

Tracking Storm Tide and Coastal Flooding During Hurricane Matthew

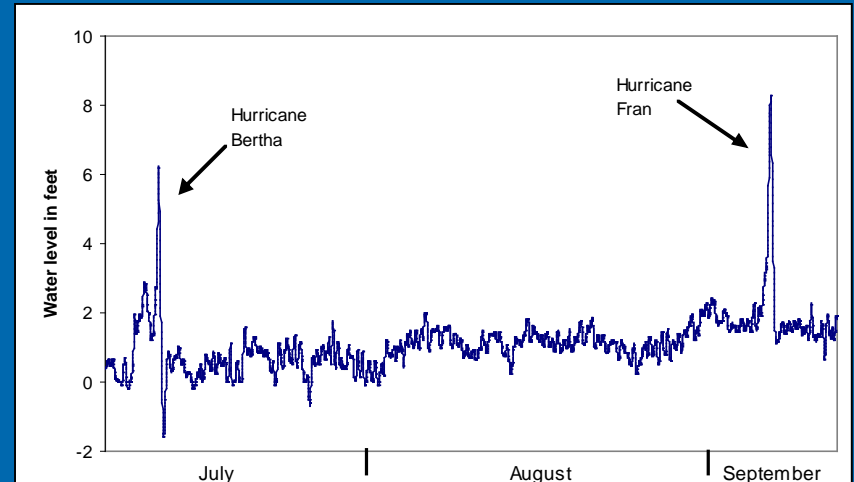


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U.S. Geological Survey, South Atlantic Water Science Center

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Background

- USGS has documented hurricane storm tides during past 20 years
- Historical data collection
 - Continuous streamgages
 - High-water marks

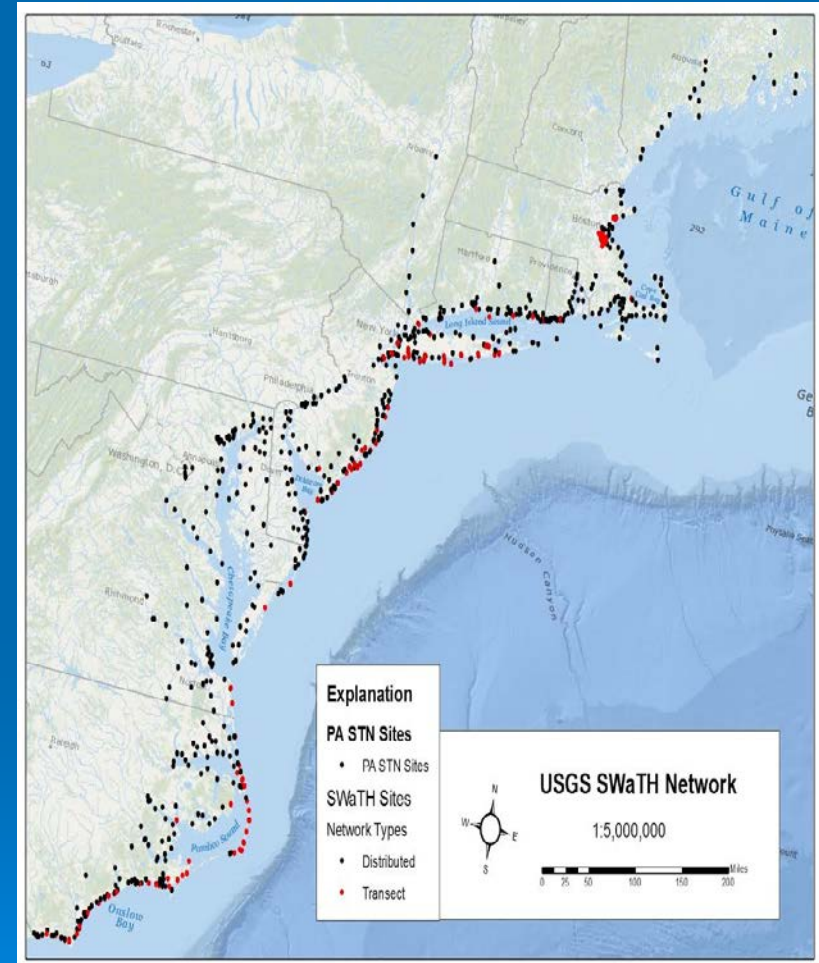


- HWMs provide useful data on peak water levels
- HWMs have limited utility to assess:
 - Timing or duration of flooding
 - Travel pathways by which storm-surge waters arrived
 - Magnitude of waves and wave run-up



Mobile Storm-Tide Monitoring Network

- Provide time-series data during the entire surge event
- Networks allow rapid deployment of storm-tide sensors to monitor a storm
- Improves the timeliness of data analysis and release
- Networks along Atlantic and Gulf coast states



Storm-Tide Network in North Carolina

- Pre-established sites where fixed brackets have been installed and surveyed to a datum
- Sites used to deploy
 - Rapid deployment gages (RDG)
 - Storm-tide sensors (STS)
- NC network includes
 - 10 RDG sites
 - 165 STS sites
 - Not all sites will be fitted with sensors for any one storm



- Rapid Deployment Gages
 - Collect and transmit data over GOES satellite every 6 min
 - Enhances amount of real-time data provided during a storm
 - Tide stage measured through non-contact radar
 - Wind direction & speed
 - Air temperature & pressure
 - Relative humidity
 - Precipitation

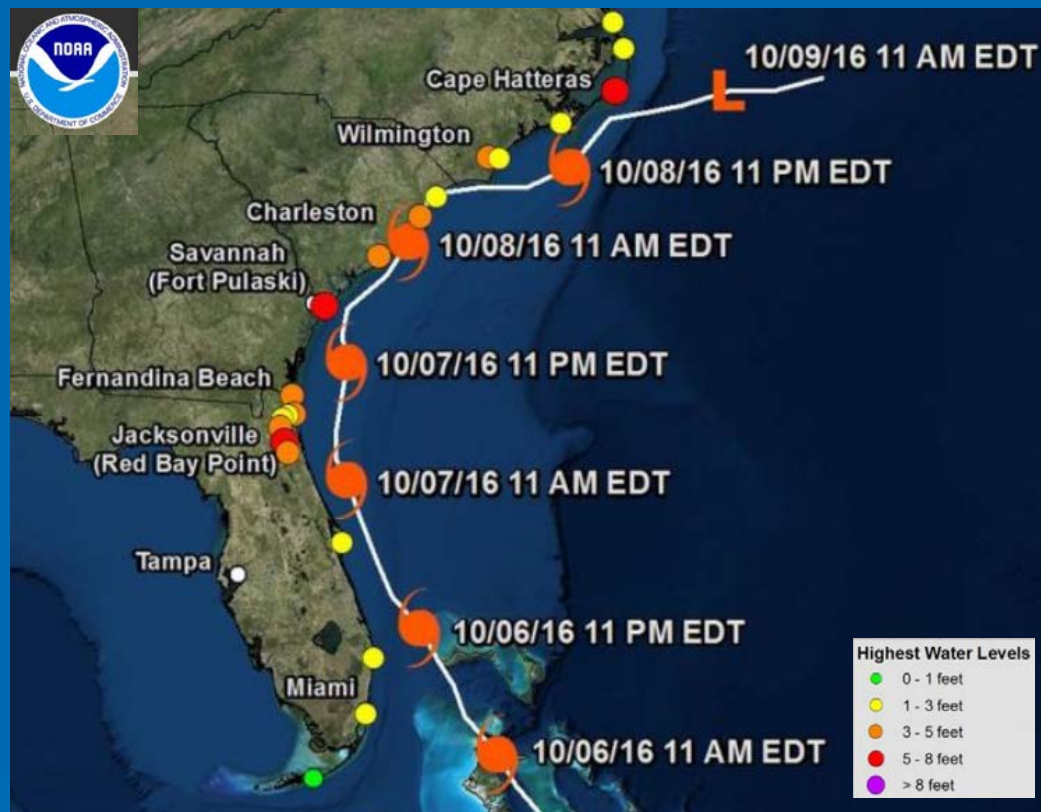


- Storm-Tide Sensors

- Self-contained pressure transducers
- Attached to inner sleeve in a protective pipe housing that is inserted into the fixed bracket
- Collect data at sub-second (0.25) or longer intervals to capture both tide and wave information
- Sensors also used to measure atmospheric pressure
- Sensors are non-real time so data retrieved, processed, and released following the storm



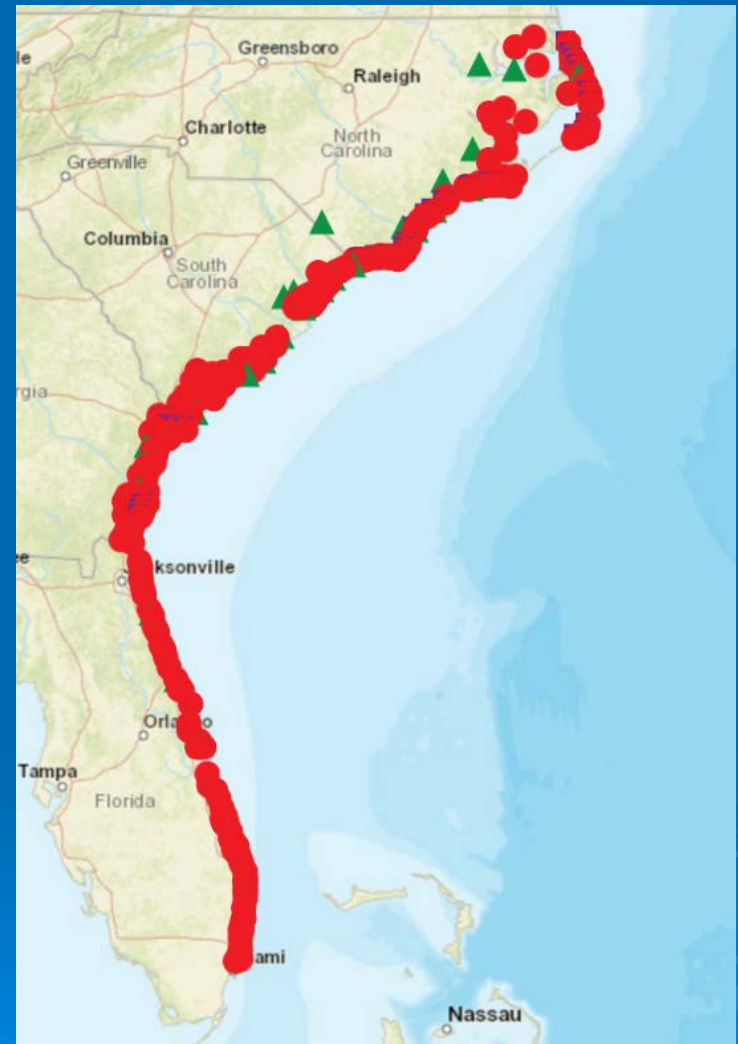
USGS Response to Hurricane Matthew



- USGS storm-tide network activated to monitor storm tide and coastal flooding generated by Hurricane Matthew

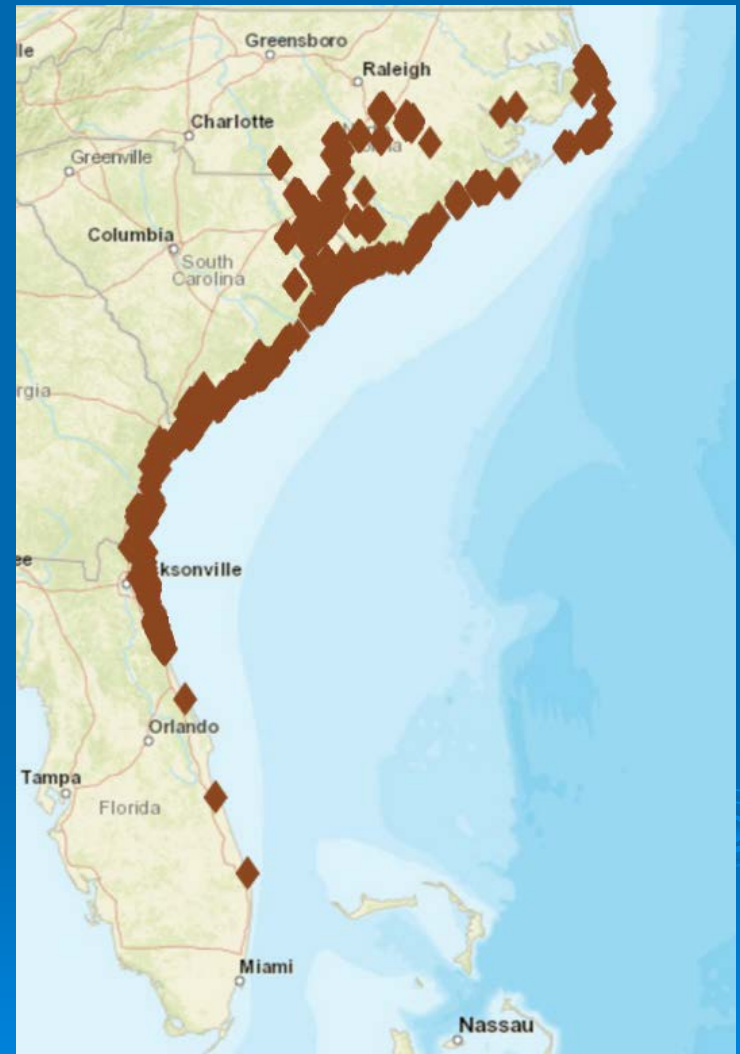
Deployed network for Hurricane Matthew

- Sensors were deployed at 284 locations along the Atlantic coast from Florida to North Carolina
- RDGs deployed at 27 sites
- STSs deployed at 257 sites
 - 223 storm-tide sites
 - 34 wave-height sites
- Barometric pressure sensors deployed at 89 locations



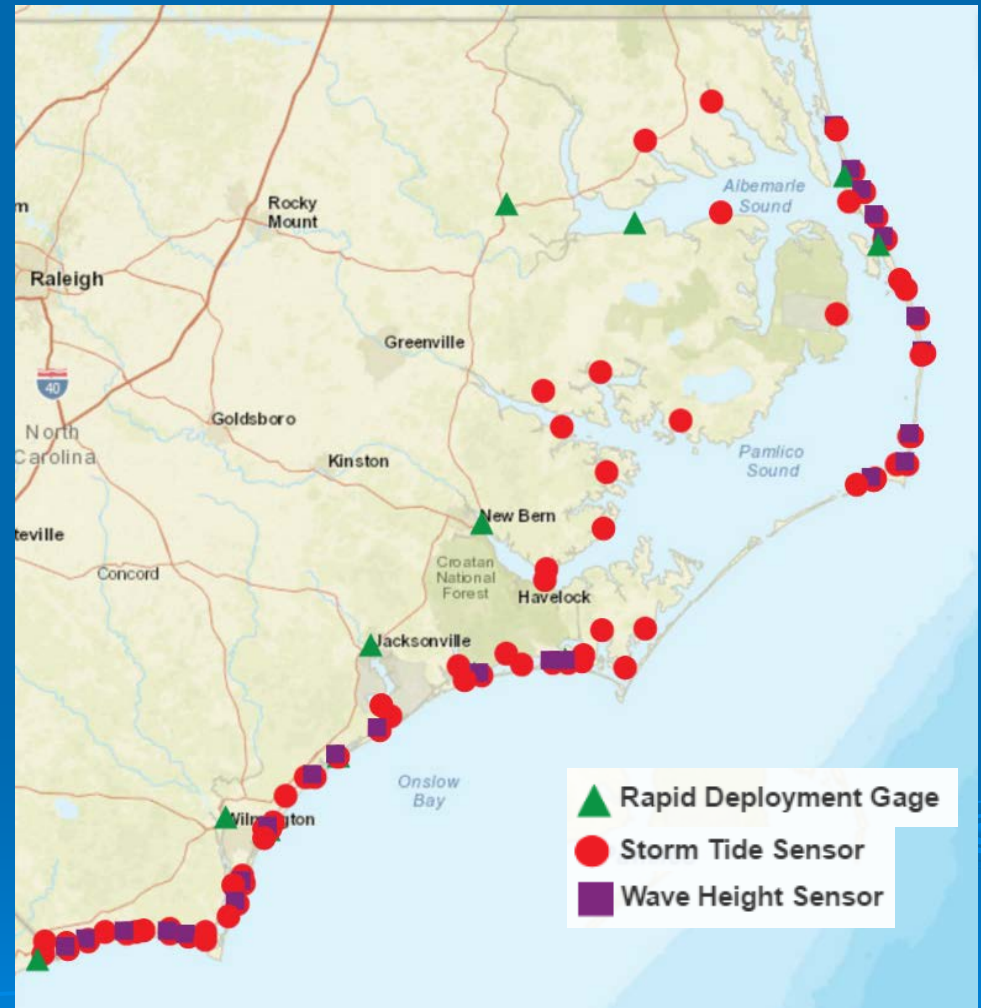
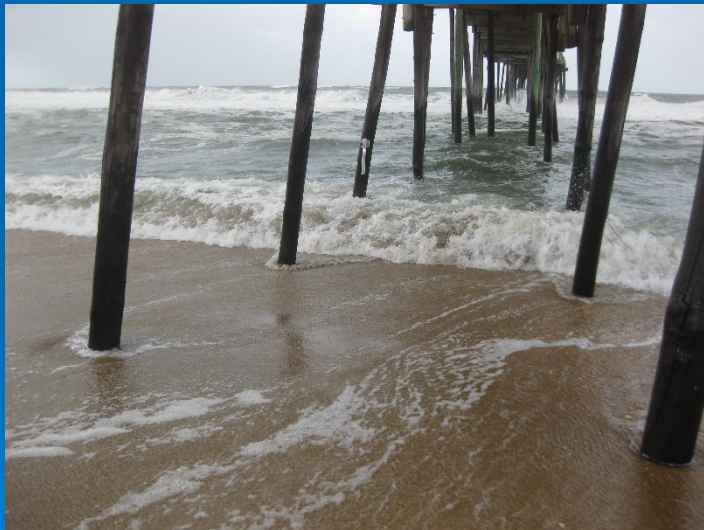
HWMs collected during Hurricane Matthew

- 543 HWM elevations surveyed to supplement data obtained with the storm-tide sensors
 - NC – 139 HWMs (coastal)
115 HWMs (inland)
 - SC – 180 HWMs
 - GA – 68 HWMs
 - FL – 156 HWMs
- 2nd largest HWM recovery effort by USGS after Hurricane Sandy in 2012
- Involved USGS staff from 15 states



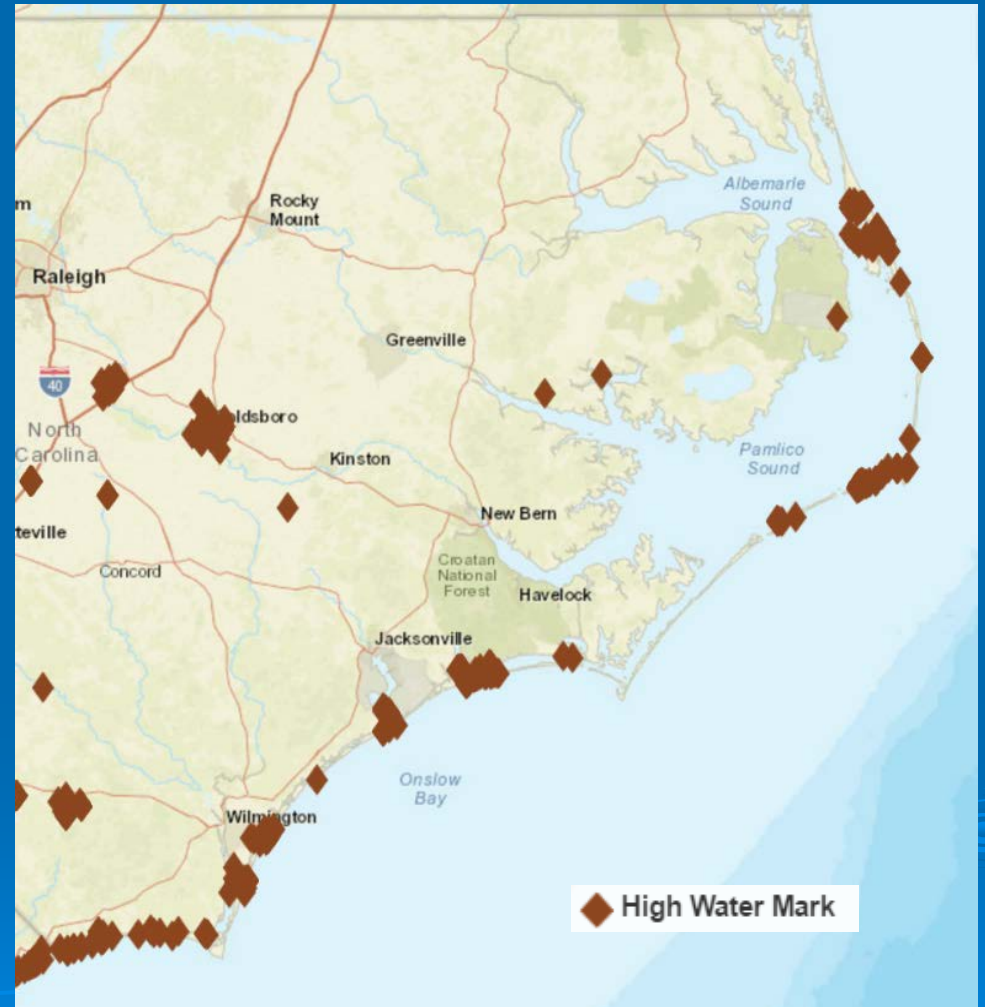
Monitoring network in North Carolina

- 11 RDGs
- 75 STSs
 - 51 storm-tide sites
 - 24 wave-height sites
- 30 BP sensors



HWMs identified in North Carolina

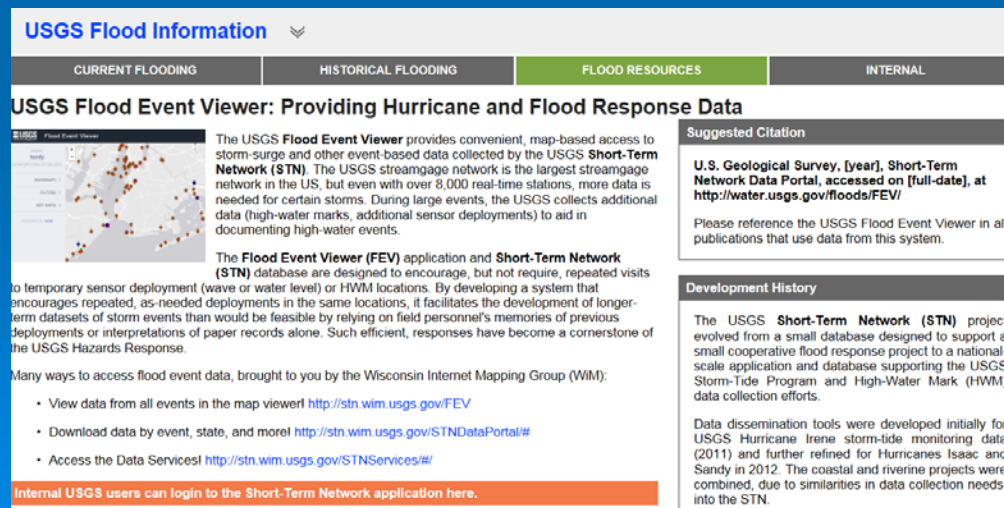
- 139 HWMs



Storm-Tide Monitoring Program Data Dissemination

Short-Term Network (STN) Database and Flood Event Viewer (FEV):

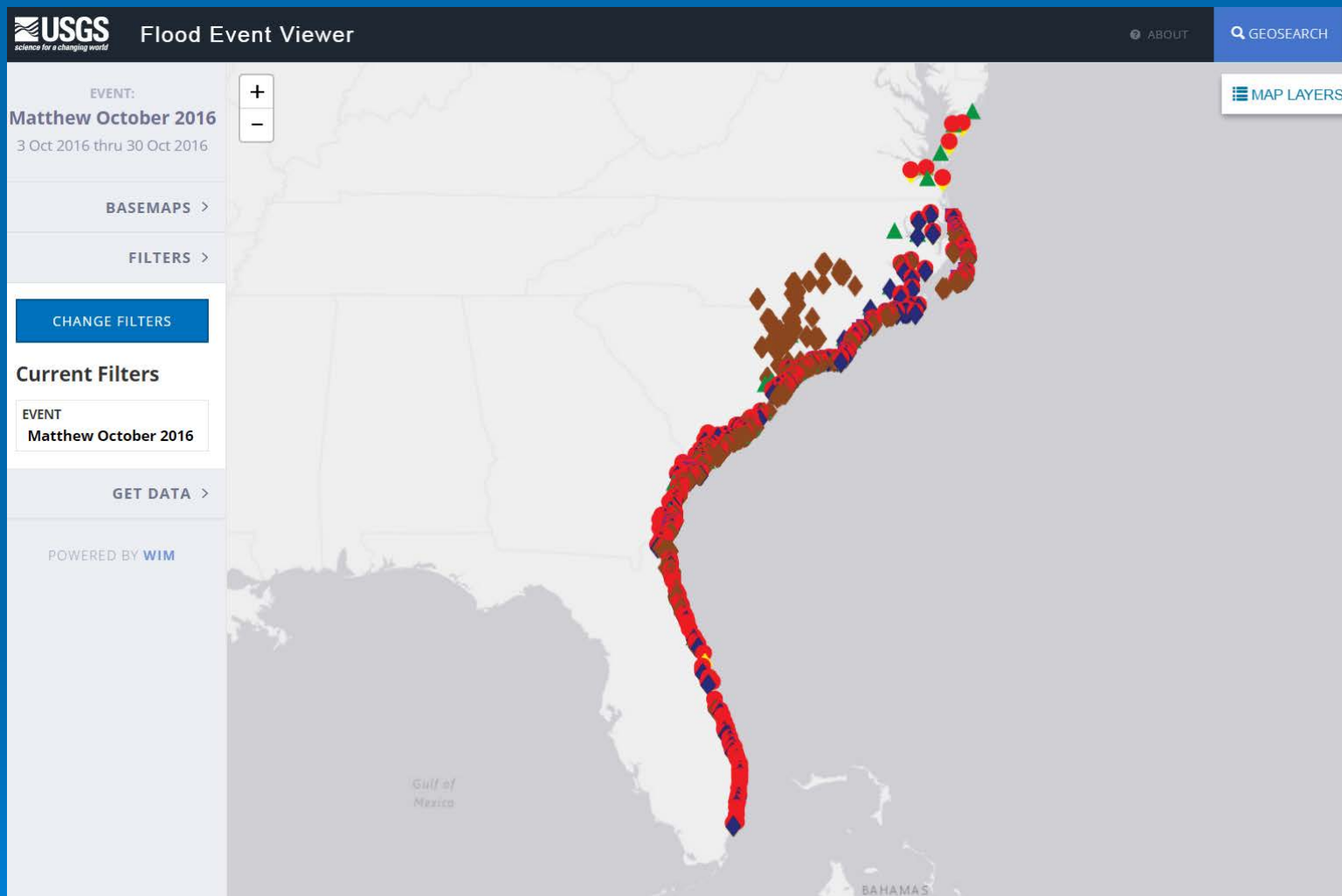
- Provide real-time RDG data before, during, and after storm
- Real-time data provides critical information for tracking flood-impacted areas and directing assistance to impacted communities
- Data from non-real time sensors and HWMs are processed and made available on FEV soon after the storm



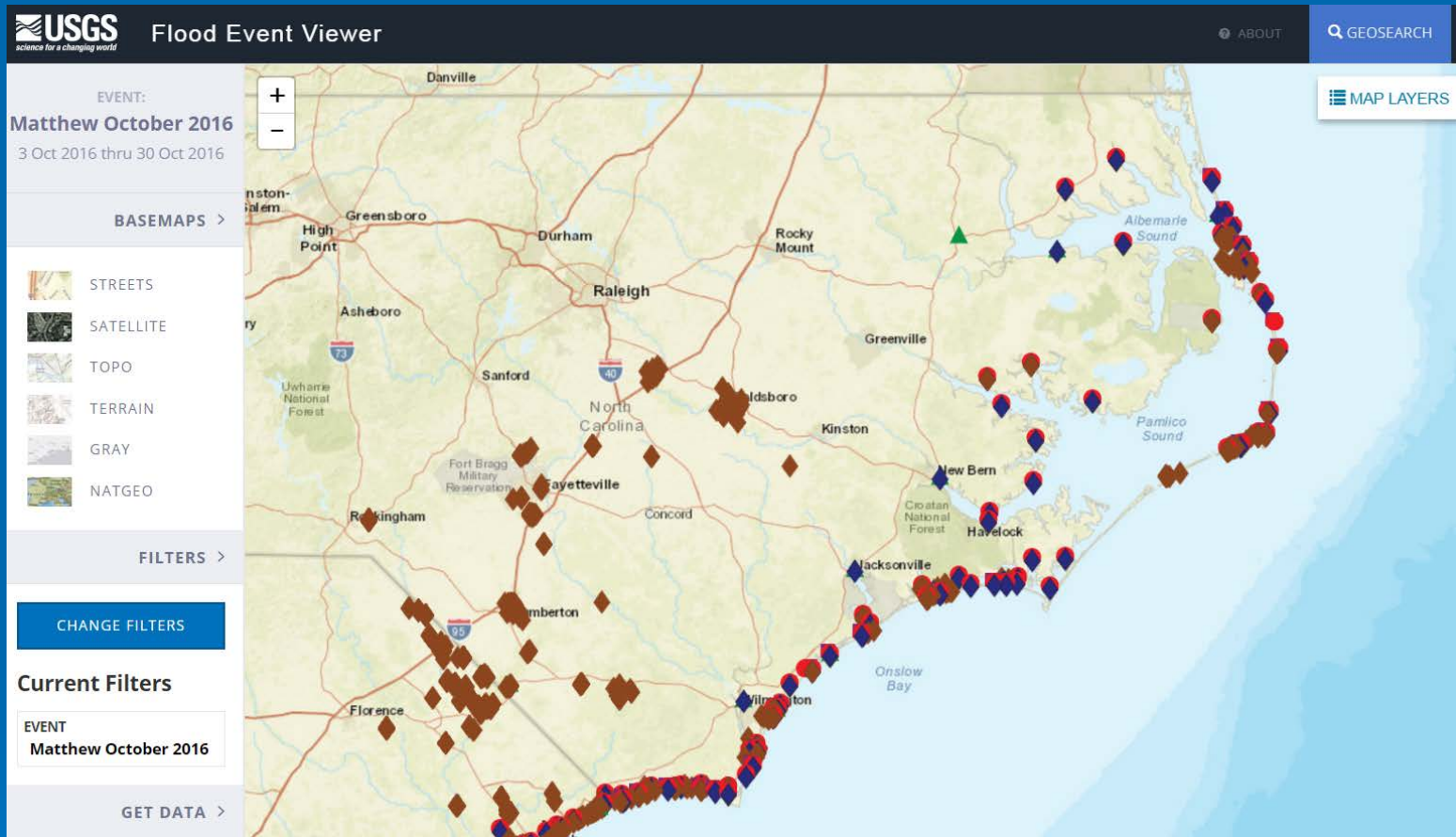
The screenshot displays the USGS Flood Information website. At the top, there is a navigation bar with tabs for 'CURRENT FLOODING', 'HISTORICAL FLOODING', 'FLOOD RESOURCES' (which is highlighted in green), and 'INTERNAL'. Below the navigation bar, the main heading reads 'USGS Flood Event Viewer: Providing Hurricane and Flood Response Data'. The page is divided into several sections:

- Map:** A map of the United States showing the locations of various flood event stations marked with colored dots.
- Text Description:** A paragraph explaining that the USGS Flood Event Viewer provides convenient, map-based access to storm-surge and other event-based data collected by the USGS Short-Term Network (STN). It notes that the STN is the largest streamgage network in the US, with over 8,000 real-time stations. During large events, the USGS collects additional data (high-water marks, additional sensor deployments) to aid in documenting high-water events.
- Suggested Citation:** A box containing the citation: 'U.S. Geological Survey, [year], Short-Term Network Data Portal, accessed on [full-date], at <http://water.usgs.gov/floods/FEV/>'.
- Development History:** A section detailing the project's evolution from a small database for Hurricane Irene (2011) to a national-scale application for Hurricanes Isaac and Sandy (2012).
- Access Information:** A list of ways to access the data, including viewing data in a map viewer, downloading data by event or state, and accessing data services.
- Internal Access:** A note at the bottom stating that internal USGS users can login to the Short-Term Network application.

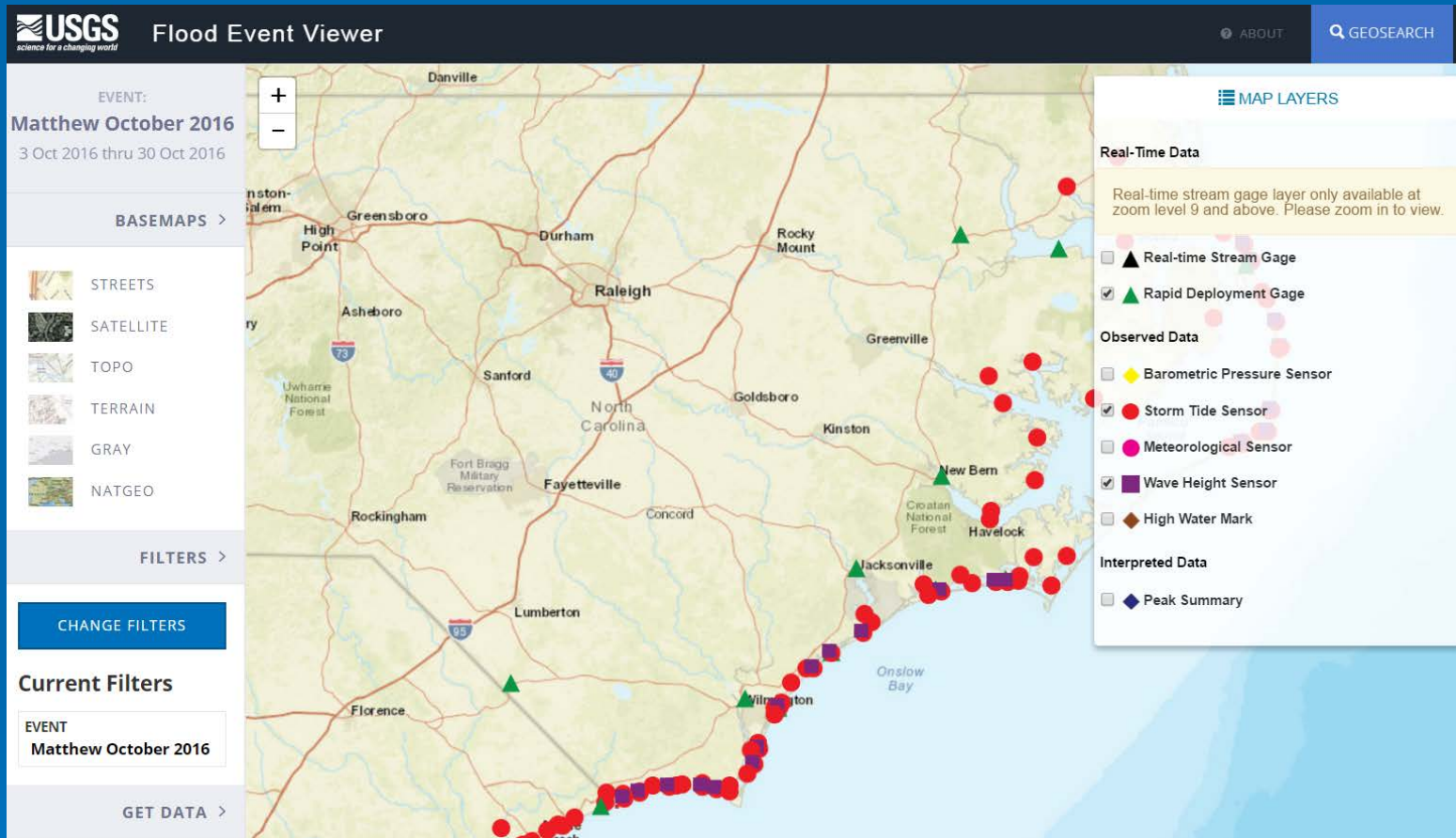
Flood Event Viewer for Hurricane Matthew



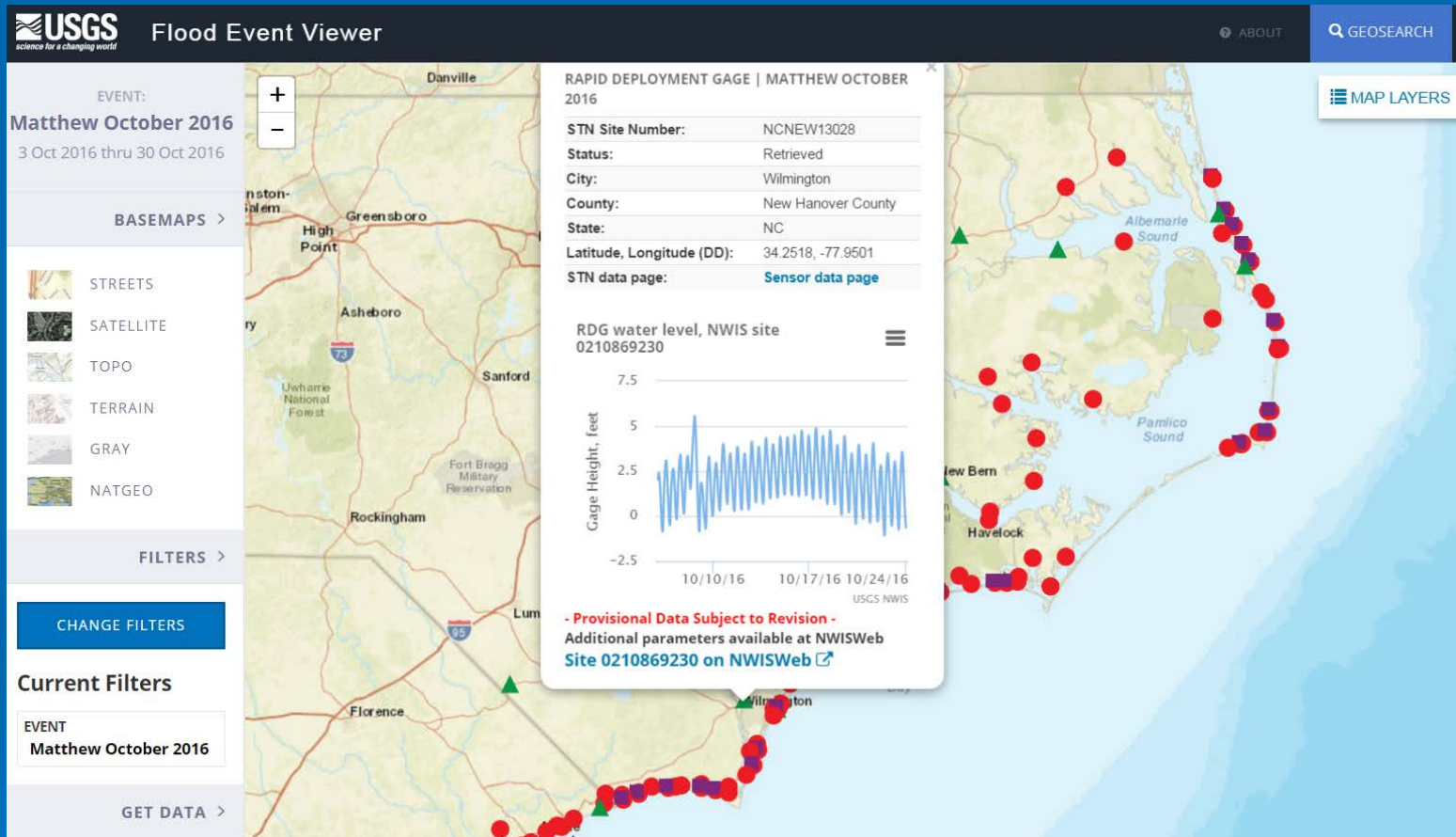
Hurricane Matthew Data in NC



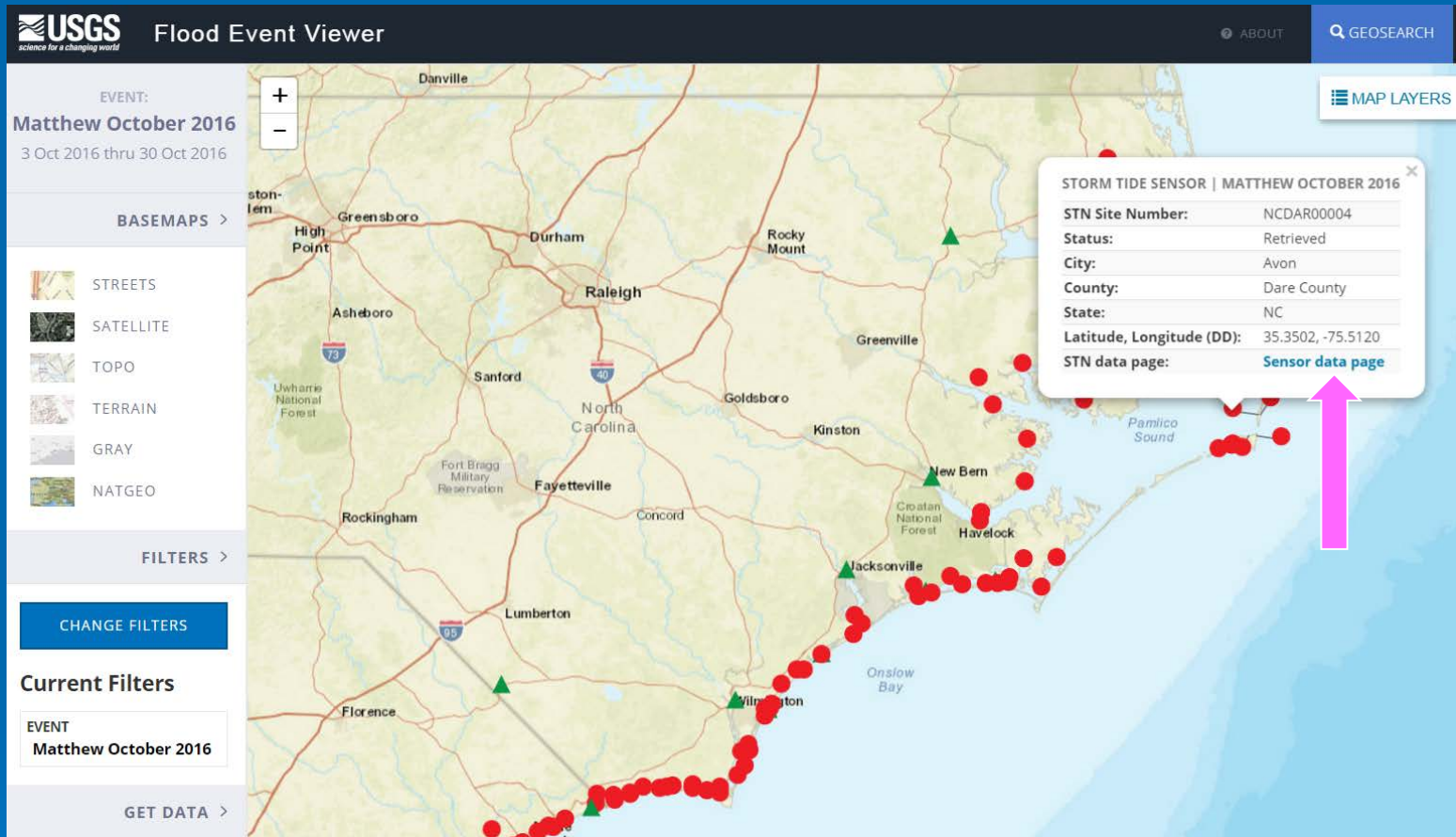
Hurricane Matthew Data in NC




Hurricane Matthew Data in NC




Hurricane Matthew Data in NC




Hurricane Matthew Data in NC

**Flood Event Viewer**ABOUTGEOSEARCHMAP LAYERS

EVENT:
Matthew October 2016
3 Oct 2016 thru 30 Oct 2016



**SHORT-TERM NETWORK MONITORING**


Site Information

SITE NUMBER: NCDAR00004
SITE DESCRIPTION: Avon Seafood
LATITUDE: 35.350154
LONGITUDE: -75.511965
HORIZONTAL DATUM: NAD83
HORIZONTAL COLLECTION METHOD: Map (digital or paper)
ADDRESS: 40073 Harbor Rd
CITY: Avon
STATE: NC
ZIP: 27915
COUNTY: Dare County
WATERBODY: Pamlico Sound
DRAINAGE AREA (SQ MI): ---
STATION ID FOR USGS GAGE: ---
STATION ID FOR NOAA GAGE: ---
OTHER STATION ID: Local ID: NC-DAR-004

Sensor Files

DATA FILES
10/17/2016: NCDAR00004_1511469_stormtide_unfiltered.nc
10/17/2016: NCDAR00004_1511469_stormtide_unfiltered.csv
10/17/2016: NCDAR00004_1511469_stormtide_unfiltered.jpg

PHOTO FILES
Photo of deployed WL sensor at Avon Seafood, Dare County, NC, 10/06/2016. Photograph by Curtis Weaver, USGS NC.



Peak Summaries for Site NCDAR00004

Elevation (ft)	Date/Time	Event
4.96	10/09/2016 10:11 AM	Matthew October 2016
2.59	10/06/2015 22:48 PM	Joaquin

STORM TIDE SENSOR | MATTHEW OCTOBER 2016

Number: NCDAR00004
Retrieved: Avon
Dare County
NC
Latitude (DD): 35.3502, -75.5120
[Sensor data page](#)

Hurricane Matthew Data in NC



Flood Event Viewer

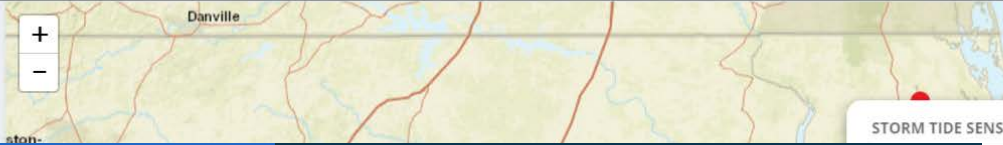
ABOUT

GEOSEARCH

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MAP LAYERS

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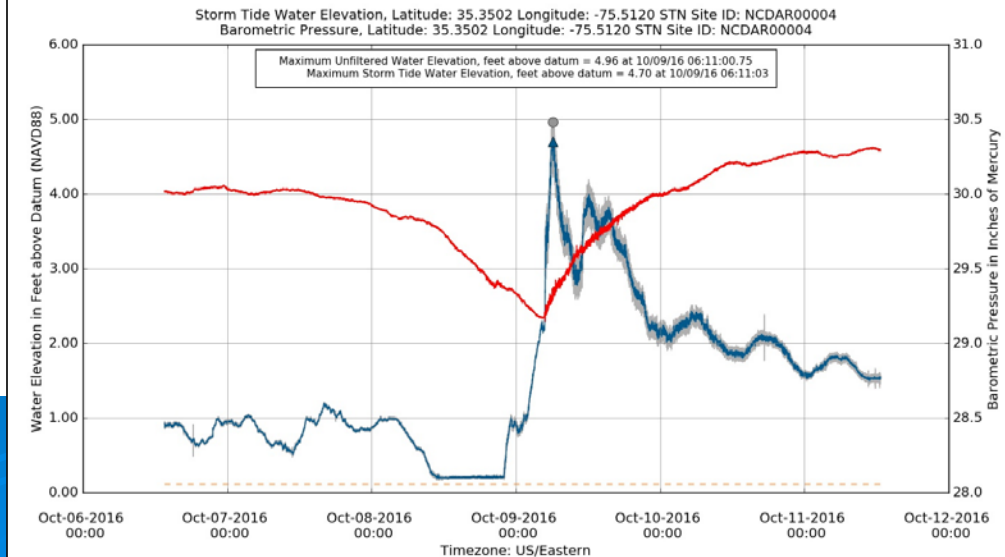
PHOTO FILES

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EXPLANATION
 — Unfiltered Water Elevation
 — Storm Tide (Lowpass Filtered) Water Elevation
 — Minimum Recordable Water Elevation
 — Barometric Pressure
 ● Maximum Unfiltered Water Elevation
 ▲ Maximum Storm Tide Water Elevation



STN Data Portal

The screenshot displays the USGS Flood Event Viewer interface. At the top left is the USGS logo with the tagline "science for a changing world". The main title is "Flood Event Viewer". On the right side, there are links for "ABOUT" and "GEOSEARCH", and a "MAP LAYERS" button. The left sidebar contains the following elements:

- EVENT:** Matthew October 2016 (3 Oct 2016 thru 30 Oct 2016)
- BASEMAPS >**
- FILTERS >**
- CHANGE FILTERS** (button)
- Current Filters**
- EVENT:** Matthew October 2016
- GET DATA >**
- Use buttons to access event-based data, reflecting the filters chosen above.
- Sensor Data ▾**
- High-water Mark Data ▾**
- Peak Summary Data ▾**
- Visit the [STN Data Portal](#) for broader data retrieval capability.

The main map area shows a geographical view of North Carolina and the surrounding coastal region. It features a network of roads, major cities (e.g., Danville, Greensboro, Durham, Raleigh, Rocky Mount, Goldsboro, Kinston, New Bern, Havelock, Jacksonville, Lumberton, Florence, Beaufort), and water bodies (e.g., Albemarle Sound, Pamlico Sound, Onslow Bay, Long Bay). Numerous data points are plotted on the map, primarily along the coast and around major water bodies. These points are represented by red circles, green triangles, and purple squares. A pink arrow points from the text in the sidebar to the "STN Data Portal" link.

Data Options

Event Options

Event Type

Event Name

Event Status

Location Options

State

County

Data Type Options

Data type

HWM Type


Quality

Environment

Survey Completed

Stillwater location

Get Data

 Get REST URLs

 **DOWNLOAD**

Data will download in CSV format

EVENT:

Matthew October 2016

3 Oct 2016 thru 30 Oct 2016

BASEMAPS >

FILTERS >

CHANGE FILTERS

Current Filters

EVENT

Matthew October 2016

GET DATA >

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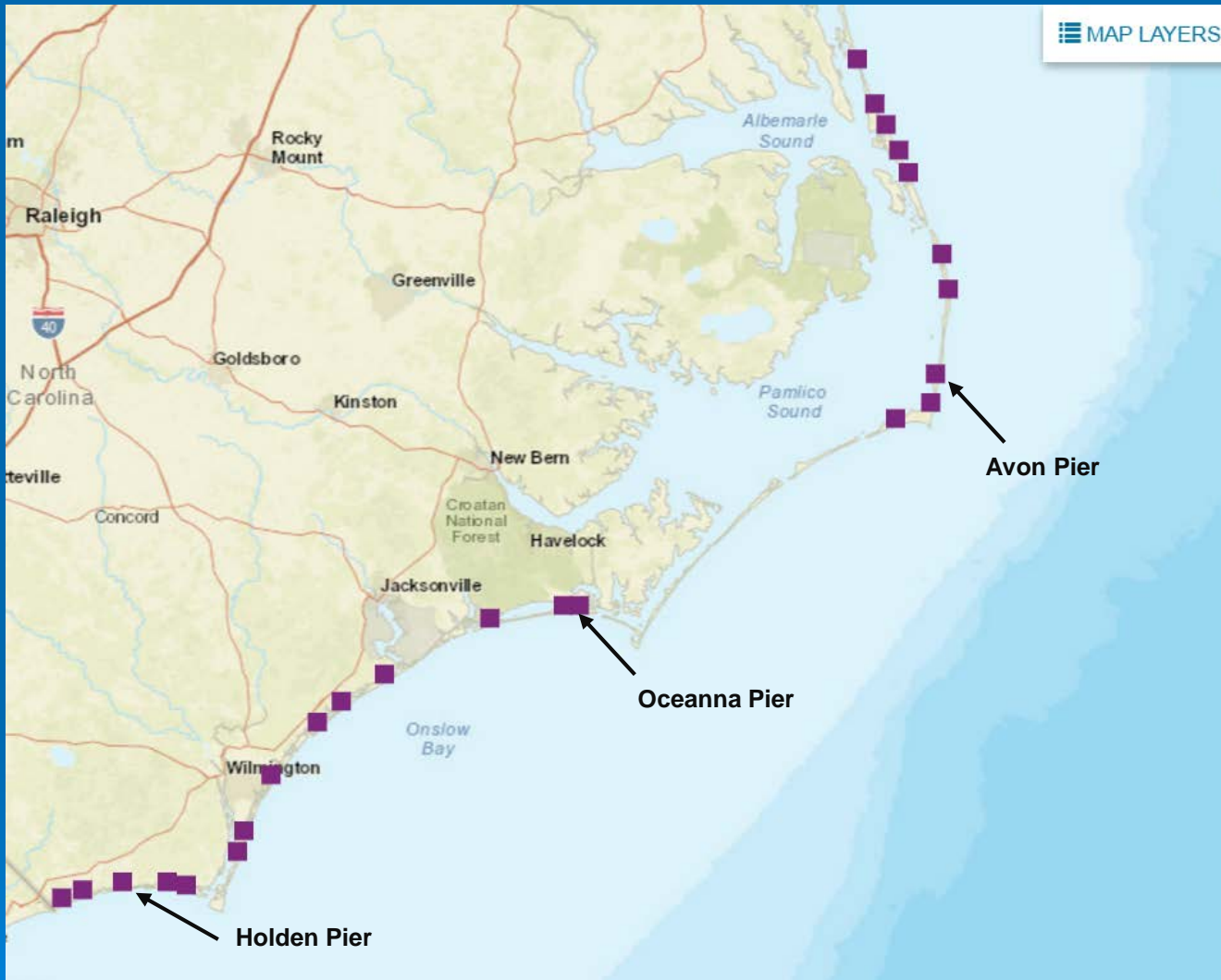
Sensor Data ▾

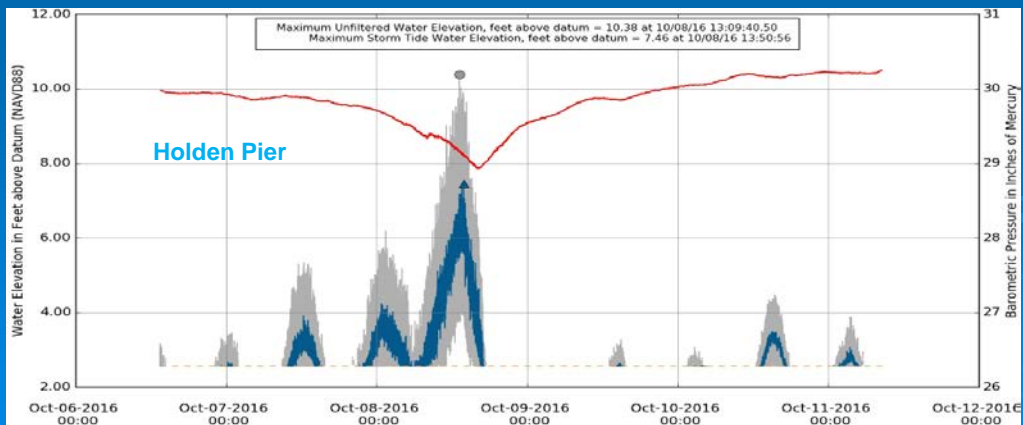
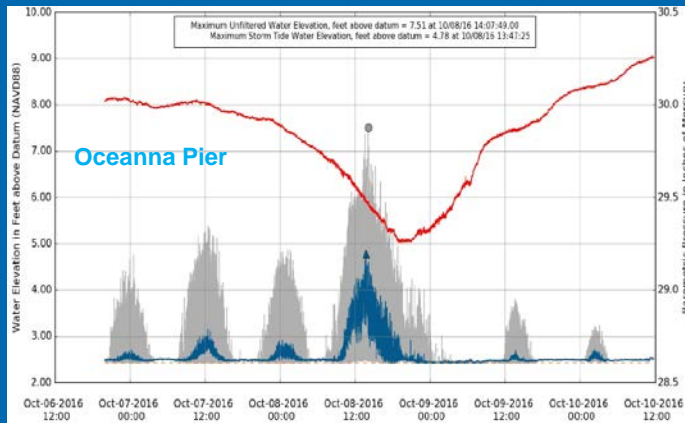
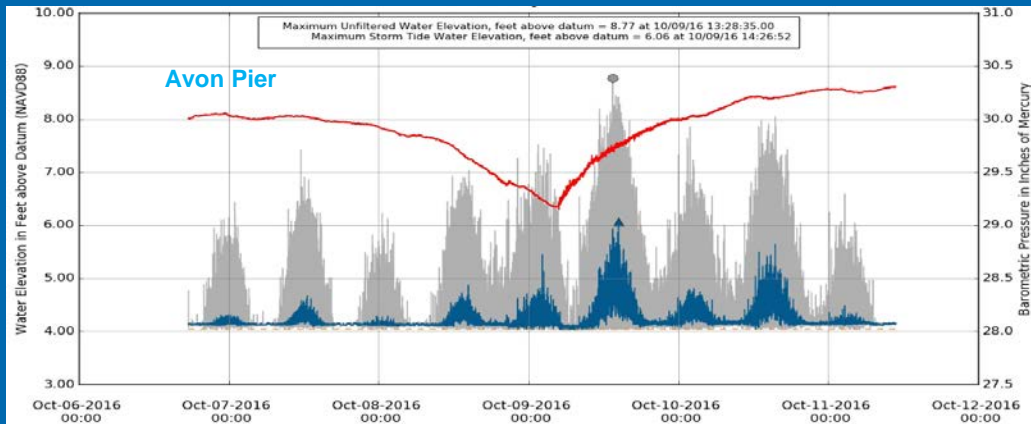
High-water Mark Data ▾

Peak Summary Data ▾

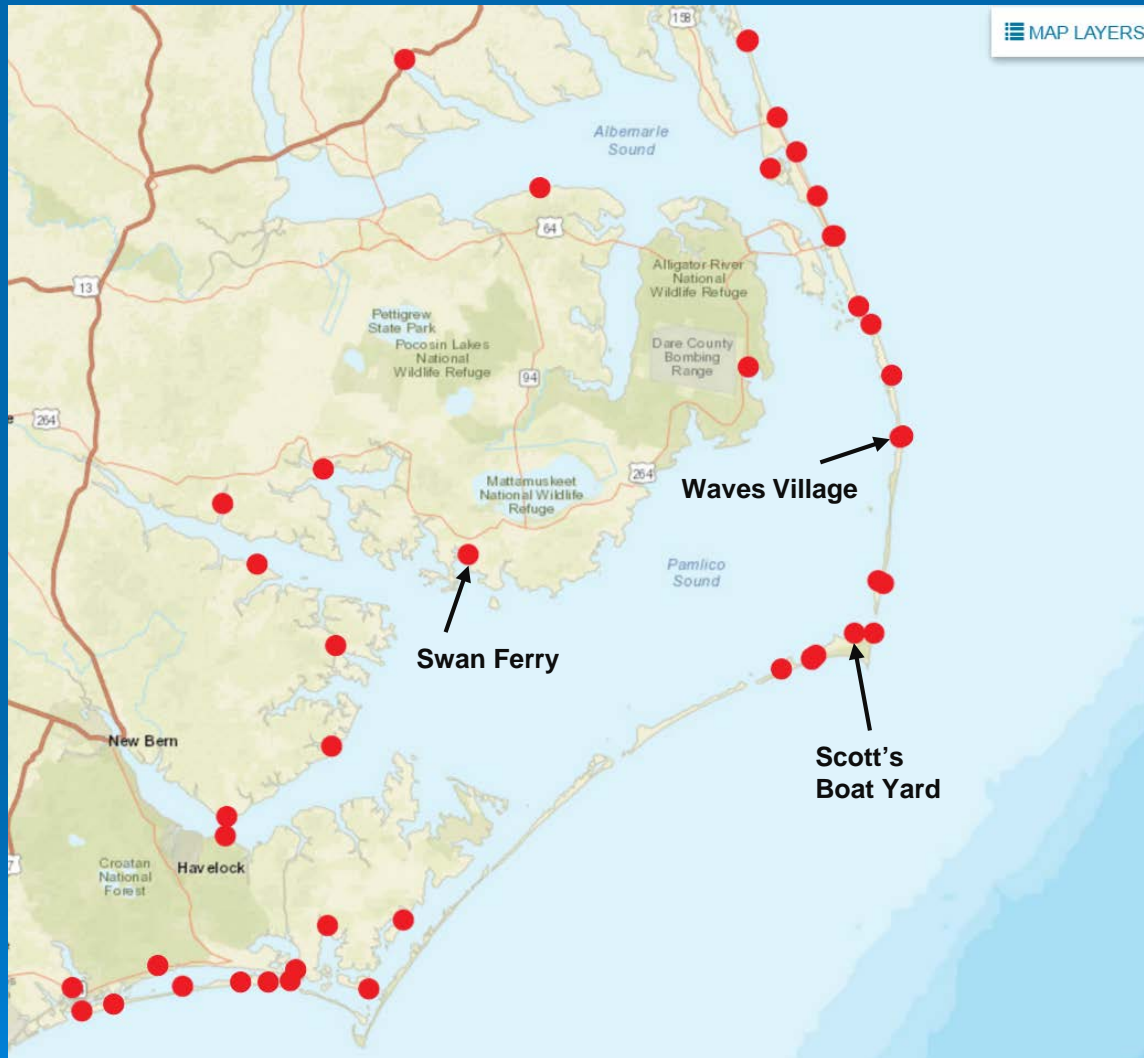
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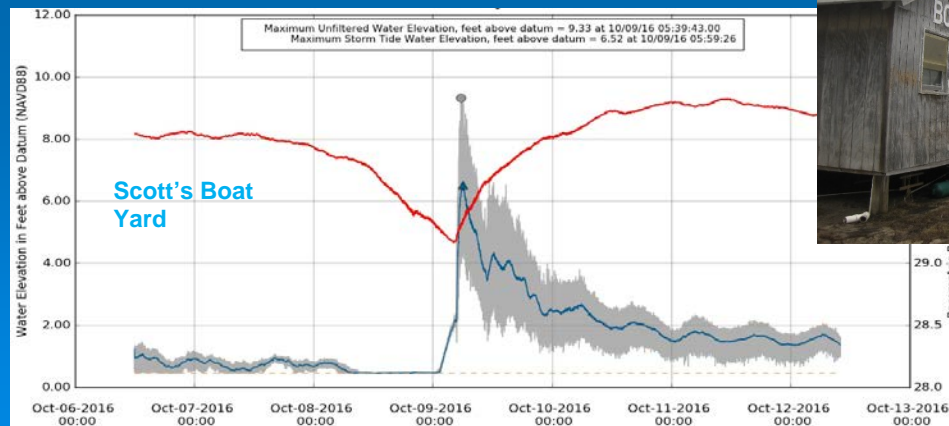
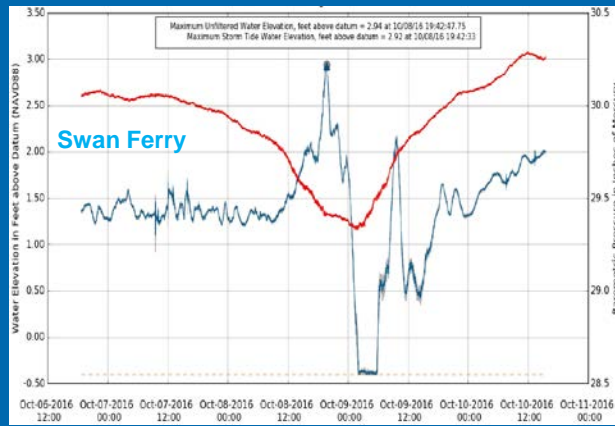
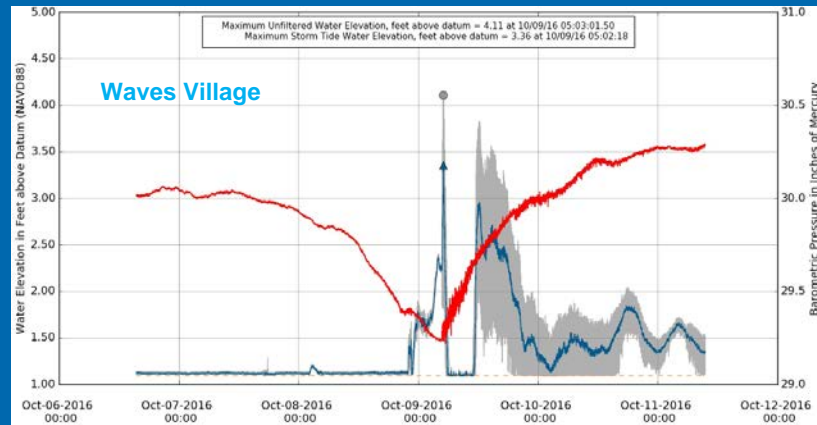
Oceanfront Data Examples





Pamlico Sound Data Examples





USGS Storm-Tide Monitoring Program Benefits and Opportunities

- Provides information before, during, and after storms for use by emergency agencies responding to storm surge and coastal flooding
- Helps to document
 - Timing and duration of flooding
 - Travel pathways by which storm-tide waters arrived
 - Magnitude of waves and wave run-up
- Validate riverine flood forecasts and provide enhanced early warning
- Helps scientists develop better models to:
 - Predict flooding ahead of storms
 - Simulate long-term, future flood patterns and trends
 - Forecast the probability of coastal erosion associated with a storm

For More Information:

U.S. Geological Survey
South Atlantic Water Science Center
Raleigh, NC 27607

Stephen Harden

slharden@usgs.gov

Useful Links

<https://nc.water.usgs.gov>

<https://water.usgs.gov/floods/FEV/>

<http://stn.wim.usgs.gov/STNDataPortal/#>

