

Motivation

- Sea level rise continues to accelerate as global temperature increases, ocean reaching 90 degrees Fahrenheit in Caribbean
- Hurricanes have cost trillions of dollars in damages to coastal communities, mainly due to storm surge, the pressure and wind-driven rise of water above astronomical tides that causes extreme coastal flooding.

- How will coastal flooding risks increase with sea-level rise?**



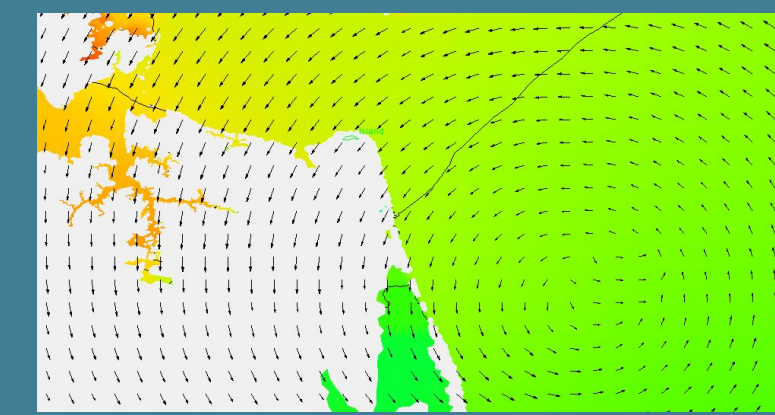
Storm Simulated: Hurricane Irene

- Slow moving storm that damaged infrastructure across east coast
- Most costly Cat. 1 storm (15.8 Billion USD)

Methods

APS ADCIRC Prediction System™

- ADvanced CIRCulation Model
- Used on NCSU High Performance Computing Cluster
- Grid/ Boundary Information (100 meter resolution mesh)
- Parametric Vortex Wind Model; Simulates Irene



Sea Level ↑ (SLR)

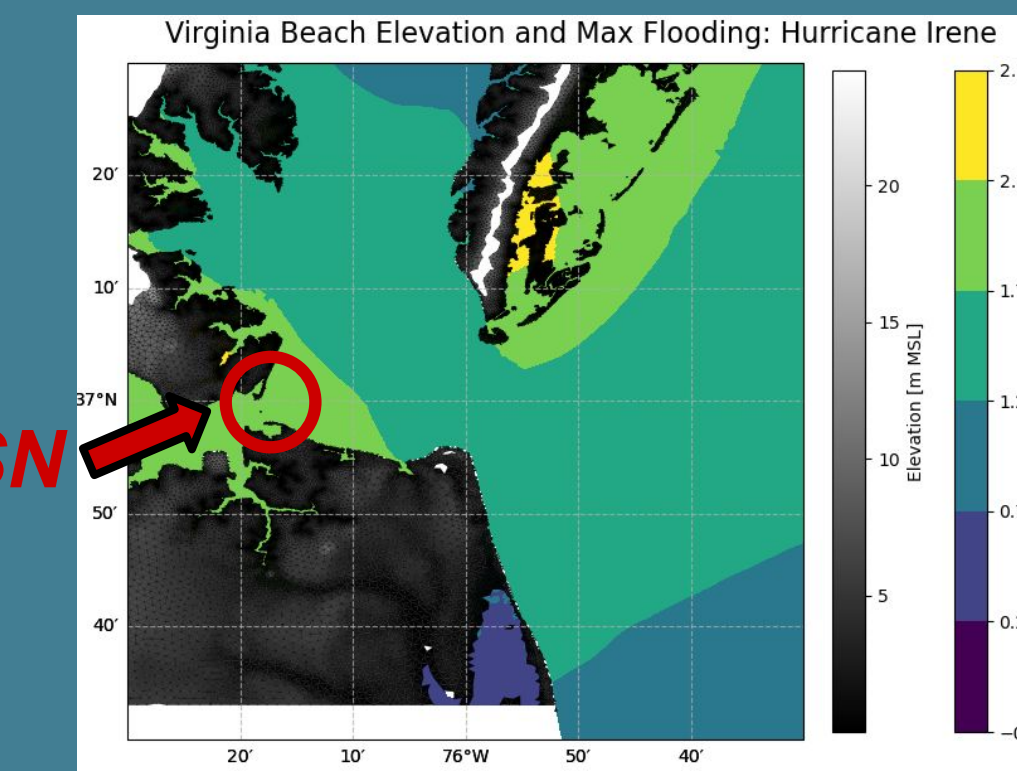
- 0.4 meter (m) rise, 0.8m, & 1.3m
- 2050, 2100, & 2150 predictions



Ref. Global and Regional Sea Level Rise Scenarios for the United States; Sweet et al.

KALPANA

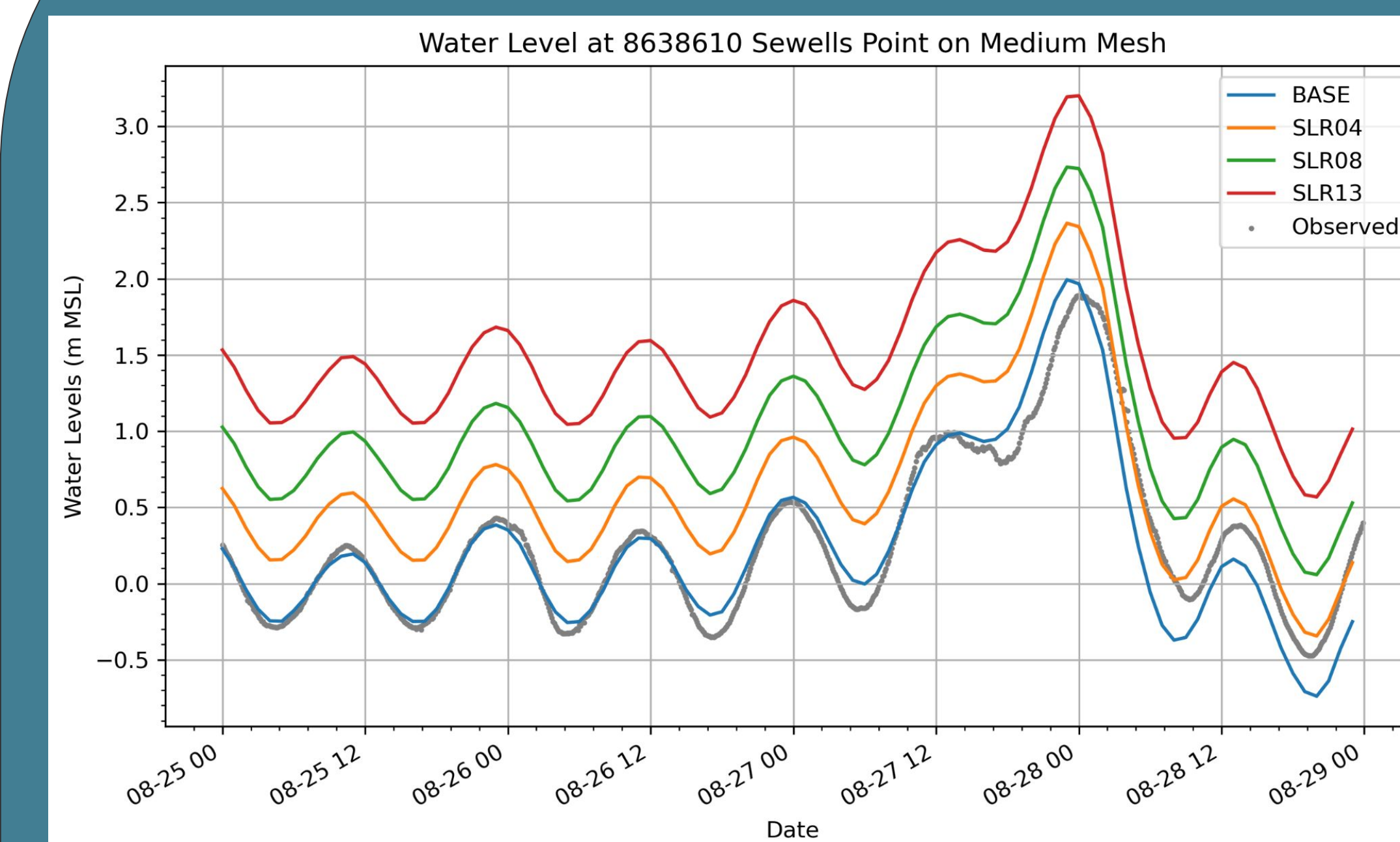
- Geospatial post-processing tool
- Python scripts that can export max water levels and other data



QGIS

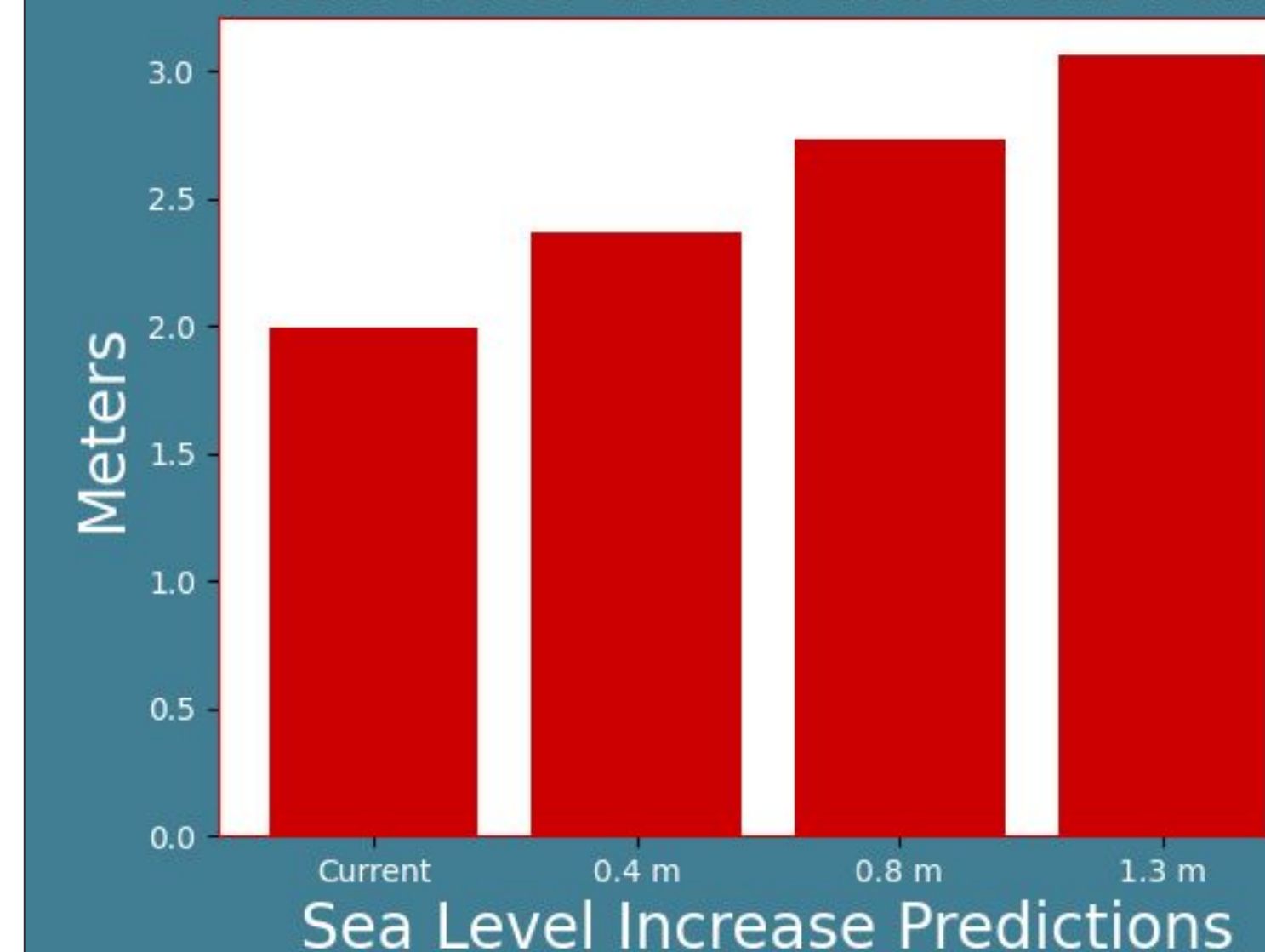
- Free GIS application
- Used outputs from Kalpana to measure area inundated and validate
- Used to create NSN shapefile
- Process is then repeated with each sea level
- ArcGIS can be used as alternative

Results



- Water levels behave similarly leading up to peak storm surge, but differences are less extreme during and after peak
- Base model almost identical to storm until peak water levels

Peak Water Levels at Sewells Point



SLR Cases	Peak Storm Surge (m)	% NSN Inundated
SL	1.99	3.21
+0.4 m	2.36	5.70
+0.8 m	2.73	18.49
+1.3 m	3.06	54.33

- Peak storm surge will increase in height at an average rate of 0.354 m every 50 years

Conclusions & Future Work

- Coastal flooding will be more extreme, frequent, and difficult to predict
- Lower areas of NSN more likely to be flooded with SLR
- Storm surge increasing at rate slightly below SLR
- To be most accurate increasing amounts of morphological changes will have to be constantly accounted for in modeling and post-processing
- Focus on increasing accuracy of base model predictions post-storm

Author can be reached at jtvoight@ncsu.edu

Study Area

- Norfolk has the highest rate of rise on the U.S East Coast at 5.8 mm/yr according to William & Mary's Virginia Institute of Marine Science
- Located at mouth of Chesapeake Bay; lots of channels and canals leads to a dynamic environment to analyze; flooding an issue on sunny days
- Naval Station Norfolk (NSN) located on Sewells Point; World's largest naval station

Shapefile to measure inundation in NSN and critical infrastructure in its boundaries
Approx. 21.627 kilometers²

