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

USGS SWaTH Network
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
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

Site Information

- **SITE NUMBER:** NCDAR00004
- **SITE DESCRIPTION:** Avon Seaweed
- **LATITUDE:** 35.35015
- **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: NCDAR-004

Peak Summaries for Site NCDAR00004

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Date/Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.96</td>
<td>10/09/2016</td>
<td>Matthew</td>
</tr>
<tr>
<td></td>
<td>10:11 AM</td>
<td>October 2016</td>
</tr>
<tr>
<td>2.59</td>
<td>10/05/2015</td>
<td>Joaquin</td>
</tr>
<tr>
<td></td>
<td>22:48 PM</td>
<td></td>
</tr>
</tbody>
</table>

Sensor Files

- **DATA FILES**
  - 10/17/2016: NCDAR00004_1511469_stormtide_unfiltered.nc
  - 10/17/2016: NCDAR00004_1511469_stormtide_unfiltered.csv

- **PHOTO FILES**
  - Photo of deployed WL sensor at Avon Seaweed, Dare County, NC, 10/06/2016. Photograph by Curtis Weaver, USGS NC.
## Hurricane Matthew Data in NC

### 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

### Site Information

**Site Number:** NCDAR00004  
**Site Description:** Avon Seawall  
**Latitude:** 35.350154  
**Longitude:** -75.511965  
**Horizontal Datum:** NAD83  
**Hazardous Collection Method:** Map (digital or paper)  
**Address:** 40073 Harbor Rd  
**City:** Avon  
**State:** NC  
**ZIP:** 27915  
**County:** Dare County  
**Waterbody:** Pamlico Sound  
**Drainage Area:** NC  
**Station ID for USGS:** NCDAR00004  
**Gage:** NCDAR00004  
**Station ID for NOAA:**  
**Other Station ID:** Local ID: NCDAR-004  

### Peak Summaries for Site NCDAR00004

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<tr>
<td>2.59</td>
<td>10/05/2016 22:48 PM</td>
<td>Joaquin</td>
</tr>
</tbody>
</table>

### Storm Tide Water Elevation

- **Latitude:** 35.3502  
- **Longitude:** -75.5120  
- **STN Site ID:** NCDAR00004

- **Maximum Unfiltered Water Elevation:** 4.96 ft above datum on 10/09/2016 08:11:00.75
- **Maximum Storm Tide Water Elevation:** 4.70 ft above datum on 10/09/2016 08:13:03
STN Data Portal
### Event Options

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<thead>
<tr>
<th>Event Options</th>
<th>Value</th>
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<tbody>
<tr>
<td>Event Type</td>
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<tr>
<td>Event Name</td>
<td>Matthew October 2016</td>
</tr>
<tr>
<td>Event Status</td>
<td>Active</td>
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### Location Options

<table>
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<tr>
<th>Location Options</th>
<th>Value</th>
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<tbody>
<tr>
<td>State</td>
<td>North Carolina</td>
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<tr>
<td>County</td>
<td>All Counties</td>
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### Data Type Options

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<tr>
<th>Data Type Options</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Data Type</td>
<td>Sensor Data, High-Water Mark Data, Peak Summary Data</td>
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<tr>
<td>HWM Type</td>
<td>All HWM Types</td>
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<td>Quality</td>
<td>All HWM Qualities</td>
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<tr>
<td>Environment</td>
<td>Coastal, Riverine</td>
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<td>Survey Completed</td>
<td>Yes, No</td>
</tr>
<tr>
<td>Stillwater location</td>
<td>Yes, No</td>
</tr>
</tbody>
</table>

### Get Data

- **Get REST URLs**
- **DOWNLOAD**

*Data will download in CSV format*
Pamlico Sound Data Examples

- Swan Ferry
- Waves Village
- Scott’s Boat Yard
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

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Useful Links
https://nc.water.usgs.gov
https://water.usgs.gov/floods/FEV/