Exploring Coastal Hazards in Virginia and North Carolina via Reanalysis of 2011 Hurricane Irene with Future Sea Level Rise

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in collaboration with:

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Background

- In FY17, NASA's Applied Sciences: Disasters Program began a small pilot project titled "***Mid-Atlantic Resiliency Demonstration Study, Communities at Intensive Risk***"
- Strategic Goals and Objectives:
  - Demonstrate how coupling diverse models, data and predictions enable us to develop and extend our **collective knowledge** of compounding risk
  - Collaborate with partners to understand their data-driven needs for decision making in coastal communities with intensive risk
  - Demonstrate how various tools, ranging from modeling to remote sensing, can help to identify current and future areas of risk.
  - Engage with key external partners to understand their goals for improving disaster resilience and participate as a key collaborator.
- Focus:
  - Holistic, interdisciplinary research and integrated application outcomes focused on improving resilience for coastal communities.

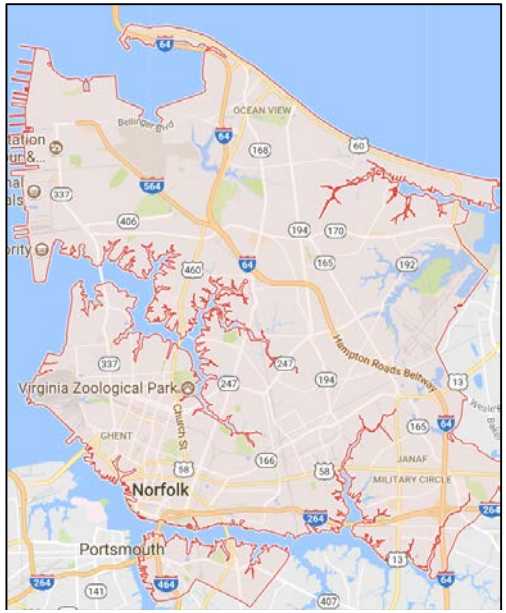
Areas of Interest: Virginia

- Preliminary focus in Virginia based upon previously established partnerships in these areas and significant impacts from past events.

Portsmouth, VA

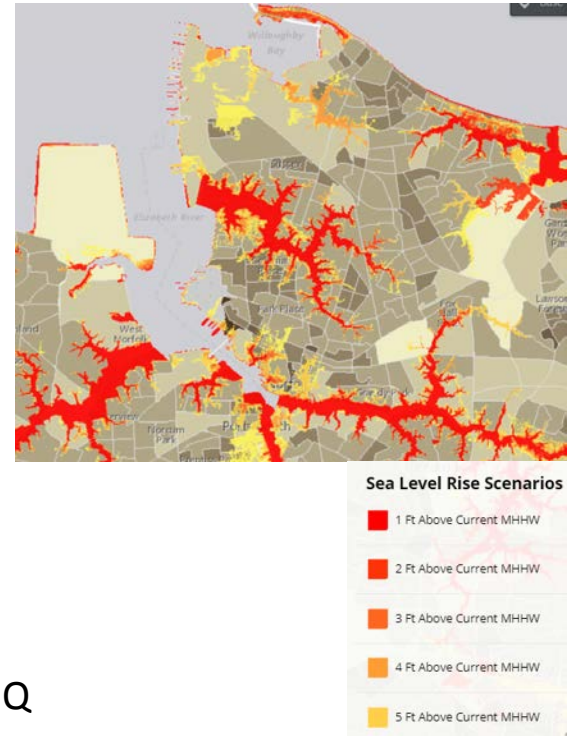
- Craney Island Naval Supply Center
- Norfolk Naval Shipyard

Norfolk, VA



- Naval Station Norfolk
- NATO Strategic Command HQ

Sea Level Rise Scenarios

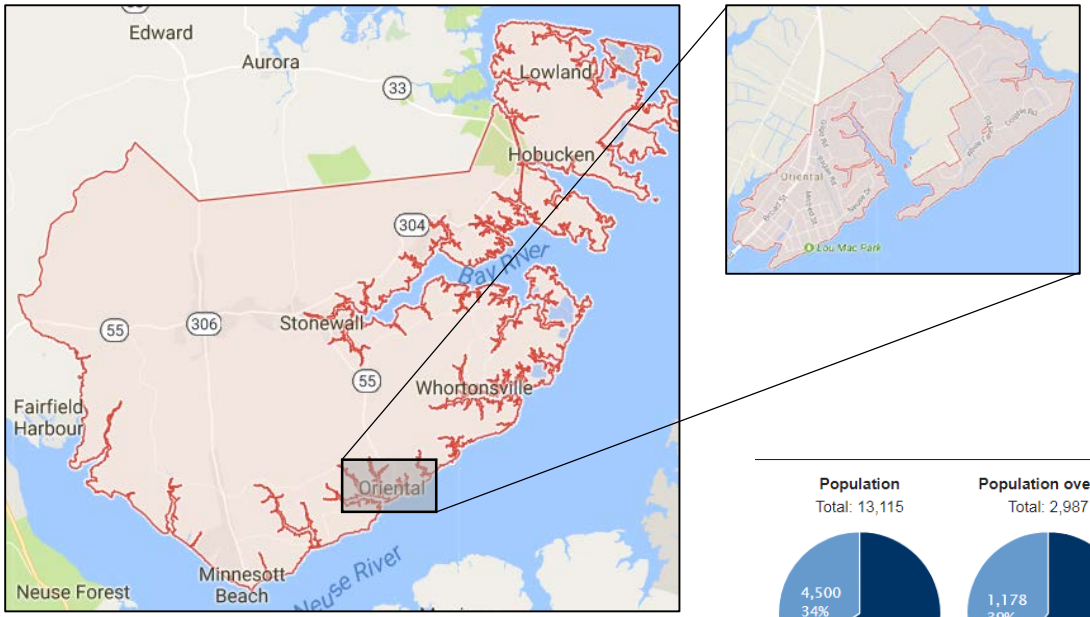


https://coast.noaa.gov/floodexposure

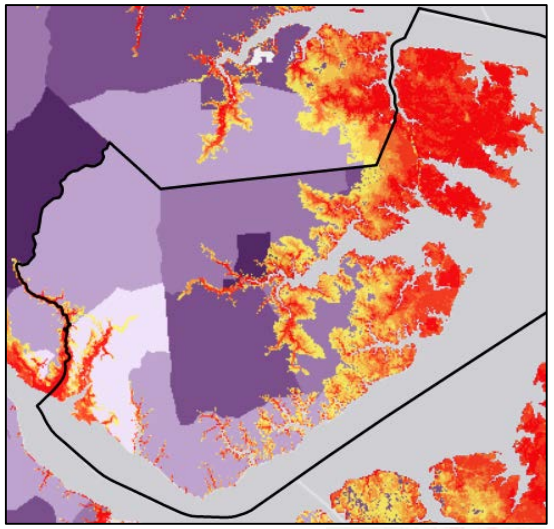
Areas of Interest: N. Carolina

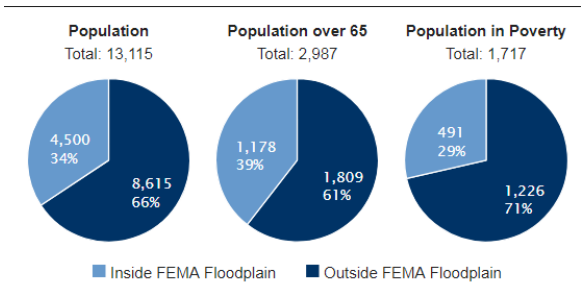
- Preliminary focus in N. Carolina focused on partnerships as well as unique access to high-resolution data for analysis.

Pamlico County, NC



Sea Level Rise Scenarios





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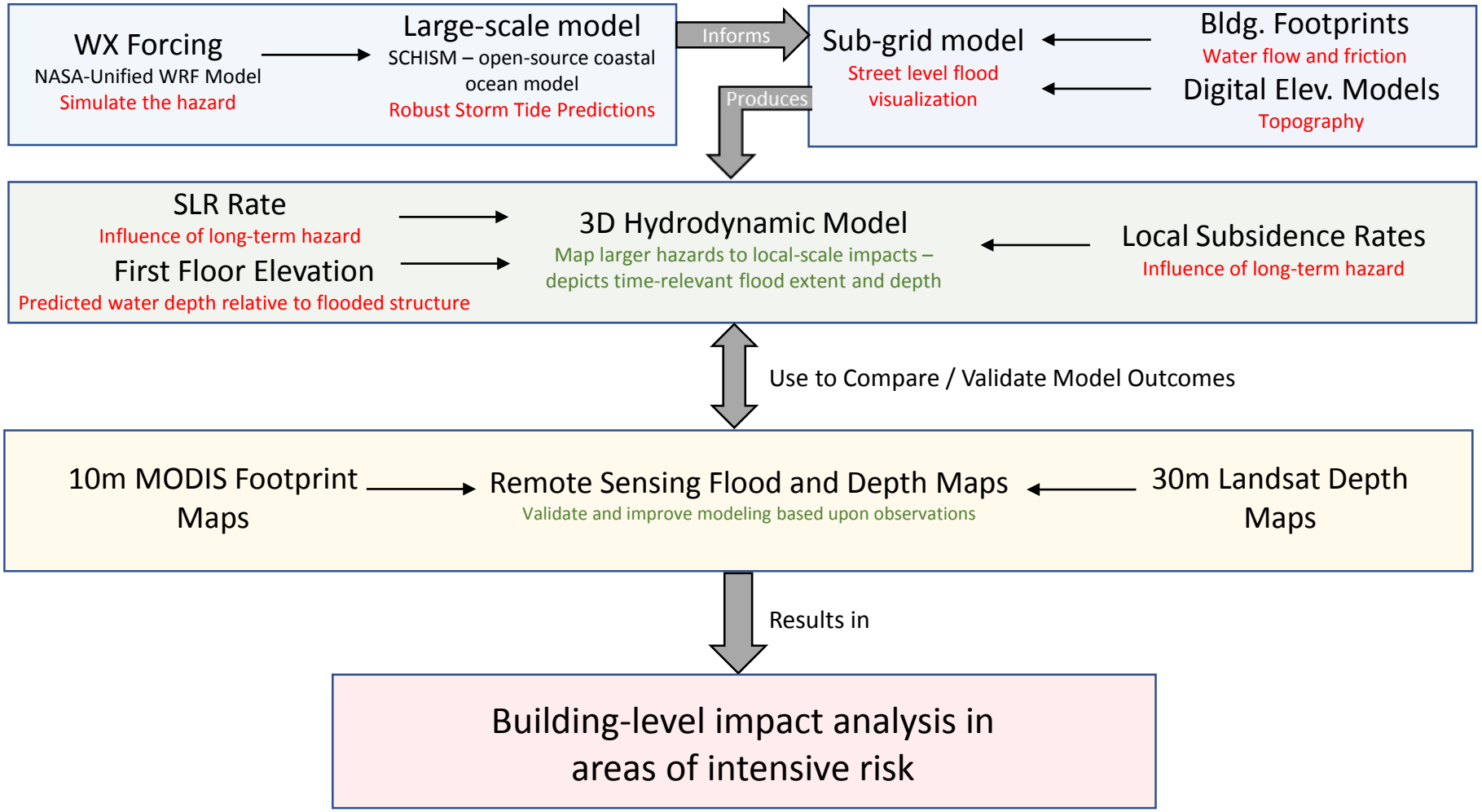
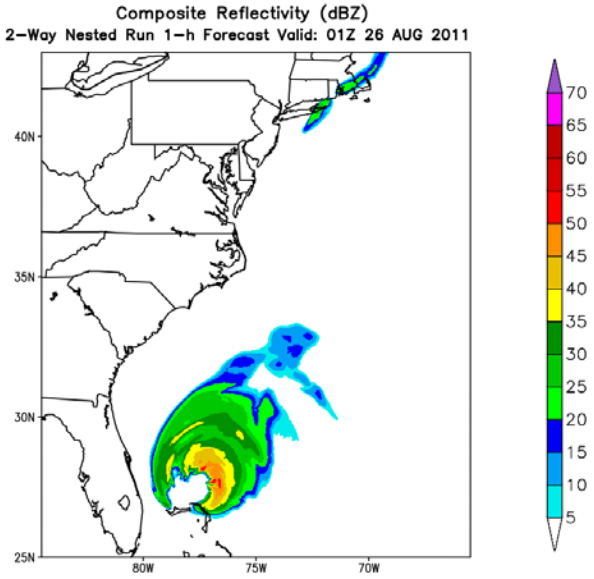
Technical Components

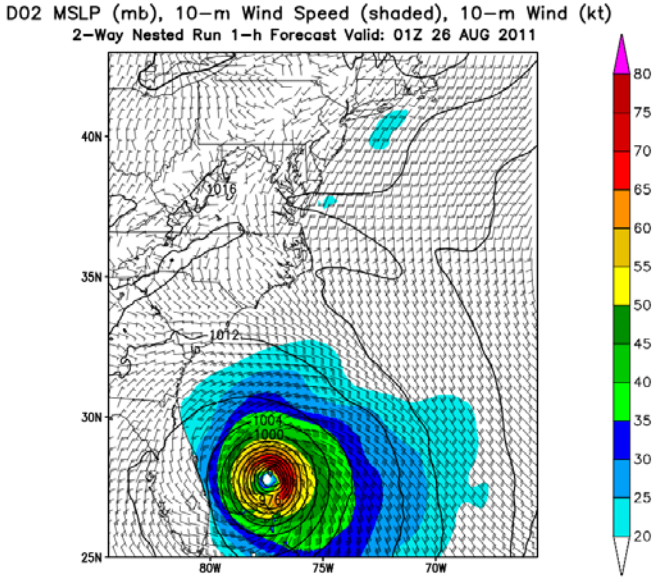


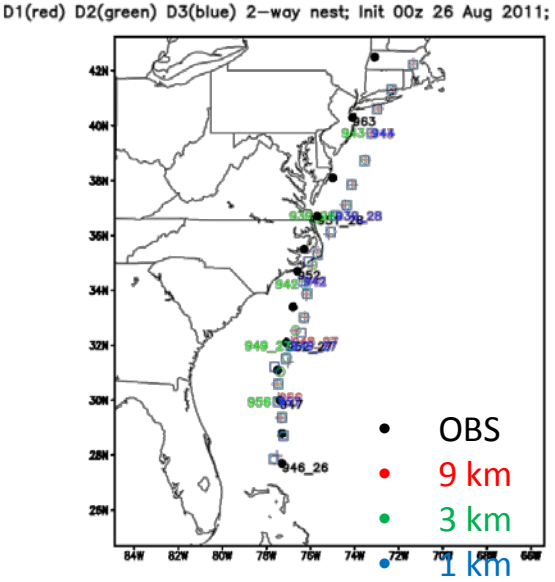
2011 Irene Simulations

J. Case, J. Srikishen, A. Molthan, NASA Marshall

- Using the NASA-Unified WRF Model to create a reanalysis of an Irene-like storm, based upon GFS analysis data available from 2011.







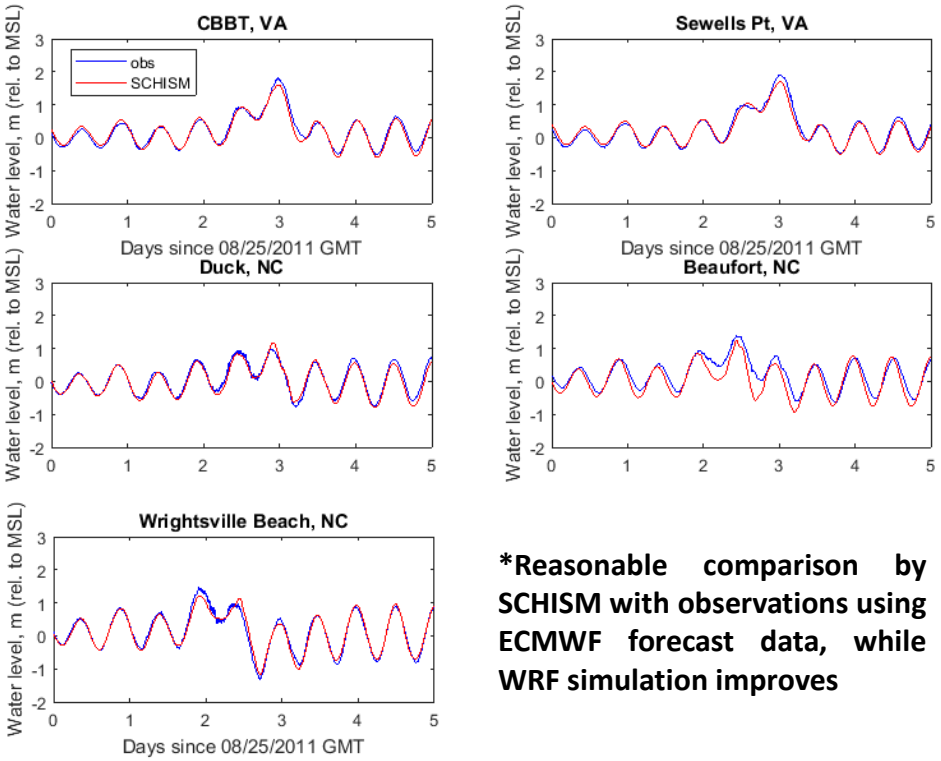
- Early issues with simulating the storm from GFS analyses: landfall was too early, storm was too intense. Exploring solutions through various initialization times, parameterizations, TC initial conditions, perhaps switch to HWRF.
- For exploratory work and fitting to other models, track and timing are reasonable for approach to NC/VA. ECMWF also provides good Irene simulations

Large-Scale Storm Tide Modeling

Z. Liu, H. Wang, Virginia Institute of Marine Science

- **SCHISM** (Semi-implicit, Cross-scale, Hydro-science Integrated System Model)
  - Operationally tested and proven (NOAA, DWR, CWB…)

SCHISM Simulation Results Driven with ECMWF Wind and Pressure Data



***Reasonable comparison by SCHISM with observations using ECMWF forecast data, while WRF simulation improves**

Animation of Model Output near Chesapeake Bay

Goal: Establish confidence in model capabilities for predicting coastal hazards when combined with supporting numerical weather prediction inputs, then explore with varying intensity and other types of coastal change (sea level, subsidence).

Street-Level Flood Modeling

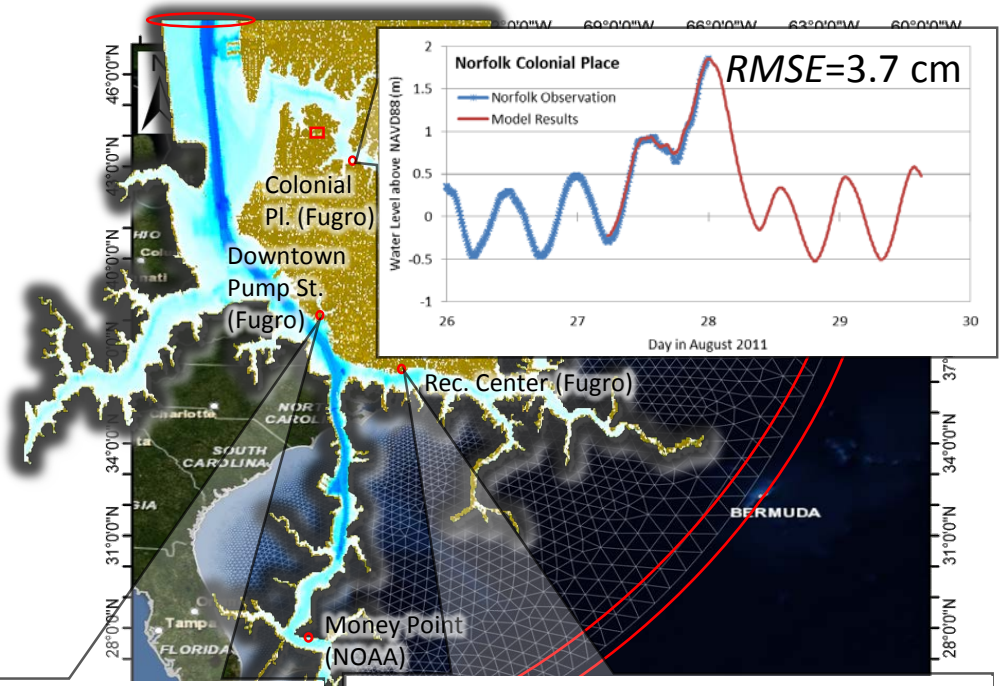
J.D. Loftis, Virginia Institute of Marine Science

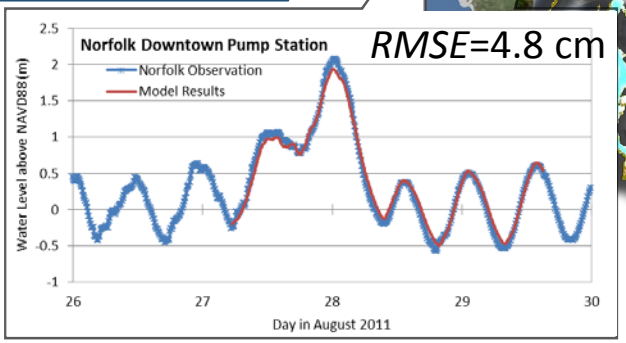
- Driven with water levels and atmospheric forecasts from Large-Scale SCHISM model
- Compares well with local sensor data

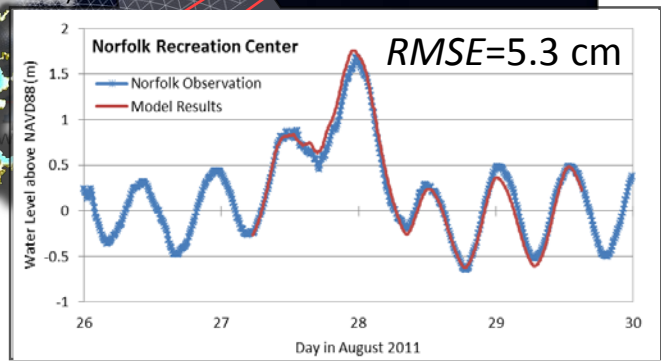
2011 Hurricane Irene Max. Flood Extent Forecast: Contour Map in Norfolk's Larchmont Neighborhood

Goal: Develop dynamic flood forecast maps to effectively and quickly communicate inundation risk; further aid prediction of long-term coastal storm hazards with sea level rise & subsidence predictions.

SCHISM East Coast Model Domain



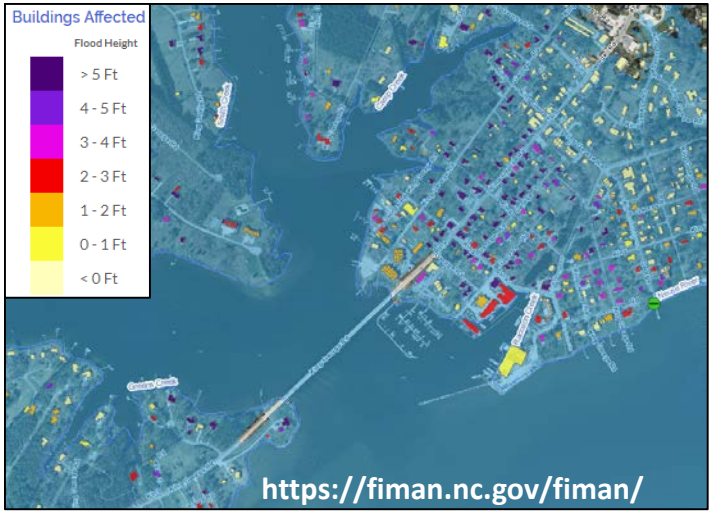


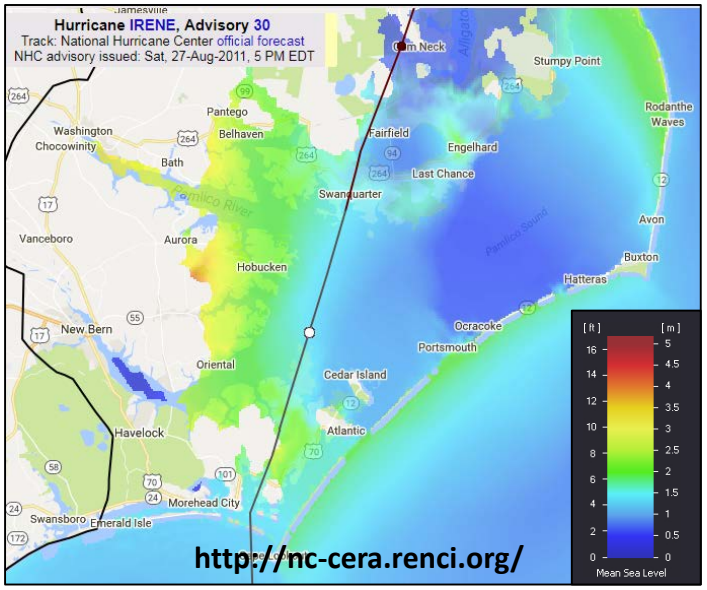


Geospatial Integration for Hurricane Irene Reanalysis

Dr. Tom Allen, Geography Program and
Commonwealth Center for Recurrent Flooding Resiliency (CCRFR)
Old Dominion University, Norfolk, VA

- Demonstrate geospatial analysis and integration for flood impacts from storm surge models, SAR, and LiDAR
- Source and provide supporting data for Irene
  - NC Flood Inundation Mapping and Alert Network
  - High Water Marks (NWS and USGS)
  - Dasymetric population demographics
  - NHC Hurricane forecast track, cone, watches, warnings, and surges
  - SLOSH surge MOMs and MEOWS, NC-CERA/Renci ADCIRC
- Engage stakeholders for needs and applications
  - NWS, cities, and Hampton Roads Planning District Commission
  - Hampton Roads Coastal Resiliency Working Group
  - Leverage modeling and remote sensing for time-dependent planning, response, and resiliency
- Develop lessons learned, uncertainties, and improvements for future research
  - Sentinel, NISAR, other platforms and data sets

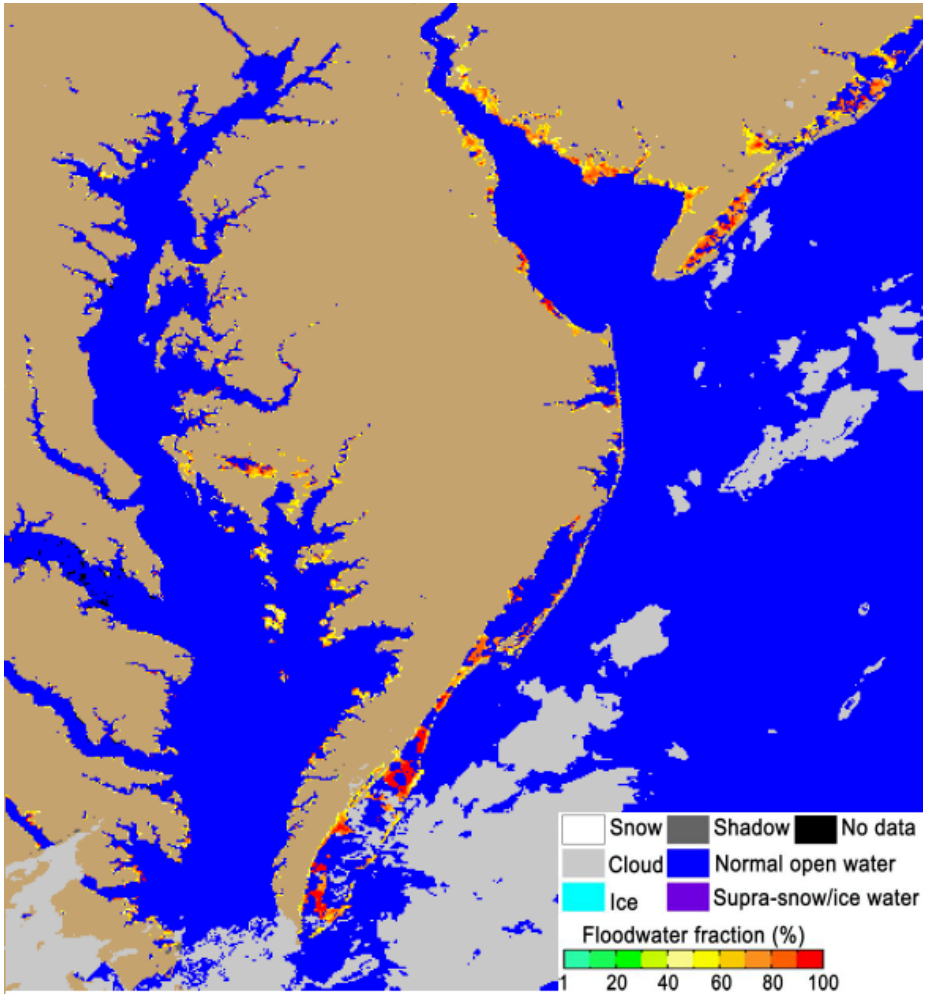




Revisiting Flood Maps with new VIIRS Flood Mapping Capability

Dr. Lillian Sun, George Mason University

- Team from George Mason University is revisiting MODIS and Landsat remote sensing adopting new techniques developed for VIIRS:
    - Reduced impact of terrain shadows, cloud shadows, and other potential errors



Improving Access to Flood Mapping

Dr. W.B. Moore, Hampton University

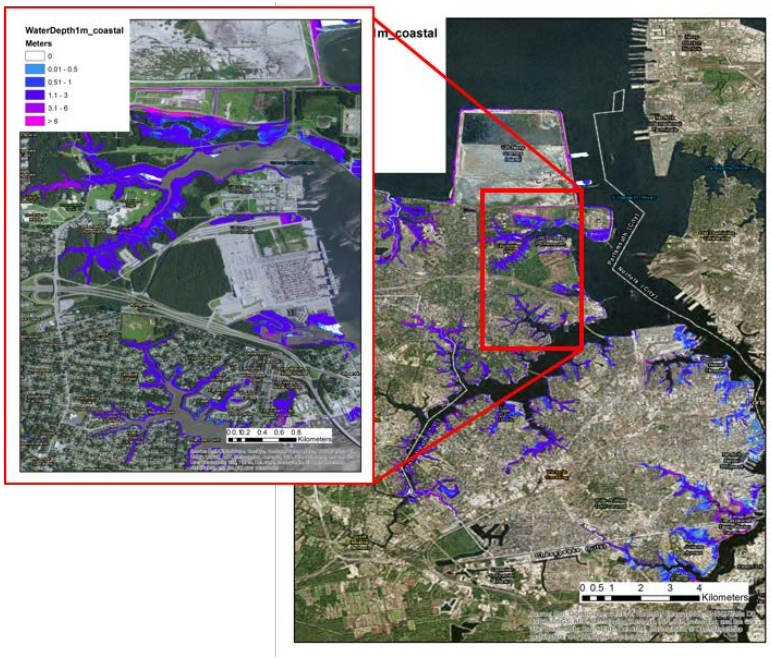
- Incorporating VIIRS algorithm for processing of NRT MODIS and other imagery
    - Share with partners to improve flood mapping capabilities from NASA MODIS sensors

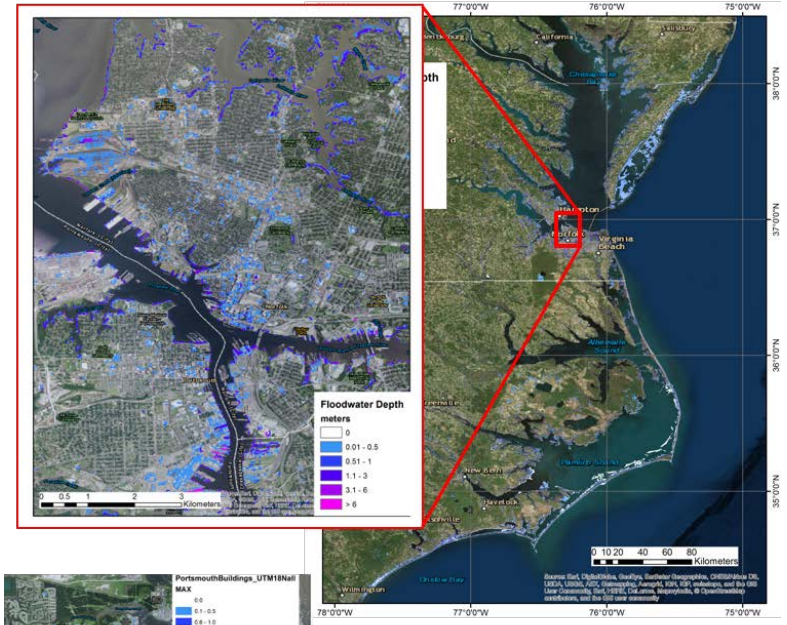
Floodwater Depth Estimates from Remote Sensing of Flood Water

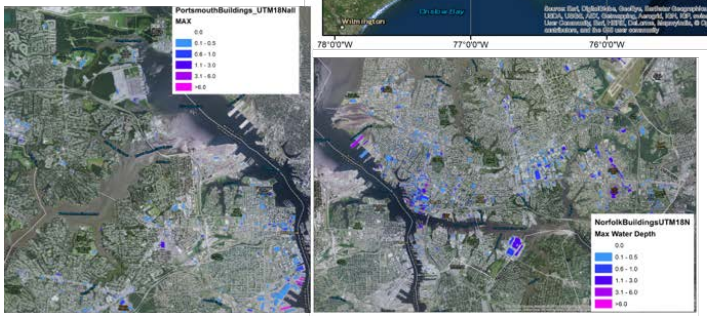
Dr. Sagy Cohen, Surface Dynamics Modeling Lab,
University of Alabama

- Estimate floodwater depth based on remote sensing inundation maps and a DEM:
  - *Landsat imagery classification and 10m NED DEM*
- Assess accuracy and feasibility of the methodology for coastal flooding:
  - *Hydrodynamic model flood extent and 1m LiDAR*

Floodwater Depth Estimation Tool (**FwDET**; Cohen et al. 2017 JAWRA) calculates water depths based solely on an inundation polygon (primarily from Remote Sensing) and a DEM.







Summary

- The NASA Applied Sciences: Disasters Program has kicked off a pilot project as "***Mid-Atlantic Resiliency Demonstration Study, Communities at Intensive Risk"*** in FY17 and FY18
- Efforts focus on a holistic, interdisciplinary approach to integrate a full suite of capabilities from numerical weather prediction, tide and surge modeling at high spatial resolution and urban/neighborhood scales, and remote sensing capabilities for water detection and depth estimation.
- Future efforts:
  - Partner with Federal Agencies, academia professional societies to complement and augment ongoing work using **Earth observations unique to NASA**
  - **Translate hazards to risk** in order to understand local and regional impacts and **minimize vulnerability**
- Points of Contact:
  - Disasters Program Manager: David Green (david.s.green@nasa.gov)
  - Project Manager: Laura Rogers, NASA Langley (laura.j.rogers@nasa.gov)

Questions?