

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.

US Army Corps of Engineers® Engineer Research and Development Center

Development

Research and

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Use of Natural and Nature-Based Features (NNBF) for Coastal Resilience

Final Report

Todd S. Bridges, Paul W. Wagner, Kelly A. Burks-Copes, Matthew E. Bates, Zachary A. Collier, Craig J. Fischenich, Joe Z. Galiani, Lauren D. Leuck, Candice D. Piercy, Julie D. Rosati, Edmond J. Russo, Deborah J. Shafer,

January 2015

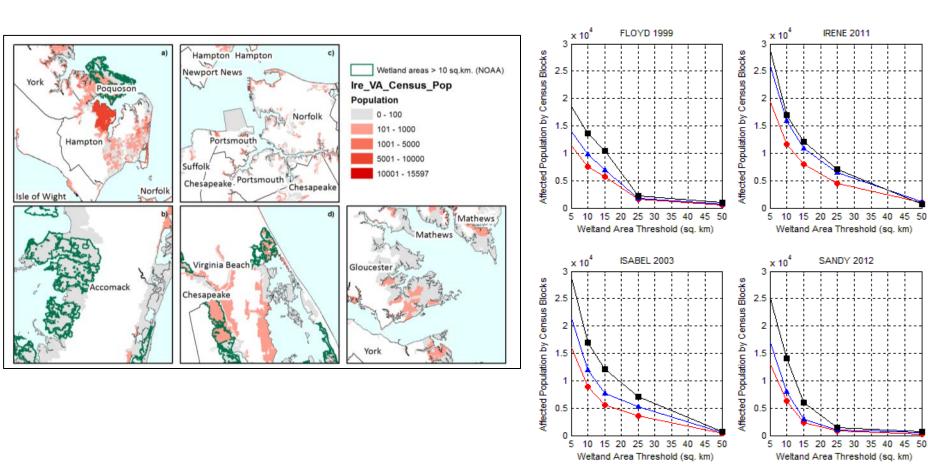


Approved for public release; distribution is unlimite

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Can we get effective protection?





Haddad et al. (2015), Natural Hazards

200m Buffer

400m Buffer

Objectives



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

- > Field Work
- High Performance Computing
- > Resilience considerations



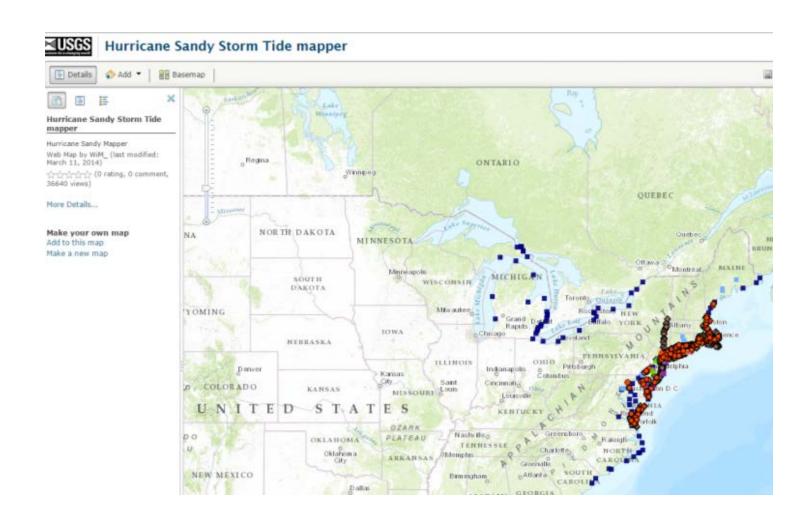
Acknowledgements:

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



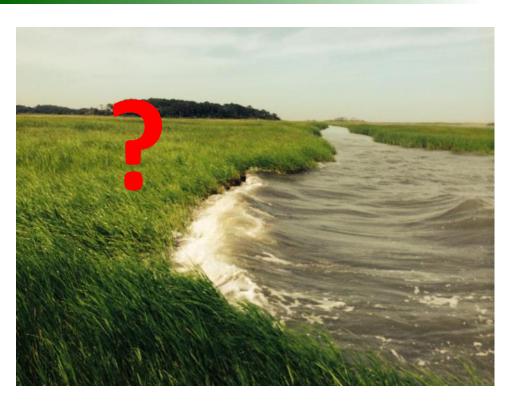
USGS Storm Tide Program

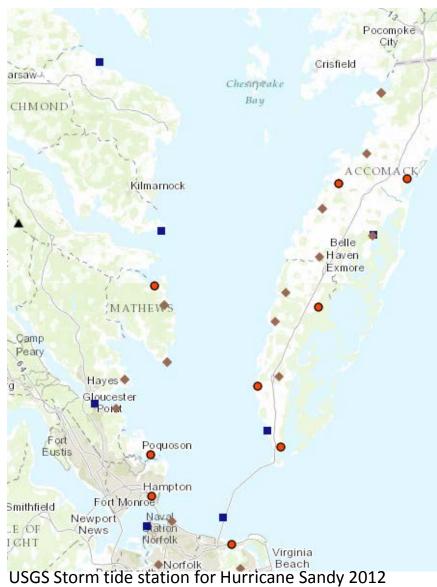




What about NNBFs data?

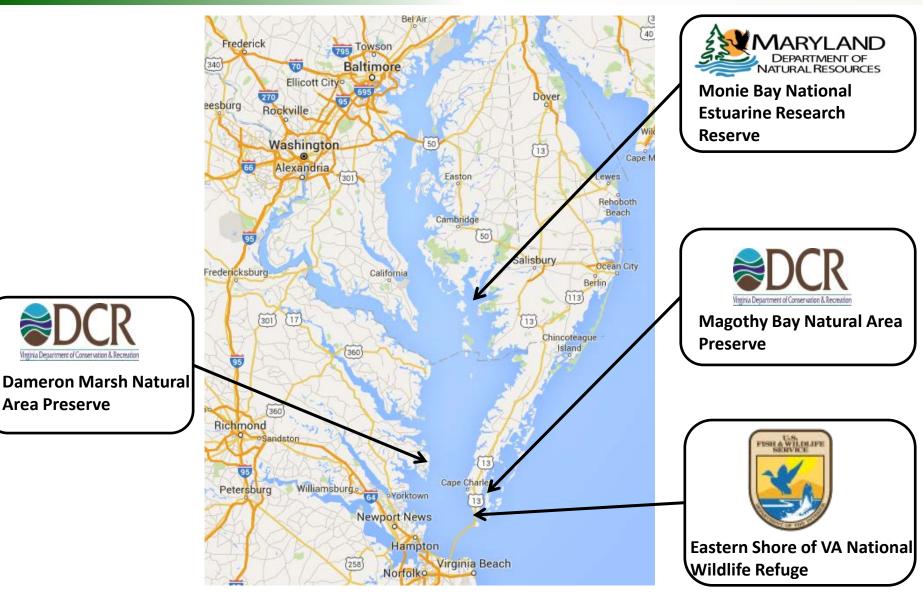






Operational Sites: Partners





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Virginia Department of Conservation & Recreation

Area Preserve



DCR Magothy Bay Natural Area Preserve

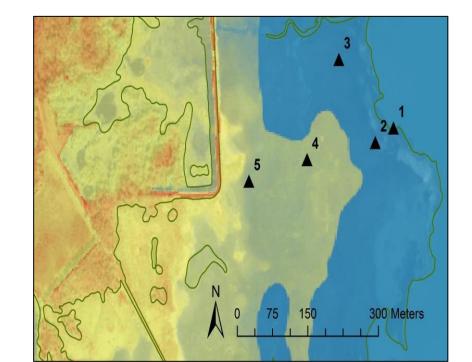












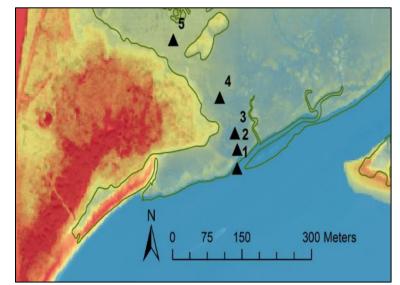


Eastern Shore of VA National Wildlife Refuge











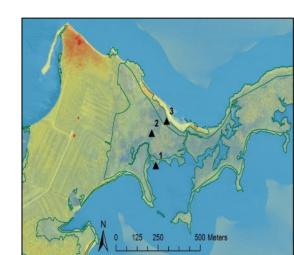
DCR Dameron Marsh Natural Area Preserve













Monie Bay National Estuarine Research Reserve











Field monitoring: methods





Hydrodynamics





Vegetation survey



Topographical survey



Photographic survey



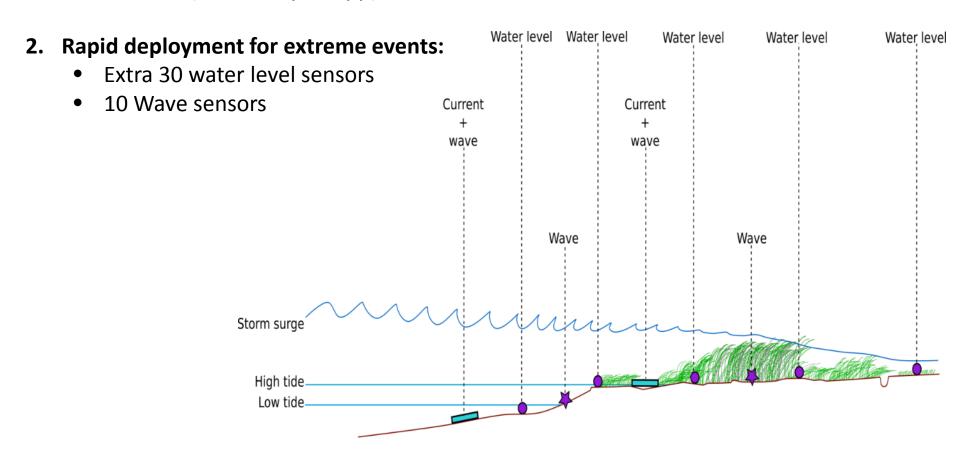
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Hydrodynamic monitoring



1. Continuous monitoring framework:

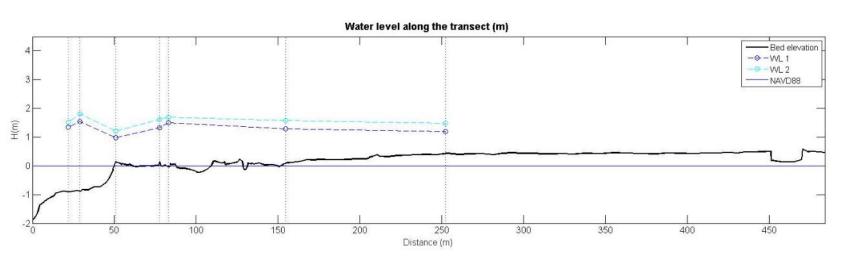
- 25 Water levels stations
- 2 ADCPs (Nortek Aquadopp)



Preliminary results: Water Levels

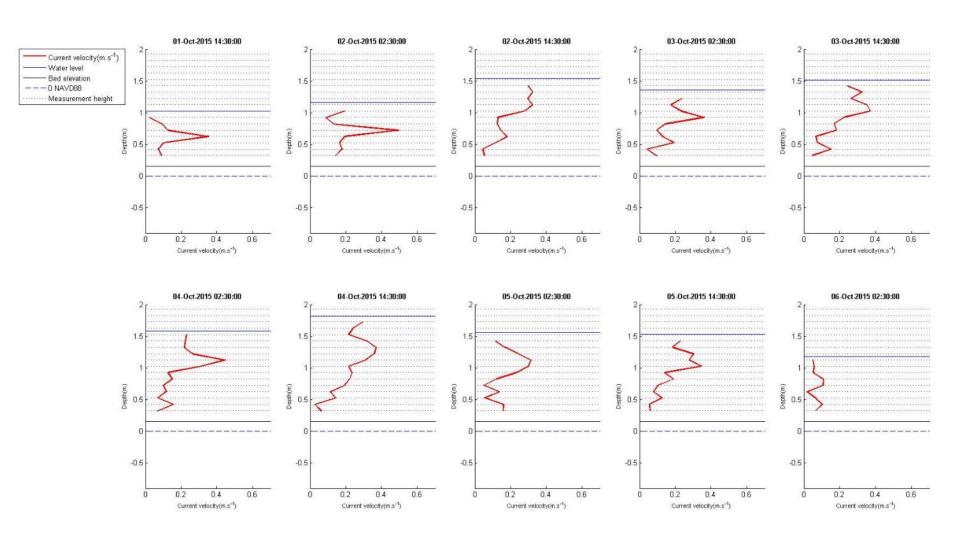






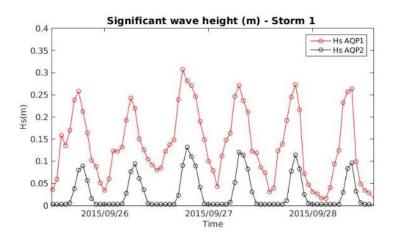
Preliminary results: Velocity profiles

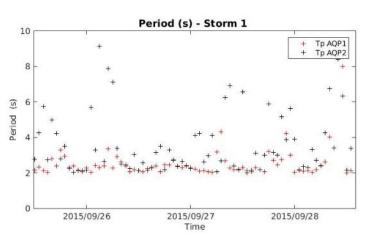


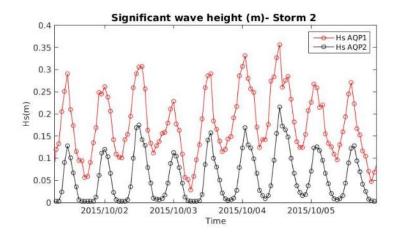


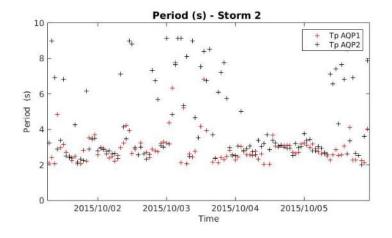
Preliminary results: Waves











Vegetation Survey

MASON UNIVERSITY

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









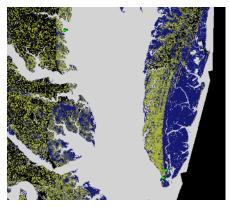


Data: Land Cover Data Sets





National Wetland Inventory (NWI)



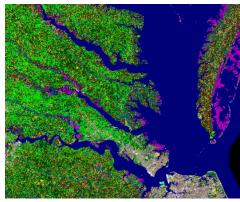


Nation Land Cover Dataset (NLCD)





Coastal Change Analysis Program (CCAP)



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

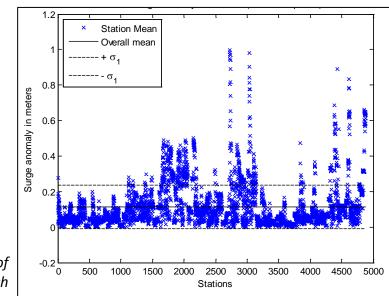
 H_0 : $\mu_{ccap2006} = \mu_{nlcd2006} = \mu_{nwi}$

 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

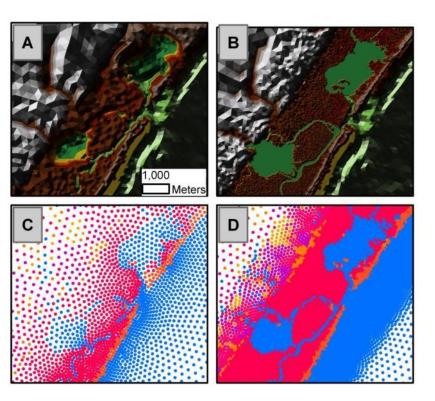


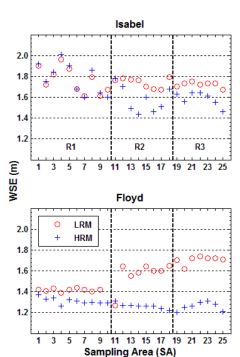
- Instrument geo-location and vertical datum validation
- 2. Seasonal Cross section surveys
- 3. One Full topo/bathy surveys

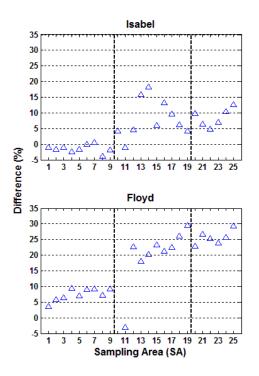


Data: Topo/bathymetric Data Sets









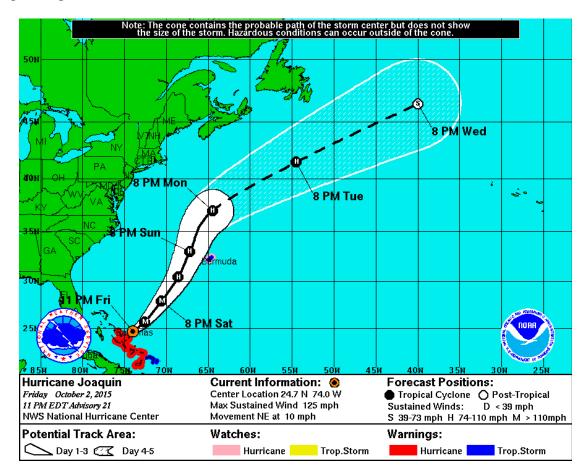
Lawler et al. (2015), Submitted to Ocean and Coastal Management

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/UCXExJRb cZMkS6J1L3rWv7Dw

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

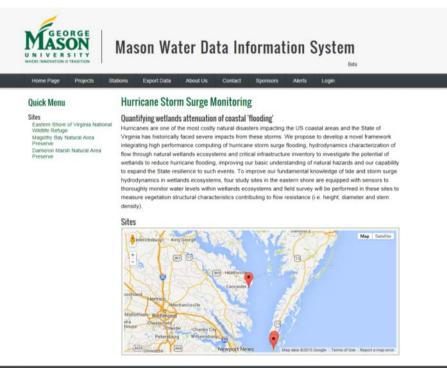
Hurricane Joaquin pre-deployment, October 2015





The Mason Water Data Information System

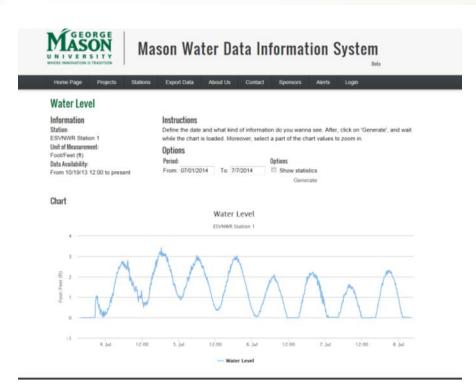




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http://water.vse.gmu.edu/





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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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