

USGS Documentation of Peak Streamflow, and Coastal and Inland Flooding following Hurricane Florence



Chad Wagner

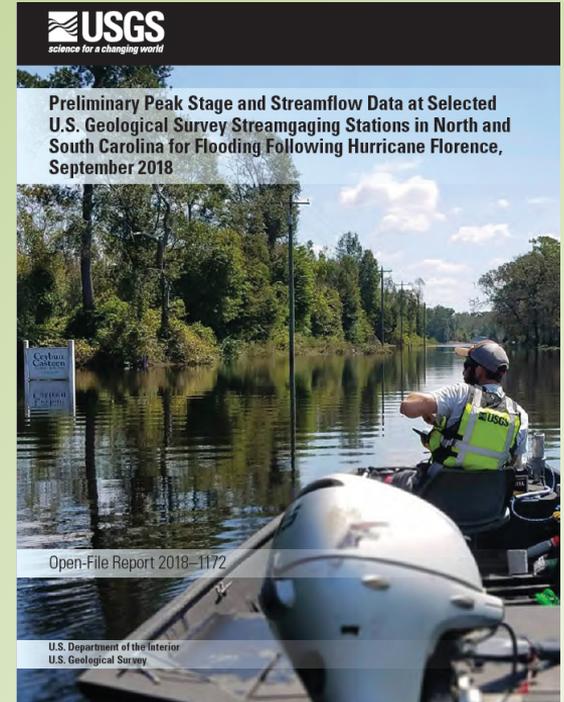
Coordinator, USGS Groundwater and Streamflow Information Program

When the floods come...so does USGS

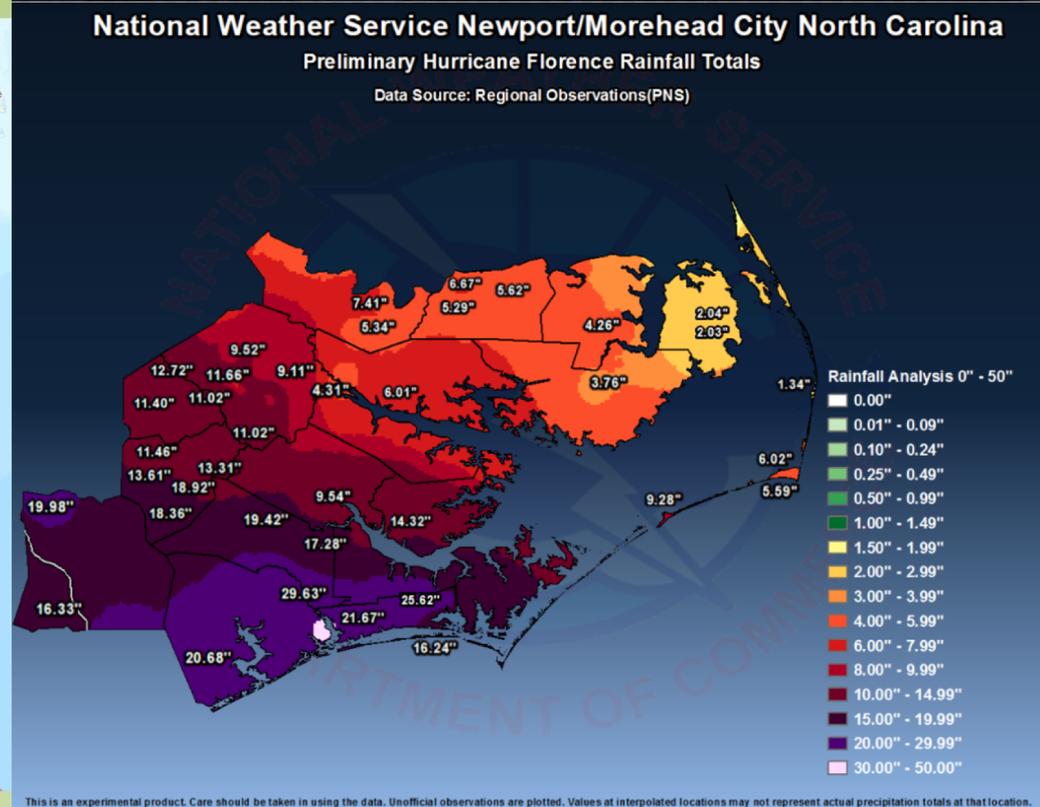
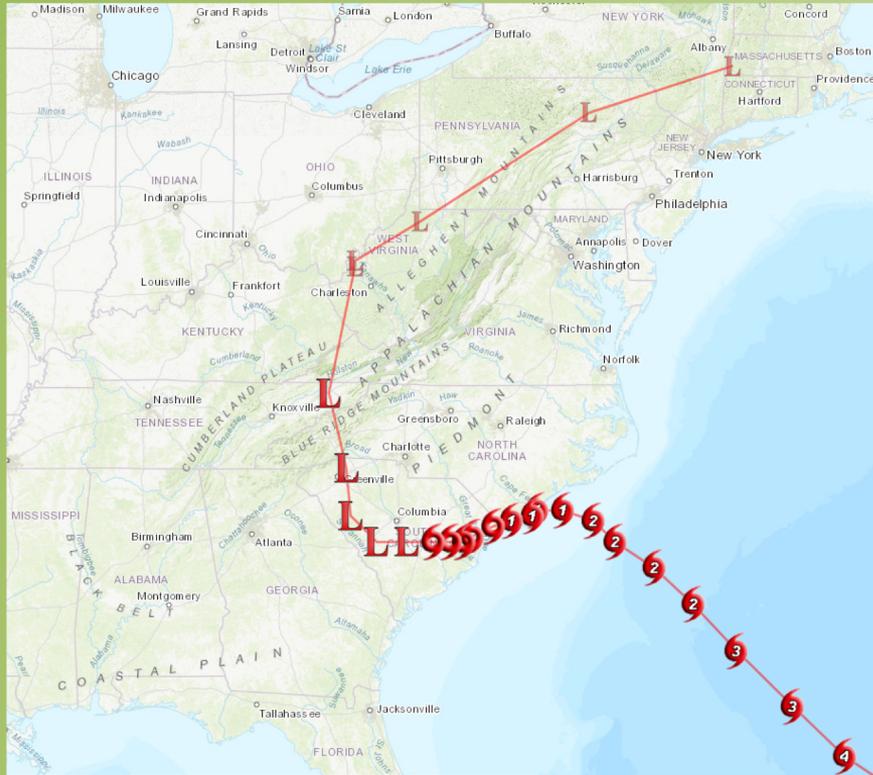
- (1) Ensure our streamgages remain operational, make high-discharge measurements, and extend ratings (when necessary)
- (2) Collect high water marks (HWM) to document the extent of flooding in affected areas
- (3) Provide timely hydrologic information to NWS (conditions for flood warnings) and Emergency Managers directing assistance to impacted communities
- (4) USGS personnel from other states are detailed to assist in data collection

Peak stages and streamflow after Florence

- USGS released a “quick hitter” report on the peak stages and streamflow at USGS streamgages in NC and SC after Florence
- *“Preliminary peak stage and streamflow data at selected streamgaging stations in North Carolina and South Carolina for flooding following Hurricane Florence, September 2018”*
- Summarized provisional peaks as of report release (October, 2018)



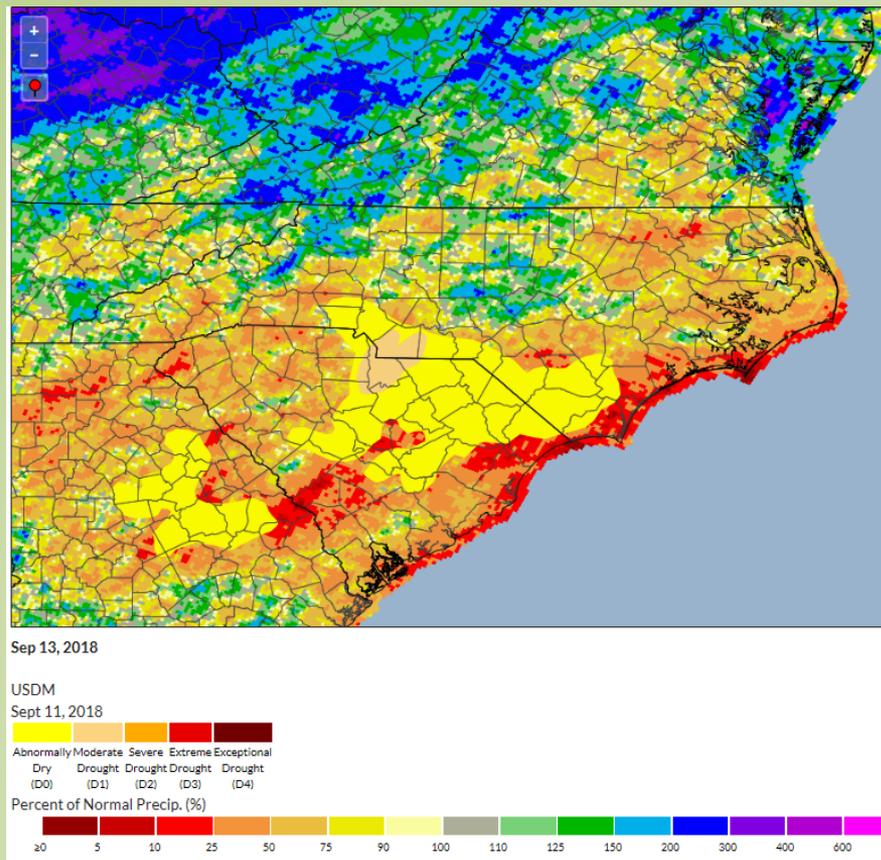
Hurricane Florence...Sept 12 -15, 2018



The wettest tropical cyclone on record in the Carolinas

All this...yet fortunately the area was in drought

Flooding from Florence could have been much worse....the antecedent conditions in the region were actually in drought across much of the lower coastal plain of NC and SC.

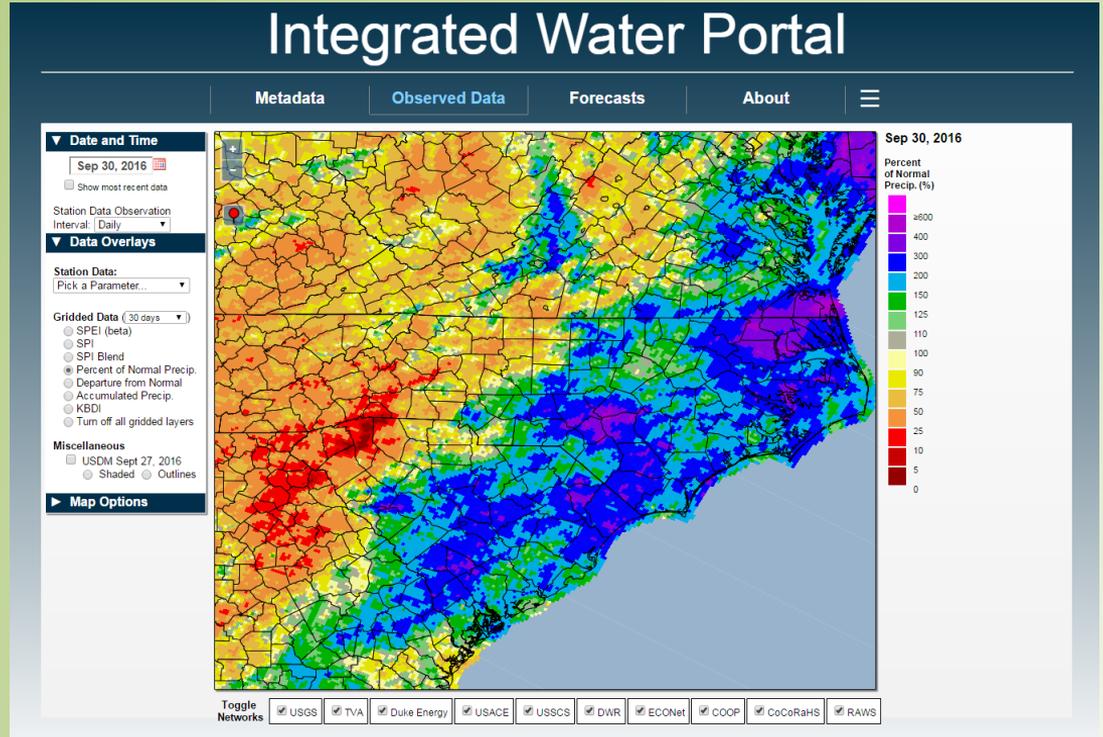


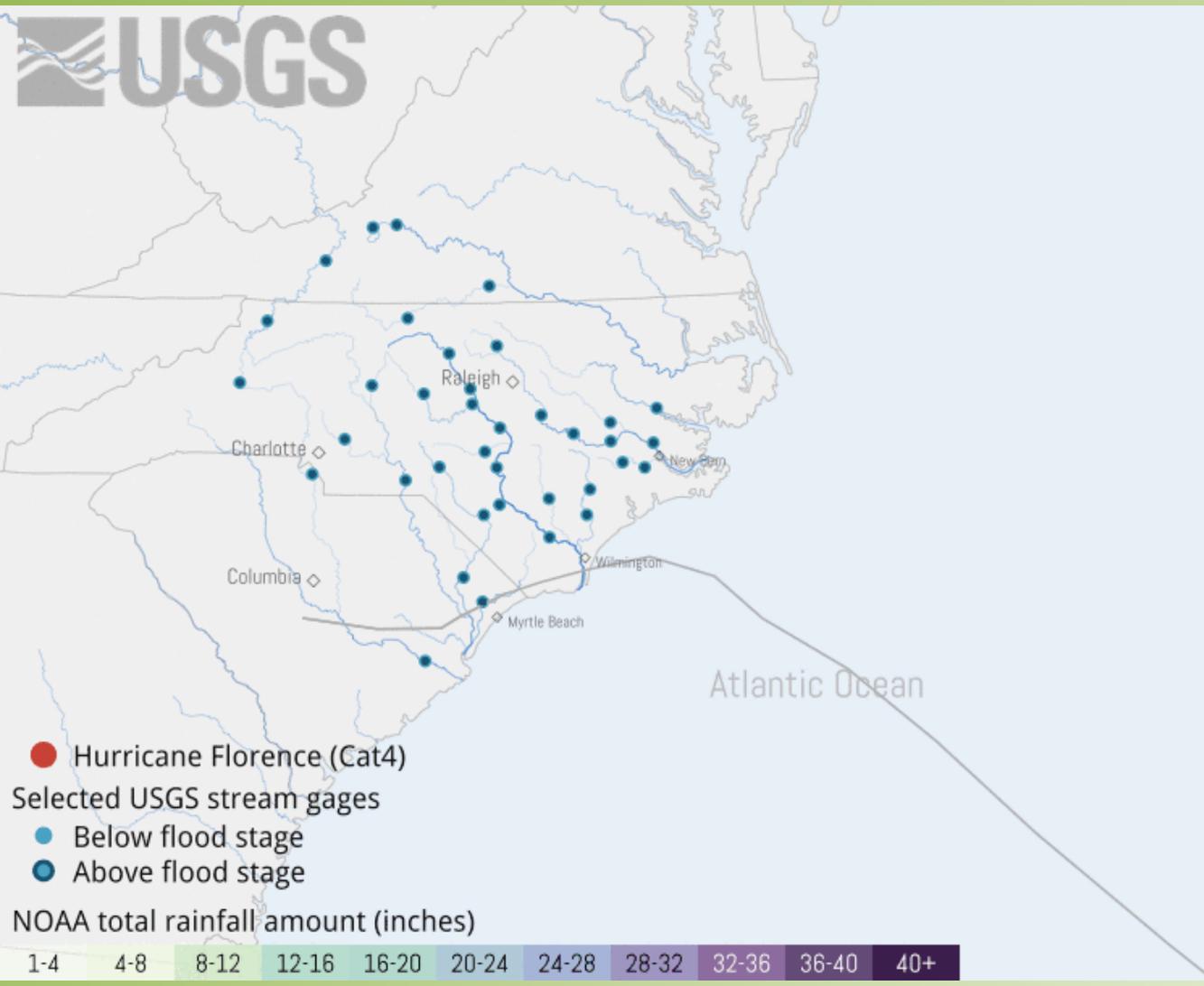
Source: [Integrated Water Portal](#), State Climate Office of North Carolina

Matthew rains came on top of a very wet Sept

Flooding after Matthew exacerbated by September rainfall totals of 150 to 300% above normal across the Coastal Plain

Antecedent conditions similar to that observed prior to Hurricane Floyd in September 1999...





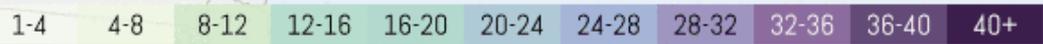
● Hurricane Florence (Cat4)

Selected USGS stream gages

● Below flood stage

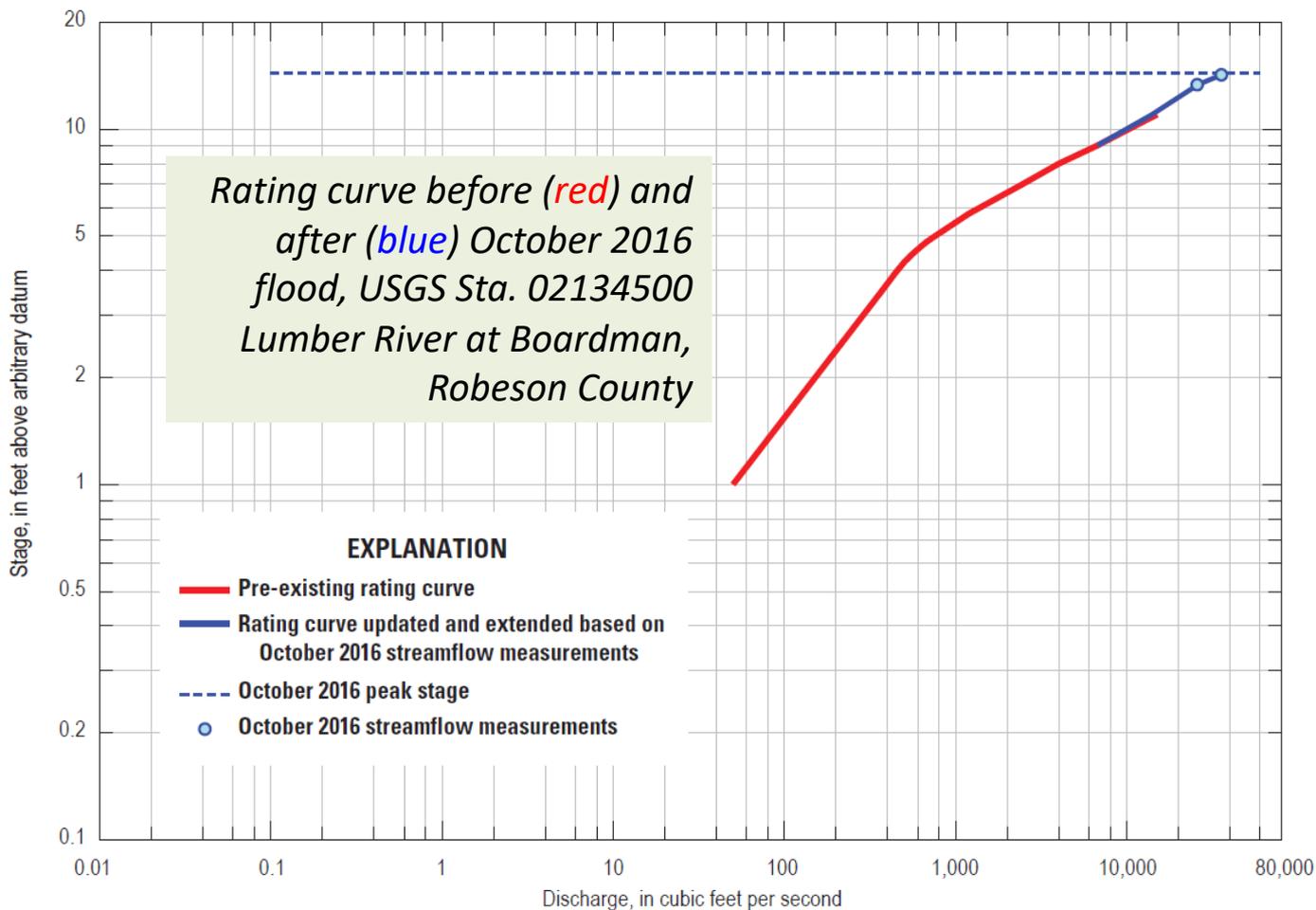
● Above flood stage

NOAA total rainfall amount (inches)



Chasing high-flow measurements...

- At height of the Florence response, over 90 USGS personnel were involved in field and/or office support activities
- Challenging travel conditions to/from streamgages
- During September 14 - 26, field crews made:
 - 72 measurements in NC (14 period of record measurements)
 - 38 measurements in SC (16 period of record measurements)
- Measurements made to verify, update, or extend existing rating curves (stage-discharge relations) for streamgages (over 30 ratings extended)

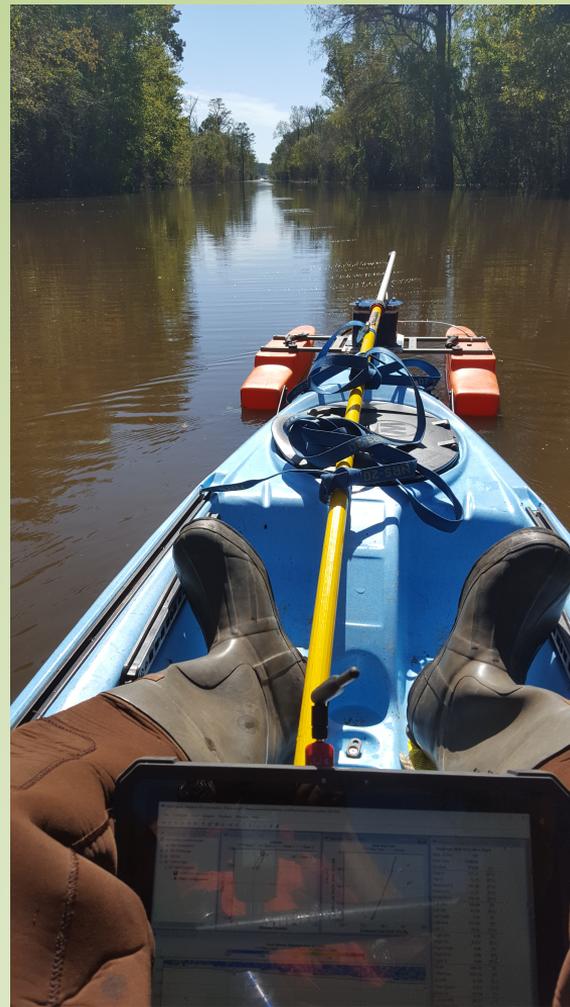












Rapid Deployment Gages (RDGs)

- RDGs also used to collect stream stage data at ungaged locations or at existing streamgage sites where equipment potentially could be inundated by rising flood levels
- Designed as portable “streamgage in a box” that can quickly be installed on a bridge and set to collect and transmit data in real time
- Total of 31 RDGs were installed across eastern NC and SC to monitor storm surge and flooding associated with Florence

Rapid Deployment Gages (RDG)

- RDG consists of shelter to house the data logger and electronics
- Stage is measured through non-contact radar
- Additional sensors used to measure meteorological parameters
- Collect and transmit data over GOES satellite every 6 min





RDG installation,
Black River near Currie, Pender County

Summary of peak stages and streamflows

Total of 139 streamgages analyzed in the most-impacted area (127 in NC, 12 in SC)

(1) 116 are monitored for both streamflow and stage data (108 in NC, 12 in SC)

==> 41 recorded new peak streamflow of record (25 in NC, 16 in SC)

(13 have long-term PORs >30 years)

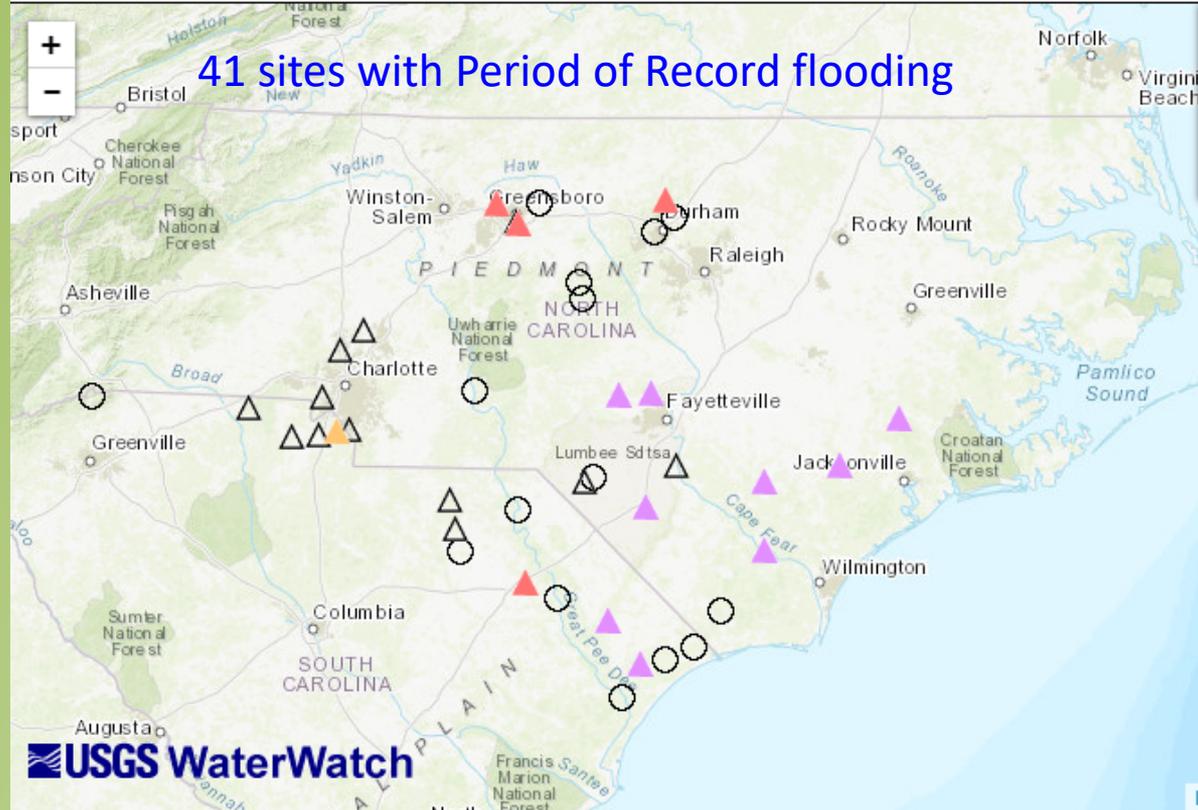
==> 67 ranked in top 5 peak streamflow of record (50 in NC, 17 in SC)

(31 have long-term PORs >30 years)

(2) 23 are monitored for stage-only data (all in NC)

==> 10 recorded new peak stage of record

(3 have long-term PORs >30 years)

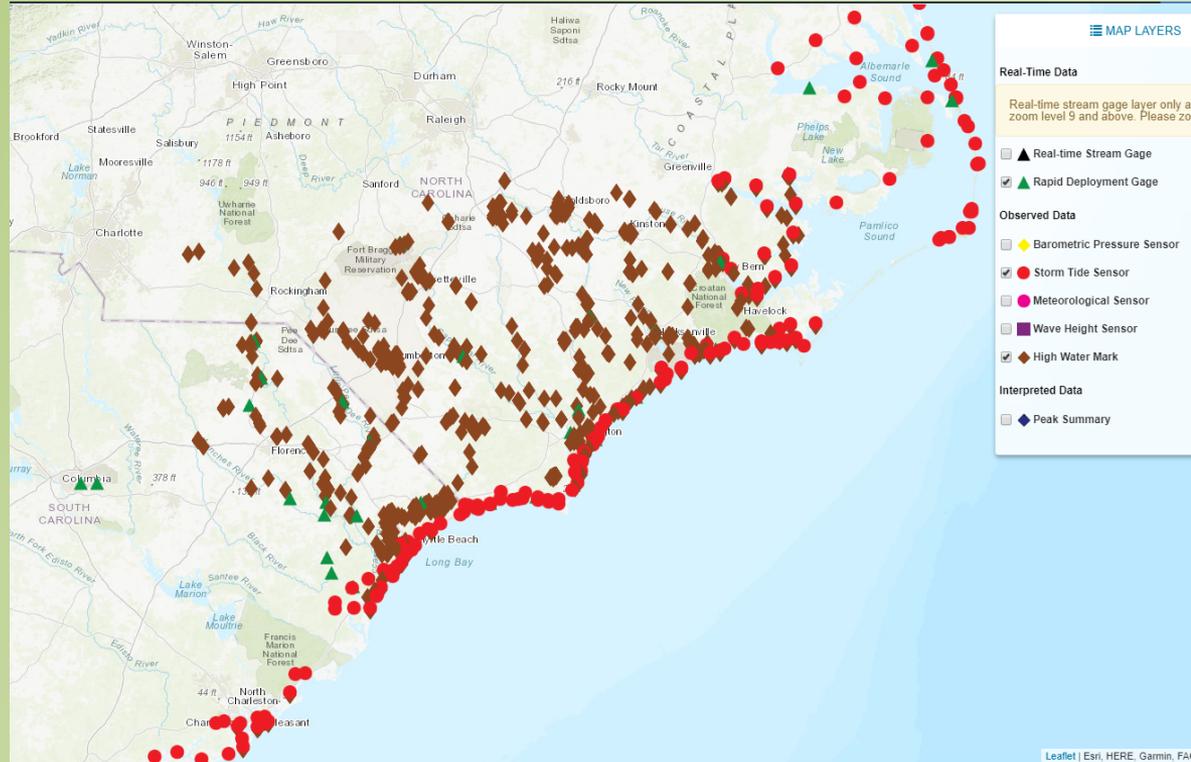


Explanation

- ▲ USGS streamgages above major flood stage as defined by the [National Weather Service](#)
- ▲ USGS streamgages above moderate flood stage as defined by the [National Weather Service](#)
- ▲ USGS streamgages above flood stage as defined by the [National Weather Service](#)
- △ USGS streamgages with flood stage as defined by the [National Weather Service](#)
- USGS streamgages without flood stage as defined by the [National Weather Service](#)

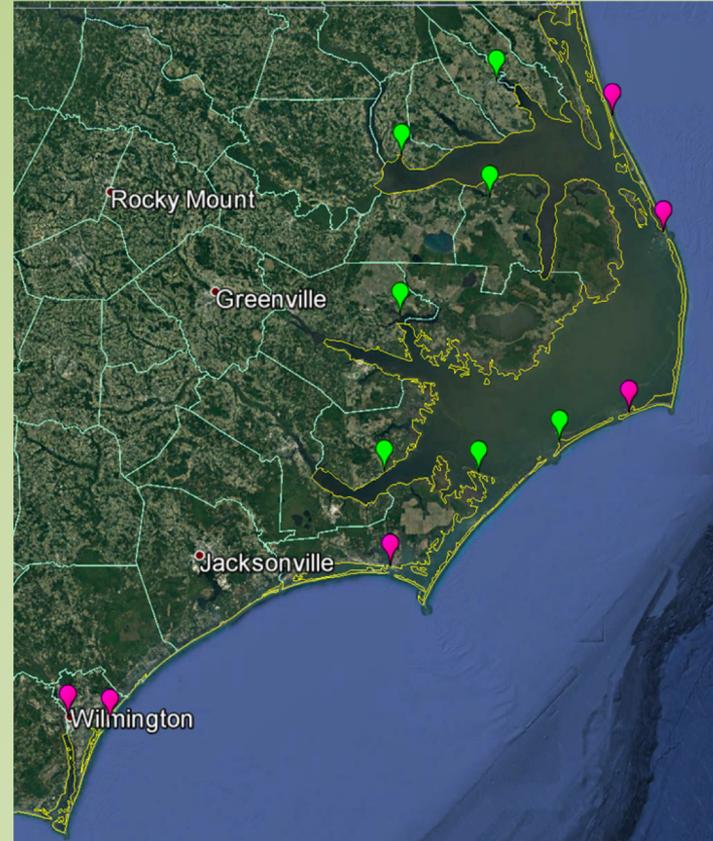
HWMs, Storm-Tide data collected during Florence

- 584 HWM elevations surveyed in NC and SC;
- A total of 57 barometric pressure sensors, 129 water level sensors, 31 wave sensors, and 31 RDGs were deployed for the event;
- Over 90 staff from the USGS SAWSC involved in the HWM and Storm-Tide Sensor efforts.



Other Agency Coastal Gages

- NCDEM
 - 7 gages (green)
- NOAA
 - 6 gages (pink)
- Data from all sources can help document surge and flooding effects from hurricanes



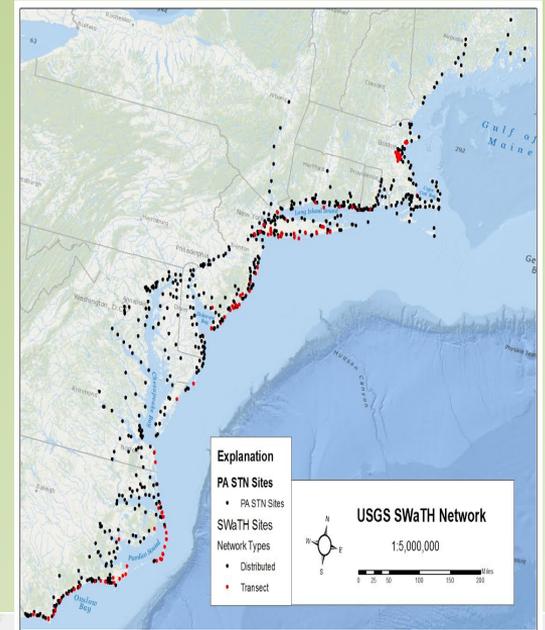




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Storm-Tide Monitoring Networks

- 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

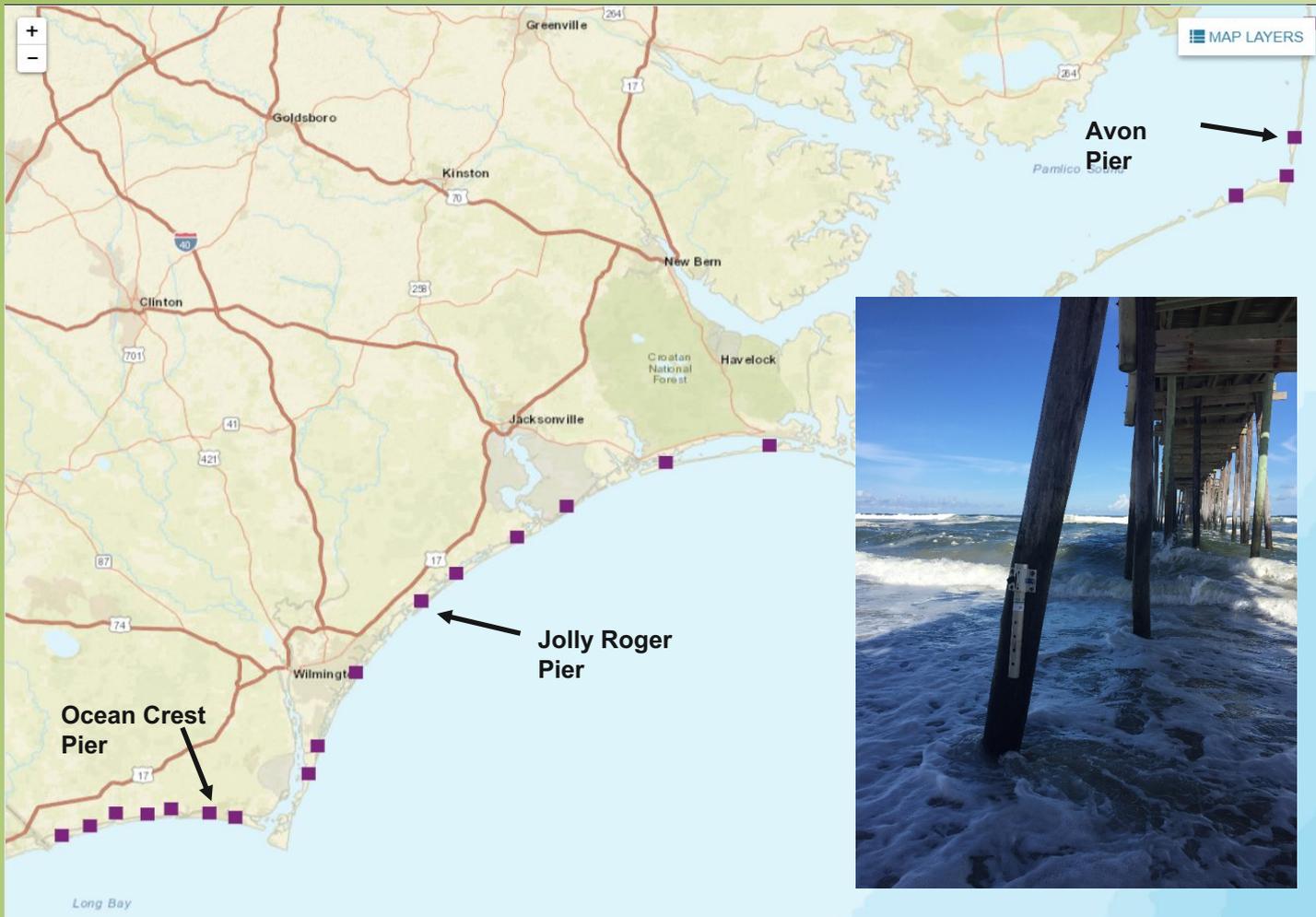


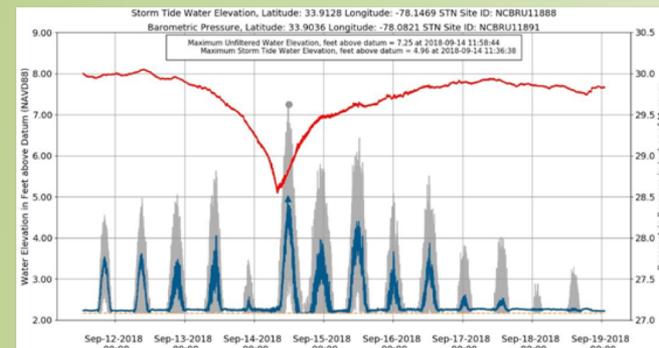
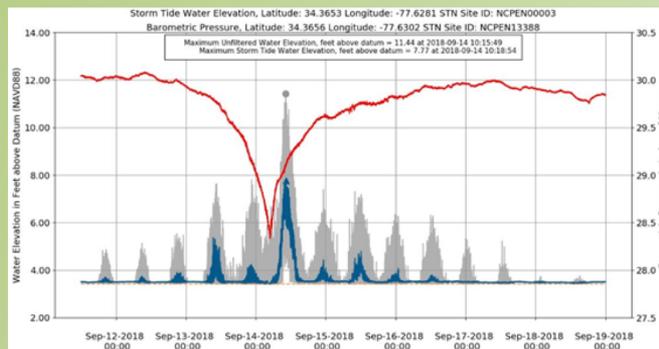
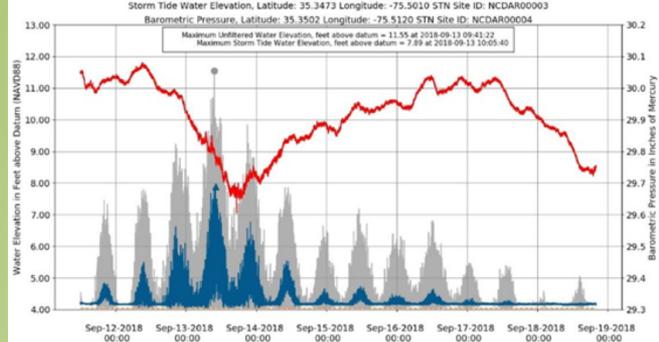
USGS Storm-Tide Monitoring Program

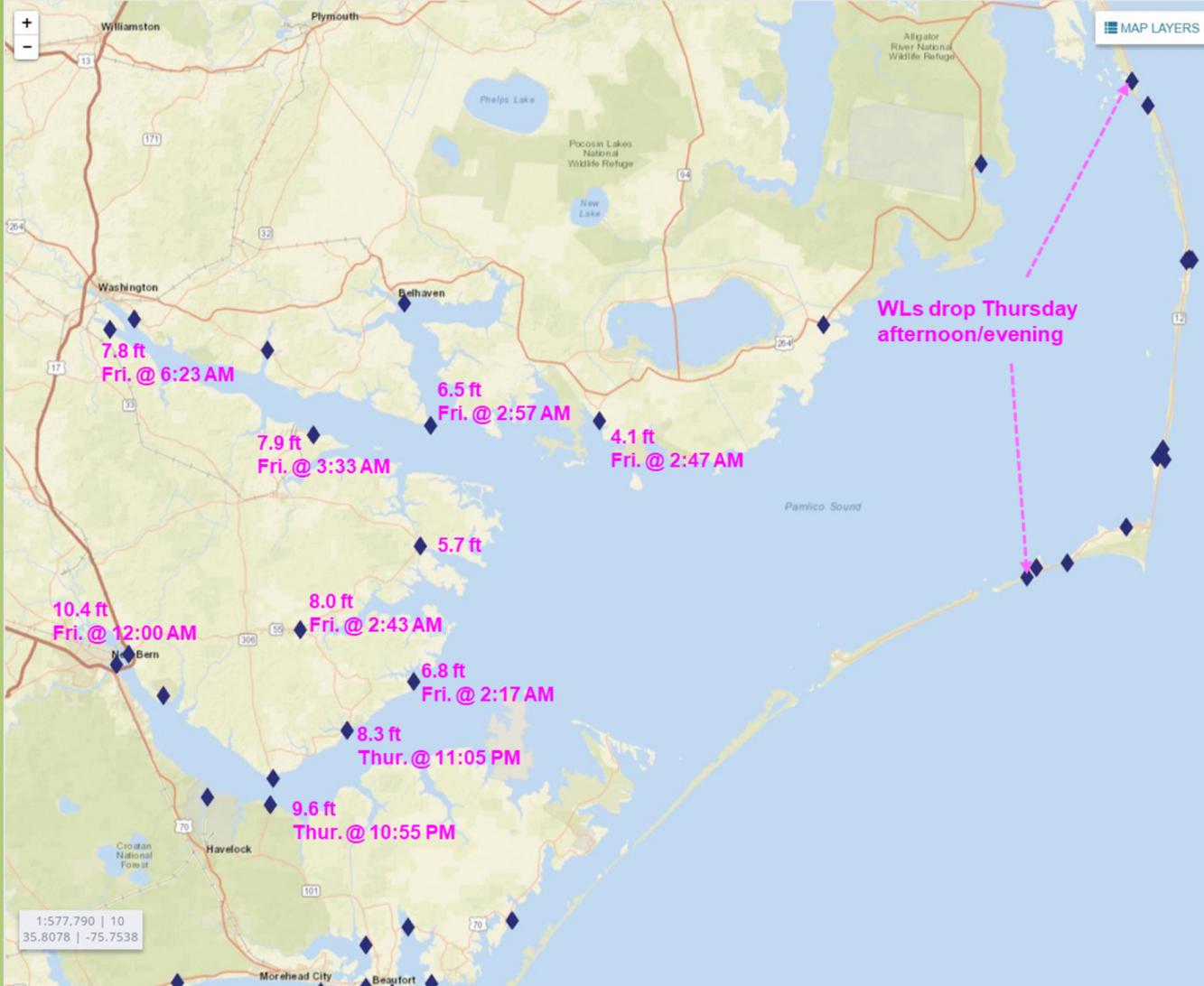
Benefits and Opportunities

- Provides information before, during, and after storms for use by emergency agencies responding to storm surge and coastal flooding
- Helps to document
 - Timing, duration, and extent 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











Data Dissemination

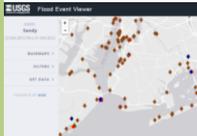
Short-Term Network (STN) Database and Flood Event Viewer (FEV):

- Provide real-time data before, during, and after storm
- Provides critical information to emergency response officials for tracking flood-impacted areas and directing assistance to impacted communities
- Data from HWMs are processed and made available on FEV soon after storm

USGS Flood Information ⌵

CURRENT FLOODING HISTORICAL FLOODING **FLOOD RESOURCES** INTERNAL

USGS Flood Event Viewer: Providing Hurricane and Flood Response Data



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)**. The USGS streamgauge network is the largest streamgauge network in the US, but even with over 8,000 real-time stations, more data is needed for certain storms. During large events, the USGS collects additional data (high-water marks, additional sensor deployments) to aid in documenting high-water events.

The **Flood Event Viewer (FEV)** application and **Short-Term Network (STN)** database are designed to encourage, but not require, repeated visits to temporary sensor deployment (wade or water level) or HWM locations. By developing a system that encourages repeated, as-needed deployments in the same locations, it facilitates the development of longer-term datasets of storm events than would be feasible by relying on field personnel's memories of previous deployments or interpretations of paper records alone. Such efficient, responses have become a cornerstone of the USGS Hazards Response.

Many ways to access flood event data, brought to you by the Wisconsin Internet Mapping Group (WIM):

- View data from all events in the map viewer! <http://stn.wim.usgs.gov/FEV>
- Download data by event, state, and more! <http://stn.wim.usgs.gov/STNDataPortal/#>
- Access the Data Services! <http://stn.wim.usgs.gov/STNServices/#>

Internal USGS users can login to the Short-Term Network application here.

Suggested Citation

U.S. Geological Survey, [year], Short-Term Network Data Portal, accessed on [full-date], at <http://water.usgs.gov/floods/FEV/>

Please reference the USGS Flood Event Viewer in all publications that use data from this system.

Development History

The USGS **Short-Term Network (STN)** project evolved from a small database designed to support a small cooperative flood response project to a national-scale application and database supporting the USGS Storm-Tide Program and High-Water Mark (HWM) data collection efforts.

Data dissemination tools were developed initially for USGS Hurricane Irene storm-tide monitoring data (2011) and further refined for Hurricanes Isaac and Sandy in 2012. The coastal and riverine projects were combined, due to similarities in data collection needs, into the STN.



EVENT:

Florence Sep 2018

7 Sep 2018 thru 7 Oct 2018

BASEMAPS >

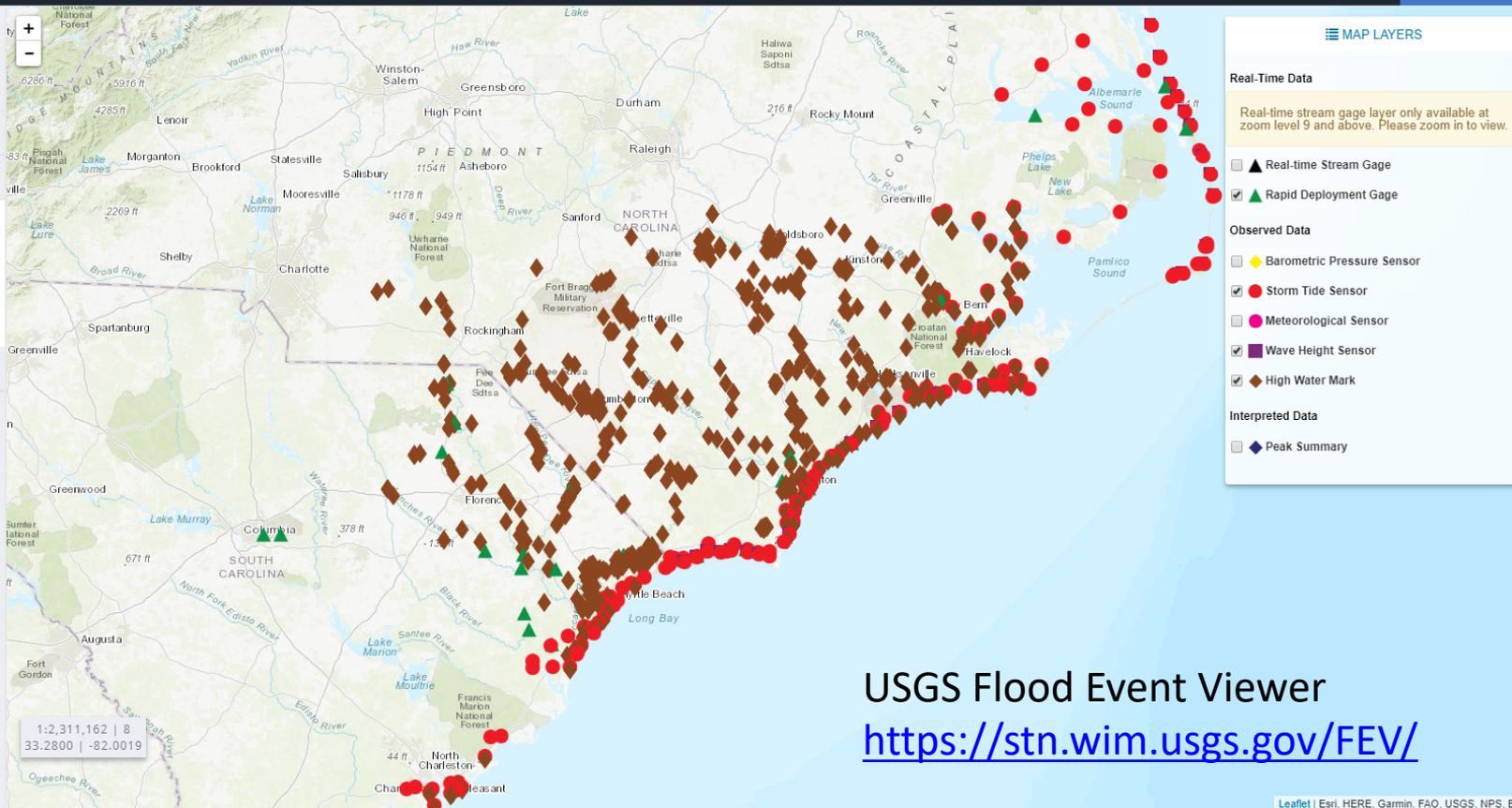
FILTERS >

CHANGE FILTERS

Current Filters

EVENT **Florence Sep 2018**

GET DATA >

POWERED BY **WIM**

MAP LAYERS

Real-Time Data

Real-time stream gage layer only available at zoom level 9 and above. Please zoom in to view.

- ▲ Real-time Stream Gage
- ▲ Rapid Deployment Gage

Observed Data

- ◆ Barometric Pressure Sensor
- Storm Tide Sensor
- Meteorological Sensor
- Wave Height Sensor
- ◆ High Water Mark

Interpreted Data

- ◆ Peak Summary

USGS Flood Event Viewer

<https://stn.wim.usgs.gov/FEV/>

Questions...

