Modeling Nearshore Dynamics of Extreme Storms in Complex Environments of Connecticut

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Background

• Flood hazard planning requires the accurate estimation of total water elevation.
• The coastal topography and nearshore circulation conditions impact the flood mapping in complex environments.
• Some conventional approaches are flawed in several ways:
  – 1) using bathtub approach,
  – 2) insufficient resolutions or model physics
  – 3) failing to calibrate and validate with real-time data, or
  – 4) not considering sea-level rise
Existing Flood Map Products

- FEMA Flood Insurance Map
- North Atlantic Coast Comprehensive Study (NACCS)
- CIRCA FVCOM-SWAVE
Objectives

• Create accurate flood maps using a capable, high-resolution wave model to determine total water elevation on the shores
• Validate the models with observations
• Examine local sea-level rise predictions of storms with 1% (100-year) and 10% (10-year) annual exceedance probability by the year 2050 in Connecticut
Study Area
Model Setup

- FUNWAVE-TVD: phase-resolving wave model
- Wavemaker generates waves with specified wave height, frequency, and direction
- Grid resolution 2 m (6.5 ft)
- Simulate 1% (100-year) and 10% (10-year) annual exceedance probability
Validation: High Water Level

- Compare with observed high water during super storm Sandy
- Modeled values are close to observations

![Graph showing modeled and observed high water levels with RMSE values of 0.25 m and 0.38 m for Fairfield.](image-url)
Validation: Wave Height

• Compare with observed wave height at stations near breakwaters in 2015
• Model forced with wave characteristics observed at NH1, compare modeled vs observed values at NH2

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<tr>
<th>Date</th>
<th>Observed</th>
<th>Modeled</th>
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Significant Wave Height at NH2 (meters)
Comparison with FEMA (100-year)
Comparison with FEMA (100-year)
Comparison with NACCS (100-year)
Comparison with FVCOM-SWAVE
10-yr with sea-level rise
Summary

• The FUNWAVE-TVD model is found to model wave processes more accurately in shallow water regions compared to the empirical equation application of FEMA and coupled circulation-phase averaged model application of NACCS and FVCOM-SWAVE.

• We also examined local sea-level rise predictions of storms with 1% (100-year) and 10% (10-year) annual exceedance probability by the year 2050 in Connecticut and found that the flood extent of these two storms showed little to no difference due to the topographic conditions.

• We suggest the planning approaches consider the increase in the frequency of the storms in the predicted inundation zones due to sea-level rise.
THANK YOU

Questions?