

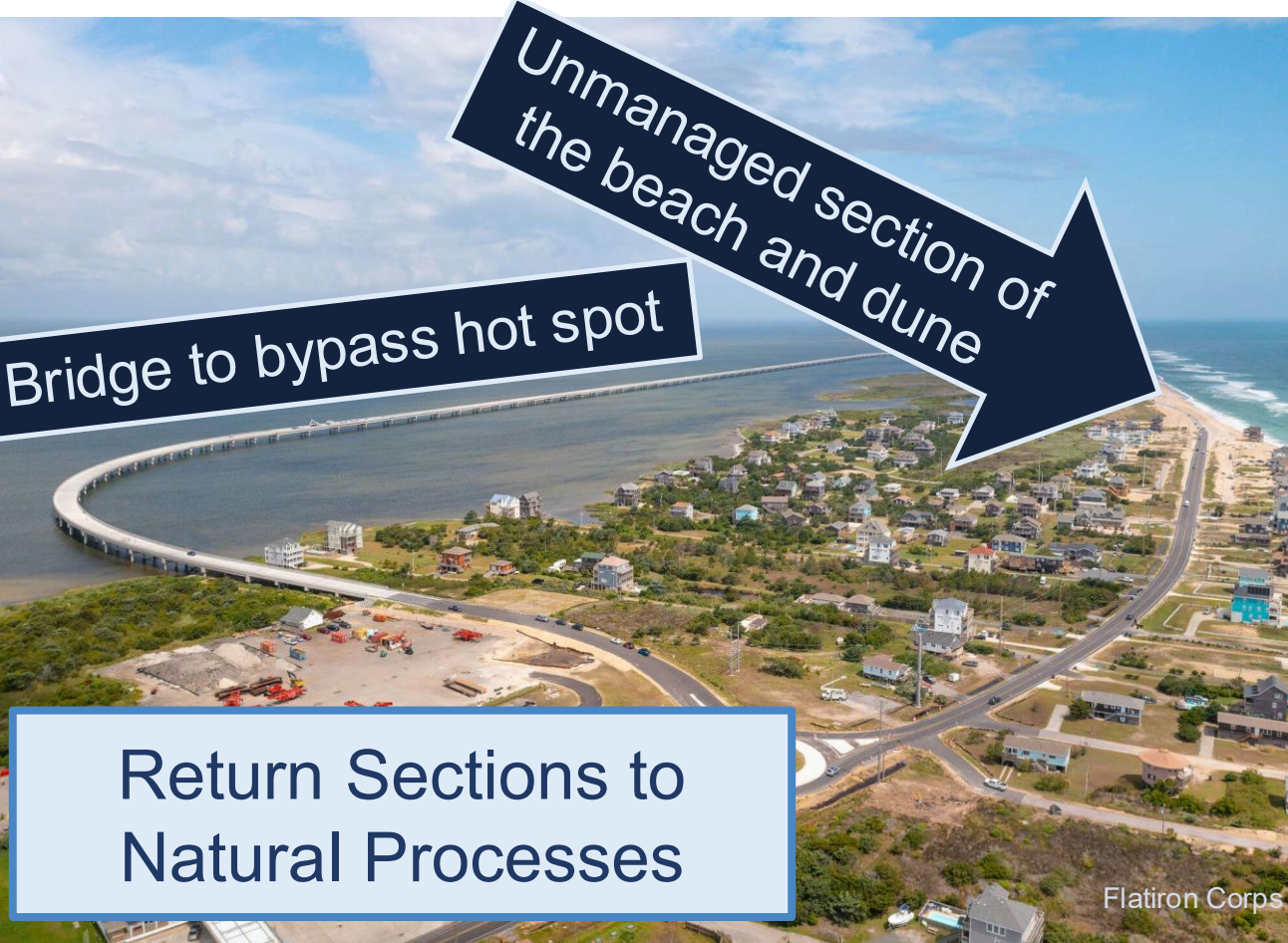
Predictions of Storm Surge Flooding for Participatory Transformation of Barrier Islands

Introduction

Barrier islands are vulnerable to storm surge flooding due to sea level rise and increased storm intensity and frequency.



Communities on barrier islands need to consider more complex adaptations to increase resiliency from storm surge flooding, such as building infrastructure around vulnerable hot spots to allow barrier island sections to return to natural processes (i.e., Rodanthe Bridge).



Hatteras Island is a wave-dominated barrier island prone to inlet breaching during storms. When a section is left unmanaged, inlets may form and change hydrodynamics for nearby communities.

How does a bridge adaptation and resulting breach change the magnitude and duration of storm surge flooding for nearby communities?

Hypothesis: The bridge-breach adaptation will reduce the surge during sound side storms and reduce draw down on marshes during all storms.

Methods

Develop a localized mesh: High resolution, Atlantic Basin-scale, unstructured, finite-element mesh.

Plan and select flood adaptations: Derived from barrier island community preferences.

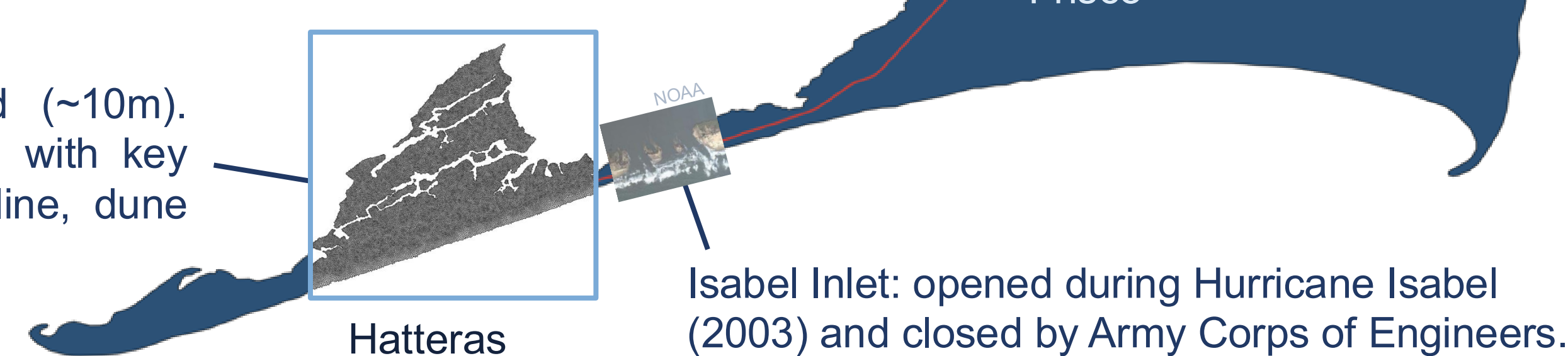
Apply adaptation as changes to mesh elevation.

Model storm surge: Run ADCIRC+SWAN with synthetic storm tracks from Bloemendaal et al., 2020.

Compare baseline and adaptation scenarios: (1) maximum difference in flood height (2) timing of flood

Buxton bridge-breach: Designed from Isabel Inlet and the Rodanthe Bridge Adaptation

ADCIRC Mesh Resolution: High Resolution over land (~10m). Mesh elements are aligned with key topographic features: coastline, dune crest, and main highway.



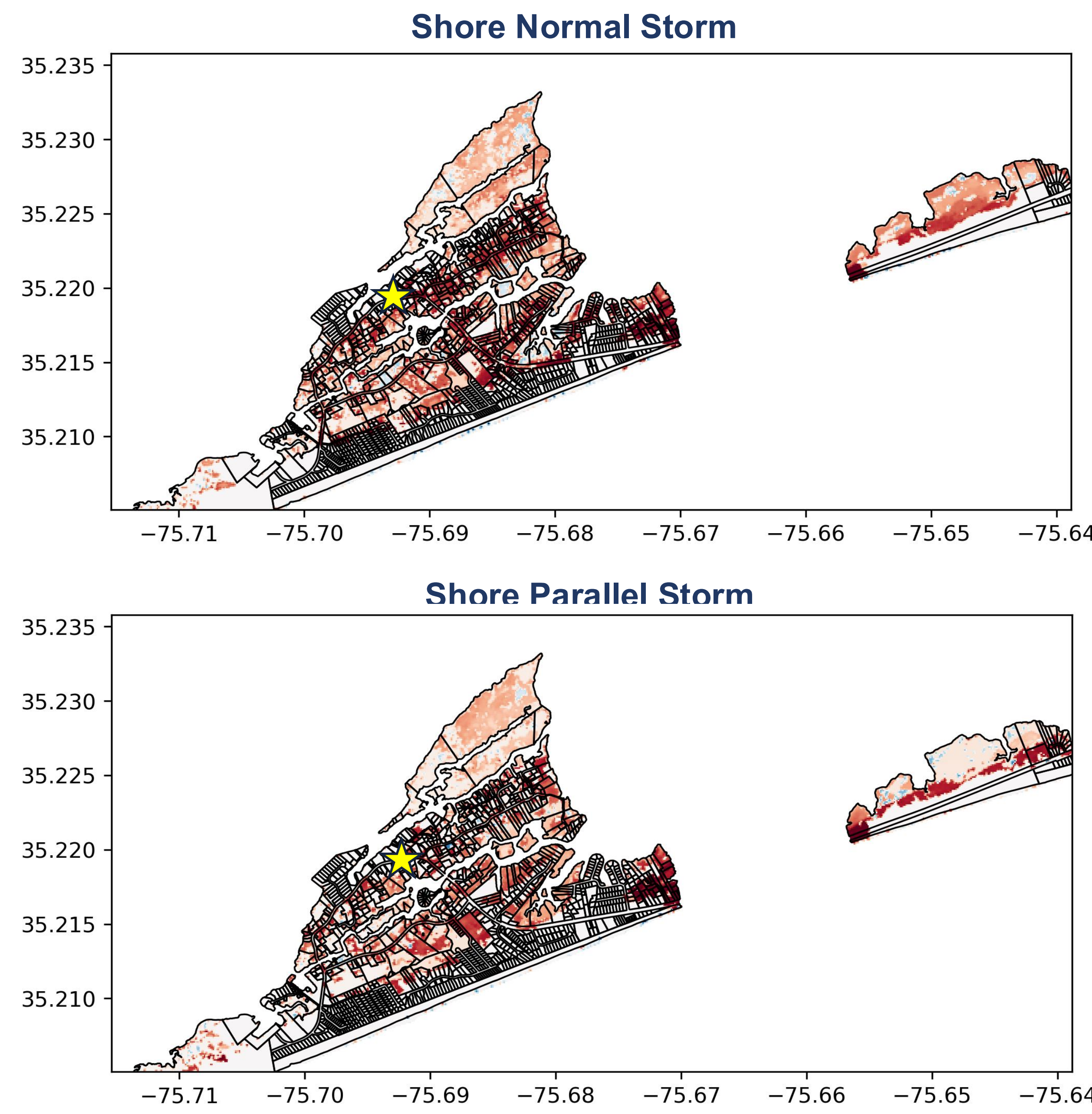
Modeling Results

How to Interpret Figures:

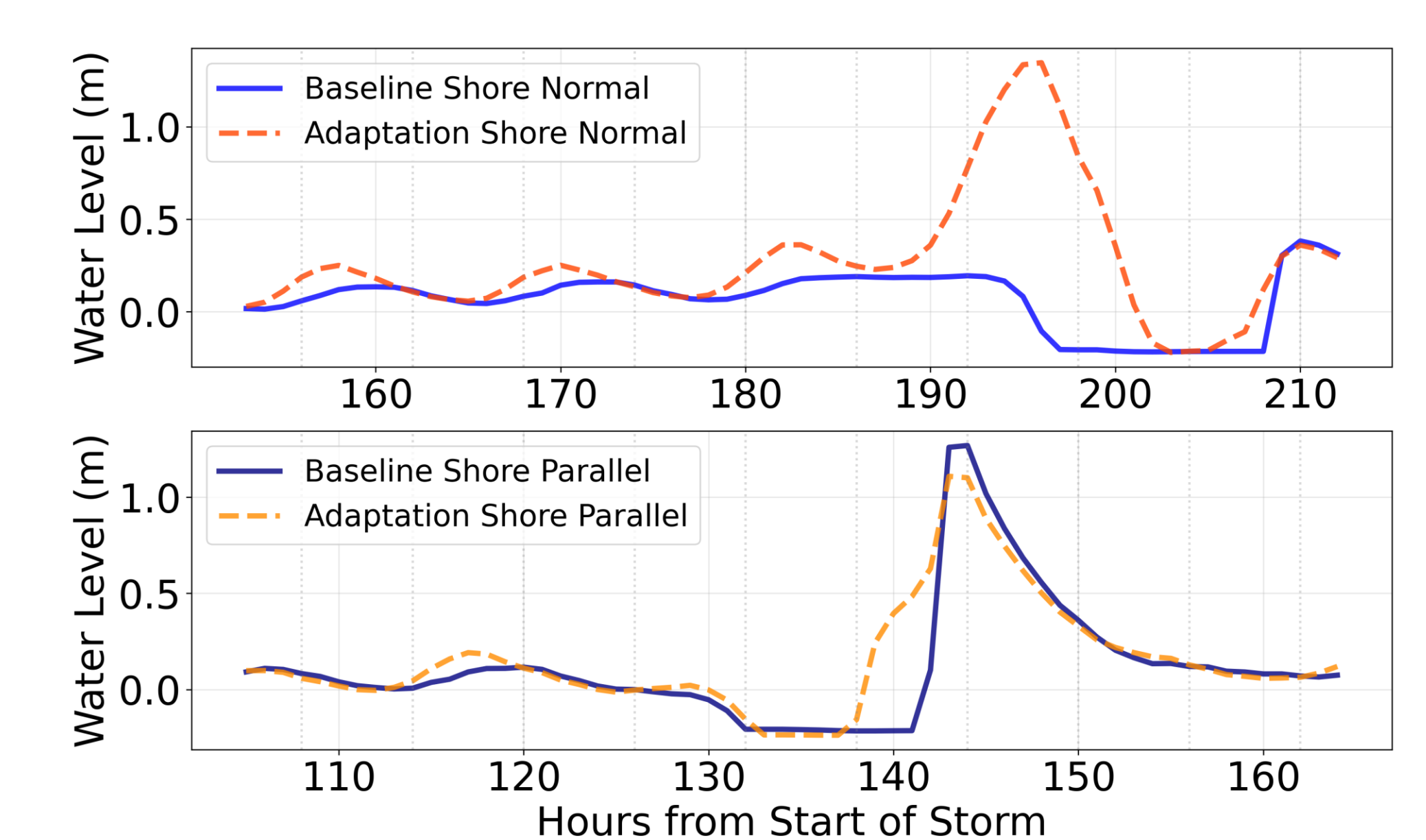
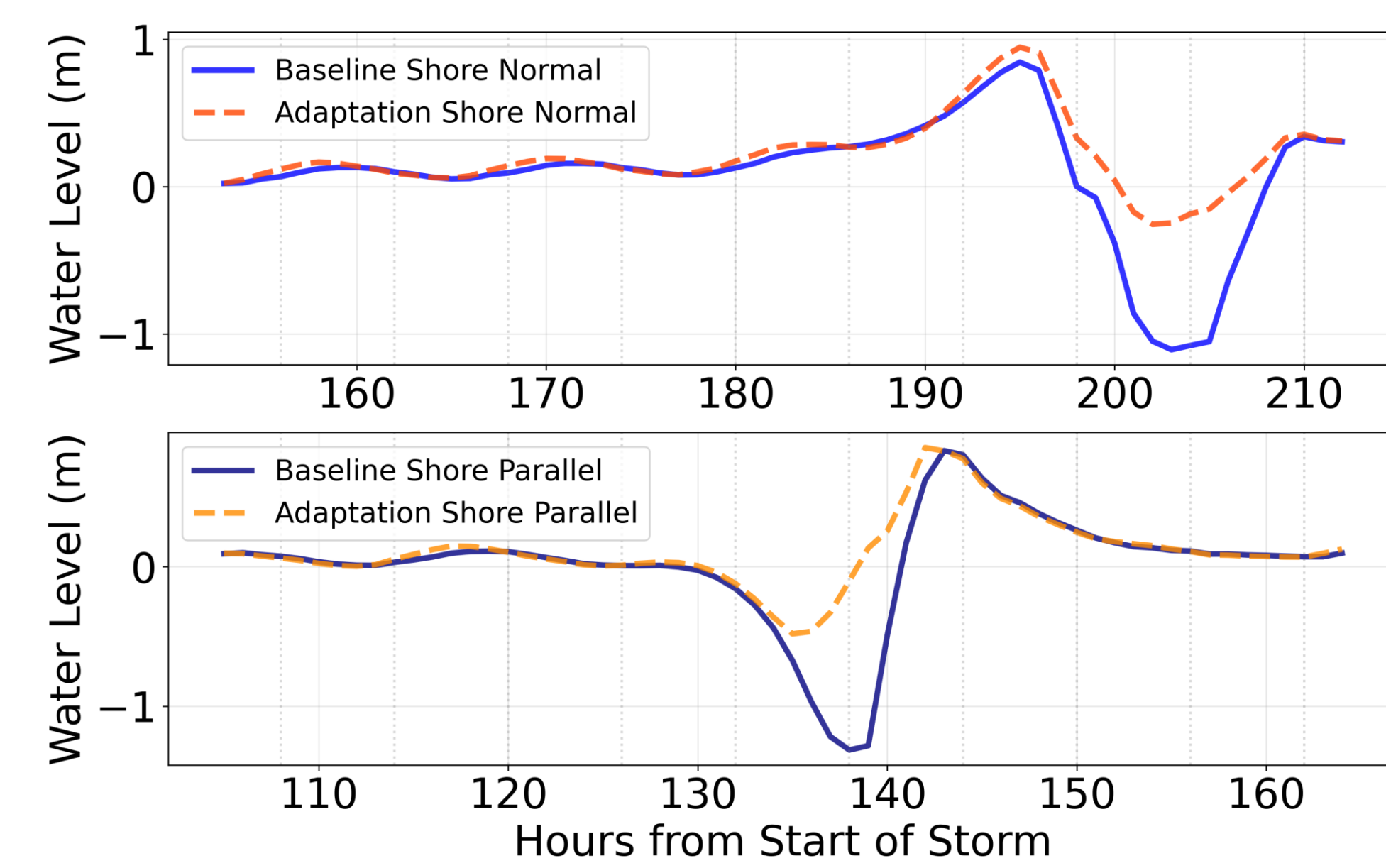
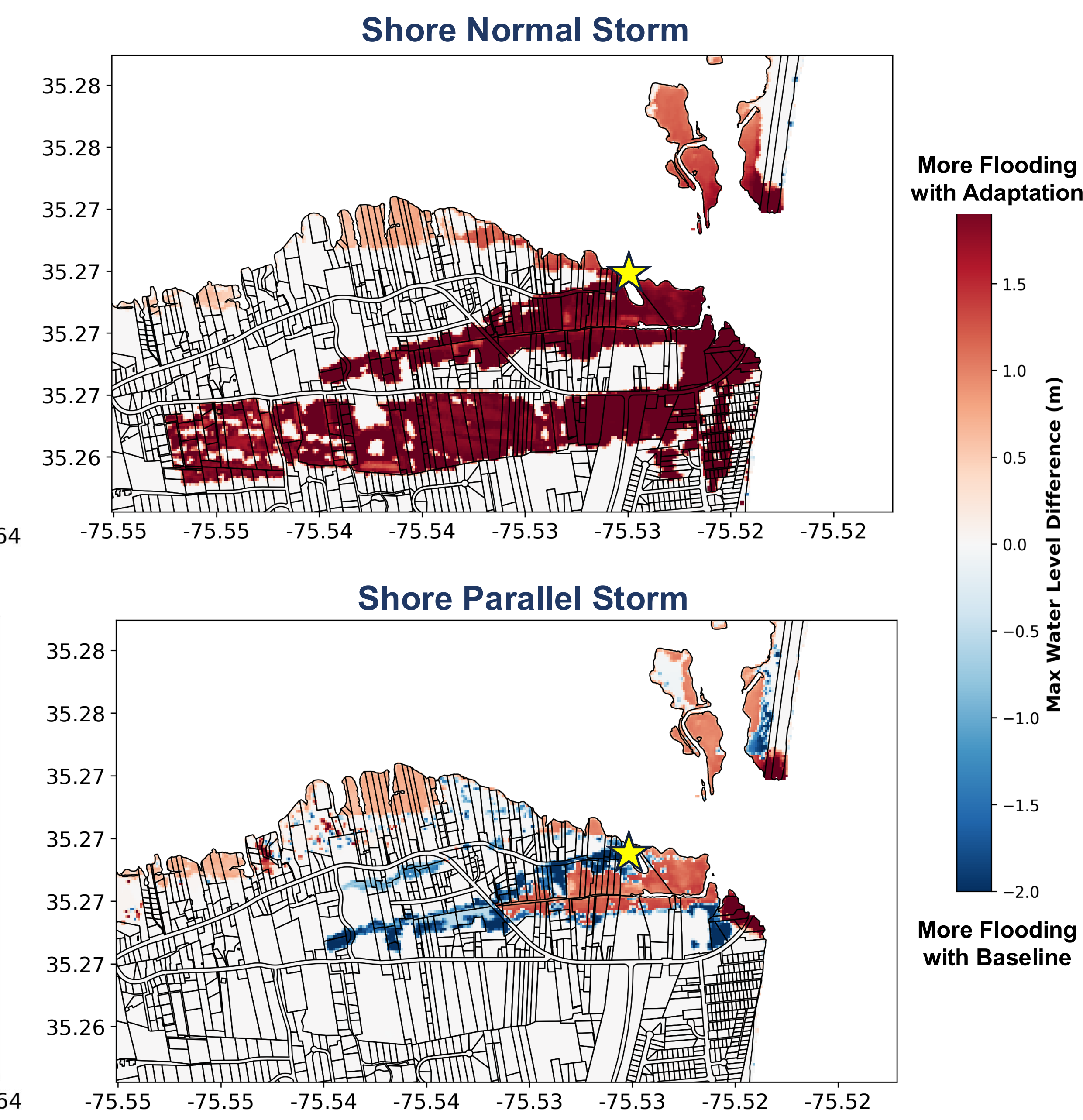
Maximum Difference of Flooding: The greatest difference in flood height (m) between the baseline (no adaptation) and adaptation scenario at every location in the ADCIRC prediction mesh calculated across the entire duration of a storm. Red is more flooding in an adaptation scenario; blue is more flooding in the baseline scenario. The gaps in the island are where we simulated inlet formation.

Hydrographs: Water levels (m) during each storm for the bridge-breach adaptation and a baseline at MSL at a single location.

Adaptation at Hatteras



Adaptation at Buxton



Conclusions and Future Work

- In low-lying topography or marsh channels in communities, the surge increased under all storm scenarios, except a shore-parallel storm in Buxton.
- Adaptations can affect flood hazard, but the extent of the effect is dependent on the community orientation and topography, adaptation placement and storm characteristics.
 - For Hatteras, the storm direction did not change the spatial flooding patterns when comparing the adaptation and baseline scenarios.

Future Work

- Run simulations with large sets of storms. Assess overall effectiveness of adaptation across possible storm scenarios.