A field experiment on storm surge and waves attenuation by NNBF in the Chesapeake Bay

Challenges and Opportunities

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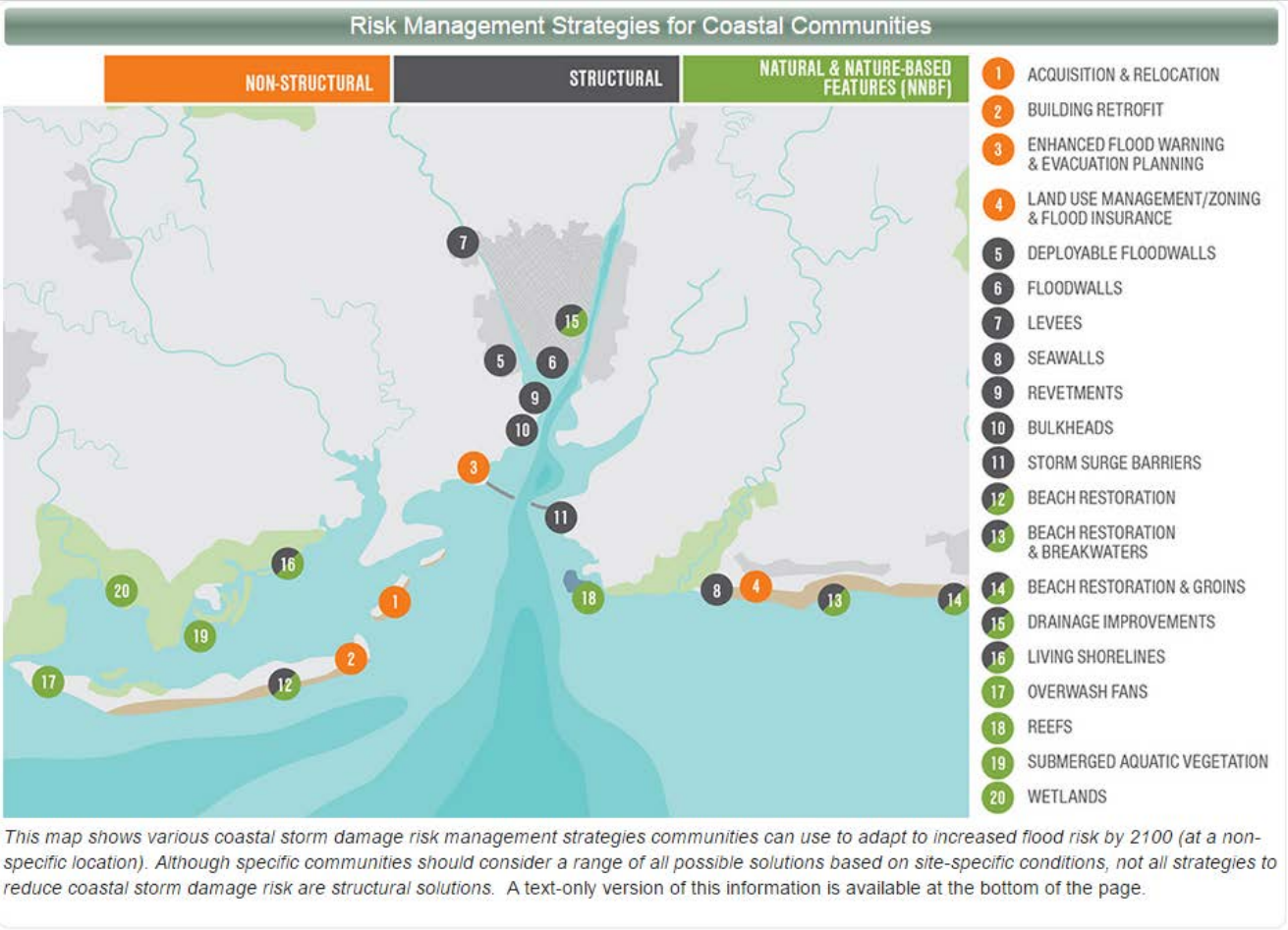
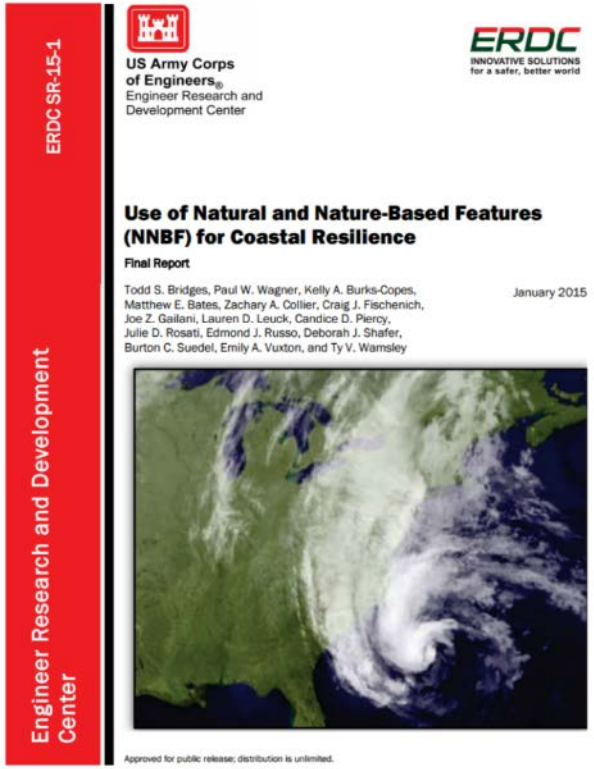
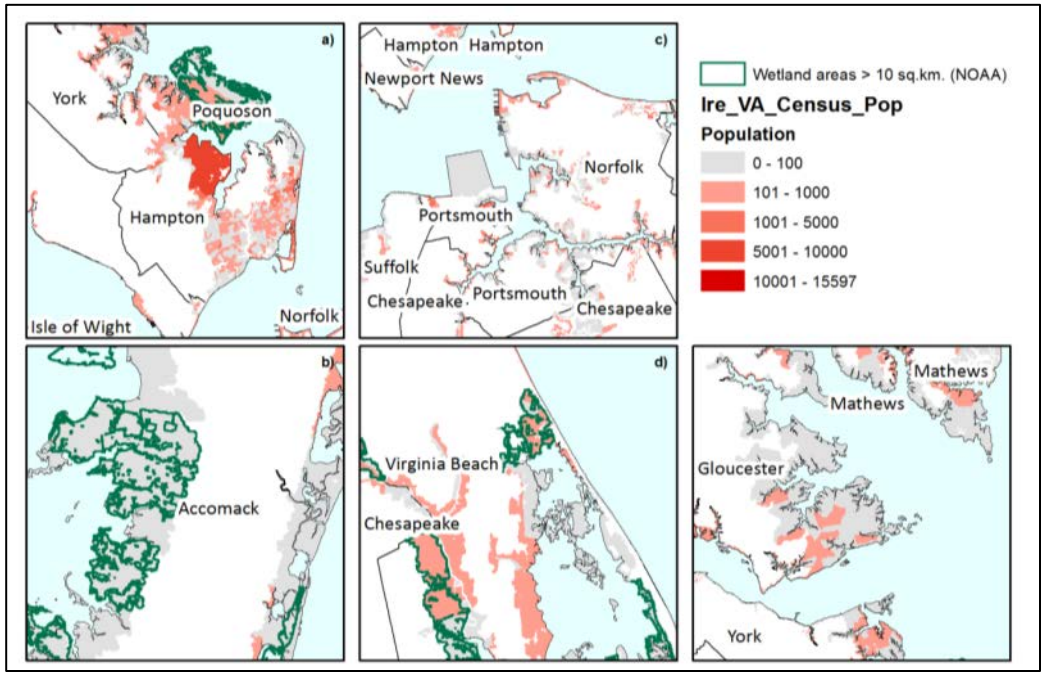
Natural and Nature-Based Features

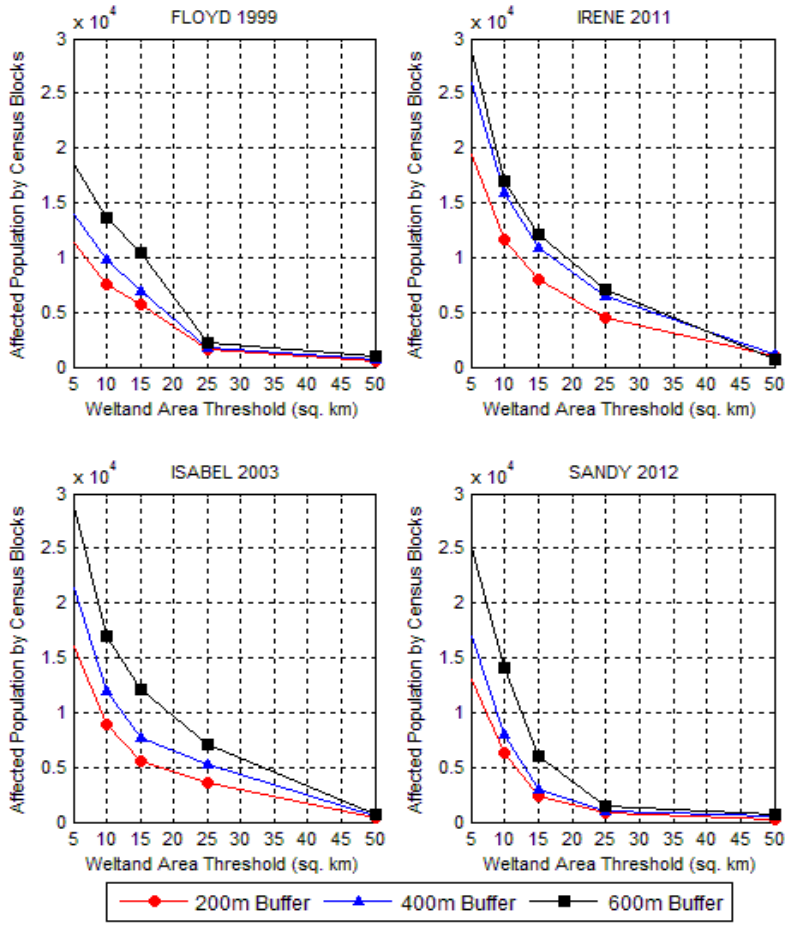


This map shows various coastal storm damage risk management strategies communities can use to adapt to increased flood risk by 2100 (at a non-specific location). Although specific communities should consider a range of all possible solutions based on site-specific conditions, not all strategies to reduce coastal storm damage risk are structural solutions. A text-only version of this information is available at the bottom of the page.



Can we get effective protection?





Haddad *et al.* (2015), *Natural Hazards*

Objectives

Quantify the potential of natural wetlands to attenuate storm surge in the Chesapeake Bay region

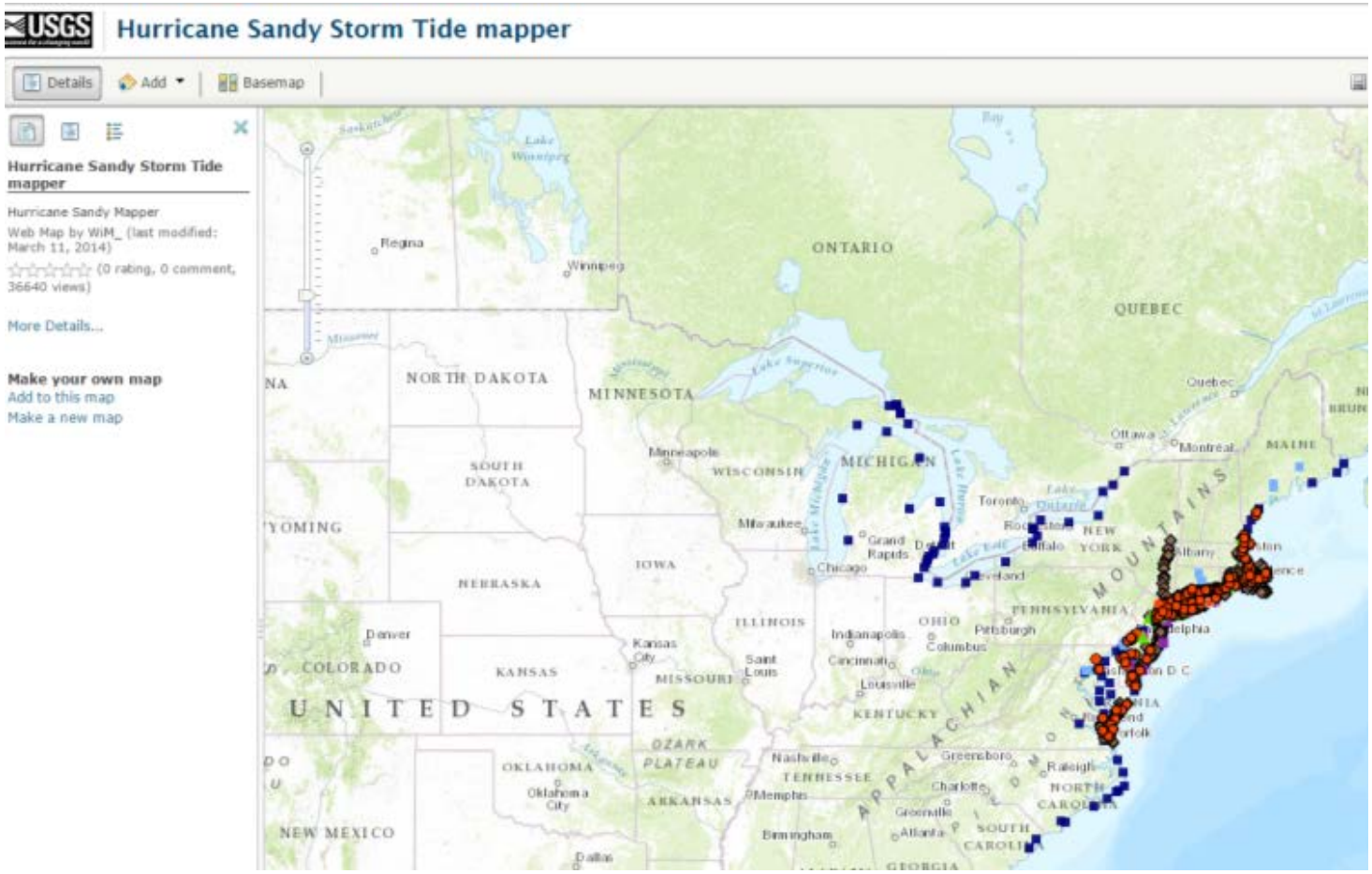
- Field Work
- High Performance Computing
- Resilience considerations

Acknowledgements:

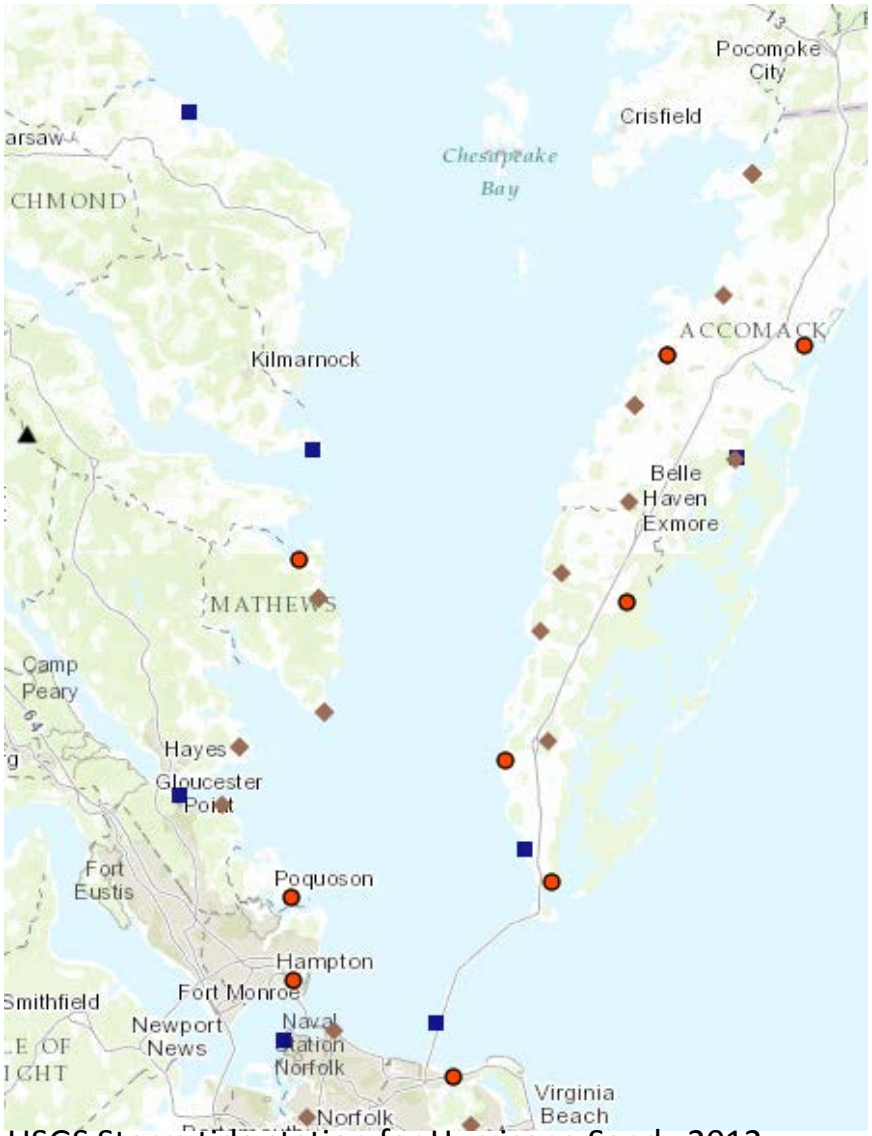
- In collaboration with Dr. Jud Harvey and Dr. Jay Choi
- Support & advising from Dr. Harry Jenter

USGS science for a changing world

USGS Storm Tide Program

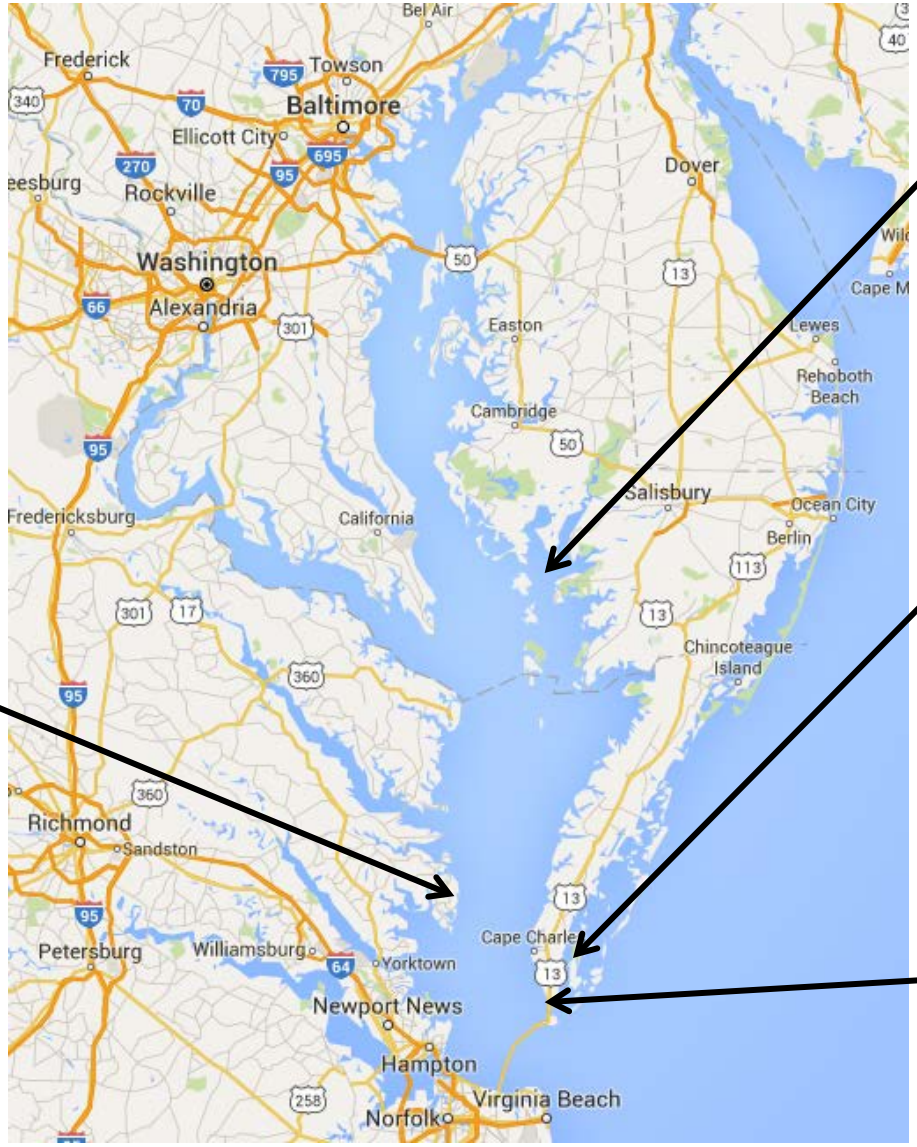


What about NNBFs data ?



USGS Storm tide station for Hurricane Sandy 2012

Operational Sites: Partners



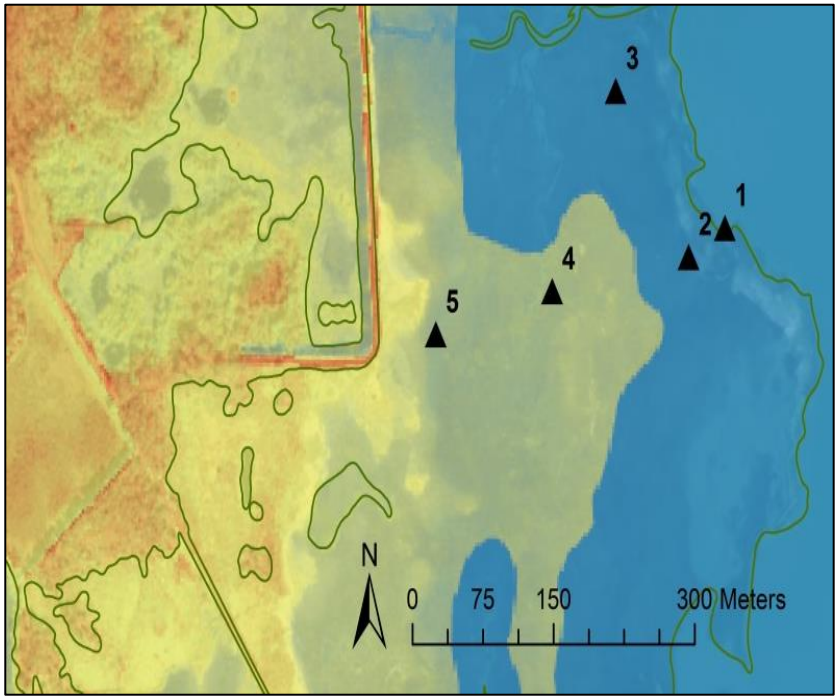
Monie Bay National Estuarine Research Reserve

Magothy Bay Natural Area Preserve

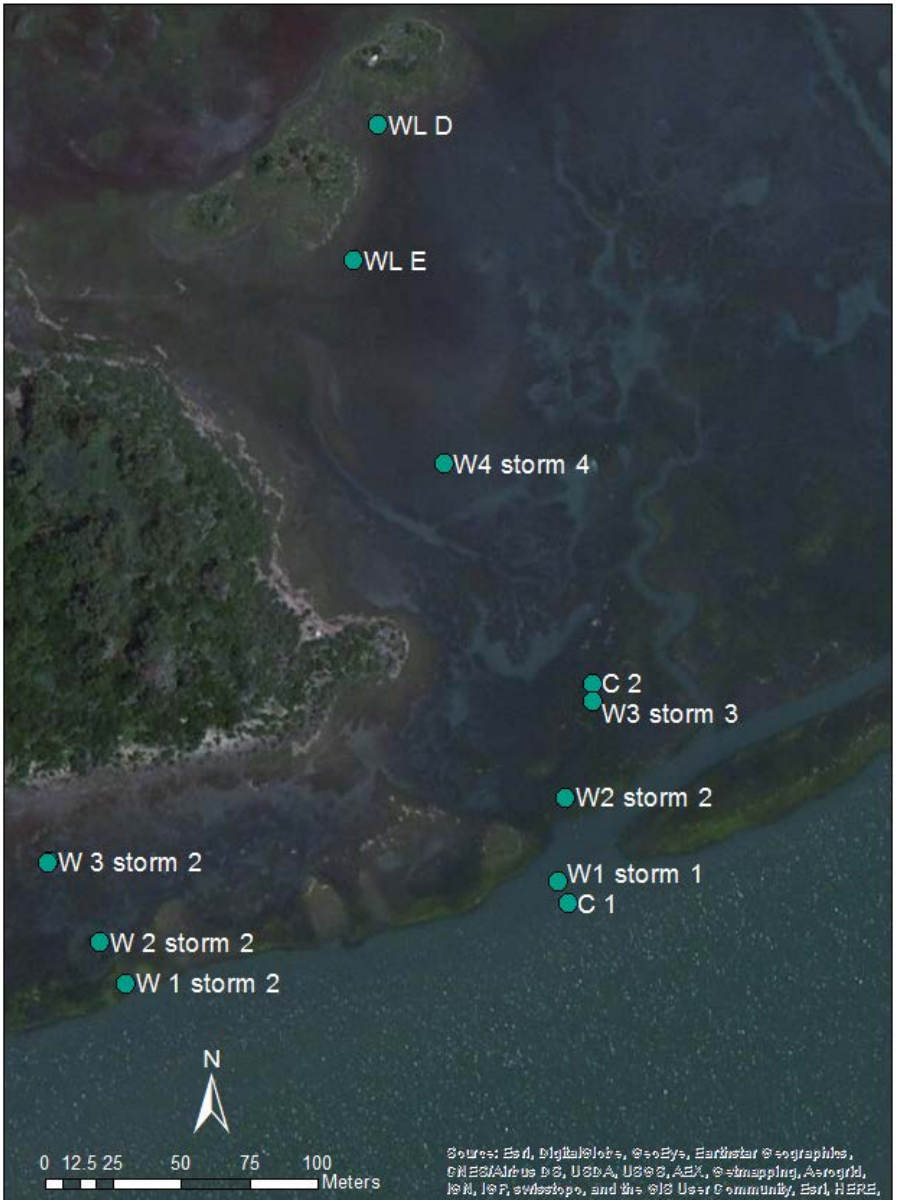
Dameron Marsh Natural Area Preserve

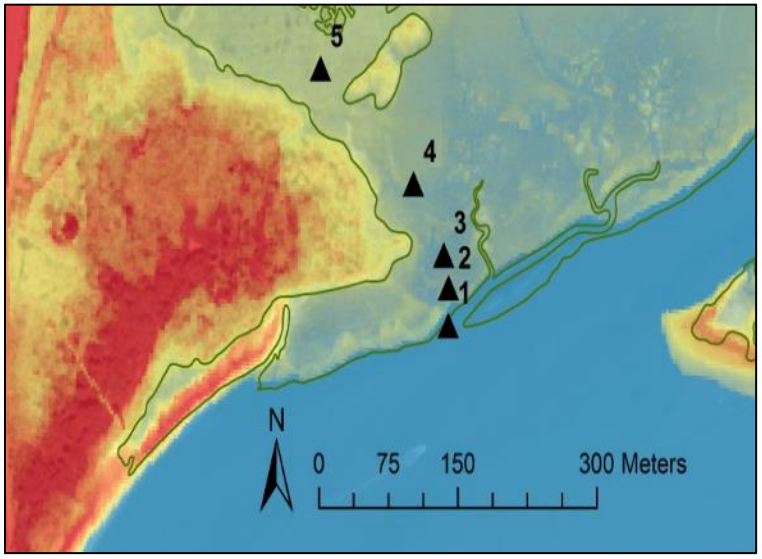
Eastern Shore of VA National Wildlife Refuge

Magothy Bay Natural Area Preserve

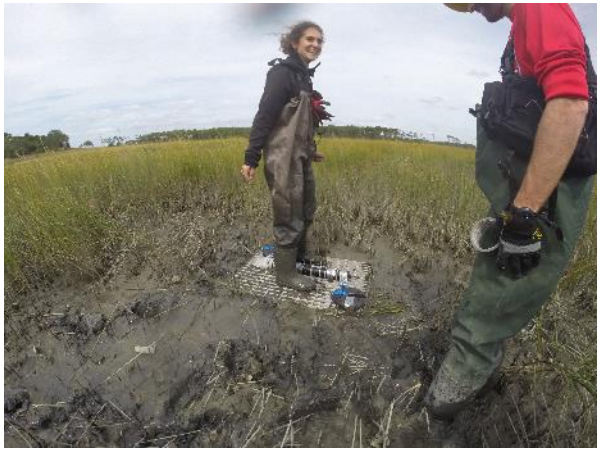


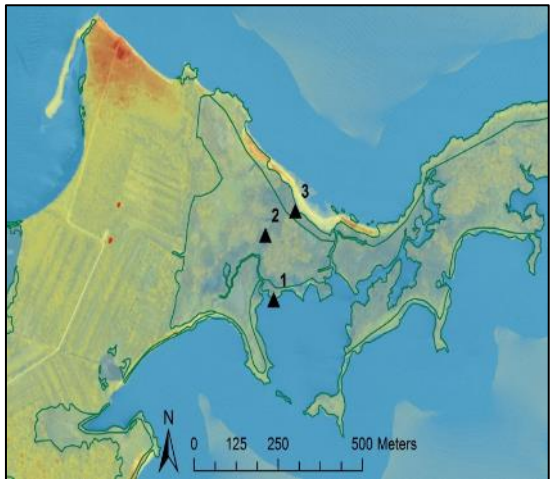
Eastern Shore of VA National Wildlife Refuge





Dameron Marsh Natural Area Preserve

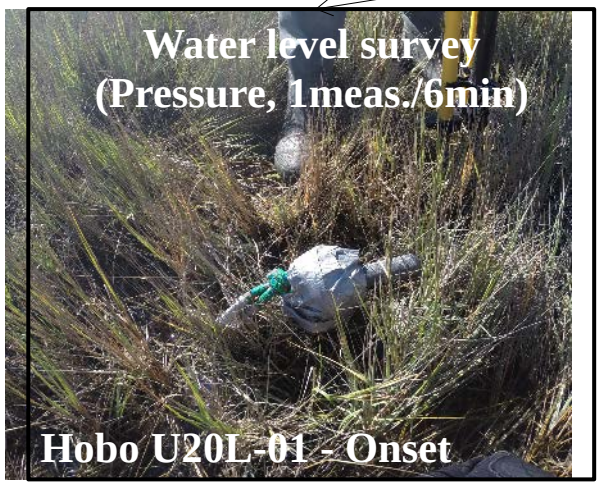


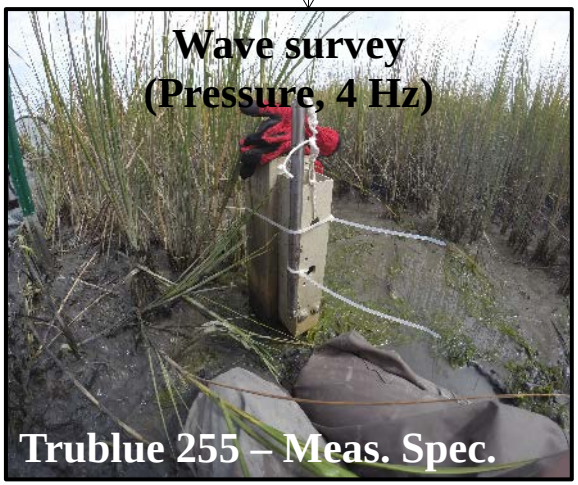


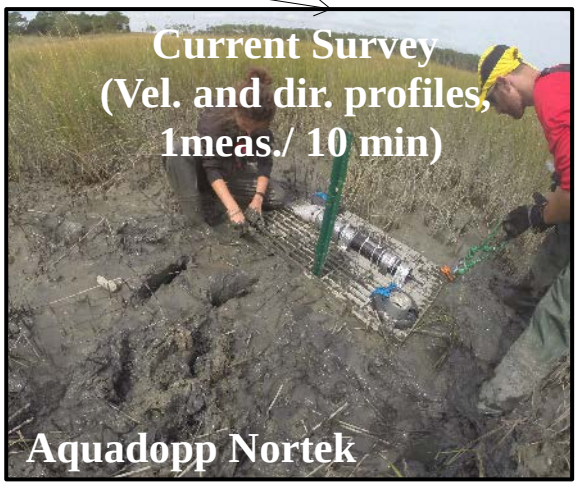
Monie Bay National Estuarine Research Reserve

Field monitoring: methods

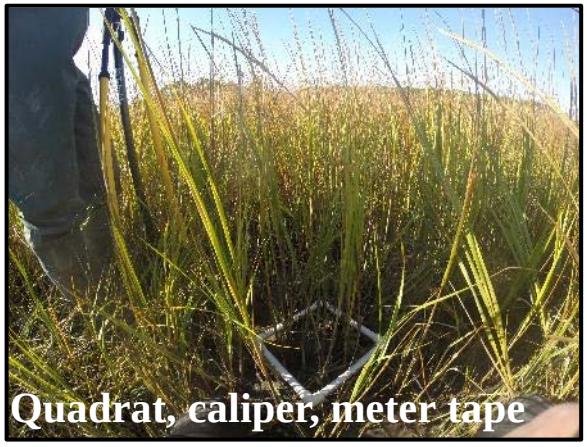
Hydrodynamics







Vegetation survey



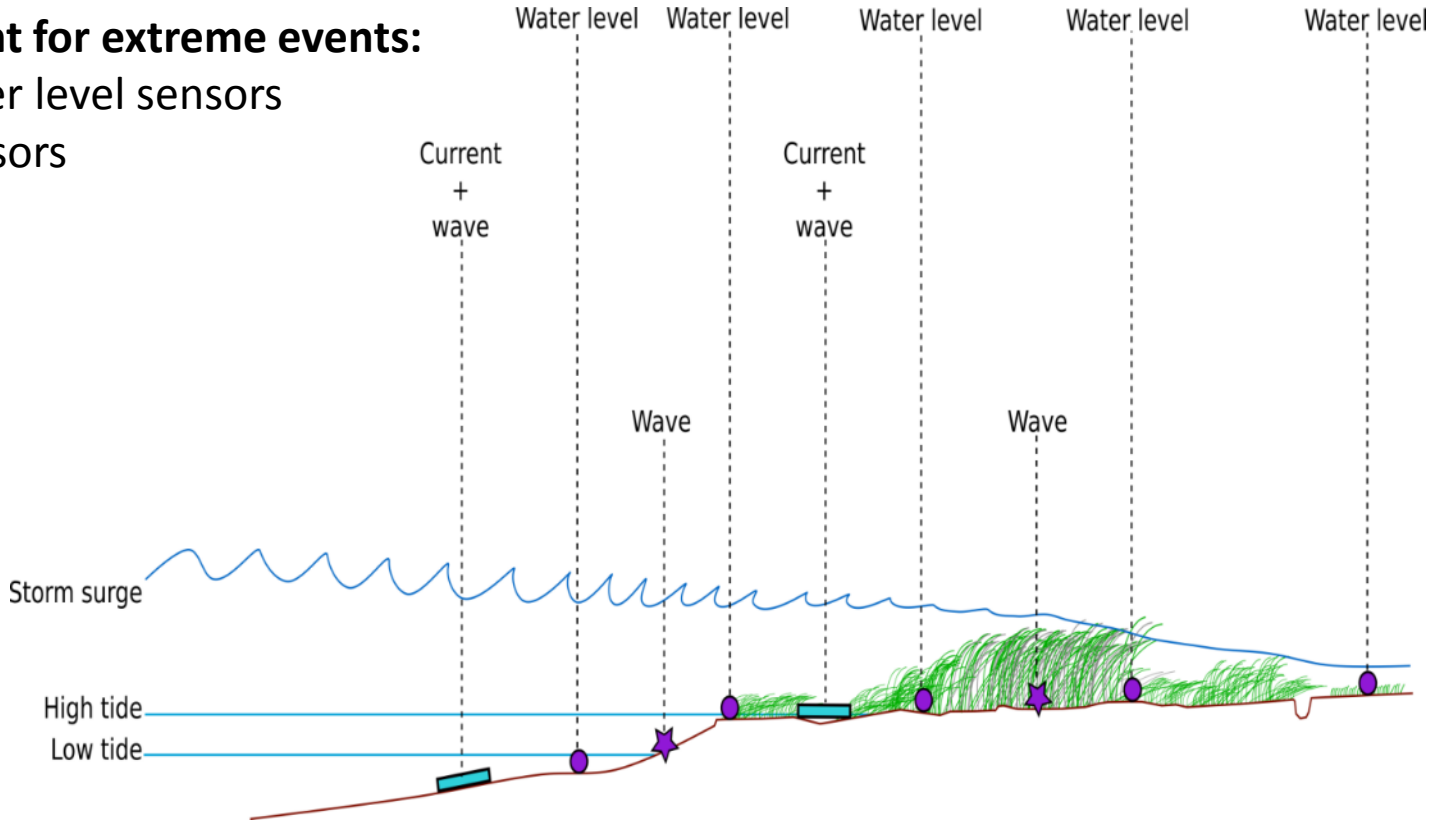
Topographical survey

Photographic survey

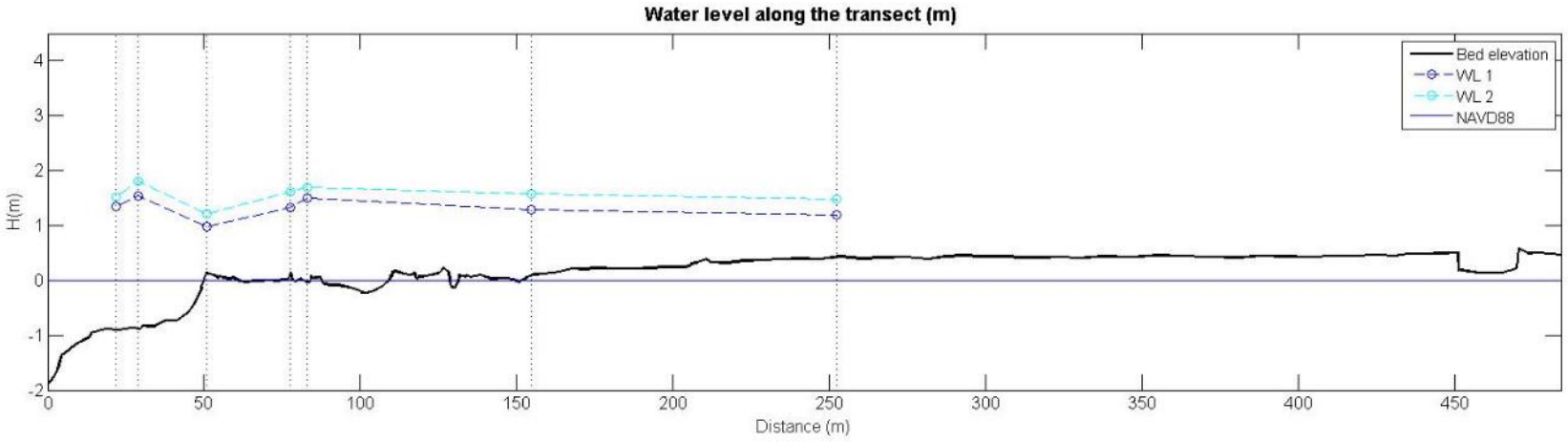
Hydrodynamic monitoring

1. **Continuous monitoring framework:**
   - 25 Water levels stations
   - 2 ADCPs (Nortek Aquadopp)

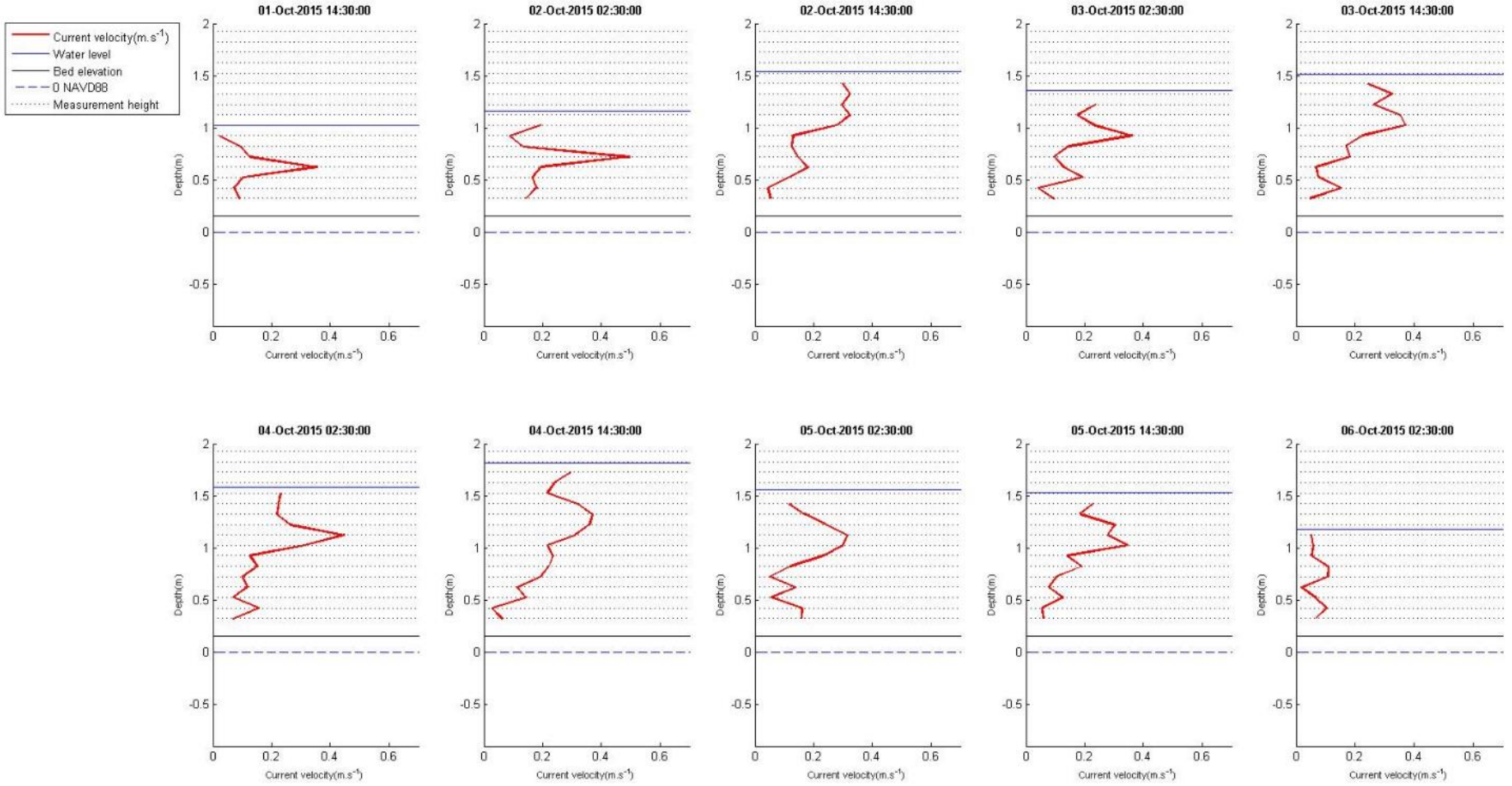
2. **Rapid deployment for extreme events:**
   - Extra 30 water level sensors
   - 10 Wave sensors



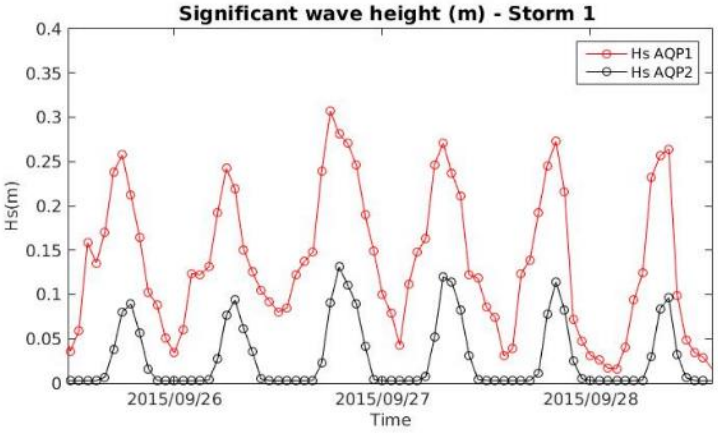
Preliminary results: Water Levels

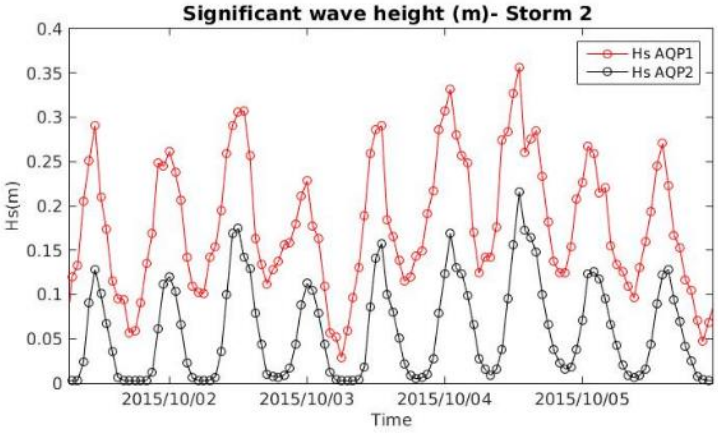


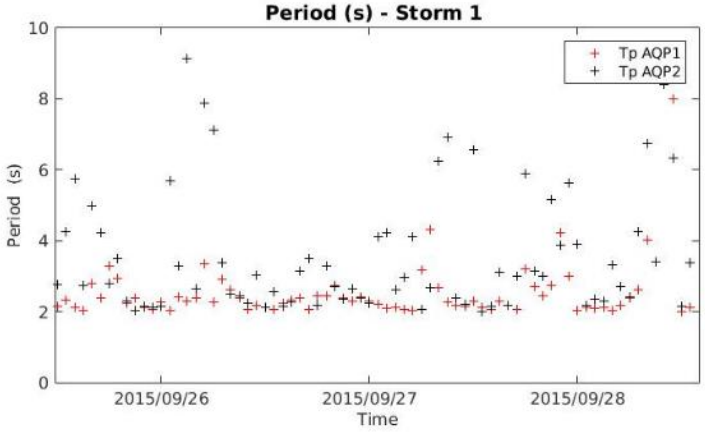
Preliminary results: Velocity profiles

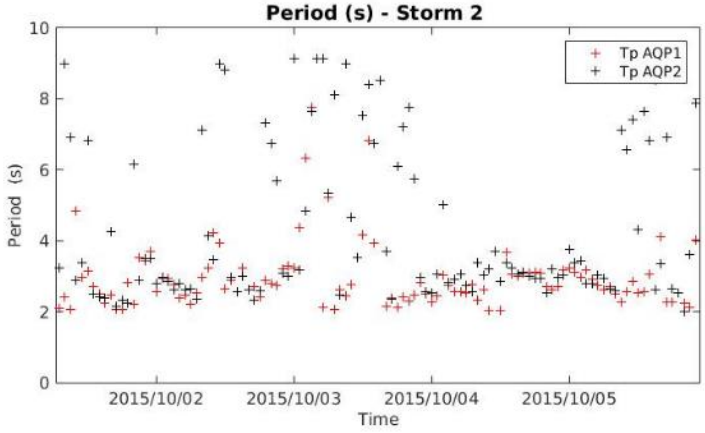


Preliminary results: Waves



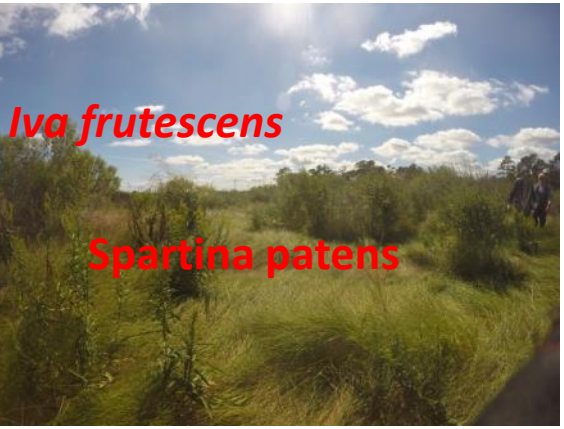






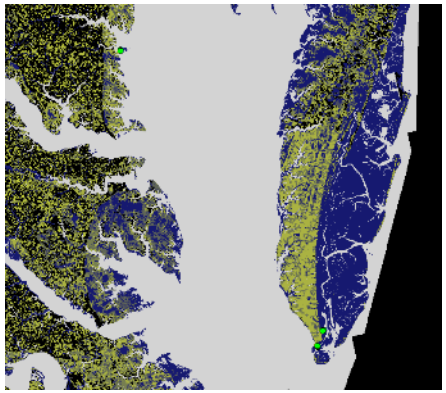
Vegetation Survey

- Sites based on topography and distance from shore
  - Stem diameter
  - Height
  - Leaf count
  - Density

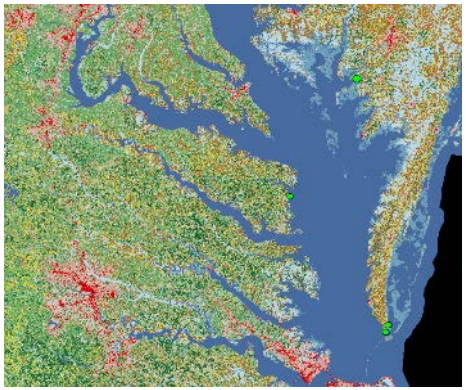


Data: Land Cover Data Sets

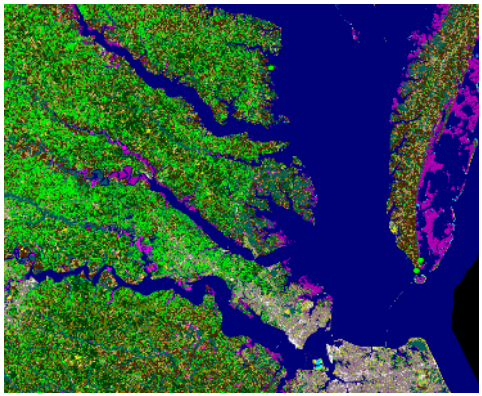
National Wetland Inventory (NWI)



Nation Land Cover Dataset (NLCD)



Coastal Change Analysis Program (CCAP)



Hypothesis: Is the surge response different for the most recent datasets?

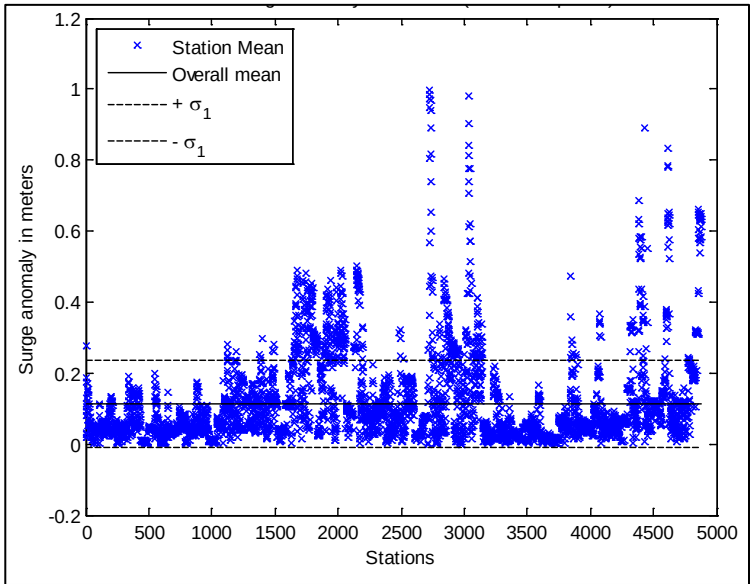
H_0: $\mu_{ccap2006} = \mu_{nlcd2006} = \mu_{nwi}$

H_1: *At least one mean is different*

Reject if: $p < 0.05$

Mean surge residual metric:

$$\mu_{residual} = \frac{\sum_1^k \sum_1^m \frac{\left|\zeta_{k(ccap)} - \zeta_{k(nlcd)}\right| + \left|\zeta_{k(ccap)} - \zeta_{k(nwi)}\right| + \left|\zeta_{k(nwi)} - \zeta_{k(nlcd)}\right|}{3}}{m * k}$$

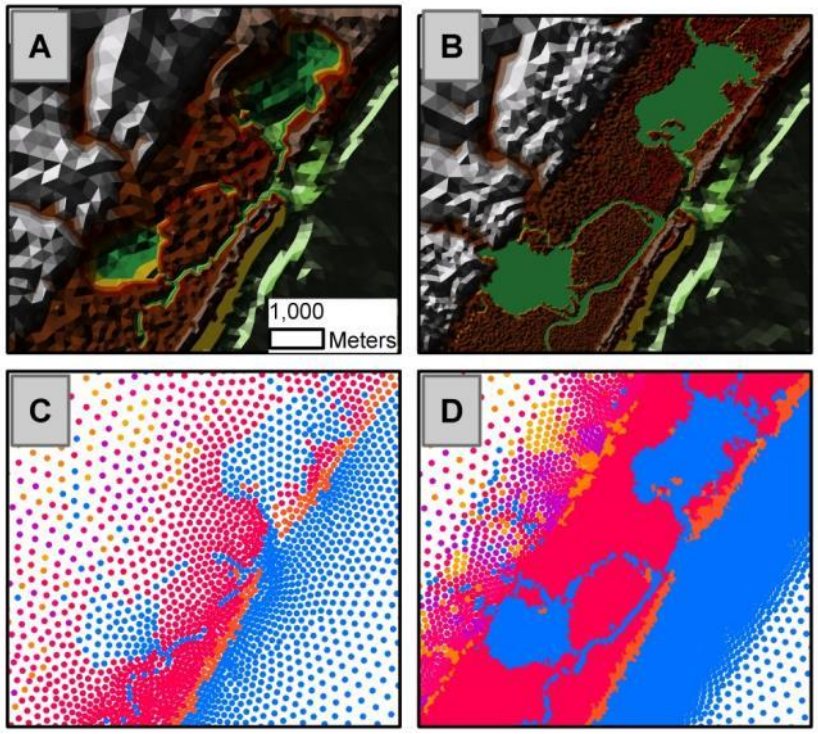


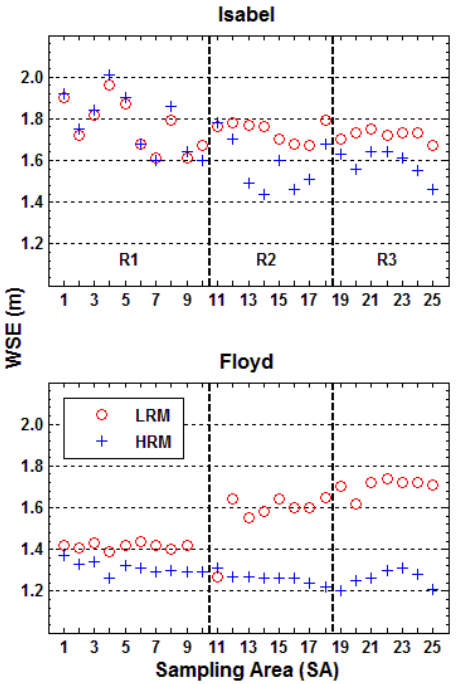
Ferreira *et al.* (2014), *Journal of Geophysical Research*

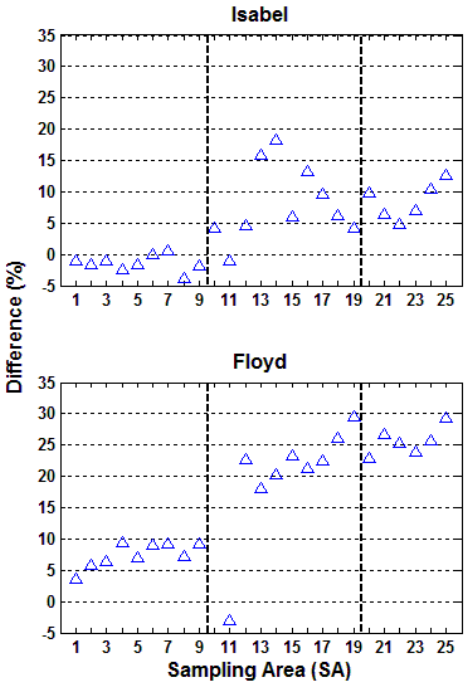
Topo-bathymetry

1. Instrument geo-location and vertical datum validation
2. Seasonal Cross section surveys
3. One Full topo/bathy surveys

Data: Topo/bathymetric Data Sets





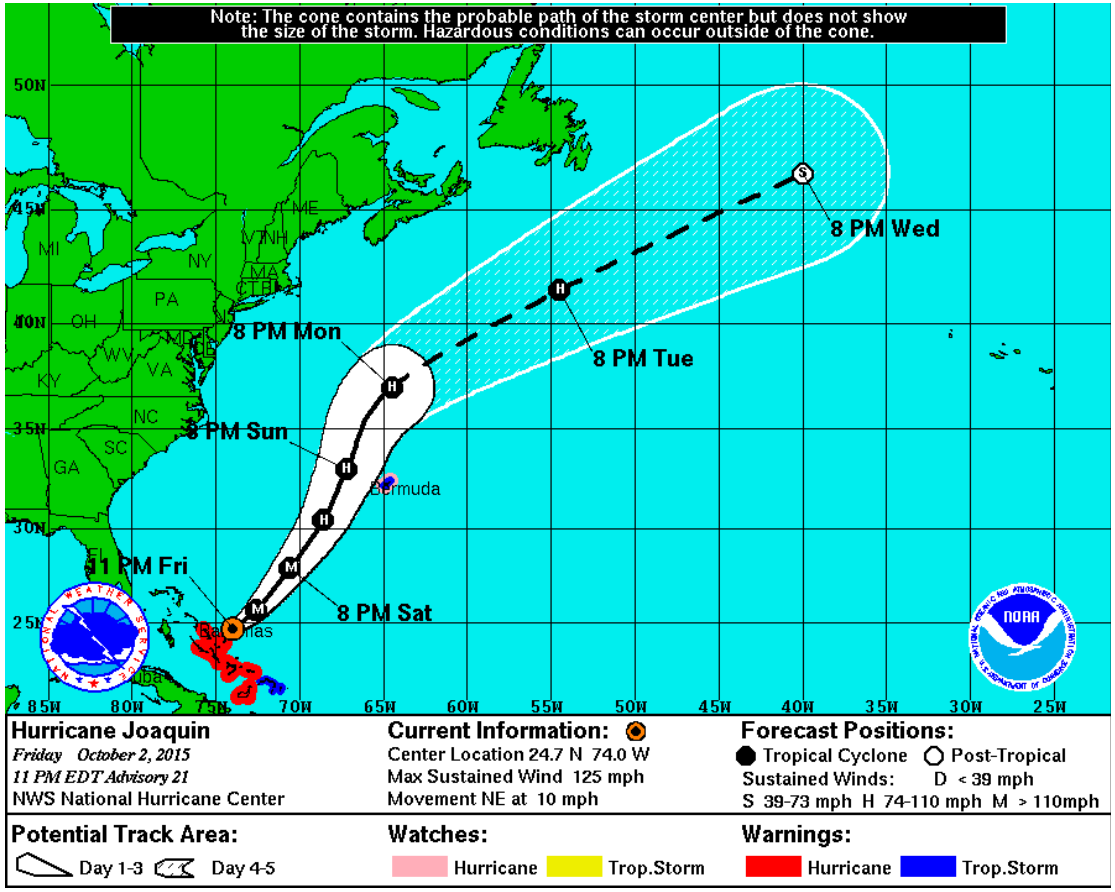


Lawler *et al.* (2015), Submitted to *Ocean and Coastal Management*

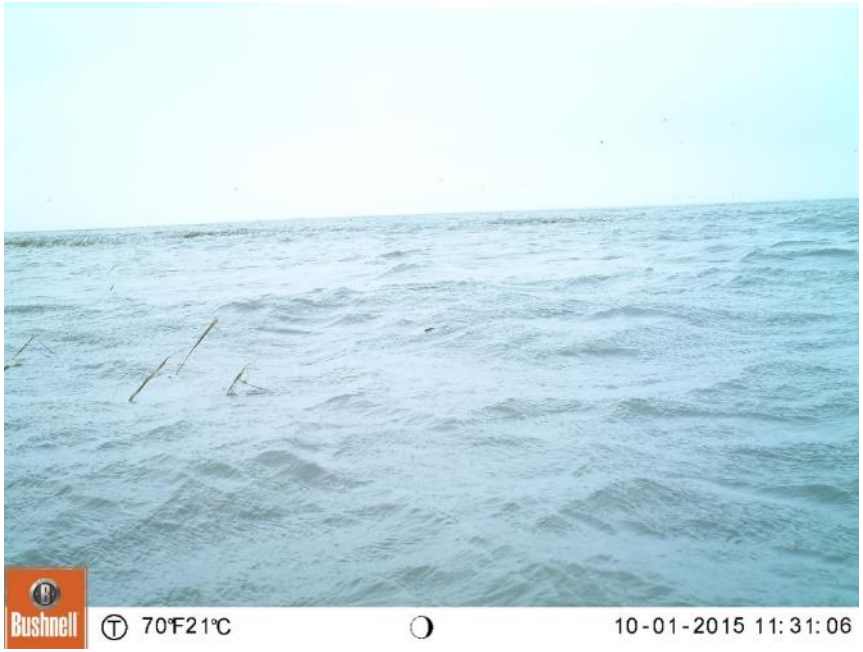
First Rapid Deployment Test

Hurricane Joaquin pre-deployment, October 2015

- 4 extra wave sensors
- 10 extra water level sensors



Photography Survey

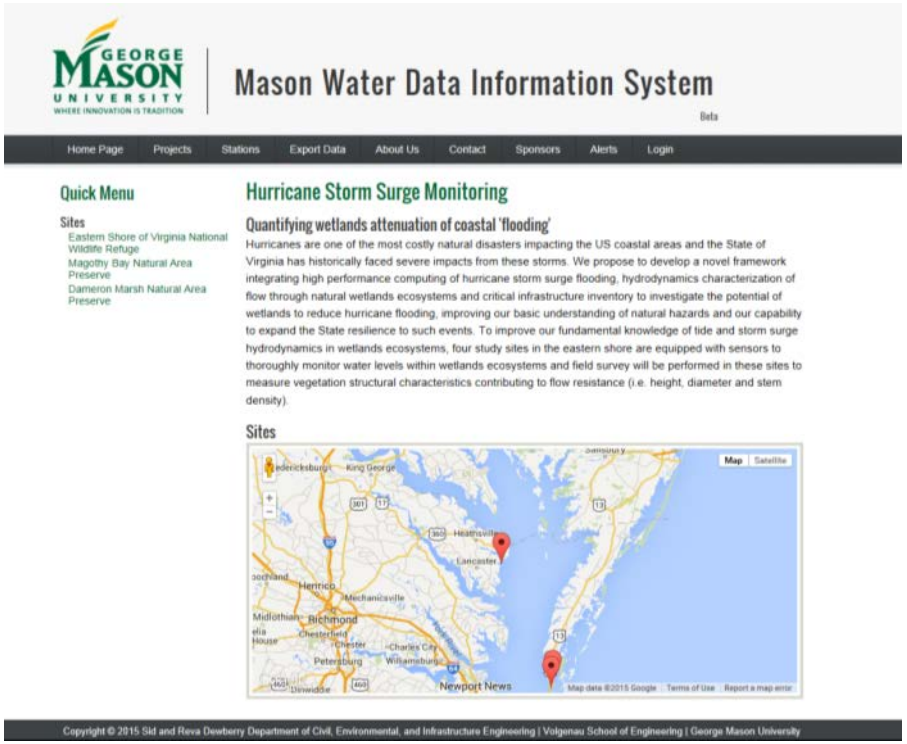


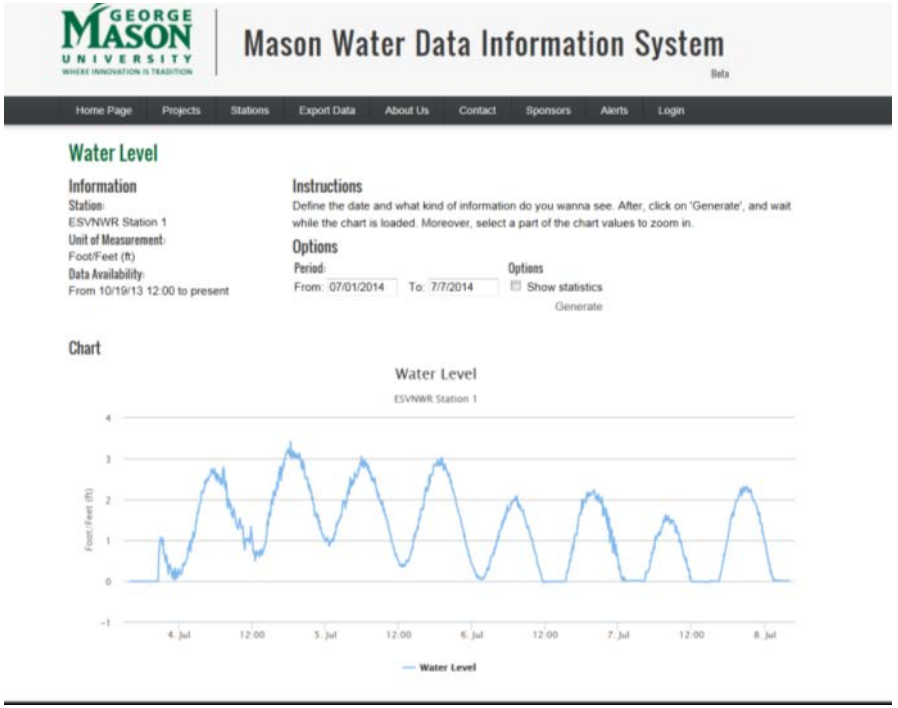
https://www.youtube.com/channel/UCXExJRbcZMkS6J1L3rWv7Dw

http://frg.vse.gmu.edu/wetlands-storm-surge

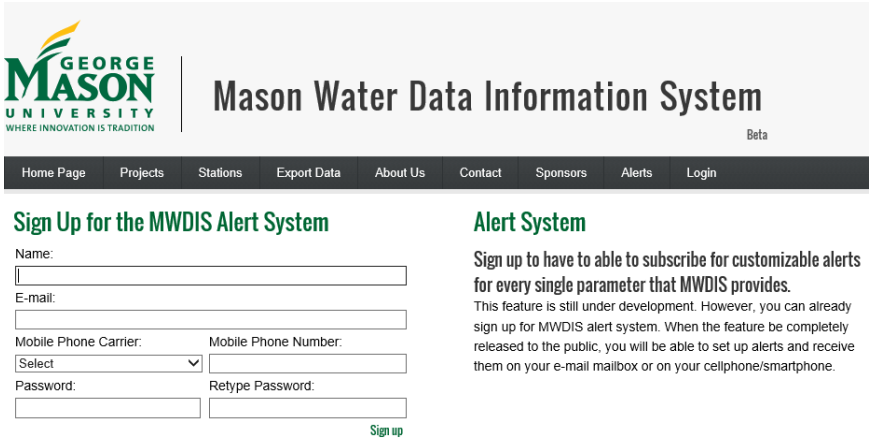
Hurricane Joaquin pre-deployment, October 2015

The Mason Water Data Information System





http://water.vse.gmu.edu/



MWDIS MASON WATER DATA INFORMATION SYSTEM

Summary

Goal:

NNBF Comprehensive database from high density measurements of:

- Water levels
- Current velocities
- Waves
- Vegetation characteristics
- Micro-topography

Status:

- All 4 sites with continuous monitoring for water levels
- Currents and waves sensors tested and ready for rapid deployment
- Ongoing vegetation and micro-topography surveys

Target deadlines:

- First online data portal available in Spring 2016
- Comprehensive database available in Spring 2017

Looking forward for collaborations to expanding and distributing the datasets

Acknowledgements

The views expressed herein are those of the research group and do not necessarily reflect views of our sponsors or any sub agencies. The use of trade names does not constitute an endorsement in the use of these products by the U.S. Government

Questions?

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