANDS, NC	35°53'06"	78°57'55"	NAD 83	75.9

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ‘, minute; “, second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									
Previous maximum			Period of record for annual peak flows	Flood of October 2016			National Weather Service flood stage (ft)	Remarks	
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)			Peak streamflow (ft <sup>3</sup> /s)
Cape Fear River Basin									
9/16/1999	25.12	15,000	1950–73, 1988–2015	4/54	10/9/2016	20.6	5,330	—	Tidally influenced, which is overcome by basin runoff at high flows
10/10/1959	12.41	3,950	1956–2015	43/62	10/8/2016	9.3	626	10	
3/28/2010	9.98	672	2005–15	8/13	10/8/2016	8.42	400	9	
9/23/2003	10.66	2,800	2000–01, 2003–15	8/17	10/8/2016	10.14	1,060	—	
7/1/1916	17.90	8,640	1916, 1970–2015	19/47	10/9/2016	9.14	2,740	—	Flow regulated since 1970 water year by series of four upstream reservoirs
9/23/2003	15.45	3,350	1999, 2000–15	19/19	10/8/2016	7.61	837	11	
9/23/2003	16.44	2,770	1999, 2000–15	9/19	10/8/2016	12.26	1,710	18	
7/13/2003	12.53	1,060	1999, 2000–15	10/19	10/8/2016	6.15	571	8	
7/15/1945	14.37	10,000	1929–37, 1939–58, 1999–2015	9/48	10/8/2016	13.63	2,930	17	
9/23/2003	14.07	—	1999, 2000–15	18/19	10/8/2016	8.19	997	10	Maximum peak flow for period of record not determined
9/23/2003	17.81	3,520	1998–2015	13/20	10/8/2016	12.87	1,680	14	
9/22/1979	20.12	9,140	1929–90, 1999–2015	24/81	10/8/2016	12.45	3,090	13	
3/20/2003	19.35	6,720	1999, 2000–15	7/19	10/9/2016	16.93	5,420	—	
9/6/1996	32.83	51,400	1929–2015	37/89	10/9/2016	19.73	12,900	18	
9/6/1996	7.90	2,060	1989–2015	9/29	10/8/2016	5.67	778	—	
9/6/1996	21.76	76,700	1974–2004, 2006–15	9/43	10/9/2016	14.98	37,200	11	Annual peak discharge and stage not determined for the 2009 water year
6/7/2013	10.56	1,010	2009, 2011–15	3/8	10/8/2016	9.83	916	—	Annual peak discharge and stage not determined for the 2010 water year
7/17/2016	10.74	3,030	2009–15	2/9	10/8/2016	9.9	2,270	—	New provisional maximum peak flow for period of record occurred during 2016 water year
9/6/1996	14.05	12,700	1983–97, 1999, 2002, 2004–09, 2011–15	3/30	10/9/2016	12.48	7,740	—	Maximum gage height of record at 18.96 ft on April 15, 2003, affected by backwater from B. Everett Jordan Lake, provisional maximum gage height for 2016 water year at 18.21 ft on January 2, 2016, also affected by backwater from the reservoir

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Cape Fear River Basin—Continued						
96	0209734440	BOLIN CREEK AT VILLAGE DRIVE AT CHAPEL HILL, NC	35°55'20"	79°03'57"	NAD 83	7.9
97	0209741387	NORTHEAST CREEK TRIB AT SR1182 NR LOWES GROVE, NC	35°54'55"	78°53'36"	NAD 83	3.3
98	0209741955	NORTHEAST CREEK AT SR1100 NR GENLEE, NC	35°52'20"	78°54'47"	NAD 83	21.1
99	02097464	MORGAN CREEK NEAR WHITE CROSS, NC	35°55'25"	79°06'54"	NAD 83	8.4
100	02097517	MORGAN CREEK NEAR CHAPEL HILL, NC	35°53'36"	79°01'11"	NAD 83	41.0
101	0209782609	WHITE OAK CR AT MOUTH NEAR GREEN LEVEL, NC	35°45'37"	78°55'13"	NAD 83	11.9
102	02098197	B. EVERETT JORDAN LAKE AT DAM NR MONCURE, NC	35°39'17"	79°04'06"	NAD 83	1,689.0
103	02098206	HAW RIVER NEAR MONCURE, NC	35°37'56"	79°03'36"	NAD 83	1,691.0
104	02099000	EAST FORK DEEP RIVER NEAR HIGH POINT, NC	36°02'14"	79°56'44"	NAD 83	14.8
105	02100500	DEEP RIVER AT RAMSEUR, NC	35°43'35"	79°39'20"	NAD 83	349.0
106	0210166029	ROCKY R AT SR1300 NR CRUTCHFIELD CROSSROADS, NC	35°48'25"	79°31'39"	NAD 83	7.4
107	02101726	ROCKY R AT US 64 NEAR SILER CITY, NC	35°44'06"	79°25'24"	NAD 27	68.7

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									
Previous maximum			Period of record for annual peak flows	'Flood of October 2016			National Weather Service flood stage (ft)	Remarks	
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)			Peak streamflow (ft <sup>3</sup> /s)
Cape Fear River Basin—Continued									
6/30/2013	9.10	3,050	2013–15	3/5	10/8/2016	6.75	1,120	—	
7/17/2016	8.32	n/a	n/a	n/a	10/8/2016	7.13	n/a	—	Stage-only records available for site
9/6/1996	13.92	5,140	1983–93, 1996–2003, 2006–15	2/31	10/8/2016	11.89	4,380	—	
8/27/1995	11.20	3,100	1989–93, 1995–2015	9/28	10/8/2016	8.89	1,050	—	Flow regulated by University Lake
9/6/1996	16.18	4,210	1983–2006, 2008–15	4/34	10/8/2016	14.58	3,180	—	
6/14/2006	13.50	5,920	2000–15	4/18	10/8/2016	10.94	1,610	—	
4/15/2003	233.83	n/a	n/a	n/a	10/14/2016	227.01	n/a	240	Stage-only records available for site
3/22/2014	10.73	10,200	2014–15	1/4	10/17/2016	14.24	12,600	—	Peak stage values reported for this site are affected by backwater from the Deep River, which joins the mainstem of the Haw River immediately downstream from this site. Peak streamflows on indicated dates typically occur after the peak stage and are associated with releases from upstream Jordan Lake. Flow releases from the impoundment are typically reduced in conjunction with high flows from the Deep River Basin
9/24/1947	13.46	6,300	1929–94, 1998–2002, 2004–15	60/85	10/8/2016	9.66	1,200	10	Annual peak discharge not determined for the 2007 water year
9/18/1945	34.04	43,000	1901, 1923–2015	59/96	10/8/2016	15.47	9,590	20	
9/6/1996	11.91	1,670	1989–2006, 2008–15	12/28	10/8/2016	7.13	468	—	Annual peak streamflow and stage not determined for the 2007 water year, new provisional maximum peak flow for period of record occurred during 2016 water year
12/30/2015	19.52	10,000	2009–15	2/9	10/8/2016	16.52	4,690	—	New provisional maximum peak flow for period of record occurred during 2016 water year

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Cape Fear River Basin—Continued						
108	02101800	TICK CREEK NEAR MOUNT VERNON SPRINGS, NC	35°39'35"	79°24'06"	NAD 83	15.5
109	02102000	DEEP RIVER AT MONCURE, NC	35°37'37"	79°06'58"	NAD 83	1,434.0
110	02102192	BUCKHORN CREEK NR CORINTH, NC	35°33'35"	78°58'25"	NAD 83	76.3
111	02102500	CAPE FEAR RIVER AT LILLINGTON, NC	35°24'22"	78°48'48"	NAD 83	3,464.0
112	02102908	FLAT CREEK NEAR INVERNESS, NC	35°10'58"	79°10'39"	NAD 83	7.6
113	02103000	LITTLE RIVER AT MANCHESTER, NC	35°11'36"	78°59'08"	NAD 83	348.0
114	02104000	CAPE FEAR RIVER AT FAYETTEVILLE, NC	35°02'50"	78°51'29"	NAD 83	4,395.0
115	02104220	ROCKFISH CREEK AT RAEFORD, NC	34°59'59"	79°12'53"	NAD 83	93.1
116	02105500	CAPE FEAR R AT WILM O HUSKE LOCK NR TARHEEL, NC	34°50'08"	78°49'25"	NAD 83	4,852.0
117	02105769	CAPE FEAR R AT LOCK #1 NR KELLY, NC	34°24'16"	78°17'37"	NAD 83	5,255.0
118	02106500	BLACK RIVER NEAR TOMAHAWK, NC	34°45'18"	78°17'19"	NAD 83	676.0
119	02108000	NORTHEAST CAPE FEAR RIVER NEAR CHINQUAPIN, NC	34°49'44"	77°49'56"	NAD 83	599.0
120	02108566	NORTHEAST CAPE FEAR R NR BURGAW, NC	34°35'54"	77°52'31"	NAD 83	920.0

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	'Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)			
Cape Fear River Basin—Continued										
9/6/1996	13.41	4,010	1959–81, 1994–2015	6/47	10/8/2016	8.6	2,430	—		
9/18/1945	17.20	80,300	1931–2015	5/87	10/9/2016	11.45	37,300	9		
9/6/1996	16.79	4,300	1981–2015	5/37	10/8/2016	10.44	1,740	—		Since December 1980, considerable regulation by Harris Lake
9/7/1996	18.97	51,800	1982–2013, 2015	1/35	10/9/2016	19.41	53,400	14		Flow regulated since September 1981 by B. Everett Jordan Lake, annual peak streamflow and stage not determined for the 2014 water year
9/6/2008	8.20	668	1969–2015	1/49	10/8/2016	8.63	733	7		
9/29/2016	31.18	9,440	1939–44, 1946–50, 2003–15	1/26	10/10/2016	32.19	10,600	18		Peak determined from observations taken by USGS personnel at site during peak occurrence, new provisional maximum peak flow for period of record occurred during 2016 water year
9/7/1996	46.17	n/a	n/a	n/a	10/9/2016	58.94	n/a	35		Stage-only records available for site since October 1986, streamflow regulated since September 1981 by B. Everett Jordan Lake
9/7/2008	9.30	1,750	1989–2015	1/29	10/9/2016	12.94	4,210	15		
9/8/1996	26.75	—	1982–95, 1997–2004, 2006–12, 2014–15	1/33	10/10/2016	36.37	77,300	42		Flow regulated since September 1981 by B. Everett Jordan Lake, previous maximum peak flow for period of record not determined, annual peak discharge not determined for the 1996 water year, annual peak discharge and stage not determined for the 2005 and 2013 water years
9/11/1996	24.29	48,300	1982–2015	1/36	10/13/2016	28.62	66,600	24		Flow regulated since September 1981 by B. Everett Jordan Lake
9/18/1999	27.14	28,500	1928, 1945, 1948, 1952–2015	1/69	10/10/2016	27.92	39,100	18		Examination of available historical flood information for this site indicates the peak discharge during October 2016 flood is highest since at least 1928
9/18/1999	23.51	30,700	1941–2015	3/75	10/11/2016	19.98	18,200	13		
9/20/1999	22.77	—	n/a	n/a	10/11/2016	17.83	n/a	10		Stage-only records available for site since December 2005; tidally influenced, which is overcome by basin runoff at high flows

**32 Preliminary Peak Stage and Streamflow Data in North and South Carolina Following Hurricane Matthew, October 2016**

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Yadkin-Pee Dee River Basin						
121	02109500	WACCAMAW RIVER AT FREELAND, NC	34°05'42"	78°32'54"	NAD 83	680.0
122	02110400	BUCK CREEK NEAR LONGS, SC	33°57'12"	78°43'12"	NAD 27	49.4
123	02110500	WACCAMAW RIVER NEAR LONGS, SC	33°54'45"	78°42'55"	NAD 27	1,110.0
124	02110704	WACCAMAW RIVER AT CONWAY MARINA AT CONWAY, SC	33°49'58"	79°02'38"	NAD 27	1,440.0
125	02130840	BLACK CREEK BELOW CHESTERFIELD, SC	34°39'48"	80°12'42"	NAD 83	51.7
126	02130900	BLACK CREEK NEAR MCBEE, SC	34°30'50"	80°11'00"	NAD 27	108.0
127	02130980	BLACK CREEK NEAR QUINBY, SC	34°14'37"	79°44'42"	NAD 27	438.0
128	02132320	BIG SHOE HEEL CREEK NR LAURINBURG, NC	34°45'02"	79°23'12"	NAD 83	83.3
129	02133500	DROWNING CREEK NEAR HOFFMAN, NC	35°03'40"	79°29'38"	NAD 83	183.0
130	02133624	LUMBER RIVER NEAR MAXTON, NC	34°46'22"	79°19'55"	NAD 83	365.0
131	02134170	LUMBER RIVER AT LUMBERTON, NC	34°37'13"	79°00'40"	NAD 83	708.0
132	02134480	BIG SWAMP NR TAR HEEL, NC	34°42'37"	78°50'11"	NAD 83	229.0
133	02134500	LUMBER RIVER AT BOARDMAN, NC	34°26'33"	78°57'37"	NAD 83	1,228.0
134	02135000	LITTLE PEE DEE RIVER AT GALIVANTS FERRY, SC	34°03'25"	79°14'50"	NAD 27	2,790.0
135	02135200	PEE DEE RIVER AT HWY 701 NEAR BUCKSPORT, SC	33°39'39"	79°09'17"	NAD 27	14,100.0
136	02136000	BLACK RIVER NEAR KINGSTREE, SC	33°39'40"	79°50'10"	NAD 27	1,252.0

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data									National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	'Flood of October 2016						
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)			
Yadkin-Pee Dee River Basin										
9/21/1999	19.30	31,200	1940–2012, 2015	2/76	10/12/2016	19	22,400	—		
10/5/2015	15.75	3,280	2006–2015	1/11	10/9/2016	16.88	4,200	—	Previous maximum streamflow data, which occurred in October 2015, are provisional. The upper limit of the current rating is 16.30 ft at a streamflow of 4,200 ft <sup>3</sup> /s	
9/22/1999	17.94	28,200	1951–2015	2/67	10/14/2016	16.95	24,300	—		
9/25/1999	17.64	24,100	1994–2015	2/23	10/18/2016	17.89	20,900	11	Tidally influenced, which is overcome by basin runoff at high flows	
11/23/2006	10.07	1,480	2006–2015	4/12	10/9/2016	9.34	834	14		
10/12/1990	13.07	4,500	1960–2015	8/58	10/10/2016	10.33	1,160	15		
10/4/2015	16.81	6,530	2002–2015	3/16	10/8/2016	16.46	5,730	10	Previous maximum streamflow data, which occurred in October 2015, are provisional	
9/10/2004	5.52	1,200	1988–91, 1994–2015	1/28	10/10/2016	6.24	1,970	14		
9/18/1945	10.29	10,900	1940–2015	5/78	10/9/2016	9	5,110	8		
3/22/1998	13.52	3,380	1988–92, 1994–2015	1/29	10/11/2016	15.49	7,140	—		
9/11/2004	18.29	7,420	2001–15	1/17	10/10/2016	21.77	14,400	13		
9/17/1999	14.34	3,570	1986–2015	1/32	10/9/2016	18.72	18,800	16		
9/24/1945	10.70	13,400	1901, 1905–06, 1908–10, 1928, 1930–2015	1/95	10/11/2016	14.43	38,200	—	Examination of available historical flood information for this site indicates the peak discharge during October 2016 flood is highest since a historic peak set in July 1901, which at the time was considered the highest since 1896	
10/9/1964	13.01	27,600	1942–2015	1/76	10/12/2016	17.1	59,100	9	Based on a historic flood mark, the October 2016 peak is likely the largest at this location since at least 1928.	
4/21/2003	19.54	86,800	2003–2015	1/14	10/14/2016	22.61	112,000	—	Regulated; tidally influenced. The peak gage height was determined from a rapid deployment gage (temporary site 333939079091400) located on the U.S. 701 bridge.	
10/6/2015	22.65	83,700	1928–2015	7/90	10/10/2016	16.41	20,600	12	Previous maximum streamflow data, which occurred in October 2015, are provisional. Annual maximum peak stage data contained in reports by the National Weather Service indicate the October 2015 flood peak is the largest since at least 1893	

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ', minute; ", second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Site index number (fig. 5)	USGS station number	Station name	Latitude	Longitude	Horizontal datum	Contributing drainage area (miles)
			(degree minute second)			
Ashepoo-Combahee-Edisto River Basin						
137	02172035	TURKEY CREEK ABOVE HUGER, SC	33°07'53"	79°47'02"	NAD 27	22.7
138	02175000	EDISTO RIVER NEAR GIVHANS, SC	33°01'40"	80°23'30"	NAD 27	2,730.0
139	02176500	COOSAWHATCHIE RIVER NEAR HAMPTON, SC	32°50'10"	81°07'55"	NAD 27	203.0

<sup>1</sup>The peak flow and stage data for October 2016 are provisional and, therefore, subject to change.

**Table 1.** Preliminary peak stage and streamflow data collected at selected streamgages in North Carolina and South Carolina for the flood of October 2016 following Hurricane Matthew.—Continued

[USGS, U.S. Geological Survey; °, degree; ′, minute; ″, second; NAD 27, North American Datum of 1927; NAD 83, North American Datum of 1983; mi<sup>2</sup>, square mile; ft, foot; ft<sup>3</sup>/s, cubic foot per second; —, data not available; n/a, not applicable; POR, period of record. Yellow shading indicates streamgages that recorded peaks of record for the October 2016 flood; green shading indicates streamgages that recorded peaks that ranked in the top 5 for the period of record; tan shading indicates stage-only sites that recorded peak stage records. Period of record is given in water years, which is the period October 1–September 30 and is identified by the year in which the period ends]

Flood data								National Weather Service flood stage (ft)	Remarks
Previous maximum			Period of record for annual peak flows	Flood of October 2016					
Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		Rank/ number of annual peak streamflows in record	Date of peak streamflow	Peak stage (ft)	Peak streamflow (ft <sup>3</sup> /s)		
Ashepoo-Combahee-Edisto River Basin									
10/5/2015	13.39	5,610	2005–2015	2/12	10/8/2016	11.06	2,990	11	Previous maximum streamflow data, which occurred in October 2015, are provisional
10/8/2015	16.06	26,600	1925, 1928, 1939–2015	10/81	10/13/2016	14.9	18,700	12	Previous maximum streamflow data, which occurred in October 2015, are provisional. Based on historic flood stage information, the October 2015 flood peak was the largest since at least 1904
10/10/1992	7.92	8,910	1952–2015	7/66	10/9/2016	9.45	3,480	12	

**Table 2.** Chronology of major floods in North Carolina since 1876.

[Much of the information is from U.S. Geological Survey, 1985, and other sources as noted in Remarks]

Date	Area affected	Remarks
June 1876	French Broad River	Named the “June Freshet,” it was exceeded only by the 1916 flood at Asheville.
August 1908	Haw, Cape Fear, and Neuse Rivers	Flood of record on Haw and upper Neuse Rivers; stage 34 feet over flood stage on Cape Fear River at Fayetteville.
July 14–16, 1916	Western one-third of State	At the time, the most extensive and destructive flood in State’s history. Excessive rainfall from a tropical cyclone resulted in one of the most extensive and destructive floods in the State’s history. In Altapass, North Carolina, a weather station measured 22.22 inches of rain from 2 p.m. on July 15 to 2 p.m. on July 16. Lives lost across the Southeastern U.S. was estimated about 80, many of which were in western North Carolina. Estimated damage across Southeastern U.S. about \$22 million (Southern Railway Company, 1917, reprinted 1995). Based on lives lost, considered the deadliest hurricane on record for North Carolina (State Climate Office of North Carolina, 2015).
August 15–16, 1928	Broad and French Broad Rivers	More than 10 inches of rain in 2 days.
September 17–18, 1928	Southern Coastal Plain	Flood of record on Lumber River; Cape Fear River 30 feet above flood stage at Fayetteville.
September 15–17, 1933	Middle and northern coast	Storm tides rose 2 feet above previous high-water marks in New Bern. Lives lost, 21; damage, \$3 million.
August 14–17 and 30, 1940	Blue Ridge and western Piedmont, Roanoke River	Floods of record in rivers of northern Blue Ridge province. Lives lost, 30–40; damage, \$30 million.
September 17, 1945	Coastal Plain and central Piedmont	Floods on upper Neuse, Haw, Cape Fear, Lumber, Rocky, and lower Pee Dee Rivers. Cape Fear River at Fayetteville was 34 feet above flood stage.
October 15, 1954	Eastern Coastal Plain	Hurricane Hazel was the costliest storm in the State’s history. Lives lost, 19; damage, \$125 million.
August 12 and 17, 1955	Middle coast	Hurricanes Connie and Diane. Estuaries of Neuse and Pamlico Rivers hardest hit. Damage, \$58 million.
September 19, 1955	Middle and northern coast	Hurricane Lone caused flooding from New River to Chowan River. Lives lost, 7. Damage, \$88 million.
September 28 and October 4, 1964	Southwestern Blue Ridge	Two floods on the upper French Broad, Little Tennessee, and Hiwassee Rivers caused damage of \$2.7 million.
November 6–7, 1977	Northwestern Blue Ridge	Storm produced 8 to 14 inches of rain. Lives lost, 13; damage, \$50 million.
August 26–28, 1995	Western and central North Carolina	Remnants from Tropical Storm Jerry produced up to 10 inches of rainfall in southwestern North Carolina as well as parts of Charlotte and Mecklenburg County where flood stage records were set. Across the State, damage was \$11 million, and there were 3 fatalities (Wikipedia, 2016a).

**Table 2.** Chronology of major floods in North Carolina since 1876.—Continued

[Much of the information is from U.S. Geological Survey, 1985, and other sources as noted in Remarks]

Date	Area affected	Remarks
September 5–6, 1996	Central and eastern North Carolina	Widespread rainfall totals of 5 to 10+ inches across central and eastern North Carolina resulted in significant flooding. Coupled with hurricane strength winds reaching far inland, substantial damage was caused by toppled trees falling onto structures and power lines. Hurricane Fran was responsible for 24 deaths across the State with damage estimates at \$2.4 billion, making it the fifth deadliest and second costliest hurricane in State history (State Climate Office of North Carolina, 2015).
September 14–17, 1999	Eastern North Carolina	Hurricane Floyd devastated eastern North Carolina with 15 to 20 inches of rain falling across the Coastal Plain, resulting in widespread and catastrophic flooding across the region, including the towns of Rocky Mount, Tarboro, Greenville, and Washington. The flooding was exacerbated by rivers swollen a few weeks earlier when Hurricane Dennis struck North Carolina. At \$8.58 billion in damages, Hurricane Floyd is the costliest hurricane on record for North Carolina. A total of 52 lives were lost in North Carolina, making it the fifth deadliest hurricane in State history (State Climate Office of North Carolina, 2015).
September 8, 2004	Western North Carolina	The remnants of Hurricane Frances moved into the southwestern mountains of North Carolina, resulting in 8 to 15+ inches of rainfall across the Blue Ridge physiographic province, including a maximum reported rainfall of 18.07 inches at Linville Falls, North Carolina (National Oceanic and Atmospheric Administration, date unknown). The heavy rainfall resulted in widespread major flooding across the region, including parts of Asheville and Biltmore Village in Buncombe County. Crop damage in North Carolina was reported at \$55 million, and widespread power outages were reported as well as a major break in the city of Asheville's water distribution system, leaving the city without water for several days (Wikipedia, 2016b).
September 17, 2004	Western North Carolina	Rainfall of 4 to 8 inches fell across much of western North Carolina as a result of the remnants of Hurricane Ivan. This rain fell on an area that was already saturated from the remnants of Hurricane Frances that had occurred almost 10 days earlier, resulting in repeated flooding of many streams and rivers in the area, including parts of Asheville. Numerous landslides also occurred, including one in the Peeks Creek Basin near Franklin in Macon County that destroyed more than a dozen homes and resulted in five fatalities (State Climate Office of North Carolina, 2015). Combined, Hurricanes Frances (see above) and Ivan resulted in 11 fatalities and about \$252 million in damage in North Carolina (State Climate Office of North Carolina, 2015).

**Table 3.** Chronology of major floods in South Carolina since 1893.

[Much of the information is from U.S. Geological Survey, 1985, and other sources; mi/h, miles per hour]

Date	Area affected	Remarks
August 27, 1893	Southern coast of South Carolina	North-northeast through South Carolina Midlands. Winds 96–120 mi/h; tremendous storm surge; major damage; moved north near Columbia, then northeast. Deaths, 2,000; damage, \$10 million.
June 1903	Santee River Basin (Pacolet River)	Major devastation occurred along the Pacolet River with six textile mills destroyed in Pacolet and Clifton, as well as 70 homes, bridges, churches, businesses, and thousands of bales of cotton. Deaths, at least 65 (some reports indicate up to 80); damage, \$3.5 million.
August 26–30, 1908	Statewide	Most extensive flood in State; rainfall, 12 inches in 24 hours at Anderson.
July 18, 1916	Eastern two-thirds of State	Record rainfall, 13 inches in 24 hours at Effingham; damage, \$10–11 million.
August 15–17, 1928	Statewide	Bridges destroyed, roads and railways impassable.
September 21–24, 1928	Lower Pee Dee River Basin and southern South Carolina	Flooding was severe. Rainfall 10–12 inches. Deaths, 5; damage, \$4–6 million.
October 2, 1929	Savannah and Santee River Basins	Entered Aiken as extratropical storm; intense rains on saturated soil caused severe flooding.
August 11–19, 1940	Statewide	Hurricane related flooding. Deaths, about 34; property and crop damage, \$10 million.
September 17–23, 1945	Statewide	Hurricane related, severe flooding; Deaths, 1; damage, \$6–7 million.
October 15, 1954	Lower Pee Dee River Basin	Hurricane Hazel. One of most severe storms in State to date; Storm surge, 16.9 feet; western half of State having drought. Deaths 1; damage, \$27 million.
September 29–30, 1959	Eastern, southern, and central South Carolina	Hurricane Gracie. Winds 140 mi/h at landfall. Six-foot storm surge. Rainfall, 6–8 inches. Deaths, 7; Excessive property damage along the coast along with heavy crop damage, \$20 million.
November 1, 1969	Coastal, northwest corner	Rainfall, 13.6 inches on Edisto Island. Deaths, 1; flood damage to homes.
June 9–15, 1973	Black and Pocotaligo Rivers	A sub-tropical disturbance remained over southeastern South Carolina for almost a week from June 9–15, 1973. In Clarendon County, 17.5 inches of rain was measured on June 12. At I-95, a few miles north of Manning, water 3 feet deep was running across the southbound lanes.
September 14, 1973	Northwestern South Carolina, Savannah and Santee River Basins	Major flash flood in Laurens; Saluda River at Ware Shoals had highest crest since 1929 flood. Damage, \$4–6 million.
August 19, 1981	Lower Pee Dee River Basin	Hurricane Dennis, greater than 6 inches of rainfall caused significant flood damage in low-lying areas. Greatest flood on upper Waccamaw River since 1945.
September 21, 1989	Eastern two-thirds of State	Hurricane Hugo made landfall at Isle of Palms, South Carolina. Winds: 140 mi/h. Gusts: 160 mi/h. Costliest storm in South Carolina's history. Deaths, 35; damage, more than \$6 billion. Storm surge over 20 feet. Severe inland damage as winds gusted to 109 mi/h at Sumter, South Carolina.
October 10–12, 1990	Central South Carolina	The remnants from tropical storms Klaus and Marco caused heavy rains and flooding; 10–11 inches rain reported in Spartanburg County; 120 dams failed statewide; 80 bridge failures; Deaths, 5.
October 8–9, 1992	Southern South Carolina	Rainfall, 9 inches in 24 hours. Bridge failures; homes damaged; 90-car train derailed.
August 25–29, 1995	Northwestern Piedmont South Carolina	Tropical Storm Jerry tracked through the upstate of South Carolina, causing flash floods and dumping 8–10 inches of rain in about an 8-hour period. Some rain totals exceeded 20 inches. Several large dams failed causing flooding across the State. Estimated \$4–5 million worth of damage to roads and bridges.
September 16, 1999	Waccamaw and Lower Pee Dee River Basins	Hurricane Floyd: Rainfall was heavy along coastal counties; 12 inches in Georgetown County; 18 inches fell in eastern Horry County. The heavy rains caused flooding to many roads and buildings. Waves were reported to be 15 feet at Cherry Grove where damage was the greatest.
October 1–5, 2015	Midlands and Coastal Plain	Heavy rainfall occurred across South Carolina as a result of an upper atmospheric low-pressure system that funneled tropical moisture from Hurricane Joaquin into the State. About 21.5 inches of rain was recorded in Columbia and almost 27 inches of rain was recorded near Mount Pleasant.

Manuscript approved December 14, 2016

Prepared by the USGS Science Publishing Network  
Reston Publishing Service Center

Edited by Kay P. Naugle

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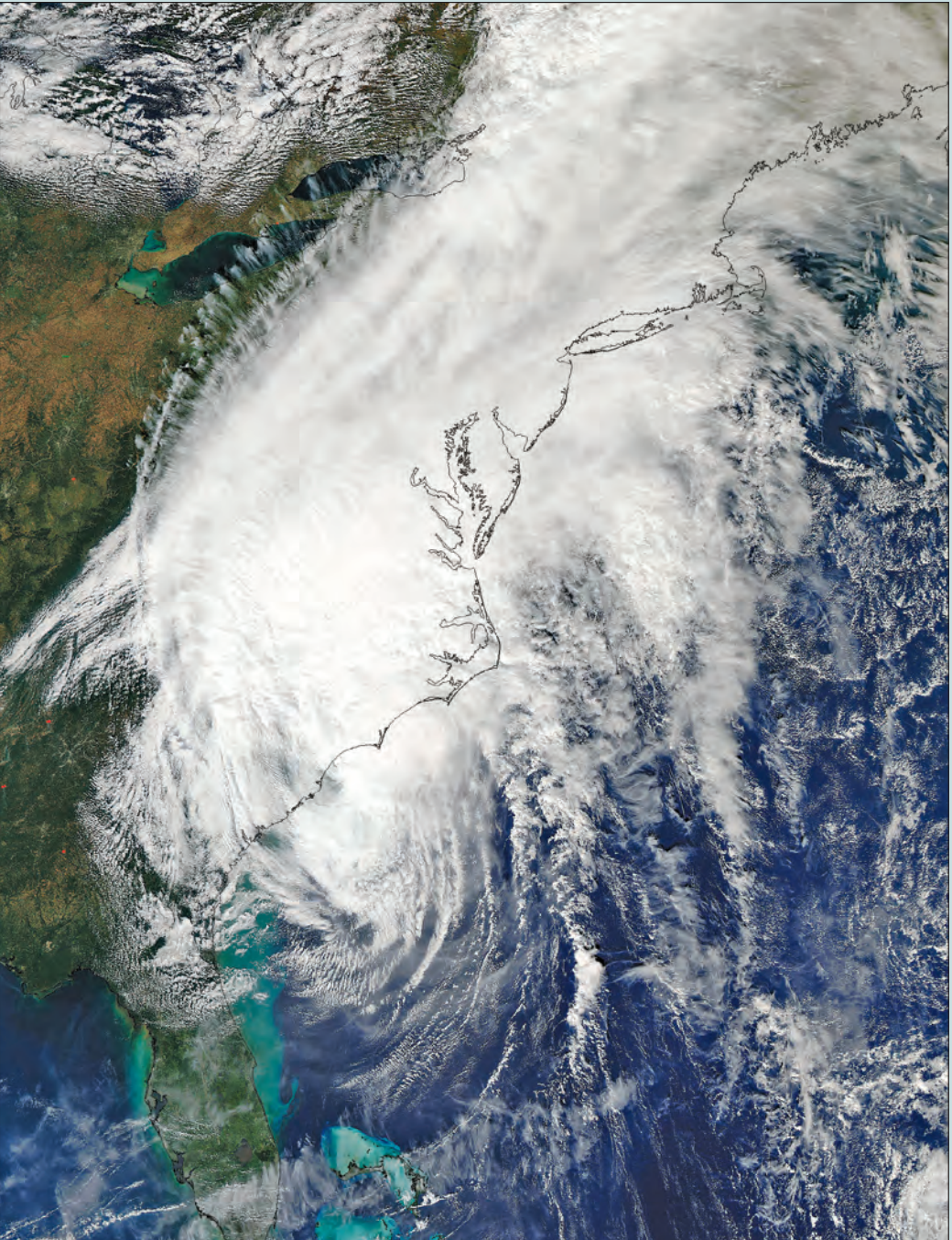
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**Back cover.** On October 8, 2016, at 2:20 p.m. EDT (18:20 UTC) NASA's Aqua satellite captured this visible image of Hurricane Matthew's clouds over the Southeastern United States. Credit: NASA Goddard MODIS Rapid Response Team.



Prepared in cooperation with the Federal Emergency Management Agency

# Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast of the United States, October 2016



Open-File Report 2017–1122

**Cover photographs.**

Left: Boat and docks damaged by Hurricane Matthew. (Tim Pojunas, USGS)

Top middle: Boat displaced by Hurricane Matthew. (J. Curtis Weaver, USGS)

Top right: USGS wave-height sensor deployed on pier in Avon, North Carolina. (J. Curtis Weaver, USGS)

Bottom middle: USGS wave-height sensor deployed on concrete jetty on Sea Island, Georgia (Skylar McHenry, USGS)

Bottom right: USGS hydrologic technician Robert Forde flagging a high-water mark at a USGS groundwater monitoring station. (O. Gary Holloway, USGS)

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**U.S. Department of the Interior**  
**U.S. Geological Survey**

**U.S. Department of the Interior**

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U.S. Geological Survey, Reston, Virginia: 2017

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Suggested citation:

Frantz, E.R., Byrne, M.J., Sr., Caldwell, A.W., and Harden, S.L., 2017, Monitoring storm tide and flooding from Hurricane Matthew along the Atlantic coast of the United States, October 2016: U.S. Geological Survey Open-File Report 2017–1122, 37 p., <https://doi.org/10.3133/ofr20171122>.

## Acknowledgments

This report was prepared in cooperation with the Federal Emergency Management Agency. The authors and U.S. Geological Survey (USGS) personnel that participated in the effort are grateful to the business and home owners who allowed USGS personnel to enter their businesses and homes in order to retrieve sensors, complete surveys, and record high-water marks. The authors and USGS personnel are also thankful to the first responders who assisted USGS personnel in accessing restricted storm damaged areas to carry out the mission.

The data in this report are the result of the long hours and effort by numerous USGS personnel from 15 different States. The authors particularly highlight the leadership and dedication of USGS personnel in the Wisconsin Water Science Center who assisted with the Flood Event Viewer to deliver these valuable data to numerous stakeholders in a very timely and accurate manner.



## Contents

Acknowledgments .....	iii
Introduction.....	1
Hurricane Matthew Storm-Tide Monitoring.....	1
Elevation Surveys.....	5
Data Presentation .....	5
References Cited.....	6
Tables 2–5.....	7

## Figures

1. Location of storm-tide sensors for monitoring time, areal extent, and magnitude of storm tide and coastal flooding generated by Hurricane Matthew, October 2016.....	3
2. U.S. Geological Survey (USGS) scientist Ryan Rasmussen deploying a storm-tide sensor near Rodanthe, North Carolina, October 2016 .....	3
3. Example of a hydrograph displaying storm-tide elevation and barometric pressure data recorded during Hurricane Matthew at the Ocean Crest pier in Brunswick County, North Carolina, October 2016.....	4
4. U.S. Geological Survey (USGS) rapid-deployment gage collecting real-time water-level and meteorological data at the Salisbury Street bridge leading to Wrightsville Beach, North Carolina, October 2016.....	4
5. U.S. Geological Survey (USGS) scientist Jonathan Graham using a global positioning system to survey storm-tide elevation for Hurricane Matthew on Wilmington Island, Georgia, October 2016.....	5

## Tables

1. Number of sites equipped to monitor Hurricane Matthew storm tide, Florida, Georgia, and North and South Carolina, October 2016 .....	3
2. Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.....	8
3. Hurricane Matthew peak storm-tide data recorded at U.S. Geological Survey long-term monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.....	21
4. Hurricane Matthew peak storm-tide data recorded at other State and Federal agency monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.....	24
5. Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.....	25

## Conversion Factors

U.S. customary units to International System of Units

<b>Multiply</b>	<b>By</b>	<b>To obtain</b>
	Length	
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Pressure	
inch of mercury at 60°F (in Hg)	3.377	kilopascal (kPa)
pound per square inch (lb/in <sup>2</sup> )	6.895	kilopascal (kPa)

## Datum

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88) unless otherwise noted.

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83) unless otherwise noted.

## Abbreviations

ASCII	American Standard Code for Information Interchange
HWM	high-water mark
NetCDF	Network Common Data Form
RDG	rapid-deployment gage
USGS	U.S. Geological Survey

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## Introduction

Hurricane Matthew moved adjacent to the coasts of Florida, Georgia, South Carolina, and North Carolina. The hurricane made landfall once near McClellanville, South Carolina, on October 8, 2016, as a Category 1 hurricane on the Saffir-Simpson Hurricane Wind Scale (National Hurricane Center, 2012). The U.S. Geological Survey (USGS) deployed a temporary monitoring network of storm-tide sensors at 284 sites along the Atlantic coast from Florida to North Carolina to record the timing, areal extent, and magnitude of hurricane storm tide and coastal flooding generated by Hurricane Matthew (fig. 1). Storm tide, as defined by the National Oceanic and Atmospheric Administration (National Oceanic and Atmospheric Administration, 2013), is the water-level rise generated by a combination of storm surge and astronomical tide during a coastal storm.

The deployment for Hurricane Matthew was the largest deployment of storm-tide sensors in USGS history and was completed as part of a coordinated Federal emergency response as outlined by the Stafford Act (Public Law 92–288, 42 U.S.C. 5121–5207) under a directed mission assignment by the Federal Emergency Management Agency. In total, 543 high-water marks (HWMs) also were collected after Hurricane Matthew, and this was the second largest HWM recovery effort in USGS history after Hurricane Sandy in 2012 (McCallum and others, 2013).

During the hurricane, real-time water-level data collected at temporary rapid deployment gages (RDGs) and long-term USGS streamgage stations were relayed immediately for display on the USGS Flood Event Viewer (<https://stn.wim.usgs.gov/FEV/#MatthewOctober2016>). These data provided emergency managers and responders with critical information for tracking flood-affected areas and directing assistance to affected communities. Data collected from this hurricane can be used to calibrate and evaluate the performance of storm-tide models for maximum and incremental water level and flood extent, and the site-specific effects of storm tide on natural and anthropogenic features of the environment.

## Hurricane Matthew Storm-Tide Monitoring

The sites for the water-level sensors were selected to augment existing tide-gage networks and to ensure adequate monitoring in areas forecasted to have substantial storm tide. A total of 223 water-level sensors, 34 wave-height sensors, 27 real-time RDGs, and 89 barometric pressure sensors were deployed at 284 sites during October 5–8 before landfall (fig. 1; table 1). Of the 284 sites monitored, 16 water-level sensors were either lost or malfunctioned during the hurricane, and 36 sensors did not record storm tide because of a lack of water level. A typical sensor installation is shown in figure 2.

The water-level and wave-height sensors deployed at the 284 monitoring sites recorded water-level elevations, in feet above the North American Vertical Datum of 1988 (NAVD 88), at either 0.25- or 30-second intervals. The 89 barometric pressure monitoring sites recorded barometric pressure, in pounds per square inch, at 30-second intervals. Water-level elevation and barometric pressure were recorded over time by the sensors during the hurricane, as shown in the example in figure 3. The 27 RDGs recorded real-time water-level elevations during the hurricane and updated every 15 minutes or less to USGS web pages. A typical RDG installation is shown in figure 4.

In the days immediately after Hurricane Matthew, storm-tide data collected with water-level and wave-height sensors were retrieved and processed for subsequent dissemination on the Flood Event Viewer. Data were collected and processed following protocols established by McGee and others (2006) and expanded upon by McCallum and others (2012), which included correcting water pressure for changes in barometric pressure and salinity for the unfiltered storm-tide peak. The filtered storm-tide peak, as shown in figure 3, was calculated using the following method. The water-level sensor pressure is subtracted by the barometric pressure sensor, and the mean of the resulting data is then subtracted. The data is filtered through a low-pass filter, and the resulting data uses



a 4th-order Butterworth filter with a cutoff of 1 minute. This data is filtered backwards with the same filter to reduce phase errors. The mean is added back into the time series, and the hydrostatic assumption is used to convert the pressure to water surface height above the sensor orifice. The final filtered water-level elevation is obtained by adding the surveyed-to-datum sensor orifice height. Quality-control checks were made by comparing water levels computed from recorded pressure data to water levels recorded at nearby USGS streamgages and National Oceanic and Atmospheric Administration tidal stations, and to independent high-water marks where possible. In the aftermath of the hurricane, 543 independent HWMs were flagged and surveyed relative to the NAVD 88 along the Atlantic coast, with particular emphasis in North Carolina and South Carolina where the initial effects of the hurricane were the most pronounced.

**Table 1.** Number of sites equipped to monitor Hurricane Matthew storm tide, Florida, Georgia, and North and South Carolina, October 2016.

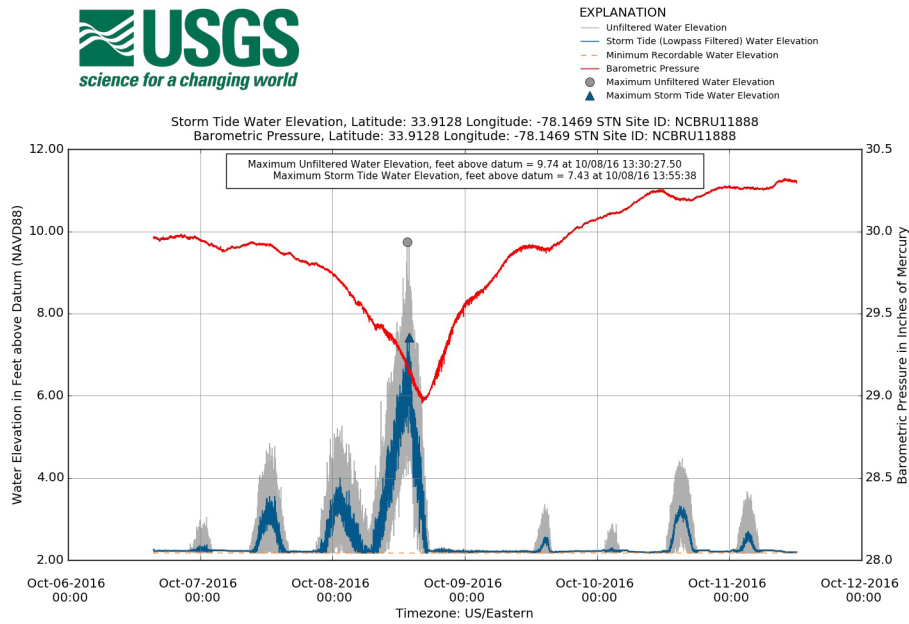
State	Type and number of sensors deployed			
	Storm tide	Wave height	Real-time rapid deployment gages	Barometric pressure
Florida	62	0	5	17
Georgia	47	10	4	22
North Carolina	51	24	10	30
South Carolina	63	0	8	20
<b>Total</b>	<b>223</b>	<b>34</b>	<b>27</b>	<b>89</b>



**Figure 2.** U.S. Geological Survey (USGS) scientist Ryan Rasmussen deploying a storm-tide sensor near Rodanthe, North Carolina, October 2016 (photograph credit: J. Curtis Weaver, USGS).

**Figure 1 (facing page).** Location of storm-tide sensors for monitoring time, areal extent, and magnitude of storm tide and coastal flooding generated by Hurricane Matthew, October 2016.

## 4 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016



**Figure 3.** Example of a hydrograph displaying storm-tide elevation and barometric pressure data recorded during Hurricane Matthew at the Ocean Crest pier in Brunswick County, North Carolina, October 2016.



**Figure 4.** U.S. Geological Survey (USGS) rapid-deployment gage collecting real-time water-level and meteorological data at the Salisbury Street bridge leading to Wrightsville Beach, North Carolina, October 2016 (photograph credit: Shawn Spivey, USGS).

## Elevation Surveys

Vertical control was established on permanent objects near the water-level sensors to relate the recorded water-surface elevation to the NAVD 88. Graduated steel tapes were used to relate the elevation of the reference points to the water-level sensors. Survey-grade Global Navigation Satellite Systems equipment (fig. 5) were used to determine the elevation above the NAVD 88 of the reference points and HWMs per USGS technical guidance in Rydland and Densmore (2012). Global Navigation Satellite Systems equipment rely on GEOID models to determine elevations above the NAVD 88. The GEOID12A model was used for consistency within the deployment area, and all elevations in this report were derived using the GEOID12A model. National Geodetic Survey benchmarks throughout the study area were surveyed for vertical control.

## Data Presentation

The data from the Hurricane Matthew storm-tide network constitute an extensive collection of continuous water-level records documenting a single landfall hurricane. The data are available in tab-delimited, American Standard Code for Information Interchange (ASCII) format, and Network Common Data Form (NetCDF) format by site for each sensor by using the USGS Flood Event Viewer at <https://stn.wim.usgs.gov/FEV/#MatthewOctober2016>. Digital photographs for selected

sites are available on the viewer. Data for each sensor include location, date, time, water level, and barometric pressure. Data for HWMs include location, description and quality of the mark, and elevation.

A list of the 284 storm-tide sensors and the unfiltered peak storm tide recorded at each are listed in table 2 (at the back of the report). Sites were categorized as storm tide or wave height because of data-collection intervals and proximity to the ocean. The survey uncertainty of the recorded peak storm tide also is included in table 2. The survey uncertainty was calculated using the methods described in Rydland and Densmore (2012). These temporary sensors were deployed to augment long-term monitoring networks operated by the USGS. The recorded peak storm tide at the long-term USGS streamgage stations along the coast of Georgia, South Carolina, and North Carolina is provided in table 3 (at the back of the report). In addition to the storm-tide data collected by the USGS, peak storm-tide elevations also were compiled for real-time monitoring stations operated by other State and Federal agencies (table 4; at the back of the report). The North Carolina Division of Emergency Management provided data for seven of their monitoring stations (David Herlong, North Carolina Division of Emergency Management, written commun., November 2016). Peak storm-tide data also were compiled for National Oceanic and Atmospheric Administration tide gages (National Oceanic Atmospheric Administration, 2016) in each State (table 4). All HWM data collected by the USGS immediately after Hurricane Matthew are listed in table 5 (at the back of the report). The reference points and HWM survey uncertainty are listed in the tables for each site.



**Figure 5.** U.S. Geological Survey (USGS) scientist Jonathan Graham using a global positioning system to survey storm-tide elevation for Hurricane Matthew on Wilmington Island, Georgia, October 2016 (photograph credit: Arthur Day, USGS).

## References Cited

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## Tables 2–5

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## 8 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
FLBRE03152	Fla.	Brevard	28.35849	-80.67858	Water level	Storm tide	0.68	10/07/2016 16:41:00	0.00
FLBRE03159	Fla.	Brevard	28.04777	-80.54750	Water level	Storm tide	None	No surge recorded	na
FLBRE03160	Fla.	Brevard	27.92150	-80.51941	Water level	Storm tide	2.62	10/07/2016 10:29:30	0.00
FLBRE03161	Fla.	Brevard	28.55336	-80.79503	Water level	Storm tide	1.22	10/07/2016 08:00:00	0.00
FLBRE03165	Fla.	Brevard	28.62375	-80.79580	Water level	Storm tide	None	No surge recorded	na
FLBRE03167	Fla.	Brevard	28.36792	-80.60198	Water level	Storm tide	None	No surge recorded	na
FLBRE03169	Fla.	Brevard	28.43646	-80.65951	Water level	Storm tide	None	No surge recorded	na
FLBRE17649	Fla.	Brevard	28.40972	-80.63194	Real-time RDG	Storm tide	3.26	10/07/2016 01:36:00	0.00
FLBRO03422	Fla.	Broward	26.00368	-80.11610	Water level	Storm tide	None	No surge recorded	na
FLBRO03522	Fla.	Broward	26.29088	-80.07988	Water level	Storm tide	1.90	10/07/2016 04:35:30	0.04
FLBRO03526	Fla.	Broward	26.22287	-80.08998	Water level	Storm tide	None	No surge recorded	na
FLBRO03530	Fla.	Broward	26.11414	-80.10607	Water level	Storm tide	None	No surge recorded	na
FLBRO03525	Fla.	Broward	26.22187	-80.10396	Water level	Storm tide	1.88	10/07/2016 05:04:00	0.00
FLDUV03108	Fla.	Duval	30.51050	-81.46080	Water level	Storm tide	7.21	10/07/2016 19:18:30	0.00
FLDUV03110	Fla.	Duval	30.42075	-81.42083	Water level	Storm tide	7.09	10/07/2016 22:23:30	0.00
FLDUV03114	Fla.	Duval	30.28758	-81.42072	Water level	Storm tide	5.07	10/07/2016 21:35:30	-0.02
FLDUV17794	Fla.	Duval	30.32415	-81.43500	Water level	Storm tide	5.19	10/07/2016 20:49:30	0.00
FLFLA03131	Fla.	Flagler	29.55939	-81.17553	Water level	Storm tide	4.85	10/07/2016 20:59:30	0.00
FLFLA03133	Fla.	Flagler	29.50744	-81.13997	Water level	Storm tide	None	No surge recorded	na
FLFLA03134	Fla.	Flagler	29.47994	-81.12603	Water level	Storm tide	7.05	10/07/2016 16:13:00	-0.05
FLIND03149	Fla.	Indian River	27.85518	-80.45213	Water level	Storm tide	3.14	10/07/2016 08:50:00	0.00
FLIND03750	Fla.	Indian River	27.64994	-80.35431	Water level	Storm tide	None	No surge recorded	na
FLIND03751	Fla.	Indian River	27.76349	-80.39688	Water level	Storm tide	None	No surge recorded	na

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
FLMAR00009	Fla.	Martin	27.25269	-80.22211	Water level	Storm tide	2.84	10/07/2016 00:36:30	0.00
FLMAR03735	Fla.	Martin	27.19967	-80.16597	Water level	Storm tide	2.73	10/07/2016 05:17:00	0.02
FLMAR03739	Fla.	Martin	27.08929	-80.12681	Water level	Storm tide	None	No surge recorded	na
FLMAR03740	Fla.	Martin	27.03762	-80.11131	Water level	Storm tide	1.22	10/07/2016 06:29:00	-0.03
FLMAR03742	Fla.	Martin	27.15384	-80.20056	Water level	Storm tide	2.75	10/07/2016 04:41:00	0.02
FLMAR17775	Fla.	Martin	26.97878	-80.08281	Water level	Storm tide	None	No surge recorded	na
FLMAR17784	Fla.	Martin	27.24488	-80.19211	Water level	Storm tide	2.92	10/07/2016 06:29:30	0.02
FLMIA03208	Fla.	Miami-Dade	25.85778	-80.12115	Water level	Storm tide	None	No surge recorded	na
FLMIA03229	Fla.	Miami-Dade	25.66670	80.15611	Real-time RDG	Storm tide	None	Equipment error	na
FLMIA03335	Fla.	Miami-Dade	25.72611	80.23556	Real-time RDG	Storm tide	None	Equipment error	na
FLMIA03341	Fla.	Miami-Dade	25.84769	-80.17326	Water level	Storm tide	1.53	10/06/2016 12:53:00	0.04
FLMIA03476	Fla.	Miami-Dade	25.90081	-80.12373	Water level	Storm tide	None	No surge recorded	na
FLPAL03554	Fla.	Palm Beach	26.34976	-80.07572	Water level	Storm tide	2.02	10/07/2016 00:50:00	0.02
FLPAL03560	Fla.	Palm Beach	26.46450	-80.05771	Water level	Storm tide	None	No surge recorded	na
FLPAL03577	Fla.	Palm Beach	26.58454	-80.03770	Water level	Storm tide	None	No surge recorded	na
FLPAL03579	Fla.	Palm Beach	26.67584	-80.03974	Water level	Storm tide	None	No surge recorded	na
FLPAL03581	Fla.	Palm Beach	26.77117	-80.03913	Water level	Storm tide	1.91	10/07/2016 04:18:00	0.00
FLPAL03582	Fla.	Palm Beach	26.34980	-80.06950	Water level	Storm tide	None	No surge recorded	na
FLPAL03586	Fla.	Palm Beach	26.78287	-80.04795	Water level	Storm tide	None	No surge recorded	na
FLPAL03587	Fla.	Palm Beach	26.82495	-80.04259	Water level	Storm tide	2.02	10/07/2016 05:01:00	-0.03
FLPAL03591	Fla.	Palm Beach	26.89318	-80.05648	Water level	Storm tide	None	No surge recorded	na
FLPAL17786	Fla.	Palm Beach	26.69225	-80.04937	Water level	Storm tide	1.93	10/07/2016 04:32:00	0.00
FLSTJ03115	Fla.	St. Johns	30.21064	-81.41042	Water level	Storm tide	5.30	10/07/2016 22:03:00	0.00

**10 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016**

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
FLSTJ03117	Fla.	St. Johns	30.13270	-81.38494	Water level	Storm tide	None	No surge recorded	na
FLSTJ03118	Fla.	St. Johns	29.94931	-81.31039	Water level	Storm tide	6.70	10/07/2016 18:12:00	-0.05
FLSTJ03125	Fla.	St. Johns	29.76244	-81.25389	Water level	Storm tide	7.75	10/07/2016 18:37:00	0.00
FLSTJ03126	Fla.	St. Johns	29.71819	-81.23083	Water level	Storm tide	8.39	10/07/2016 16:46:30	0.00
FLSTJ03129	Fla.	St. Johns	29.68003	-81.22106	Water level	Storm tide	7.30	10/07/2016 18:15:00	0.00
FLSTJ17778	Fla.	St. Johns	29.91667	-81.30000	Real-time RDG	Storm tide	7.10	10/07/2016 13:54:00	0.00
FLSTJ17848	Fla.	St. Johns	29.88579	-81.28586	Water level	Storm tide	7.47	10/07/2016 17:49:00	-0.05
FLSTL03726	Fla.	St. Lucie	27.53841	-80.31591	Water level	Storm tide	None	No surge recorded	na
FLSTL03727	Fla.	St. Lucie	27.47076	-80.28981	Water level	Storm tide	3.15	10/07/2016 04:48:00	0.00
FLSTL03729	Fla.	St. Lucie	27.36310	-80.24884	Water level	Storm tide	1.99	10/07/2016 02:40:00	0.00
FLSTL03731	Fla.	St. Lucie	27.52748	-80.34793	Water level	Storm tide	2.52	10/07/2016 07:34:00	-0.03
FLSTL03732	Fla.	St. Lucie	27.46651	-80.32996	Water level	Storm tide	1.90	10/07/2016 05:01:30	0.00
FLSTL17773	Fla.	St. Lucie	27.29273	-80.25069	Water level	Storm tide	2.01	10/07/2016 01:41:00	0.00
FLVOL03136	Fla.	Volusia	29.41078	-81.09481	Water level	Storm tide	None	No surge recorded	na
FLVOL03138	Fla.	Volusia	29.28667	-81.05464	Water level	Storm tide	None	No surge recorded	na
FLVOL03141	Fla.	Volusia	29.14647	-80.96497	Water level	Storm tide	7.00	10/07/2016 15:06:30	0.00
FLVOL03143	Fla.	Volusia	29.08497	-80.92444	Water level	Storm tide	6.62	10/07/2016 14:41:30	0.01
FLVOL03145	Fla.	Volusia	29.03143	-80.91590	Water level	Storm tide	0.52	10/07/2016 14:31:30	0.00
FLVOL03146	Fla.	Volusia	29.00950	-80.87753	Water level	Storm tide	5.62	10/07/2016 13:46:30	0.01
FLVOL03147	Fla.	Volusia	28.85843	-80.77527	Water level	Storm tide	None	No surge recorded	na
FLVOL17777	Fla.	Volusia	29.14861	-80.97417	Real-time RDG	Storm tide	None	Lost	na
GABRY17878	Ga.	Bryan	31.90467	-81.26029	Water level	Storm tide	None	Lost	na
GABRY17883	Ga.	Bryan	31.79129	-81.20207	Water level	Storm tide	6.67	10/08/2016 06:20:30	0.05
GABRY17888	Ga.	Bryan	31.97893	-81.28839	Water level	Storm tide	5.09	10/08/2016 08:48:00	0.05

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
GACAM17822	Ga.	Camden	31.11361	-81.61389	Water level	Storm tide	6.34	10/07/2016 01:23:30	0.18
GACAM17823	Ga.	Camden	30.72000	-81.54944	Water level	Storm tide	7.16	10/07/2016 19:47:00	0.20
GACAM17829	Ga.	Camden	30.78639	-81.64694	Water level	Storm tide	None	No surge recorded	na
GACAM17830	Ga.	Camden	30.74194	-81.68778	Water level	Storm tide	4.75	10/08/2016 04:22:00	0.20
GACAM17833	Ga.	Camden	30.84917	-81.63500	Water level	Storm tide	7.01	10/08/2016 03:02:30	0.07
GACAM17835	Ga.	Camden	31.12167	-81.48306	Real-time RDG	Storm tide	6.59	10/07/2016 19:15:00	na
GACAM17839	Ga.	Camden	30.90278	-81.53889	Water level	Storm tide	None	No surge recorded	na
GACAM17840	Ga.	Camden	30.84500	-81.56000	Water level	Storm tide	None	No surge recorded	na
GACAM17842	Ga.	Camden	30.77056	-81.58139	Water level	Storm tide	None	No surge recorded	na
GACAM17853	Ga.	Camden	31.03472	-81.64000	Water level	Storm tide	6.43	10/07/2016 08:14:30	0.18
GACHA17815	Ga.	Chatham	31.99255	-80.84672	Wave height	Wave height	9.87	10/08/2016 04:46:28	0.02
GACHA17816	Ga.	Chatham	32.00605	-80.84193	Wave height	Wave height	11.00	10/08/2016 06:32:11	0.02
GACHA17817	Ga.	Chatham	32.00826	-80.84940	Water level	Storm tide	6.92	10/08/2016 06:52:00	0.15
GACHA17818	Ga.	Chatham	32.00842	-80.85246	Water level	Storm tide	7.08	10/08/2016 06:57:00	0.15
GACHA17820	Ga.	Chatham	32.01816	-80.85073	Water level	Storm tide	6.99	10/08/2016 06:09:00	0.02
GACHA17824	Ga.	Chatham	32.02066	-80.89900	Water level	Storm tide	9.12	10/08/2016 06:57:00	0.02
GACHA17838	Ga.	Chatham	32.00365	-80.96099	Wave height	Wave height	5.39	10/08/2016 08:13:52	0.15
GACHA17841	Ga.	Chatham	32.02012	-80.99244	Wave height	Wave height	None	Equipment error	na
GACHA17845	Ga.	Chatham	32.03515	-81.04504	Wave height	Wave height	8.14	10/08/2016 06:42:59	0.15
GACHA17849	Ga.	Chatham	32.07242	-81.06785	Water level	Storm tide	None	Equipment error	na
GACHA17850	Ga.	Chatham	32.09791	-81.09202	Wave height	Wave height	8.55	10/08/2016 08:25:45	0.11
GACHA17851	Ga.	Chatham	32.08365	-81.15752	Water level	Storm tide	None	No surge recorded	na
GACHA17852	Ga.	Chatham	32.00773	-81.23827	Water level	Storm tide	None	No surge recorded	na

## 12 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
GACHA17858	Ga.	Chatham	32.10583	-81.19583	Water level	Storm tide	None	No surge recorded	na
GACHA17860	Ga.	Chatham	32.16083	-81.18278	Water level	Storm tide	7.58	10/07/2016 12:38:00	0.11
GACHA17861	Ga.	Chatham	31.95769	-81.01062	Water level	Storm tide	8.74	10/08/2016 06:35:30	0.05
GACHA17863	Ga.	Chatham	31.94677	-81.06678	Water level	Storm tide	7.10	10/08/2016 06:45:30	0.05
GACHA17866	Ga.	Chatham	31.88971	-81.06161	Water level	Storm tide	7.12	10/08/2016 06:03:30	0.05
GACHA17870	Ga.	Chatham	31.92868	-81.07017	Water level	Storm tide	7.25	10/08/2016 06:39:30	0.05
GAGLY17783	Ga.	Glynn	31.08840	-81.47951	Water level	Storm tide	12.06	10/08/2016 03:52:30	0.11
GAGLY17790	Ga.	Glynn	31.02102	-81.43479	Wave height	Wave height	7.07	10/07/2016 22:39:16	0.11
GAGLY17791	Ga.	Glynn	31.32806	-81.44778	Real-time RDG	Storm tide	5.49	10/07/2016 20:30:00	na
GAGLY17795	Ga.	Glynn	31.06315	-81.40454	Wave height	Wave height	10.66	10/07/2016 17:58:57	0.06
GAGLY17797	Ga.	Glynn	31.25348	-81.46430	Water level	Storm tide	17.89	10/08/2016 00:12:00	0.07
GAGLY17802	Ga.	Glynn	31.06774	-81.41337	Water level	Storm tide	5.80	10/07/2016 23:37:30	0.11
GAGLY17807	Ga.	Glynn	31.06737	-81.42580	Water level	Storm tide	6.66	10/07/2016 19:05:00	0.11
GAGLY17810	Ga.	Glynn	31.17064	-81.42840	Water level	Storm tide	6.57	10/07/2016 19:09:30	0.07
GAGLY17811	Ga.	Glynn	31.18544	-81.53303	Water level	Storm tide	7.33	10/07/2016 19:51:00	0.10
GAGLY17813	Ga.	Glynn	31.24193	-81.53513	Water level	Storm tide	7.32	10/07/2016 20:26:00	0.10
GAGLY17819	Ga.	Glynn	31.16167	-81.50028	Water level	Storm tide	6.53	10/07/2016 23:25:00	0.18
GAGLY17821	Ga.	Glynn	31.14806	-81.49806	Water level	Storm tide	6.35	10/07/2016 19:22:00	0.18
GAGLY17854	Ga.	Glynn	31.19111	-81.65889	Water level	Storm tide	None	No surge recorded	na
GAGLY17855	Ga.	Glynn	31.25639	-81.60222	Water level	Storm tide	7.95	10/07/2016 22:33:00	0.12
GAGLY17879	Ga.	Glynn	31.29528	-81.34388	Water level	Storm tide	6.02	10/07/2016 19:26:44	0.14
GAGLY17881	Ga.	Glynn	31.22108	-81.39318	Water level	Storm tide	None	Equipment error	na
GAGLY17903	Ga.	Glynn	31.17493	-81.35000	Wave height	Wave height	None	Equipment error	na

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
GAGLY18414	Ga.	Glynn	31.13415	-81.39657	Wave height	Wave height	11.89	10/07/2016 19:21:45	0.01
GALIB17843	Ga.	Liberty	31.64389	-81.39361	Real-time RDG	Storm tide	None	Peak not recorded	na
GALIB17844	Ga.	Liberty	31.82944	-81.35500	Real-time RDG	Storm tide	5.34	10/07/2016 21:15:00	na
GALIB17856	Ga.	Liberty	31.70972	-81.23944	Water level	Storm tide	None	Equipment error	na
GALIB17857	Ga.	Liberty	31.77000	-81.27806	Water level	Storm tide	6.44	10/07/2016 23:28:00	0.12
GAMCI17825	Ga.	Mcintosh	31.62139	-81.26278	Water level	Storm tide	None	Equipment error	na
GAMCI17827	Ga.	Mcintosh	31.56859	-81.32207	Water level	Storm tide	6.63	10/07/2016 19:25:30	0.06
GAMCI17828	Ga.	Mcintosh	31.45385	-81.36285	Water level	Storm tide	7.02	10/07/2016 19:20:30	0.06
GAMCI17834	Ga.	Mcintosh	31.48817	-81.44480	Water level	Storm tide	12.98	10/08/2016 14:04:00	0.06
GAMCI17837	Ga.	Mcintosh	31.53108	-81.35889	Water level	Storm tide	6.71	10/07/2016 20:32:00	0.06
GAMCI17884	Ga.	Mcintosh	31.36822	-81.43708	Water level	Storm tide	5.81	10/07/2016 20:35:17	0.07
GAMCI17891	Ga.	Mcintosh	31.58185	-81.35903	Water level	Storm tide	6.13	10/07/2016 20:32:30	0.11
NCBEA11728	N.C.	Beaufort	35.37709	-76.74821	Water level	Storm tide	4.71	10/08/2016 22:21:01	0.07
NCBEA11768	N.C.	Beaufort	35.47718	-76.81563	Water level	Storm tide	3.83	10/08/2016 22:51:33	0.01
NCBEA13648	N.C.	Beaufort	35.53285	-76.61469	Water level	Storm tide	3.44	10/08/2016 23:39:57	0.07
NCBRU00012	N.C.	Brunswick	33.88666	-78.43598	Wave height	Wave height	9.91	10/08/2016 17:20:18	0.06
NCBRU00014	N.C.	Brunswick	33.89511	-78.43937	Water level	Storm tide	6.95	10/08/2016 17:56:22	0.16
NCBRU11868	N.C.	Brunswick	33.91083	-78.29722	Wave height	Wave height	10.38	10/08/2016 17:09:40	0.18
NCBRU11888	N.C.	Brunswick	33.91275	-78.14695	Wave height	Wave height	9.74	10/08/2016 17:30:27	0.03
NCBRU11890	N.C.	Brunswick	33.92576	-78.14464	Water level	Storm tide	6.07	10/08/2016 18:22:02	0.02
NCBRU11891	N.C.	Brunswick	33.90358	-78.08212	Wave height	Wave height	9.07	10/08/2016 16:58:55	0.16
NCBRU11893	N.C.	Brunswick	33.88212	-78.51110	Water level	Storm tide	7.01	10/08/2016 17:46:02	0.09
NCBRU11908	N.C.	Brunswick	33.91398	-78.37380	Water level	Storm tide	7.04	10/08/2016 17:57:22	0.01

**14 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016**

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
NCBRU11909	N.C.	Brunswick	33.92175	-78.23783	Water level	Storm tide	7.32	10/08/2016 17:49:03	0.03
NCBRU12008	N.C.	Brunswick	33.91735	-78.26750	Water level	Storm tide	6.51	10/08/2016 17:54:52	0.03
NCBRU12048	N.C.	Brunswick	33.89547	-78.01882	Water level	Storm tide	5.83	10/08/2016 18:07:13	0.02
NCBRU12068	N.C.	Brunswick	33.91696	-78.01791	Water level	Storm tide	7.35	10/08/2016 17:26:04	0.01
NCBRU13608	N.C.	Brunswick	33.86692	-78.50635	Wave height	Wave height	11.08	10/08/2016 18:00:06	0.14
NCCAR00001	N.C.	Carteret	34.68481	-76.52602	Water level	Storm tide	3.10	10/08/2016 18:59:51	0.01
NCCAR00005	N.C.	Carteret	34.64808	-77.09567	Water level	Storm tide	4.27	10/08/2016 18:48:13	0.07
NCCAR00006	N.C.	Carteret	34.69676	-76.78119	Wave height	Wave height	8.13	10/08/2016 17:48:05	0.10
NCCAR00007	N.C.	Carteret	34.69886	-76.68149	Water level	Storm tide	6.15	10/09/2016 04:48:53	0.14
NCCAR00012	N.C.	Carteret	34.78924	-76.60853	Water level	Storm tide	4.32	10/08/2016 21:31:31	0.01
NCCAR12128	N.C.	Carteret	34.79692	-76.45610	Water level	Storm tide	3.26	10/08/2016 21:20:38	0.10
NCCAR12248	N.C.	Carteret	34.71734	-76.67089	Water level	Storm tide	3.86	10/08/2016 18:00:55	0.06
NCCAR12328	N.C.	Carteret	34.69675	-76.72698	Wave height	Wave height	7.51	10/08/2016 18:07:49	0.14
NCCAR12388	N.C.	Carteret	34.71135	-76.73683	Real-time RDG	Storm tide	3.38	10/08/2016 18:30:00	0.05
NCCAR12409	N.C.	Carteret	34.69023	-76.89569	Water level	Storm tide	4.08	10/08/2016 20:39:31	0.07
NCCAR12410	N.C.	Carteret	34.72260	-76.94621	Water level	Storm tide	4.14	10/08/2016 20:51:29	0.05
NCCAR12412	N.C.	Carteret	34.66045	-77.03399	Wave height	Wave height	7.62	10/08/2016 16:38:43	0.07
NCCAR12413	N.C.	Carteret	34.66773	-77.06335	Real-time RDG	Storm tide	3.96	10/08/2016 19:06:00	0.01
NCCRA12488	N.C.	Craven	35.10265	-77.03667	Real-time RDG	Storm tide	3.31	10/08/2016 18:42:00	0.04
NCCRV00003	N.C.	Craven	34.93583	-76.81074	Water level	Storm tide	3.89	10/09/2016 06:00:17	0.05
NCDAR00001	N.C.	Dare	35.20791	-75.70284	Water level	Storm tide	7.07	10/09/2016 10:00:54	0.05
NCDAR00002	N.C.	Dare	35.26652	-75.55763	Water level	Storm tide	9.33	10/09/2016 09:39:43	0.12
NCDAR00003	N.C.	Dare	35.34729	-75.50095	Wave height	Wave height	8.77	10/09/2016 17:28:35	0.15

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
NCDAR00004	N.C.	Dare	35.35015	-75.51197	Water level	Storm tide	4.96	10/09/2016 10:11:00	0.12
NCDAR00005	N.C.	Dare	35.79660	-75.54920	Water level	Storm tide	2.66	10/09/2016 05:51:52	0.04
NCDAR00008	N.C.	Dare	36.22168	-75.77185	Water level	Storm tide	2.86	10/09/2016 06:17:45	0.01
NCDAR00009	N.C.	Dare	35.90997	-75.59582	Wave height	Wave height	na	Peak not recorded	na
NCDAR00010	N.C.	Dare	35.69831	-75.77044	Water level	Storm tide	2.97	10/09/2016 05:15:53	0.05
NCDAR12588	N.C.	Dare	36.09311	-75.74306	Real-time RDG	Storm tide	3.16	10/09/2016 07:06:00	0.15
NCDAR12629	N.C.	Dare	35.89644	-75.62209	Real-time RDG	Storm tide	3.01	10/09/2016 08:30:00	0.04
NCDAR12631	N.C.	Dare	35.90963	-75.60209	Water level	Storm tide	4.43	10/09/2016 08:56:37	0.15
NCDAR12633	N.C.	Dare	35.97308	-75.63148	Wave height	Wave height	9.79	10/09/2016 14:45:43	0.04
NCDAR12668	N.C.	Dare	36.01794	-75.72683	Water level	Storm tide	4.50	10/09/2016 07:44:05	0.04
NCDAR12669	N.C.	Dare	36.10126	-75.71108	Wave height	Wave height	8.63	10/09/2016 19:06:50	0.15
NCDAR12688	N.C.	Dare	35.76755	-75.52592	Water level	Storm tide	4.23	10/09/2016 19:04:39	0.04
NCDAR12689	N.C.	Dare	35.68470	-75.48386	Wave height	Wave height	na	Peak not recorded	na
NCDAR12709	N.C.	Dare	35.58330	-75.46863	Water level	Storm tide	4.11	10/09/2016 09:03:01	0.05
NCDAR12729	N.C.	Dare	35.22422	-75.64322	Wave height	Wave height	na	Peak not recorded	na
NCDAR12748	N.C.	Dare	35.22946	-75.63530	Water level	Storm tide	7.31 <sup>a</sup>	10/09/2016 09:45:36	0.05
NCDAR12768	N.C.	Dare	36.22444	-75.77011	Wave height	Wave height	na	Peak not recorded	na
NCDAR12788	N.C.	Dare	35.58507	-75.46141	Wave height	Wave height	7.68	10/09/2016 19:15:13	0.05
NCDAR12790	N.C.	Dare	35.26621	-75.51936	Wave height	Wave height	7.43	10/09/2016 10:04:00	0.12
NCDAR13668	N.C.	Dare	36.04432	-75.67441	Wave height	Wave height	10.38	10/09/2016 18:39:14	0.03
NCDAR18739	N.C.	Dare	35.22470	-75.64360	Water level	Storm tide	7.20	10/09/2016 10:02:54	0.05
NCHYD00001	N.C.	Hyde	35.39354	-76.32849	Water level	Storm tide	2.94	10/08/2016 23:42:47	0.08
NCNEW00002	N.C.	New Hanover	33.96128	-77.93975	Water level	Storm tide	5.55	10/08/2016 18:48:32	0.09

**16 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016**

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
NCNEW00003	N.C.	New Hanover	33.99787	-77.90542	Wave height	Wave height	8.11	10/08/2016 16:38:39	0.05
NCNEW00004	N.C.	New Hanover	34.05701	-77.88131	Wave height	Wave height	7.60	10/08/2016 17:44:24	0.09
NCNEW00005	N.C.	New Hanover	34.18918	-77.81284	Water level	Storm tide	5.08	10/08/2016 17:33:35	0.06
NCNEW00006	N.C.	New Hanover	34.21424	-77.78839	Wave height	Wave height	10.01	10/08/2016 14:34:16	0.06
NCNEW12888	N.C.	New Hanover	34.05847	-77.88868	Water level	Storm tide	5.18	10/08/2016 18:13:04	0.09
NCNEW12908	N.C.	New Hanover	34.05068	-77.91902	Water level	Storm tide	5.48	10/08/2016 18:55:30	0.09
NCNEW12928	N.C.	New Hanover	34.07788	-77.88745	Water level	Storm tide	5.18	10/08/2016 17:47:04	0.06
NCNEW12988	N.C.	New Hanover	34.21636	-77.79358	Real-time RDG	Storm tide	4.89	10/08/2016 17:18:00	0.09
NCNEW13008	N.C.	New Hanover	34.21835	-77.81145	Water level	Storm tide	5.22	10/08/2016 17:17:26	0.01
NCNEW13028	N.C.	New Hanover	34.25183	-77.95013	Real-time RDG	Storm tide	5.56	10/08/2016 20:00:00	0.04
NCNEW13629	N.C.	New Hanover	34.23531	-77.77670	Water level	Storm tide	5.26	10/08/2016 17:45:41	0.14
NCONS00001	N.C.	Onslow	34.68753	-77.11688	Water level	Storm tide	4.21	10/08/2016 20:26:14	0.07
NCONS00002	N.C.	Onslow	34.50286	-77.39649	Wave height	Wave height	6.61	10/08/2016 18:07:52	0.08
NCONS13068	N.C.	Onslow	34.75118	-77.43425	Real-time RDG	Storm tide	3.03	10/08/2016 23:00:00	0.06
NCONS13128	N.C.	Onslow	34.57625	-77.39544	Water level	Storm tide	3.36	10/08/2016 21:15:18	0.06
NCONS13168	N.C.	Onslow	34.54367	-77.36082	Water level	Storm tide	3.15	10/08/2016 19:22:34	0.05
NCPAM13230	N.C.	Pamlico	34.96749	-76.80711	Water level	Storm tide	4.65	10/09/2016 12:44:03	0.04
NCPAM13248	N.C.	Pamlico	35.08274	-76.60077	Water level	Storm tide	3.15	10/09/2016 12:49:46	0.04
NCPAM13270	N.C.	Pamlico	35.24493	-76.59166	Water level	Storm tide	3.15	10/08/2016 23:00:25	0.05
NCPAS13288	N.C.	Pasquotank	36.30310	-76.21638	Water level	Storm tide	0.86	10/09/2016 03:43:30	0.01
NCPEN00001	N.C.	Pender	34.31128	-77.73298	Water level	Storm tide	5.36	10/08/2016 17:06:51	0.06
NCPEN00003	N.C.	Pender	34.36542	-77.62815	Wave height	Wave height	8.45	10/08/2016 17:59:40	0.09
NCPEN13368	N.C.	Pender	34.42478	-77.54535	Wave height	Wave height	10.28	10/08/2016 16:24:54	0.16

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
NCPEN13408	N.C.	Pender	34.36652	-77.66425	Water level	Storm tide	5.17	10/08/2016 17:39:25	0.06
NCPEN13448	N.C.	Pender	34.43075	-77.54927	Real-time RDG	Storm tide	3.88	10/08/2016 20:24:00	0.10
NCPER00001	N.C.	Perquimans	36.19306	-76.45437	Water level	Storm tide	3.06	10/09/2016 02:40:03	0.04
NCTYR13548	N.C.	Tyrrell	35.98782	-76.18460	Water level	Storm tide	6.32	10/09/2016 07:53:52	0.15
NCWAS13588	N.C.	Washington	35.96040	-76.48994	Real-time RDG	Storm tide	3.87	10/09/2016 02:30:00	0.10
SCBEA14138	S.C.	Beaufort	32.43000	-80.66972	Water level	Storm tide	7.71	10/08/2016 06:00:00	0.01
SCBEA14139	S.C.	Beaufort	32.28944	-80.93056	Water level	Storm tide	8.51	10/08/2016 06:56:00	0.04
SCBEA14148	S.C.	Beaufort	32.23167	-80.92889	Water level	Storm tide	8.27	10/08/2016 06:21:00	0.04
SCBEA14277	S.C.	Beaufort	32.40306	-80.44972	Water level	Storm tide	8.43	10/08/2016 07:37:00	0.00
SCBEA14278	S.C.	Beaufort	32.65222	-80.68361	Water level	Storm tide	None	No surge recorded	na
SCBEA14279	S.C.	Beaufort	32.54167	-80.74472	Water level	Storm tide	7.85	10/08/2016 06:50:00	0.05
SCBEA14280	S.C.	Beaufort	32.23111	-80.79389	Water level	Storm tide	8.46	10/08/2016 06:23:00	0.10
SCBEA14281	S.C.	Beaufort	32.39000	-80.77500	Water level	Storm tide	None	No surge recorded	na
SCBEA14282	S.C.	Beaufort	32.48361	-80.59972	Water level	Storm tide	8.09	10/08/2016 08:16:00	0.04
SCBEA14283	S.C.	Beaufort	32.37611	-80.71667	Water level	Storm tide	8.10	10/08/2016 07:09:00	0.10
SCBEA14284	S.C.	Beaufort	32.23111	-80.86333	Water level	Storm tide	8.73	10/08/2016 05:56:00	0.10
SCBEA14285	S.C.	Beaufort	32.28694	-80.81389	Water level	Storm tide	8.68	10/08/2016 07:19:00	0.10
SCBEA14286	S.C.	Beaufort	32.34250	-80.46306	Water level	Storm tide	7.81	10/08/2016 06:09:00	0.01
SCBEA14287	S.C.	Beaufort	32.13972	-80.80861	Water level	Storm tide	8.05	10/08/2016 07:02:00	0.10
SCBEA14288	S.C.	Beaufort	32.20333	-80.7000	Real-time RDG	Storm tide	6.22	10/08/2016 03:45:00	na
SCBEA14289	S.C.	Beaufort	32.35194	-80.70139	Water level	Storm tide	7.33	10/08/2016 07:12:00	0.14
SCBEA14290	S.C.	Beaufort	32.33472	-80.67167	Water level	Storm tide	7.65	10/08/2016 07:02:00	0.14
SCBEA14291	S.C.	Beaufort	32.45278	-80.70222	Water level	Storm tide	8.00	10/08/2016 06:41:00	0.14

**18 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016**

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
SCBEA14292	S.C.	Beaufort	32.37389	-80.83694	Water level	Storm tide	8.17	10/08/2016 06:50:00	0.03
SCBEA14293	S.C.	Beaufort	32.17667	-80.76972	Water level	Storm tide	7.88	10/08/2016 07:00:00	0.03
SCBER14294	S.C.	Berkeley	32.92250	-79.82722	Water level	Storm tide	None	No surge recorded	na
SCCHA14228	S.C.	Charleston	32.78444	-80.10694	Water level	Storm tide	6.37	10/08/2016 07:30:00	0.13
SCCHA14229	S.C.	Charleston	32.81194	-79.85444	Water level	Storm tide	5.99	10/08/2016 06:06:00	0.06
SCCHA14248	S.C.	Charleston	32.79333	-80.05667	Water level	Storm tide	5.52	10/08/2016 13:10:00	0.18
SCCHA14295	S.C.	Charleston	32.78444	-79.95861	Water level	Storm tide	6.16	10/08/2016 05:56:00	0.01
SCCHA14296	S.C.	Charleston	33.03028	-79.62528	Water level	Storm tide	7.46	10/09/2016 15:11:00	0.02
SCCHA14297	S.C.	Charleston	32.66250	-79.94389	Water level	Storm tide	6.30	10/08/2016 05:11:00	0.18
SCCHA14298	S.C.	Charleston	32.76694	-79.97389	Water level	Storm tide	5.89	10/08/2016 06:12:00	0.08
SCCHA14299	S.C.	Charleston	32.55861	-80.27944	Water level	Storm tide	6.52	10/08/2016 06:28:00	0.20
SCCHA14300	S.C.	Charleston	32.63556	-80.34139	Water level	Storm tide	6.98	10/08/2016 07:46:00	0.13
SCCHA14301	S.C.	Charleston	32.78972	-79.78833	Water level	Storm tide	6.12	10/08/2016 05:13:00	0.15
SCCHA14302	S.C.	Charleston	32.81556	-79.80889	Water level	Storm tide	9.12	10/08/2016 12:24:00	0.07
SCCHA14304	S.C.	Charleston	32.75278	-80.01361	Water level	Storm tide	6.29	10/08/2016 07:19:00	0.13
SCCHA14305	S.C.	Charleston	32.77167	-79.84167	Water level	Storm tide	6.16	10/08/2016 05:28:00	0.01
SCCHA14306	S.C.	Charleston	32.77667	-79.81083	Real-time RDG	Storm tide	2.06	10/08/2016 01:05:00	na
SCCHA14307	S.C.	Charleston	33.03833	-79.56111	Real-time RDG	Storm tide	6.30	10/08/2016 01:15:00	na
SCCHA14308	S.C.	Charleston	32.94000	-79.65722	Water level	Storm tide	6.61	10/08/2016 05:40:00	0.01
SCCHA14309	S.C.	Charleston	32.76222	-79.85667	Water level	Storm tide	5.89	10/08/2016 05:29:00	0.00
SCCHA14310	S.C.	Charleston	32.59750	-80.19639	Water level	Storm tide	6.59	10/08/2016 06:48:00	0.00
SCCHA14311	S.C.	Charleston	32.62750	-80.02861	Real-time RDG	Storm tide	6.49	10/08/2016 01:10:00	na
SCCHA14312	S.C.	Charleston	32.70611	-79.94889	Water level	Storm tide	6.45	10/08/2016 05:53:00	0.18

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
SCCOL14313	S.C.	Colleton	32.49361	-80.33917	Water level	Storm tide	6.59	10/08/2016 05:44:00	0.20
SCCOL14314	S.C.	Colleton	32.61278	-80.48111	Water level	Storm tide	7.06	10/08/2016 10:49:00	0.00
SCGEO14168	S.C.	Georgetown	33.39333	-79.38083	Water level	Storm tide	6.96	10/08/2016 17:06:00	0.19
SCGEO14169	S.C.	Georgetown	33.46917	-79.27944	Water level	Storm tide	3.04	10/08/2016 17:10:00	0.01
SCGEO14315	S.C.	Georgetown	33.36694	-79.26778	Real-time RDG	Storm tide	5.49	10/08/2016 11:15:00	na
SCGEO14316	S.C.	Georgetown	33.43500	-79.12306	Water level	Storm tide	7.65	10/08/2016 15:28:00	0.13
SCGEO14317	S.C.	Georgetown	33.51306	-79.18083	Water level	Storm tide	5.18	10/08/2016 17:55:00	0.23
SCGEO14318	S.C.	Georgetown	33.47083	-79.10111	Water level	Storm tide	7.06	10/09/2016 03:35:00	0.14
SCGEO14319	S.C.	Georgetown	33.35694	-79.29444	Water level	Storm tide	5.75	10/08/2016 15:03:00	0.13
SCGEO14320	S.C.	Georgetown	33.55472	-79.03417	Real-time RDG	Storm tide	None	Damaged	na
SCGEO14321	S.C.	Georgetown	33.52667	-79.03139	Water level	Storm tide	10.23	10/08/2016 15:46:00	0.07
SCGEO14322	S.C.	Georgetown	33.36194	-79.38306	Water level	Storm tide	6.00	10/08/2016 15:53:00	0.13
SCGEO14323	S.C.	Georgetown	33.36750	-79.16917	Water level	Storm tide	7.00	10/08/2016 15:18:00	0.19
SCGEO14324	S.C.	Georgetown	33.42528	-79.13056	Water level	Storm tide	7.68	10/09/2016 15:23:00	0.10
SCGEO14325	S.C.	Georgetown	33.56194	-79.08556	Water level	Storm tide	7.87	10/08/2016 17:38:00	0.00
SCHOR00003	S.C.	Horry	33.68111	-78.89167	Real-time RDG	Storm tide	7.71	10/08/2016 11:30:00	na
SCHOR14188	S.C.	Horry	33.75000	-79.07750	Water level	Storm tide	6.49	10/08/2016 17:31:00	0.01
SCHOR14326	S.C.	Horry	33.88833	-78.59278	Water level	Storm tide	7.42	10/08/2016 16:49:00	0.07
SCHOR14327	S.C.	Horry	33.57972	-79.00333	Water level	Storm tide	7.31	10/08/2016 15:55:00	0.02
SCHOR14328	S.C.	Horry	33.60250	-78.97389	Water level	Storm tide	9.52	10/08/2016 16:02:00	0.09
SCHOR14329	S.C.	Horry	33.84056	-78.61667	Real-time RDG	Storm tide	7.05	10/08/2016 12:15:00	na
SCHOR14330	S.C.	Horry	33.68583	-78.98139	Water level	Storm tide	10.01	10/08/2016 18:27:00	0.07
SCHOR14331	S.C.	Horry	33.74056	-78.86694	Water level	Storm tide	7.21	10/08/2016 18:28:00	0.09

**Table 2.** Hurricane Matthew peak storm-tide and wave-height data for 284 temporarily deployed sites in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; na, not applicable; RDG, rapid deployment gage; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Sensor deployment type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide elevation date and time (UTC)	Surveyed sensor elevation uncertainty (±ft)
			Decimal degrees						
SCHOR14332	S.C.	Horry	33.76472	-78.81667	Water level	Storm tide	7.38	10/08/2016 18:27:00	0.07
SCHOR14333	S.C.	Horry	33.79278	-78.73639	Water level	Storm tide	7.29	10/08/2016 16:20:00	0.07
SCHOR14335	S.C.	Horry	33.64139	-78.94778	Water level	Storm tide	7.75	10/08/2016 16:39:00	0.07
SCHOR17779	S.C.	Horry	33.65944	-78.91750	Water level	Storm tide	8.57	10/08/2016 15:28:00	0.07
SCHOR17780	S.C.	Horry	33.75861	-78.79278	Water level	Storm tide	7.61	10/08/2016 15:50:00	0.09
SCHOR17781	S.C.	Horry	33.69972	-78.93694	Water level	Storm tide	7.07	10/08/2016 18:54:00	0.07
SCHOR17782	S.C.	Horry	33.85278	-78.59389	Water level	Storm tide	7.15	10/08/2016 16:20:00	0.07

<sup>a</sup>The peak water elevation for this site is considered estimated.

**Table 3.** Hurricane Matthew peak storm-tide data recorded at U.S. Geological Survey long-term monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; Fla., Florida; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Site type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide date and time (UTC)
			Decimal degrees					
02231291	Fla.	Duval	30.44567	-91.19156	Real-time streamgage	None	None	Damaged
02244040	Fla.	Putnam	29.59636	-81.68314	Real-time streamgage	Storm tide	14.73 <sup>a</sup>	10/07/2016 23:00
02244440	Fla.	Duval	29.57775	-81.06262	Real-time streamgage	Storm tide	4.21	10/07/2016 16:15
02245260	Fla.	St. Johns	29.72969	-81.48674	Real-time streamgage	Storm tide	6.71	10/08/2016 00:00
02246000	Fla.	Clay	30.11330	-81.90650	Real-time streamgage	Storm tide	11.04	10/09/2016 05:45
02246010	Fla.	Clay	30.07607	-81.86371	Real-time streamgage	Storm tide	16.15	10/07/2016 23:00
02246160	Fla.	Duval	30.14333	-81.55590	Real-time streamgage	Storm tide	4.61	10/08/2016 04:00
02246200	Fla.	St. Johns	30.09941	-81.52592	Real-time tidegage	Storm tide	4.68	10/08/2016 05:15
02246459	Fla.	Duval	30.28218	-81.74038	Real-time streamgage	Storm tide	14.76	10/08/2016 03:15
02246500	Fla.	Duval	30.32246	-81.66537	Real-time streamgage	Storm tide	14.02	10/08/2016 03:15
02246515	Fla.	Duval	30.26413	-81.59009	Real-time streamgage	Storm tide	26.37	10/07/2016 19:15
02246518	Fla.	Duval	30.28697	-81.57000	Real-time tidegage	Storm tide	5.15	10/07/2016 18:45
02246621	Fla.	Duval	30.41746	-81.69649	Real-time streamgage	Storm tide	3.52	10/07/2016 16:15
02246621	Fla.	Duval	30.41746	-81.69649	Real-time streamgage	Storm tide	3.52	10/07/2016 16:15
02246751	Fla.	Duval	30.44334	-81.66820	Real-time streamgage	Storm tide	4.47	10/07/2016 19:00
02246825	Fla.	Duval	30.44838	-81.51826	Real-time streamgage	Storm tide	4.36	10/07/2016 15:30
02248350	Fla.	Volusia	28.82107	-80.85979	Real-time streamgage	Storm tide	1.03	10/08/2016 01:00
02248380	Fla.	Brevard	28.73638	-80.45477	Real-time streamgage	Storm tide	2.38	10/08/2016 01:15
02250030	Fla.	Brevard	28.01724	-80.59589	Real-time streamgage	Storm tide	9.82	10/07/2016 10:30
02251000	Fla.	Indian River	27.76947	-80.50589	Real-time streamgage	Storm tide	18.44	10/07/2016 15:30
02251767	Fla.	Brevard	27.83058	-80.53422	Real-time streamgage	Storm tide	4.23	10/07/2016 19:30
02251800	Fla.	Indian River	27.75447	-80.42755	Real-time streamgage	None	None	Damaged
02253500	Fla.	Indian River	27.60450	-80.38658	Real-time streamgage	Storm tide	9.10	10/07/2016 10:00
02276877	Fla.	Martin	26.98578	-80.61539	Real-time streamgage	None	None	Damaged
02277100	Fla.	Martin	27.20227	-80.25865	Real-time tidegage	Storm tide	4.36	10/07/2016 01:30

**22 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016**

**Table 3.** Hurricane Matthew peak storm-tide data recorded at U.S. Geological Survey long-term monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; Fla., Florida; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Site type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide date and time (UTC)
			Decimal degrees					
02277110	Fla.	Martin	27.19977	-80.20671	Real-time tidegage	Storm tide	4.07	10/07/2016 01:30
02280500	Fla.	Palm Beach	26.70034	-80.71228	Real-time tidegage	Storm tide	10.77	10/07/2016 21:45
02283500	Fla.	Palm Beach	26.69757	-80.71370	Real-time streamgage	Storm tide	10.78 <sup>a</sup>	10/07/2016 21:45
02286400	Fla.	Palm Beach	26.69534	-80.80673	Real-time streamgage	Storm tide	11.58 <sup>a</sup>	10/07/2016 17:30
022907085	Fla.	Miami-Dade	25.57091	-80.37875	Real-time streamgage	Storm tide	1.21	10/06/2016 16:00
02290709	Fla.	Miami-Dade	25.55986	-80.35956	Real-time streamgage	Storm tide	1.22	10/06/2016 15:45
251003080435500	Fla.	Miami-Dade	25.13560	-80.73338	Real-time streamgage	Storm tide	0.26	10/07/2016 16:45
251032080473400	Fla.	Miami-Dade	25.17555	-80.79278	Real-time streamgage	Storm tide	0.38	10/07/2016 11:30
251115081075800	Fla.	Monroe	25.18765	-81.13278	Real-time streamgage	Storm tide	0.49	10/07/2016 07:15
251209080350100	Fla.	Miami-Dade	25.20370	-80.58389	Real-time streamgage	Storm tide	0.47	10/07/2016 18:00
251433080265000	Fla.	Miami-Dade	25.24210	-80.47757	Real-time streamgage	Storm tide	0.28	10/06/2016 22:30
02198820	Ga.	Effingham	32.24917	-81.15361	Real-time streamgage	Storm tide	6.87	10/08/2016 09:30
02198840	Ga.	Effingham	32.23556	-81.15139	Real-time streamgage	Storm tide	6.91	10/08/2016 09:30
02198920	Ga.	Chatham	32.16583	-81.15389	Real-time streamgage	None	None	Damaged
02198950	Ga.	Chatham	32.16556	-81.13833	Real-time streamgage	Storm tide	7.83	10/08/2016 08:15
02198955	Ga.	Chatham	32.14278	-81.13528	Real-time streamgage	None	None	Damaged
021989715	Ga.	Chatham	32.11556	-81.12944	Real-time streamgage	Storm tide	8.26	10/08/2016 07:45
021989773	Ga.	Chatham	32.08083	-81.08139	Real-time streamgage	Storm tide	8.13	10/08/2016 07:30
021989792	Ga.	Chatham	32.16583	-81.13000	Real-time streamgage	Storm tide	7.18	10/08/2016 08:00
02198980	Ga.	Chatham	32.03389	-80.90333	Real-time streamgage	None	None	Damaged
02199000	Ga.	Chatham	32.08250	-81.00250	Real-time streamgage	Storm tide	7.76	10/08/2016 07:15
02203536	Ga.	Bryan	31.97778	-81.28972	Real-time streamgage	Storm tide	5.54	10/08/2016 09:00
022035975	Ga.	McIntosh	31.45333	-81.36278	Real-time streamgage	Storm tide	5.99	10/07/2016 19:30
02226160	Ga.	Glynn	31.42694	-81.60556	Real-time streamgage	Storm tide	4.87	10/08/2016 00:15
02226180	Ga.	Glynn	31.13333	-81.39667	Real-time streamgage	Storm tide	6.15	10/07/2016 19:00

**Table 3.** Hurricane Matthew peak storm-tide data recorded at U.S. Geological Survey long-term monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; Fla., Florida; Ga., Georgia; N.C., North Carolina; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	Site type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide date and time (UTC)
			Decimal degrees					
02228070	Ga.	Camden	30.97444	-81.72583	Real-time streamgage	Storm tide	5.31	10/07/2016 21:30
02228295	Ga.	Camden	30.76433	81.47136	Real-time streamgage	Storm tide	6.83	10/07/2016 19:30
02231254	Ga.	Camden	30.74389	-81.65444	Real-time streamgage	Storm tide	5.26	10/07/2016 22:30
02043433	N.C.	Currituck	36.37444	-75.83444	Real-time streamgage	Storm tide	2.25	10/09/2016 04:15
0208114150	N.C.	Washington	35.91500	-76.72278	Real-time streamgage	Storm tide	4.97 <sup>a</sup>	10/09/2016 02:00
02084472	N.C.	Beaufort	35.54333	-77.06194	Real-time streamgage	Storm tide	5.18	10/08/2016 23:45
02110725	S.C.	Charleston	33.68712	-79.00476	Real-time streamgage	Storm tide	6.16	10/08/2016 15:45
02110777	S.C.	Charleston	33.85156	-78.65585	Real-time streamgage	Storm tide	7.56 <sup>a</sup>	10/08/2016 14:00
02110802	S.C.	Charleston	33.64906	-79.09421	Real-time streamgage	Storm tide	5.92 <sup>a</sup>	10/08/2016 15:00
021108125	S.C.	Charleston	33.50656	-79.12699	Real-time streamgage	Storm tide	5.14	10/08/2016 13:00
02110815	S.C.	Charleston	33.44461	-79.17393	Real-time streamgage	Storm tide	6.72 <sup>a</sup>	10/08/2016 12:30
02171800	S.C.	Charleston	33.20850	-79.38256	Real-time streamgage	Storm tide	6.13 <sup>a</sup>	10/08/2016 11:30
02171850	S.C.	Charleston	33.18406	-79.40589	Real-time streamgage	Storm tide	6.24 <sup>a</sup>	10/08/2016 10:45
02171905	S.C.	Charleston	33.15433	-79.35422	Real-time streamgage	None	None	Damaged
021720677	S.C.	Charleston	32.89045	-79.96286	Real-time streamgage	Storm tide	5.51	10/08/2016 01:00
021720698	S.C.	Charleston	32.85906	-79.89620	Real-time streamgage	Storm tide	6.76	10/08/2016 01:45
021720709	S.C.	Charleston	32.80240	-79.91009	Real-time streamgage	Storm tide	6.06	10/08/2016 01:45
021720711	S.C.	Charleston	32.78045	-79.92370	Real-time streamgage	Storm tide	7.35 <sup>a</sup>	10/08/2016 01:30
021720869	S.C.	Charleston	32.83462	-80.02370	Real-time streamgage	Storm tide	7.57 <sup>a</sup>	10/08/2016 02:15
0219897993	S.C.	Jasper	32.10306	81.00694	Real-time streamgage	Storm tide	8.07	10/08/2016 07:15

<sup>a</sup>The peak water elevation for this site is referenced to the National Geodetic Vertical Datum of 1929.

## 24 Monitoring Storm Tide and Flooding From Hurricane Matthew Along the Atlantic Coast, October 2016

**Table 4.** Hurricane Matthew peak storm-tide data recorded at other State and Federal agency monitoring stations in Florida, Georgia, and North and South Carolina, October 2016.

[ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; NOAA, National Oceanic and Atmospheric Administration; Fla., Florida; Ga., Georgia; N.C., North Carolina; NCDEM, North Carolina Division of Emergency Management; S.C., South Carolina]

Site identification	Agency	State	County	Latitude	Longitude	Site type	Type of data collected	Peak storm-tide elevation (ft above NAVD 88)	Peak storm-tide date and time (UTC)
				Decimal degrees					
8720030	NOAA	Fla.	Nassau	30.67167	-81.46500	Real-time tidegage	Storm tide	6.91	10/07/2016 19:30
8720218	NOAA	Fla.	Duval	30.39833	-81.42833	Real-time tidegage	Storm tide	5.22	10/07/2016 18:54
8720219	NOAA	Fla.	Duval	30.38667	-81.55833	Real-time tidegage	Storm tide	4.15	10/07/2016 19:24
8721604	NOAA	Fla.	Brevard	28.41500	-80.59333	Real-time tidegage	Storm tide	2.83	10/07/2016 05:48
8723214	NOAA	Fla.	Miami-Dade	25.73167	-80.16167	Real-time tidegage	Storm tide	1.30	10/06/2016 17:48
8670870	NOAA	Ga.	Chatham	32.03488	-80.90659	Real-time tidegage	Storm tide	8.50	10/08/2016 07:42
8651370	NOAA	N.C.	Dare	36.18330	-75.74660	Real-time tidegage	Storm tide	3.32	10/09/2016 18:36
8652587	NOAA	N.C.	Dare	35.79583	-75.54806	Real-time tidegage	Storm tide	2.87	10/09/2016 05:54
8654467	NOAA	N.C.	Dare	35.20863	-75.70418	Real-time tidegage	Storm tide	5.97	10/09/2016 10:00
8656483	NOAA	N.C.	Carteret	34.71731	-76.67066	Real-time tidegage	Storm tide	3.56	10/08/2016 18:00
8658120	NOAA	N.C.	Brunswick	34.22667	-77.95333	Real-time tidegage	Storm tide	5.77 <sup>a</sup>	10/08/2016 19:54
8658163	NOAA	N.C.	New Hanover	34.21330	-77.78660	Real-time tidegage	Storm tide	4.40	10/08/2016 16:42
BLHN7	NCDEM	N.C.	Beaufort	35.53729	-76.62281	Real-time tidegage	Storm tide	3.36	10/08/2016 23:45
COLN7	NCDEM	N.C.	Tyrrell	35.91750	-76.25436	Real-time tidegage	Storm tide	3.79	10/09/2016 08:20
EMWN7	NCDEM	N.C.	Pasquotank	36.29852	-76.21856	Real-time tidegage	Storm tide	1.83	10/09/2016 03:40
EWPN7	NCDEM	N.C.	Chowan	36.05651	-76.61139	Real-time tidegage	Storm tide	2.84	10/09/2016 02:50
GRMN7	NCDEM	N.C.	Pitt	35.57390	-77.17580	Real-time streamgage	Storm tide	4.25	10/09/2016 01:05
OCAN7	NCDEM	N.C.	Hyde	35.11537	-75.98735	Real-time tidegage	Storm tide	4.73	10/09/2016 09:45
ORLN7	NCDEM	N.C.	Pamlico	35.02443	-76.69194	Real-time tidegage	Storm tide	3.12	10/09/2016 12:55
8661070	NOAA	S.C.	Horry	33.65534	-78.91623	Real-time tidegage	None	None	Damaged
8662245	NOAA	S.C.	Georgetown	33.34940	-79.18892	Real-time tidegage	Storm tide	7.11	10/08/2016 16:00
8665530	NOAA	S.C.	Charleston	32.77990	-79.92374	Real-time tidegage	Storm tide	6.15	10/08/2016 06:48

<sup>a</sup>The peak water elevation for this NOAA tidegage site is referenced to mean sea level

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
FLNAS18572	Fla.	Nassau	30.53131	-81.45218	6.9	10/07/2016	0.05
FLBRE03160	Fla.	Brevard	27.92150	-80.51941	2.5	10/07/2016	0.01
FLDUV03108	Fla.	Duval	30.51053	-81.46083	6.8	10/07/2016	0.01
FLDUV03114	Fla.	Duval	30.28758	-81.42072	5.4	10/07/2016	0.10
FLDUV18393	Fla.	Duval	30.26060	-81.38260	11.9	10/07/2016	0.18
FLDUV18521	Fla.	Duval	30.27326	-81.38679	7.7	10/07/2016	0.18
FLDUV18523	Fla.	Duval	30.27743	-81.38758	8.7	10/07/2016	0.18
FLDUV18527	Fla.	Duval	30.32455	-81.39488	11.4	10/07/2016	0.18
FLDUV18530	Fla.	Duval	30.31559	-81.42078	5.1	10/07/2016	0.18
FLDUV18533	Fla.	Duval	30.30710	-81.41925	5.3	10/07/2016	0.18
FLDUV18534	Fla.	Duval	30.29152	-81.41953	5.5	10/07/2016	0.18
FLDUV18580	Fla.	Duval	30.44421	-81.46181	5.9	10/07/2016	0.13
FLDUV18581	Fla.	Duval	30.33190	-81.39607	15.7	10/07/2016	0.17
FLDUV18583	Fla.	Duval	30.34005	-81.39643	13.5	10/07/2016	0.17
FLDUV18591	Fla.	Duval	30.34950	-81.39722	10.1	10/07/2016	0.17
FLDUV18603	Fla.	Duval	30.36987	-81.39825	11.5	10/07/2016	0.17
FLDUV18605	Fla.	Duval	30.36320	-81.39801	8.8	10/07/2016	0.17
FLDUV18607	Fla.	Duval	30.32582	-81.44794	5.4	10/07/2016	0.18
FLDUV18608	Fla.	Duval	30.35211	-81.44375	5.2	10/07/2016	0.18
FLDUV18608	Fla.	Duval	30.30670	-81.43526	5.3	10/07/2016	0.18
FLDUV18615	Fla.	Duval	30.32500	-81.42389	5.4	10/07/2016	0.18
FLDUV18621	Fla.	Duval	30.34905	-81.42427	5.0	10/07/2016	0.18
FLDUV18639	Fla.	Duval	30.36694	-81.42167	5.2	10/07/2016	0.17
FLDUV18641	Fla.	Duval	30.39444	-81.43028	5.4	10/07/2016	0.01
FLDUV18642	Fla.	Duval	30.25949	-81.40595	5.4	10/07/2016	0.18
FLDUV18643	Fla.	Duval	30.36056	-81.46778	5.6	10/07/2016	0.18
FLDUV18644	Fla.	Duval	30.41806	-81.53389	4.5	10/07/2016	0.13
FLDUV18645	Fla.	Duval	30.27177	-81.40695	5.5	10/07/2016	0.18
FLDUV18646	Fla.	Duval	30.46139	-81.42750	6.6	10/07/2016	0.01
FLDUV18649	Fla.	Duval	30.28000	-81.40920	5.2	10/07/2016	0.18
FLDUV18654	Fla.	Duval	30.26637	-81.43622	5.3	10/07/2016	0.18
FLDUV18661	Fla.	Duval	30.28930	-81.42978	5.0	10/07/2016	0.13
FLDUV18683	Fla.	Duval	30.30621	-81.44303	5.3	10/07/2016	0.13
FLDUV18686	Fla.	Duval	30.32175	-81.44026	5.0	10/07/2016	0.13
FLDUV18694	Fla.	Duval	30.32705	-81.42462	3.1	10/07/2016	0.13
FLDUV18696	Fla.	Duval	30.35616	-81.42851	5.2	10/07/2016	0.13
FLFLA18215	Fla.	Flagler	29.60777	-81.18678	13.8	10/07/2016	0.07
FLFLA18220	Fla.	Flagler	29.59819	-81.19895	6.0	10/07/2016	0.07
FLFLA18229	Fla.	Flagler	29.60970	-81.18767	11.8	10/07/2016	0.07
FLFLA18230	Fla.	Flagler	29.61632	-81.19720	8.2	10/07/2016	0.08
FLFLA18237	Fla.	Flagler	29.62024	-81.20140	7.9	10/07/2016	0.08
FLFLA18240	Fla.	Flagler	29.61275	-81.19188	8.2	10/07/2016	0.08

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
FLFLA18242	Fla.	Flagler	29.61559	-81.20382	6.5	10/07/2016	0.01
FLFLA18243	Fla.	Flagler	29.64693	-81.20532	7.9	10/07/2016	0.08
FLFLA18248	Fla.	Flagler	29.63108	-81.20451	7.5	10/07/2016	0.01
FLFLA18252	Fla.	Flagler	29.63040	-81.20932	6.6	10/07/2016	0.01
FLMAR03740	Fla.	Martin	27.03768	-80.11147	1.0	10/07/2016	0.18
FLNAS18570	Fla.	Nassau	30.58853	-81.44384	10.2	10/07/2016	0.06
FLNAS18571	Fla.	Nassau	30.57412	-81.44446	9.2	10/07/2016	0.06
FLNAS18576	Fla.	Nassau	30.57404	-81.45861	7.1	10/07/2016	0.06
FLNAS18577	Fla.	Nassau	30.58553	-81.46187	5.5	10/07/2016	0.06
FLNAS18578	Fla.	Duval	30.53154	-81.48059	7.9	10/07/2016	0.06
FLNAS18652	Fla.	Nassau	30.70361	-81.45250	6.4	10/07/2016	0.07
FLNAS18655	Fla.	Nassau	30.70003	-81.43083	9.9	10/07/2016	0.07
FLNAS18657	Fla.	Nassau	30.69667	-81.45972	5.3	10/07/2016	0.07
FLNAS18659	Fla.	Nassau	30.69285	-81.45894	6.7	10/07/2016	0.07
FLNAS18662	Fla.	Nassau	30.69111	-81.45250	6.7	10/07/2016	0.07
FLNAS18663	Fla.	Nassau	30.68833	-81.45056	6.9	10/07/2016	0.07
FLNAS18678	Fla.	Nassau	30.67333	-81.46444	6.9	10/07/2016	0.07
FLNAS18680	Fla.	Nassau	30.66972	-81.46528	6.6	10/07/2016	0.01
FLNAS18682	Fla.	Nassau	30.65448	-81.46588	6.8	10/07/2016	0.07
FLNAS18684	Fla.	Nassau	30.64541	-81.46526	7.2	10/07/2016	0.07
FLNAS18687	Fla.	Nassau	30.62473	-81.47229	6.2	10/07/2016	0.07
FLNAS18807	Fla.	Nassau	30.70430	-81.45574	6.3	10/07/2016	0.07
FLSTJ03115	Fla.	St. Johns	30.21064	-81.41042	5.4	10/07/2016	0.10
FLSTJ03125	Fla.	St. Johns	29.76244	-81.25389	7.8	10/07/2016	0.09
FLSTJ18249	Fla.	St. Johns	29.65062	-81.20660	8.5	10/07/2016	0.08
FLSTJ18256	Fla.	St. Johns	29.65800	-81.20840	10.6	10/07/2016	0.08
FLSTJ18260	Fla.	St. Johns	29.66921	-81.21410	7.3	10/07/2016	0.08
FLSTJ18264	Fla.	St. Johns	29.67790	-81.21944	6.6	10/07/2016	0.01
FLSTJ18267	Fla.	St. Johns	29.68169	-81.22162	8.5	10/07/2016	0.01
FLSTJ18269	Fla.	St. Johns	29.76272	-81.25280	7.5	10/07/2016	0.18
FLSTJ18344	Fla.	St. Johns	29.76921	-81.25404	7.9	10/07/2016	0.18
FLSTJ18347	Fla.	St. Johns	29.77348	-81.25693	7.9	10/07/2016	0.18
FLSTJ18349	Fla.	St. Johns	29.79239	-81.26241	7.7	10/07/2016	0.21
FLSTJ18354	Fla.	St. Johns	29.69368	-81.22673	7.0	10/07/2016	0.01
FLSTJ18355	Fla.	St. Johns	29.79895	-81.27039	6.3	10/07/2016	0.23
FLSTJ18361	Fla.	St. Johns	29.70094	-81.22874	8.0	10/07/2016	0.01
FLSTJ18373	Fla.	St. Johns	29.71951	-81.23590	7.7	10/07/2016	0.18
FLSTJ18382	Fla.	St. Johns	29.80911	-81.27171	6.5	10/07/2016	0.23
FLSTJ18387	Fla.	St. Johns	29.85519	-81.26910	6.9	10/07/2016	0.28
FLSTJ18391	Fla.	St. Johns	29.77770	-81.25640	7.9	10/07/2016	0.18
FLSTJ18399	Fla.	St. Johns	30.14136	-81.38933	5.1	10/07/2016	0.18
FLSTJ18404	Fla.	St. Johns	30.22029	-81.41230	5.5	10/07/2016	0.07

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
FLSTJ18407	Fla.	St. Johns	29.72927	-81.23845	7.5	10/07/2016	0.18
FLSTJ18408	Fla.	St. Johns	30.22009	-81.41260	5.4	10/07/2016	0.07
FLSTJ18410	Fla.	St. Johns	29.73818	-81.24151	7.9	10/07/2016	0.18
FLSTJ18411	Fla.	St. Johns	30.21850	-81.41170	5.3	10/07/2016	0.07
FLSTJ18416	Fla.	St. Johns	30.17676	-81.39982	5.3	10/07/2016	0.07
FLSTJ18417	Fla.	St. Johns	29.74732	-81.24563	6.1	10/07/2016	0.18
FLSTJ18422	Fla.	St. Johns	29.89558	-81.30478	7.3	10/07/2016	0.29
FLSTJ18430	Fla.	St. Johns	29.75400	-81.24880	7.8	10/07/2016	0.18
FLSTJ18442	Fla.	St. Johns	29.77652	-81.25592	7.9	10/07/2016	0.18
FLSTJ18451	Fla.	St. Johns	29.78122	-81.26254	7.3	10/07/2016	0.23
FLSTJ18454	Fla.	St. Johns	29.78841	-81.26042	6.7	10/07/2016	0.23
FLSTJ18456	Fla.	St. Johns	29.79343	-81.26809	6.8	10/07/2016	0.23
FLSTJ18457	Fla.	St. Johns	29.80565	-81.26816	7.0	10/07/2016	0.23
FLSTJ18458	Fla.	St. Johns	29.81590	-81.27371	7.6	10/07/2016	0.23
FLSTJ18459	Fla.	St. Johns	29.82688	-81.27631	7.6	10/07/2016	0.23
FLSTJ18462	Fla.	St. Johns	29.85870	-81.27106	6.9	10/07/2016	0.28
FLSTJ18482	Fla.	St. Johns	29.88513	-81.29700	7.5	10/07/2016	0.28
FLSTJ18483	Fla.	St. Johns	29.82583	-81.30438	8.2	10/07/2016	0.29
FLSTJ18484	Fla.	St. Johns	29.81125	-81.29536	7.6	10/07/2016	0.28
FLSTJ18485	Fla.	St. Johns	29.88644	-81.32285	7.1	10/07/2016	0.29
FLSTJ18489	Fla.	St. Johns	29.89127	-81.32160	7.1	10/07/2016	0.30
FLSTJ18490	Fla.	St. Johns	29.91734	-81.29820	7.3	10/07/2016	0.32
FLSTJ18491	Fla.	St. Johns	29.88651	-81.32587	6.8	10/07/2016	0.29
FLSTJ18492	Fla.	St. Johns	29.88370	-81.31567	7.2	10/07/2016	0.29
FLSTJ18493	Fla.	St. Johns	30.02988	-81.32503	13.1	10/07/2016	0.01
FLSTJ18495	Fla.	St. Johns	29.91495	-81.29687	7.0	10/07/2016	0.32
FLSTJ18497	Fla.	St. Johns	29.95459	-81.31112	6.7	10/07/2016	0.32
FLSTJ18499	Fla.	St. Johns	29.91184	-81.29394	7.0	10/07/2016	0.32
FLSTJ18504	Fla.	St. Johns	29.95527	-81.31259	6.7	10/07/2016	0.32
FLSTJ18505	Fla.	St. Johns	29.94995	-81.30860	6.5	10/07/2016	0.32
FLSTJ18507	Fla.	St. Johns	29.94965	-81.30606	6.7	10/07/2016	0.32
FLSTJ18509	Fla.	St. Johns	29.91352	-81.29129	8.3	10/07/2016	0.32
FLSTJ18510	Fla.	St. Johns	29.94661	-81.30777	6.7	10/07/2016	0.32
FLSTJ18512	Fla.	St. Johns	29.91405	-81.28961	9.1	10/07/2016	0.32
FLSTJ18513	Fla.	St. Johns	29.94553	-81.30396	6.7	10/07/2016	0.21
FLSTJ18516	Fla.	St. Johns	29.94335	-81.30703	6.6	10/07/2016	0.32
FLSTJ18517	Fla.	St. Johns	29.95524	-81.30891	5.9	10/07/2016	0.32
FLSTJ18520	Fla.	St. Johns	29.91539	-81.29057	6.6	10/07/2016	0.32
FLSTJ18524	Fla.	St. Johns	29.91859	-81.29404	7.2	10/07/2016	0.01
FLSTJ18525	Fla.	St. Johns	29.91998	-81.29573	7.1	10/07/2016	0.06
FLSTJ18529	Fla.	St. Johns	29.92210	-81.29843	7.1	10/07/2016	0.06
FLSTJ18532	Fla.	St. Johns	29.92294	-81.30014	7.2	10/07/2016	0.06

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
FLSTJ18535	Fla.	St. Johns	29.92415	-81.29867	7.1	10/07/2016	0.06
FLSTJ18536	Fla.	St. Johns	29.92435	-81.29654	7.1	10/07/2016	0.06
FLSTJ18537	Fla.	St. Johns	29.92545	-81.29609	7.1	10/07/2016	0.06
FLSTJ18539	Fla.	St. Johns	29.94018	-81.30274	6.9	10/07/2016	0.06
FLSTJ18540	Fla.	St. Johns	29.94248	-81.30724	6.9	10/07/2016	0.07
FLSTJ18541	Fla.	St. Johns	29.94383	-81.30216	6.8	10/07/2016	0.07
FLSTJ18542	Fla.	St. Johns	29.94004	-81.30524	7.0	10/07/2016	0.06
FLSTJ18579	Fla.	St. Johns	29.88115	-81.28260	7.8	10/07/2016	0.28
FLSTJ18582	Fla.	St. Johns	29.90013	-81.30034	7.5	10/07/2016	0.29
FLSTJ18584	Fla.	St. Johns	29.87958	-81.29290	7.4	10/07/2016	0.28
FLSTJ18585	Fla.	St. Johns	29.89988	-81.31625	6.4	10/07/2016	0.29
FLSTJ18587	Fla.	St. Johns	29.90512	-81.31633	7.6	10/07/2016	0.29
FLSTJ18588	Fla.	St. Johns	29.89375	-81.31535	7.1	10/07/2016	0.01
FLSTJ18590	Fla.	St. Johns	29.89226	-81.29831	7.6	10/07/2016	0.28
FLSTJ18592	Fla.	St. Johns	29.89267	-81.31440	7.1	10/07/2016	0.29
FLSTJ18594	Fla.	St. Johns	29.88185	-81.31423	7.2	10/07/2016	0.29
FLSTJ18595	Fla.	St. Johns	29.88210	-81.30842	7.2	10/07/2016	0.29
FLSTJ18597	Fla.	St. Johns	29.88423	-81.30963	7.1	10/07/2016	0.29
FLSTJ18598	Fla.	St. Johns	29.89605	-81.31875	7.0	10/07/2016	0.29
FLSTJ18599	Fla.	St. Johns	29.91869	-81.31583	7.0	10/07/2016	0.29
FLSTJ18600	Fla.	St. Johns	29.91195	-81.31928	6.0	10/07/2016	0.29
FLSTJ18601	Fla.	St. Johns	29.91472	-81.31707	6.9	10/07/2016	0.29
FLSTJ18602	Fla.	St. Johns	29.91517	-81.31178	7.3	10/07/2016	0.29
FLSTJ18610	Fla.	St. Johns	29.86313	-81.31403	7.6	10/07/2016	0.28
FLSTJ18616	Fla.	St. Johns	29.85370	-81.31334	7.4	10/07/2016	0.29
FLSTJ18630	Fla.	St. Johns	29.85609	-81.33070	7.6	10/07/2016	0.28
FLSTJ18633	Fla.	St. Johns	29.89905	-81.32799	6.9	10/07/2016	0.19
FLSTJ18636	Fla.	St. Johns	29.91471	-81.33329	6.6	10/07/2016	0.32
FLSTJ18809	Fla.	St. Johns	29.91684	-81.29799	7.1	10/07/2016	0.32
FLVOL03145	Fla.	Volusia	29.03143	-81.91590	0.4	10/07/2016	0.01
GABRY17927	Ga.	Bryan	31.88667	-81.19125	6.9	10/08/2016	0.14
GABRY17935	Ga.	Bryan	31.88094	-81.17806	6.4	10/08/2016	0.14
GABRY17945	Ga.	Bryan	31.90644	-81.25239	8.5	10/08/2016	0.14
GACAM17823	Ga.	Camden	30.72000	-81.54944	7.6	10/07/2016	0.20
GACAM17987	Ga.	Camden	30.72106	-81.54570	6.6	10/07/2016	0.20
GACAM18008	Ga.	Camden	30.73123	-81.54187	6.7	10/07/2016	0.20
GACAM18028	Ga.	Camden	30.72282	-81.55974	6.5	10/07/2016	0.20
GACAM18034	Ga.	Camden	30.88949	-81.55843	5.8	10/07/2016	0.07
GACAM18042	Ga.	Camden	31.09246	-81.57200	6.7	10/07/2016	0.04
GACAM18044	Ga.	Camden	30.74061	-81.56929	6.3	10/07/2016	0.07
GACAM18056	Ga.	Camden	30.74120	-81.59854	6.6	10/07/2016	0.07
GACAM18063	Ga.	Camden	31.02918	-81.53010	7.3	10/07/2016	0.04

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
GACAM18075	Ga.	Camden	30.75278	-81.65812	5.0	10/07/2016	0.07
GACAM18222	Ga.	Camden	30.81528	-81.57694	6.4	10/07/2016	0.07
GACHA17838	Ga.	Chatham	32.00365	-80.96099	7.3	10/08/2016	0.10
GACHA17904	Ga.	Chatham	31.95826	-81.01139	8.1	10/08/2016	0.01
GACHA17905	Ga.	Chatham	31.93970	-81.02504	7.0	10/08/2016	0.04
GACHA17906	Ga.	Chatham	31.97600	-81.00100	10.9	10/08/2016	0.02
GACHA17907	Ga.	Chatham	31.97278	-81.00003	7.5	10/08/2016	0.02
GACHA17908	Ga.	Chatham	31.89087	-81.06056	7.1	10/08/2016	0.31
GACHA17909	Ga.	Chatham	31.95841	-81.01239	8.6	10/08/2016	0.04
GACHA17910	Ga.	Chatham	31.91015	-81.07119	7.9	10/08/2016	0.04
GACHA17911	Ga.	Chatham	31.98947	-81.02159	8.0	10/08/2016	0.31
GACHA17912	Ga.	Chatham	31.97904	-80.99432	8.9	10/08/2016	0.02
GACHA17913	Ga.	Chatham	32.00764	-80.99047	7.9	10/08/2016	0.35
GACHA17914	Ga.	Chatham	31.92339	-81.07031	10.5	10/08/2016	0.31
GACHA17915	Ga.	Chatham	31.99215	-80.98011	7.7	10/08/2016	0.35
GACHA17916	Ga.	Chatham	31.94709	-81.02077	8.2	10/08/2016	0.04
GACHA17917	Ga.	Chatham	32.03375	-80.90287	8.5	10/08/2016	0.17
GACHA17918	Ga.	Chatham	31.96485	-81.04361	6.7	10/08/2016	0.31
GACHA17919	Ga.	Chatham	32.03997	-80.97077	7.8	10/08/2016	0.14
GACHA17920	Ga.	Chatham	32.03099	-80.90149	8.6	10/08/2016	0.17
GACHA17924	Ga.	Chatham	32.01449	-80.88276	8.0	10/08/2016	0.14
GACHA17926	Ga.	Chatham	32.00137	-80.86307	7.9	10/08/2016	0.20
GACHA17932	Ga.	Chatham	32.02087	-80.85939	8.8	10/08/2016	0.05
GACHA17937	Ga.	Chatham	32.01988	-80.86129	9.0	10/08/2016	0.17
GACHA17939	Ga.	Chatham	32.00210	-80.84852	7.3	10/08/2016	0.05
GACHA17944	Ga.	Chatham	31.99738	-80.85448	7.5	10/08/2016	0.05
GACHA17950	Ga.	Chatham	32.01102	-80.84124	9.5	10/08/2016	0.17
GACHA17983	Ga.	Chatham	32.00757	-80.84169	9.9	10/08/2016	0.05
GAGLY17929	Ga.	Glynn	31.15653	-81.49898	4.4	10/07/2016	0.04
GAGLY17930	Ga.	Glynn	31.14293	-81.41391	6.6	10/07/2016	0.10
GAGLY17933	Ga.	Glynn	31.13514	-81.47851	6.2	10/07/2016	0.04
GAGLY17936	Ga.	Glynn	31.13384	-81.39460	9.4	10/07/2016	0.10
GAGLY17938	Ga.	Glynn	31.15282	-81.47786	6.6	10/07/2016	0.04
GAGLY17940	Ga.	Glynn	31.13789	-81.38058	7.3	10/07/2016	0.13
GAGLY17943	Ga.	Glynn	31.11390	-81.41545	6.8	10/07/2016	0.06
GAGLY17946	Ga.	Glynn	31.13398	-81.39517	7.6	10/07/2016	0.13
GAGLY17949	Ga.	Glynn	31.14353	-81.37250	7.7	10/07/2016	0.13
GAGLY17953	Ga.	Glynn	31.17183	-81.36986	6.7	10/07/2016	0.13
GAGLY17958	Ga.	Glynn	31.02250	-81.43437	7.0	10/07/2016	0.06
GAGLY17958	Ga.	Glynn	31.02288	-81.43415	7.6	10/07/2016	0.06
GAGLY17973	Ga.	Glynn	31.18984	-81.33796	9.5	10/07/2016	0.13
GAGLY17975	Ga.	Glynn	31.22359	-81.32139	6.4	10/07/2016	0.13

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
GAGLY18010	Ga.	Glynn	31.10959	-81.41345	6.7	10/07/2016	0.06
GAGLY18015	Ga.	Glynn	31.05223	-81.42128	6.7	10/07/2016	0.06
GAGLY18018	Ga.	Glynn	31.16961	-81.53375	6.8	10/07/2016	0.04
GAGLY18030	Ga.	Glynn	31.15244	-81.54701	6.9	10/07/2016	0.04
GAGLY18061	Ga.	Glynn	31.05055	-81.44594	6.6	10/07/2016	0.06
GAGLY18083	Ga.	Glynn	31.17041	-81.40872	6.5	10/07/2016	0.13
GALIB17974	Ga.	Liberty	31.69501	-81.27148	6.7	10/08/2016	0.12
GALIB17976	Ga.	Liberty	31.71202	-81.28653	7.1	10/08/2016	0.12
GALIB17978	Ga.	Liberty	31.64410	-81.39302	5.2	10/08/2016	0.12
GALIB18059	Ga.	Liberty	31.76442	-81.28000	6.6	10/08/2016	0.12
GALIB18066	Ga.	Liberty	31.73425	-81.23864	7.0	10/08/2016	0.12
GAMCII7980	Ga.	Mcintosh	31.63615	-81.33689	6.4	10/08/2016	0.12
GAMCII7991	Ga.	Mcintosh	31.49505	-81.35787	10.0	10/08/2016	0.12
GAMCII8050	Ga.	Mcintosh	31.61864	-81.26508	6.3	10/08/2016	0.12
NCBEA11768	N.C.	Beaufort	35.47718	-76.81563	3.8	10/08/2016	0.01
NCBEA13648	N.C.	Beaufort	35.53285	-76.61469	3.2	10/08/2016	0.07
NCBRU12068	N.C.	Brunswick	33.91696	-78.01791	6.0	10/08/2016	0.12
NCBRU17982	N.C.	Brunswick	33.91972	-78.18972	5.8	10/08/2016	0.12
NCBRU18039	N.C.	Brunswick	33.86578	-78.51686	6.0	10/08/2016	0.12
NCBRU18045	N.C.	Brunswick	33.86961	-78.51937	6.8	10/08/2016	0.12
NCBRU18052	N.C.	Brunswick	33.91831	-78.02818	5.6	10/08/2016	0.12
NCBRU18067	N.C.	Brunswick	33.91612	-78.02287	5.2	10/08/2016	0.12
NCBRU18112	N.C.	Brunswick	33.87333	-78.49528	7.1	10/08/2016	0.06
NCBRU18130	N.C.	Brunswick	33.91341	-78.14641	7.8	10/08/2016	0.12
NCBRU18139	N.C.	Brunswick	33.87333	-78.49528	7.0	10/08/2016	0.02
NCBRU18153	N.C.	Brunswick	33.87361	-78.54861	7.3	10/08/2016	0.00
NCBRU18181	N.C.	Brunswick	33.89028	-78.43361	6.8	10/08/2016	0.00
NCBRU18190	N.C.	Brunswick	33.92278	-78.21281	6.2	10/08/2016	0.12
NCBRU18201	N.C.	Brunswick	33.87778	-78.47194	6.8	10/08/2016	0.00
NCBRU18219	N.C.	Brunswick	33.92616	-78.12595	5.4	10/08/2016	0.12
NCBRU18236	N.C.	Brunswick	33.89778	-78.39583	8.3	10/08/2016	0.00
NCBRU18241	N.C.	Brunswick	33.90194	-78.39222	6.8	10/08/2016	0.00
NCBRU18297	N.C.	Brunswick	33.92306	-78.40917	7.1	10/08/2016	0.12
NCBRU18320	N.C.	Brunswick	34.03848	-77.94429	5.4	10/08/2016	0.12
NCBRU18325	N.C.	Brunswick	33.91583	-78.39472	6.9	10/08/2016	0.12
NCBRU18358	N.C.	Brunswick	33.93015	-78.22126	6.0	10/08/2016	0.12
NCBRU18394	N.C.	Brunswick	33.91720	-78.26875	6.4	10/08/2016	0.12
NCBRU18405	N.C.	Brunswick	33.91060	-78.36247	6.4	10/08/2016	0.12
NCBRU18586	N.C.	Brunswick	33.90236	-78.39222	6.8	10/08/2016	0.00
NCCAR06848	N.C.	Carteret	34.68673	-77.04570	2.3	10/08/2016	0.05
NCCAR06850	N.C.	Carteret	34.69450	-77.00800	4.2	10/08/2016	0.05
NCCAR06854	N.C.	Carteret	34.70273	-77.01162	4.2	10/08/2016	0.05

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
NCCAR18053	N.C.	Carteret	34.67803	-77.10895	2.4	10/08/2016	0.23
NCCAR18183	N.C.	Carteret	34.64500	-77.09154	6.6	10/08/2016	0.23
NCCAR18186	N.C.	Carteret	34.64446	-77.09524	6.5	10/08/2016	0.23
NCCAR18211	N.C.	Carteret	34.66487	-77.05801	4.7	10/08/2016	0.05
NCCAR18214	N.C.	Carteret	34.66751	-77.04883	4.1	10/08/2016	0.05
NCCAR18225	N.C.	Carteret	34.67152	-77.03256	3.1	10/08/2016	0.05
NCCAR18247	N.C.	Carteret	34.66907	-77.02471	3.9	10/08/2016	0.05
NCCAR18259	N.C.	Carteret	34.67115	-77.00665	2.8	10/08/2016	0.05
NCCAR18276	N.C.	Carteret	34.67308	-76.99565	3.8	10/08/2016	0.05
NCCAR18285	N.C.	Carteret	34.67415	-76.98737	2.1	10/08/2016	0.05
NCCAR18353	N.C.	Carteret	34.68063	-77.06515	2.5	10/08/2016	0.23
NCCAR18364	N.C.	Carteret	34.66561	-77.06319	2.6	10/08/2016	0.23
NCCAR18380	N.C.	Carteret	34.64680	-77.09841	3.9	10/08/2016	0.23
NCCAR18395	N.C.	Carteret	34.66166	-77.07174	3.9	10/08/2016	0.23
NCCAR18400	N.C.	Carteret	34.67470	-76.98325	2.5	10/08/2016	0.05
NCCAR18433	N.C.	Carteret	34.71908	-76.71592	4.1	10/08/2016	0.16
NCCAR18446	N.C.	Carteret	34.72256	-76.75031	3.8	10/08/2016	0.16
NCDAR00001	N.C.	Dare	35.20791	-75.70284	6.0	10/09/2016	0.05
NCDAR00002	N.C.	Dare	35.26652	-75.55763	6.4	10/09/2016	0.12
NCDAR00004	N.C.	Dare	35.35015	-75.51197	4.8	10/09/2016	0.12
NCDAR00005	N.C.	Dare	35.79660	-75.54920	2.7	10/09/2016	0.04
NCDAR00010	N.C.	Dare	35.69831	-75.77044	2.7	10/09/2016	0.05
NCDAR12631	N.C.	Dare	35.90963	-75.60209	4.3	10/09/2016	0.15
NCDAR12790	N.C.	Dare	35.26621	-75.51936	7.6	10/09/2016	0.12
NCDAR17981	N.C.	Dare	36.01389	-75.68028	3.4	10/09/2016	0.06
NCDAR17999	N.C.	Dare	36.01528	-75.68417	3.3	10/09/2016	0.06
NCDAR18011	N.C.	Dare	36.01361	-75.68639	3.2	10/09/2016	0.06
NCDAR18013	N.C.	Dare	36.01417	-75.69028	2.6	10/09/2016	0.06
NCDAR18040	N.C.	Dare	36.00275	-75.68986	2.3	10/09/2016	0.06
NCDAR18057	N.C.	Dare	36.00944	-75.69861	3.5	10/09/2016	0.06
NCDAR18064	N.C.	Dare	36.00917	-75.70389	3.4	10/09/2016	0.01
NCDAR18072	N.C.	Dare	36.01417	-75.71111	3.9	10/09/2016	0.06
NCDAR18080	N.C.	Dare	36.02111	-75.71111	3.1	10/09/2016	0.06
NCDAR18092	N.C.	Dare	36.02222	-75.72667	5.0	10/09/2016	0.06
NCDAR18103	N.C.	Dare	36.00860	-75.72790	3.3	10/09/2016	0.06
NCDAR18109	N.C.	Dare	36.00472	-75.72583	5.0	10/09/2016	0.06
NCDAR18171	N.C.	Dare	35.99611	-75.70139	3.2	10/09/2016	0.06
NCDAR18175	N.C.	Dare	35.95139	-75.63194	3.9	10/09/2016	0.06
NCDAR18180	N.C.	Dare	35.94556	-75.62806	4.2	10/09/2016	0.06
NCDAR18185	N.C.	Dare	35.93680	-75.62180	4.3	10/09/2016	0.06
NCDAR18195	N.C.	Dare	35.92999	-75.61751	4.0	10/09/2016	0.06
NCDAR18203	N.C.	Dare	35.92317	-75.61202	3.7	10/09/2016	0.06

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
NCDAR18205	N.C.	Dare	35.26484	-75.52645	5.8	10/09/2016	0.04
NCDAR18239	N.C.	Dare	35.91495	-75.60471	4.1	10/09/2016	0.06
NCDAR18257	N.C.	Dare	35.89304	-75.64457	4.2	10/09/2016	0.06
NCDAR18293	N.C.	Dare	35.88640	-75.58570	2.4	10/09/2016	0.06
NCDAR18303	N.C.	Dare	35.88480	-75.58890	2.4	10/09/2016	0.06
NCDAR18318	N.C.	Dare	35.21012	-75.69976	3.8	10/09/2016	0.06
NCDAR18319	N.C.	Dare	35.24696	-75.61299	6.3	10/09/2016	0.04
NCDAR18321	N.C.	Dare	35.22902	-75.63368	6.8	10/09/2016	0.04
NCDAR18323	N.C.	Dare	35.20861	-75.69806	6.2	10/09/2016	0.06
NCDAR18324	N.C.	Dare	35.21362	-75.69553	6.3	10/09/2016	0.06
NCDAR18326	N.C.	Dare	35.22009	-75.69058	6.3	10/09/2016	0.06
NCDAR18327	N.C.	Dare	35.22015	-75.69028	6.5	10/09/2016	0.04
NCDAR18329	N.C.	Dare	35.22486	-75.68259	6.0	10/09/2016	0.04
NCDAR18330	N.C.	Dare	35.21849	-75.69540	6.4	10/09/2016	0.06
NCDAR18331	N.C.	Dare	35.21470	-75.69153	6.3	10/09/2016	0.06
NCDAR18332	N.C.	Dare	35.21078	-75.69399	6.0	10/09/2016	0.04
NCDAR18342	N.C.	Dare	35.90374	-75.66976	4.2	10/09/2016	0.06
NCDAR18350	N.C.	Dare	35.92312	-75.66630	3.5	10/09/2016	0.02
NCDAR18366	N.C.	Dare	35.93309	-75.72611	4.2	10/09/2016	0.02
NCDAR18379	N.C.	Dare	35.92191	-75.71386	3.1	10/09/2016	0.02
NCDAR18383	N.C.	Dare	35.90699	-75.69572	2.9	10/09/2016	0.02
NCDAR18409	N.C.	Dare	35.21783	-75.67456	7.2	10/09/2016	0.01
NCDAR18413	N.C.	Dare	35.21440	-75.68476	6.6	10/09/2016	0.04
NCDAR18419	N.C.	Dare	35.22103	-75.65643	7.6	10/09/2016	0.04
NCDAR18421	N.C.	Dare	35.21742	-75.66913	7.8	10/09/2016	0.01
NCDAR18425	N.C.	Dare	35.26438	-75.59025	6.1	10/09/2016	0.04
NCHYD18476	N.C.	Hyde	35.11057	-75.97057	5.2	10/09/2016	0.00
NCHYD18478	N.C.	Hyde	35.11692	-75.98453	4.2	10/09/2016	0.00
NCHYD18479	N.C.	Hyde	35.11186	-75.97998	4.7	10/09/2016	0.00
NCHYD18480	N.C.	Hyde	35.10893	-75.98603	3.5	10/09/2016	0.00
NCHYD18481	N.C.	Hyde	35.12616	-75.92184	5.6	10/09/2016	0.00
NCNEW17955	N.C.	New Hanover	34.21808	-77.81372	5.4	10/08/2016	0.09
NCNEW17956	N.C.	New Hanover	34.22638	-77.78077	9.7	10/08/2016	0.04
NCNEW17971	N.C.	New Hanover	34.21480	-77.81733	4.8	10/08/2016	0.09
NCNEW17972	N.C.	New Hanover	34.21975	-77.78507	9.0	10/08/2016	0.04
NCNEW18014	N.C.	New Hanover	34.20119	-77.79911	11.0	10/08/2016	0.04
NCNEW18020	N.C.	New Hanover	34.19239	-77.80564	10.4	10/08/2016	0.04
NCNEW18024	N.C.	New Hanover	34.18719	-77.80978	8.5	10/08/2016	0.04
NCNEW18104	N.C.	New Hanover	34.21792	-77.79758	5.1	10/08/2016	0.09
NCNEW18106	N.C.	New Hanover	34.21781	-77.81200	5.4	10/08/2016	0.09
NCNEW18107	N.C.	New Hanover	34.19978	-77.82658	3.2	10/08/2016	0.09
NCNEW18107	N.C.	New Hanover	34.19978	-77.82658	3.2	10/08/2016	0.09

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
NCNEW18192	N.C.	New Hanover	34.19767	-77.86331	5.5	10/08/2016	0.09
NCNEW18193	N.C.	New Hanover	34.19217	-77.85431	5.2	10/08/2016	0.09
NCNEW18197	N.C.	New Hanover	34.18636	-77.83458	5.7	10/08/2016	0.09
NCNEW18333	N.C.	New Hanover	34.04028	-77.88867	12.0	10/08/2016	na
NCNEW18334	N.C.	New Hanover	34.07519	-77.88686	4.9	10/08/2016	0.17
NCNEW18336	N.C.	New Hanover	34.07678	-77.87842	5.6	10/08/2016	0.17
NCNEW18337	N.C.	New Hanover	34.07625	-77.87875	4.6	10/08/2016	0.17
NCNEW18338	N.C.	New Hanover	34.05331	-77.88292	8.2	10/08/2016	0.17
NCNEW18339	N.C.	New Hanover	34.04672	-77.88589	13.7	10/08/2016	na
NCNEW18434	N.C.	New Hanover	34.07794	-77.92394	6.6	10/08/2016	0.17
NCNEW18436	N.C.	New Hanover	34.11369	-77.92536	5.6	10/08/2016	0.17
NCNEW18439	N.C.	New Hanover	34.07264	-77.92061	4.9	10/08/2016	0.17
NCONS18007	N.C.	Onslow	34.68650	-77.12008	4.1	10/08/2016	0.23
NCONS18016	N.C.	Onslow	34.68615	-77.12453	3.2	10/08/2016	0.23
NCONS18031	N.C.	Onslow	34.68356	-77.12902	4.4	10/08/2016	0.23
NCONS18071	N.C.	Onslow	34.68400	-77.11415	3.7	10/08/2016	0.23
NCONS18078	N.C.	Onslow	34.68532	-77.11543	4.1	10/08/2016	0.23
NCONS18238	N.C.	Onslow	34.57219	-77.39389	3.6	10/08/2016	0.11
NCONS18255	N.C.	Onslow	34.56650	-77.39391	2.1	10/08/2016	0.11
NCONS18281	N.C.	Onslow	34.56807	-77.38570	1.9	10/08/2016	0.11
NCONS18288	N.C.	Onslow	34.56323	-77.38108	1.8	10/08/2016	0.11
NCONS18298	N.C.	Onslow	34.56061	-77.37228	3.4	10/08/2016	0.11
NCONS18346	N.C.	Onslow	34.55250	-77.36600	3.3	10/08/2016	0.11
NCONS18368	N.C.	Onslow	34.50436	-77.39414	7.0	10/08/2016	0.11
NCONS18370	N.C.	Onslow	34.50632	-77.39115	3.2	10/08/2016	0.11
NCONS18375	N.C.	Onslow	34.51484	-77.37291	3.2	10/08/2016	0.11
NCPEN18548	N.C.	Pender	34.36499	-77.62862	9.4	10/08/2016	0.11
SCBEA17963	S.C.	Beaufort	32.13833	-80.81085	8.0	10/08/2016	0.06
SCBEA17964	S.C.	Beaufort	32.13375	-80.81323	8.0	10/08/2016	0.06
SCBEA17965	S.C.	Beaufort	32.13381	-80.81318	8.0	10/08/2016	0.06
SCBEA17968	S.C.	Beaufort	32.12338	-80.78909	10.2	10/08/2016	0.10
SCBEA17969	S.C.	Beaufort	32.14055	-80.75175	10.9	10/08/2016	0.10
SCBEA17970	S.C.	Beaufort	32.10951	-80.82182	7.9	10/08/2016	0.27
SCBEA18155	S.C.	Beaufort	32.20013	-80.68959	8.1	10/08/2016	0.10
SCBEA18156	S.C.	Beaufort	32.23099	-80.68798	7.6	10/08/2016	0.06
SCBEA18157	S.C.	Beaufort	32.24618	-80.74522	8.4	10/08/2016	0.06
SCBEA18159	S.C.	Beaufort	32.19875	-80.71910	7.2	10/08/2016	0.10
SCBEA18162	S.C.	Beaufort	32.16241	-80.78709	7.8	10/08/2016	0.06
SCBEA18163	S.C.	Beaufort	32.22653	-80.75534	9.3	10/08/2016	0.06
SCBEA18164	S.C.	Beaufort	32.25446	-80.80089	8.1	10/08/2016	0.27
SCBEA18165	S.C.	Beaufort	32.28459	-80.83587	8.6	10/08/2016	0.08
SCBEA18166	S.C.	Beaufort	32.29201	-80.85943	9.3	10/08/2016	0.08

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
SCBEA18200	S.C.	Beaufort	32.30736	-80.50075	8.1	10/08/2016	0.11
SCBEA18235	S.C.	Beaufort	32.30906	-80.49300	8.4	10/08/2016	0.11
SCBEA18244	S.C.	Beaufort	32.31454	-80.48090	7.5	10/08/2016	0.11
SCBEA18519	S.C.	Beaufort	32.33820	-80.85745	9.3	10/08/2016	0.18
SCBEA18531	S.C.	Beaufort	32.31961	-80.85699	8.0	10/08/2016	0.18
SCBEA18538	S.C.	Beaufort	32.34234	-80.84061	9.4	10/08/2016	0.18
SCBEA18543	S.C.	Beaufort	32.33041	-80.81367	7.5	10/08/2016	0.18
SCBEA18550	S.C.	Beaufort	32.37318	-80.71624	7.4	10/08/2016	0.11
SCBEA18551	S.C.	Beaufort	32.35078	-80.69949	6.0	10/08/2016	0.11
SCBEA18552	S.C.	Beaufort	32.32914	-80.71118	8.8	10/08/2016	0.11
SCBEA18553	S.C.	Beaufort	32.30663	-80.67593	7.6	10/08/2016	0.11
SCBEA18554	S.C.	Beaufort	32.35153	-80.67038	8.7	10/08/2016	0.11
SCBEA18555	S.C.	Beaufort	32.37058	-80.68704	5.5	10/08/2016	0.11
SCBEA18556	S.C.	Beaufort	32.38733	-80.67923	7.7	10/08/2016	0.11
SCBEA18557	S.C.	Beaufort	32.37132	-80.72931	7.3	10/08/2016	0.11
SCBEA18565	S.C.	Beaufort	32.34308	-80.46270	7.8	10/08/2016	0.12
SCBEA18566	S.C.	Beaufort	32.40460	-80.43369	7.5	10/08/2016	0.12
SCBEA18567	S.C.	Beaufort	32.41115	-80.43529	8.0	10/08/2016	0.12
SCBEA18569	S.C.	Beaufort	32.44738	-80.65794	7.2	10/08/2016	0.08
SCBEA18575	S.C.	Beaufort	32.50080	-80.67840	8.1	10/08/2016	0.08
SCBEA18589	S.C.	Beaufort	32.32598	-80.46957	5.9	10/08/2016	0.11
SCBEA18593	S.C.	Beaufort	32.31871	-80.46817	8.4	10/08/2016	0.11
SCCHA18114	S.C.	Charleston	32.79014	-79.92536	7.5	10/08/2016	0.00
SCCHA18116	S.C.	Charleston	32.77532	-79.92591	6.4	10/08/2016	0.02
SCCHA18118	S.C.	Charleston	32.79028	-79.92544	7.2	10/08/2016	0.00
SCCHA18119	S.C.	Charleston	32.76972	-79.93000	5.6	10/08/2016	0.02
SCCHA18121	S.C.	Charleston	32.56234	-80.18030	7.2	10/08/2016	0.20
SCCHA18123	S.C.	Charleston	32.55975	-80.17295	12.4	10/08/2016	0.20
SCCHA18124	S.C.	Charleston	32.55984	-80.17262	12.0	10/08/2016	0.20
SCCHA18127	S.C.	Charleston	32.55984	-80.17246	11.0	10/08/2016	0.20
SCCHA18129	S.C.	Charleston	32.56039	-80.16627	7.1	10/08/2016	0.20
SCCHA18131	S.C.	Charleston	32.58901	-80.12449	10.5	10/08/2016	0.02
SCCHA18132	S.C.	Charleston	32.56019	-80.16643	10.5	10/08/2016	0.20
SCCHA18133	S.C.	Charleston	32.59389	-80.11303	13.3	10/08/2016	0.02
SCCHA18134	S.C.	Charleston	32.56884	-80.16371	7.1	10/08/2016	0.20
SCCHA18138	S.C.	Charleston	32.57213	-80.16340	7.4	10/08/2016	0.20
SCCHA18140	S.C.	Charleston	32.58090	-80.15916	7.3	10/08/2016	0.20
SCCHA18143	S.C.	Charleston	32.64843	-79.95357	9.8	10/08/2016	0.03
SCCHA18144	S.C.	Charleston	32.68111	-79.89182	8.1	10/08/2016	na
SCCHA18145	S.C.	Charleston	32.65294	-79.94418	10.0	10/08/2016	0.03
SCCHA18146	S.C.	Charleston	32.65730	-79.93343	9.7	10/08/2016	0.03
SCCHA18150	S.C.	Charleston	32.66243	-79.92200	10.0	10/08/2016	0.03

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
SCCHA18151	S.C.	Charleston	32.66581	-79.91491	7.6	10/08/2016	0.03
SCCHA18152	S.C.	Charleston	32.56929	-80.18489	6.3	10/08/2016	0.20
SCCHA18168	S.C.	Charleston	32.81904	-79.98168	6.2	10/08/2016	0.03
SCCHA18169	S.C.	Charleston	32.82253	-80.01105	6.4	10/08/2016	0.03
SCCHA18170	S.C.	Charleston	32.80249	-79.93252	6.3	10/08/2016	0.00
SCCHA18173	S.C.	Charleston	32.75247	-79.91585	5.0	10/08/2016	0.06
SCCHA18177	S.C.	Charleston	32.77644	-79.96342	6.3	10/08/2016	0.03
SCCHA18182	S.C.	Charleston	32.83326	-79.93830	6.1	10/08/2016	0.00
SCCHA18209	S.C.	Charleston	32.87029	-79.96685	6.1	10/08/2016	0.00
SCCHA18254	S.C.	Charleston	32.95230	-79.64658	6.5	10/08/2016	0.00
SCCHA18271	S.C.	Charleston	32.96174	-79.64136	7.0	10/08/2016	0.00
SCCHA18290	S.C.	Charleston	32.98112	-79.62443	6.2	10/08/2016	0.00
SCCHA18301	S.C.	Charleston	33.00480	-79.59903	7.1	10/08/2016	0.00
SCCHA18305	S.C.	Charleston	32.81322	-79.72039	6.5	10/08/2016	0.12
SCCHA18306	S.C.	Charleston	32.80561	-79.76093	4.6	10/08/2016	0.12
SCCHA18308	S.C.	Charleston	32.79857	-79.74988	7.9	10/08/2016	0.12
SCCHA18309	S.C.	Charleston	32.81067	-79.73749	5.9	10/08/2016	0.12
SCCHA18310	S.C.	Charleston	32.66613	-79.91438	9.7	10/08/2016	0.03
SCCHA18311	S.C.	Charleston	32.78565	-79.78556	8.6	10/08/2016	0.19
SCCHA18312	S.C.	Charleston	32.78322	-79.79812	3.6	10/08/2016	0.19
SCCHA18313	S.C.	Charleston	32.77162	-79.81486	8.4	10/08/2016	0.19
SCCHA18315	S.C.	Charleston	32.76485	-79.86261	5.7	10/08/2016	0.19
SCCHA18316	S.C.	Charleston	32.75652	-79.84208	6.4	10/08/2016	0.19
SCCHA18464	S.C.	Charleston	32.77330	-79.86280	6.1	10/08/2016	0.19
SCCHA18465	S.C.	Charleston	32.77344	-79.86294	5.0	10/08/2016	0.19
SCCHA18467	S.C.	Charleston	32.78593	-79.90679	6.2	10/08/2016	0.24
SCCOL17959	S.C.	Colleton	32.51338	-80.29149	7.8	10/08/2016	0.07
SCCOL17960	S.C.	Colleton	32.51510	-80.28789	8.0	10/08/2016	0.07
SCCOL17993	S.C.	Colleton	32.49549	-80.34517	6.8	10/08/2016	0.13
SCCOL18001	S.C.	Colleton	32.48280	-80.33997	7.6	10/08/2016	0.13
SCCOL18002	S.C.	Colleton	32.47959	-80.33358	7.8	10/08/2016	0.13
SCCOL18003	S.C.	Colleton	32.48420	-80.32555	8.0	10/08/2016	0.13
SCCOL18006	S.C.	Colleton	32.48842	-80.31854	8.1	10/08/2016	0.13
SCCOL18012	S.C.	Colleton	32.49425	-80.31028	8.1	10/08/2016	0.13
SCCOL18017	S.C.	Colleton	32.49966	-80.30216	9.2	10/08/2016	0.13
SCCOL18021	S.C.	Colleton	32.49912	-80.30293	9.4	10/08/2016	0.13
SCCOL18023	S.C.	Colleton	32.50239	-80.29849	8.2	10/08/2016	0.13
SCCOL18026	S.C.	Colleton	32.50426	-80.29768	6.8	10/08/2016	0.13
SCCOL18544	S.C.	Colleton	32.47914	-80.33070	10.2	10/08/2016	0.07
SCCOL18545	S.C.	Colleton	32.48859	-80.31727	9.0	10/08/2016	0.07
SCCOL18546	S.C.	Colleton	32.49997	-80.30113	9.3	10/08/2016	0.07
SCCOL18547	S.C.	Colleton	32.50837	-80.28982	8.1	10/08/2016	0.07

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
SCGEO17921	S.C.	Georgetown	33.53133	-79.05689	7.6	10/08/2016	0.03
SCGEO17922	S.C.	Georgetown	33.53386	-79.05419	7.7	10/08/2016	0.14
SCGEO17923	S.C.	Georgetown	33.53619	-79.05350	7.9	10/08/2016	0.14
SCGEO17925	S.C.	Georgetown	33.53828	-79.05133	6.9	10/08/2016	0.14
SCGEO17931	S.C.	Georgetown	33.57135	-79.00501	7.4	10/08/2016	0.24
SCGEO17934	S.C.	Georgetown	33.54350	-79.04725	6.7	10/08/2016	0.14
SCGEO17941	S.C.	Georgetown	33.54692	-79.04361	7.2	10/08/2016	0.14
SCGEO17942	S.C.	Georgetown	33.53469	-79.03074	7.2	10/08/2016	0.24
SCGEO17947	S.C.	Georgetown	33.56064	-79.02881	7.4	10/08/2016	0.04
SCGEO17948	S.C.	Georgetown	33.54230	-79.02355	9.2	10/08/2016	0.24
SCGEO17948	S.C.	Georgetown	33.54230	-79.02355	9.3	10/08/2016	0.24
SCGEO18037	S.C.	Georgetown	33.56572	-79.02417	7.5	10/08/2016	0.05
SCGEO18041	S.C.	Georgetown	33.56964	-79.02406	7.6	10/08/2016	0.05
SCGEO18046	S.C.	Georgetown	33.57117	-79.01733	6.8	10/08/2016	0.04
SCGEO18428	S.C.	Georgetown	33.30446	-79.29340	7.1	10/08/2016	0.07
SCGEO18431	S.C.	Georgetown	33.30623	-79.29369	5.7	10/08/2016	0.07
SCGEO18452	S.C.	Georgetown	33.35764	-79.15313	7.6	10/08/2016	0.14
SCGEO18468	S.C.	Georgetown	33.44426	-79.11353	6.4	10/08/2016	0.17
SCGEO18469	S.C.	Georgetown	33.43836	-79.11722	7.5	10/08/2016	0.17
SCGEO18470	S.C.	Georgetown	33.43414	-79.12035	8.1	10/08/2016	0.17
SCGEO18471	S.C.	Georgetown	33.42766	-79.12290	7.6	10/08/2016	0.17
SCGEO18472	S.C.	Georgetown	33.41859	-79.12838	7.4	10/08/2016	0.17
SCGEO18473	S.C.	Georgetown	33.41298	-79.13188	7.4	10/08/2016	0.17
SCGEO18475	S.C.	Georgetown	33.40170	-79.13778	8.3	10/08/2016	0.17
SCGEO18477	S.C.	Georgetown	33.44929	-79.11743	7.8	10/08/2016	0.05
SCGEO18488	S.C.	Georgetown	33.46826	-79.09683	9.7	10/08/2016	0.05
SCGEO18506	S.C.	Georgetown	33.49341	-79.07487	10.1	10/08/2016	0.05
SCGEO18526	S.C.	Georgetown	33.51603	-79.05048	7.7	10/08/2016	0.05
SCGEO18528	S.C.	Georgetown	33.51597	-79.05104	7.7	10/08/2016	0.05
SCHOR18029	S.C.	Horry	33.57734	-78.99934	6.9	10/08/2016	0.09
SCHOR18029	S.C.	Horry	33.57724	-78.99897	6.9	10/08/2016	0.09
SCHOR18048	S.C.	Horry	33.57533	-79.01186	6.7	10/08/2016	0.09
SCHOR18051	S.C.	Horry	33.57831	-79.00683	7.5	10/08/2016	0.09
SCHOR18055	S.C.	Horry	33.57681	-79.00056	7.2	10/08/2016	0.09
SCHOR18062	S.C.	Horry	33.57286	-79.00383	7.2	10/08/2016	0.09
SCHOR18074	S.C.	Horry	33.71340	-78.85369	10.1	10/08/2016	0.03
SCHOR18076	S.C.	Horry	33.58153	-78.99658	7.0	10/08/2016	0.03
SCHOR18084	S.C.	Horry	33.58739	-78.99283	7.0	10/08/2016	0.03
SCHOR18101	S.C.	Horry	33.58872	-78.98836	8.3	10/08/2016	0.04
SCHOR18108	S.C.	Horry	33.72400	-78.84037	9.2	10/08/2016	0.03
SCHOR18204	S.C.	Horry	33.84104	-78.60469	7.5	10/08/2016	0.09
SCHOR18212	S.C.	Horry	33.76990	-78.77247	10.8	10/08/2016	0.10

**Table 5.** Hurricane Matthew peak storm-tide high-water mark data recorded by the U.S. Geological Survey in Florida, Georgia, and North and South Carolina, October 2016.—Continued

[HWM, high water mark; ft, foot; NAVD 88, North American Vertical Datum of 1988; UTC, Coordinated Universal Time; ±, plus or minus; Fla., Florida; Ga., Georgia; N.C., North Carolina; na, not applicable; S.C., South Carolina]

Site identification	State	County	Latitude	Longitude	HWM surveyed elevation (ft above NAVD 88)	Peak storm-tide estimated date (UTC)	HWM survey uncertainty (± ft)
			Decimal degrees				
SCHOR18213	S.C.	Horry	33.83741	-78.62368	7.6	10/08/2016	0.09
SCHOR18218	S.C.	Horry	33.83369	-78.63661	7.6	10/08/2016	0.09
SCHOR18218	S.C.	Horry	33.83369	-78.63661	7.6	10/08/2016	0.09
SCHOR18228	S.C.	Horry	33.78890	-78.74073	8.0	10/08/2016	0.10
SCHOR18258	S.C.	Horry	33.83162	-78.64418	7.2	10/08/2016	0.09
SCHOR18266	S.C.	Horry	33.59414	-78.98275	9.5	10/08/2016	0.04
SCHOR18270	S.C.	Horry	33.83757	-78.64270	7.9	10/08/2016	0.07
SCHOR18275	S.C.	Horry	33.59819	-78.97908	9.4	10/08/2016	0.07
SCHOR18278	S.C.	Horry	33.79816	-78.71972	10.2	10/08/2016	0.07
SCHOR18279	S.C.	Horry	33.60161	-78.97542	8.2	10/08/2016	0.03
SCHOR18283	S.C.	Horry	33.60533	-78.97194	8.6	10/08/2016	0.03
SCHOR18289	S.C.	Horry	33.61375	-78.96461	7.9	10/08/2016	0.03
SCHOR18294	S.C.	Horry	33.63897	-78.94700	7.9	10/08/2016	0.06
SCHOR18299	S.C.	Horry	33.64325	-78.93753	7.6	10/08/2016	0.06
SCHOR18340	S.C.	Horry	33.80941	-78.69494	10.1	10/08/2016	0.07
SCHOR18359	S.C.	Horry	33.81698	-78.67542	10.0	10/08/2016	0.07
SCHOR18385	S.C.	Horry	33.68459	-78.88617	9.6	10/08/2016	0.03
SCHOR18390	S.C.	Horry	33.69060	-78.88033	11.2	10/08/2016	0.03
SCHOR18392	S.C.	Horry	33.69673	-78.87376	10.6	10/08/2016	0.03
SCHOR18445	S.C.	Horry	33.70261	-78.86727	9.8	10/08/2016	0.03
SCHOR18448	S.C.	Horry	33.82398	-78.65460	11.4	10/08/2016	0.07
SCHOR18448	S.C.	Horry	33.82398	-78.65460	11.4	10/08/2016	0.07
SCHOR18453	S.C.	Horry	33.80175	-78.71220	10.2	10/08/2016	0.07
SCHOR18460	S.C.	Horry	33.70864	-78.85986	9.3	10/08/2016	0.03
SCHOR18461	S.C.	Horry	33.80615	-78.70174	12.6	10/08/2016	0.07
SCHOR18463	S.C.	Horry	33.72965	-78.83259	9.2	10/08/2016	0.10
SCHOR18494	S.C.	Horry	33.73769	-78.82161	9.9	10/08/2016	0.10
SCHOR18494	S.C.	Horry	33.73769	-78.82161	9.5	10/08/2016	0.10
SCHOR18494	S.C.	Horry	33.73769	-78.82161	8.8	10/08/2016	0.10
SCHOR18496	S.C.	Horry	33.61536	-78.96220	11.5	10/08/2016	0.03
SCHOR18498	S.C.	Horry	33.61744	-78.96049	8.5	10/08/2016	0.07
SCHOR18502	S.C.	Horry	33.74632	-78.80930	11.6	10/08/2016	0.10
SCHOR18502	S.C.	Horry	33.74632	-78.80930	10.9	10/08/2016	0.10
SCHOR18503	S.C.	Horry	33.62134	-78.95776	8.9	10/08/2016	0.07
SCHOR18508	S.C.	Horry	33.65418	-78.92102	10.5	10/08/2016	0.06
SCHOR18511	S.C.	Horry	33.66201	-78.91402	8.5	10/08/2016	0.06
SCHOR18514	S.C.	Horry	33.67808	-78.89435	9.3	10/08/2016	0.06
SCHOR18515	S.C.	Horry	33.62828	-78.95023	10.3	10/08/2016	0.06
SCHOR18518	S.C.	Horry	33.68058	-78.89115	8.8	10/08/2016	0.06



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Publishing support provided by:

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