Evaluating the effect of wave and hydrology coupling on tropical cyclone driven storm surge

Fariborz Daneshvar[1,2], Soroosh Mani[1], William Pringle[3], Felicio Cassalho[1,2], Saeed Moghimi[1], Edward Myers[1]

[1]NOAA/Coast Survey Development Laboratory; [2]Ocean Associates Inc. (OAI); [3]Environmental Science Division, Argonne National Laboratory

Motivation

- To consider interaction of multiple factors on coastal flooding, and quantifying the impact of inland hydrology and wave on maximum water elevation.
- To provide a more accurate evaluation of tropical storm driven coastal flooding.

Selected Storms

Hurricane Helene (2024)
- A category 4 storm that made landfall in the Big Bend region of Florida on September 26, 2024.
- More than 250 fatalities, and over $78 Billion damage.

Hurricane Milton (2024)
- A category 5 storm that made landfall as category 3 on the west coast on October 10, 2024.
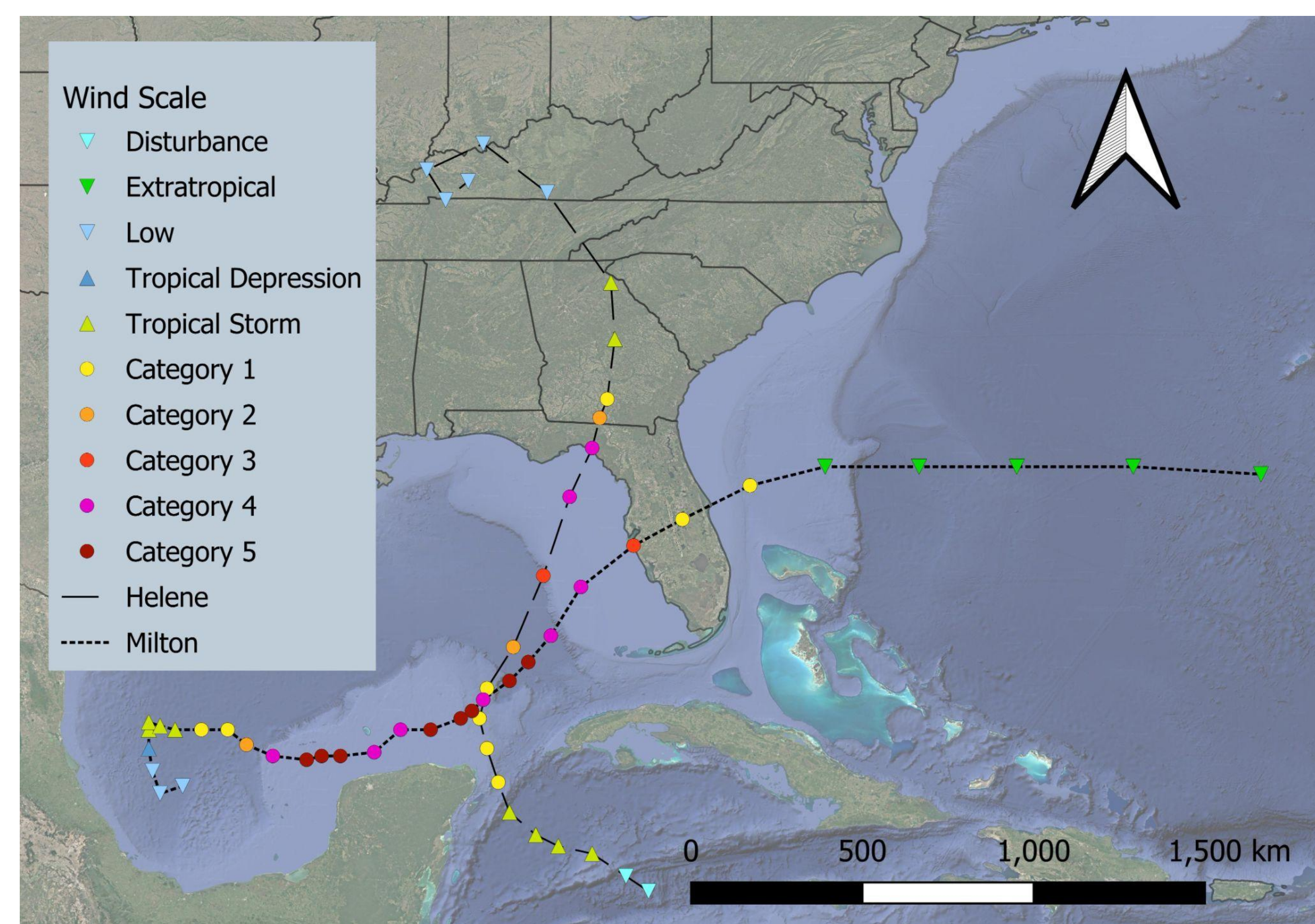- Over $34 Billion damage in the US.

Figure 1. Best track hindcast of the trajectory and intensities of hurricanes Helene and Milton.

Contact: fariborz.daneshvar@noaa.gov

Methodology

The Semi-implicit Cross-scale Hydroscience Integrated System Model (SCHISM)

- Mesh: subset of STOFTS-3D Atlantic & a coarse mesh.
- Tidal forcing: TPXO dataset
- Atmospheric forcing: Generalized Asymetric Holland Model (GAHM)
- Inland Hydrology: National Water Model (NWM) source/sinks.
- Wave: The 3rd generation Wind Wave Model (WWM)

Results

Table 1. Statistical measure of three model's performance at USGS sensors' locations.

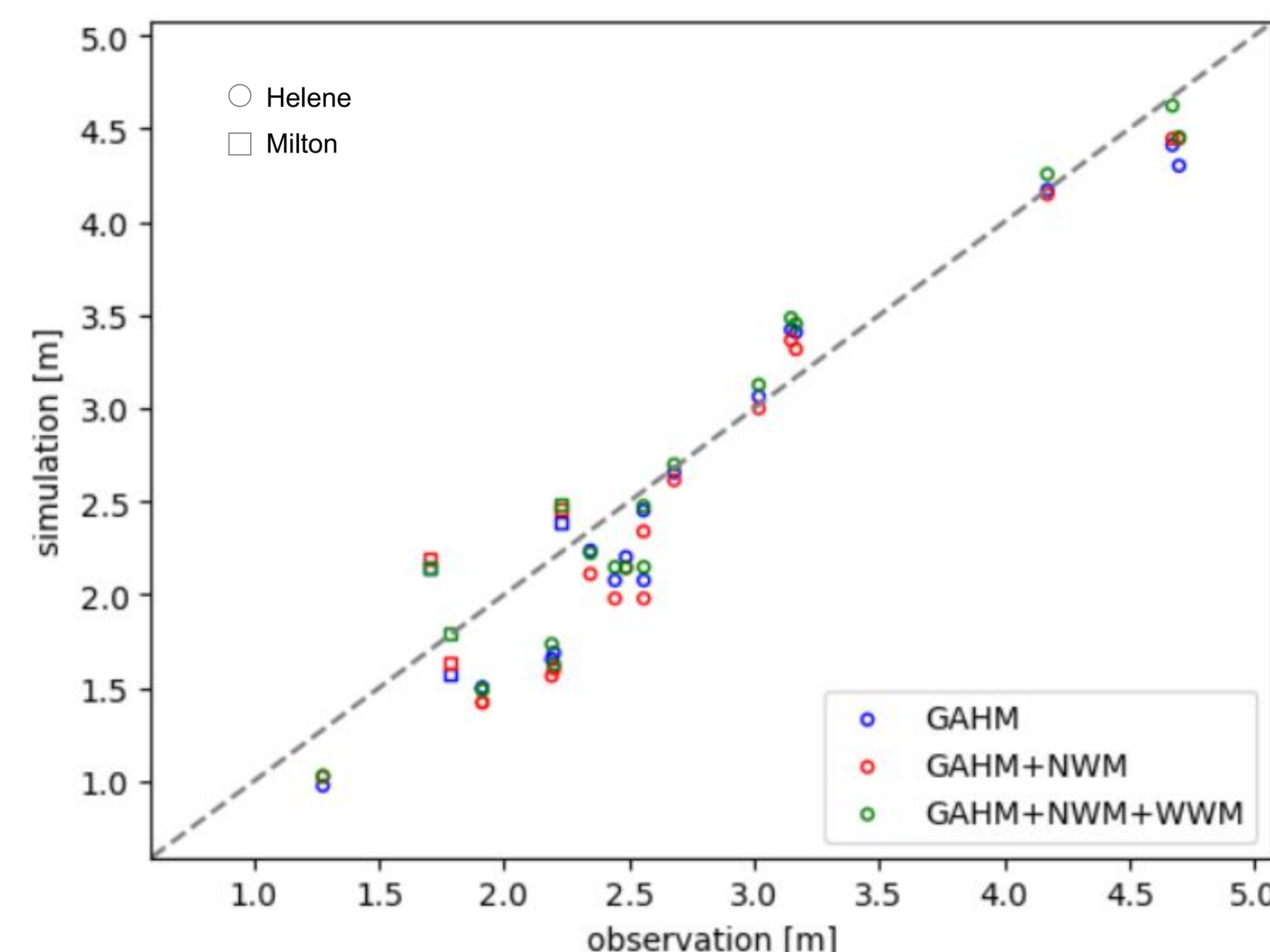| Scenario	CORR.	BIAS	RMSE
GAHM	0.958	-0.163	0.322
GAHM+NWM	0.954	-0.197	0.359
GAHM+NWM+WWM	**0.960**	**-0.106**	**0.307**

Figure 2. Comparison of simulated maximum water elevations with USGS sensors' measurements for hurricanes Helene and Milton.
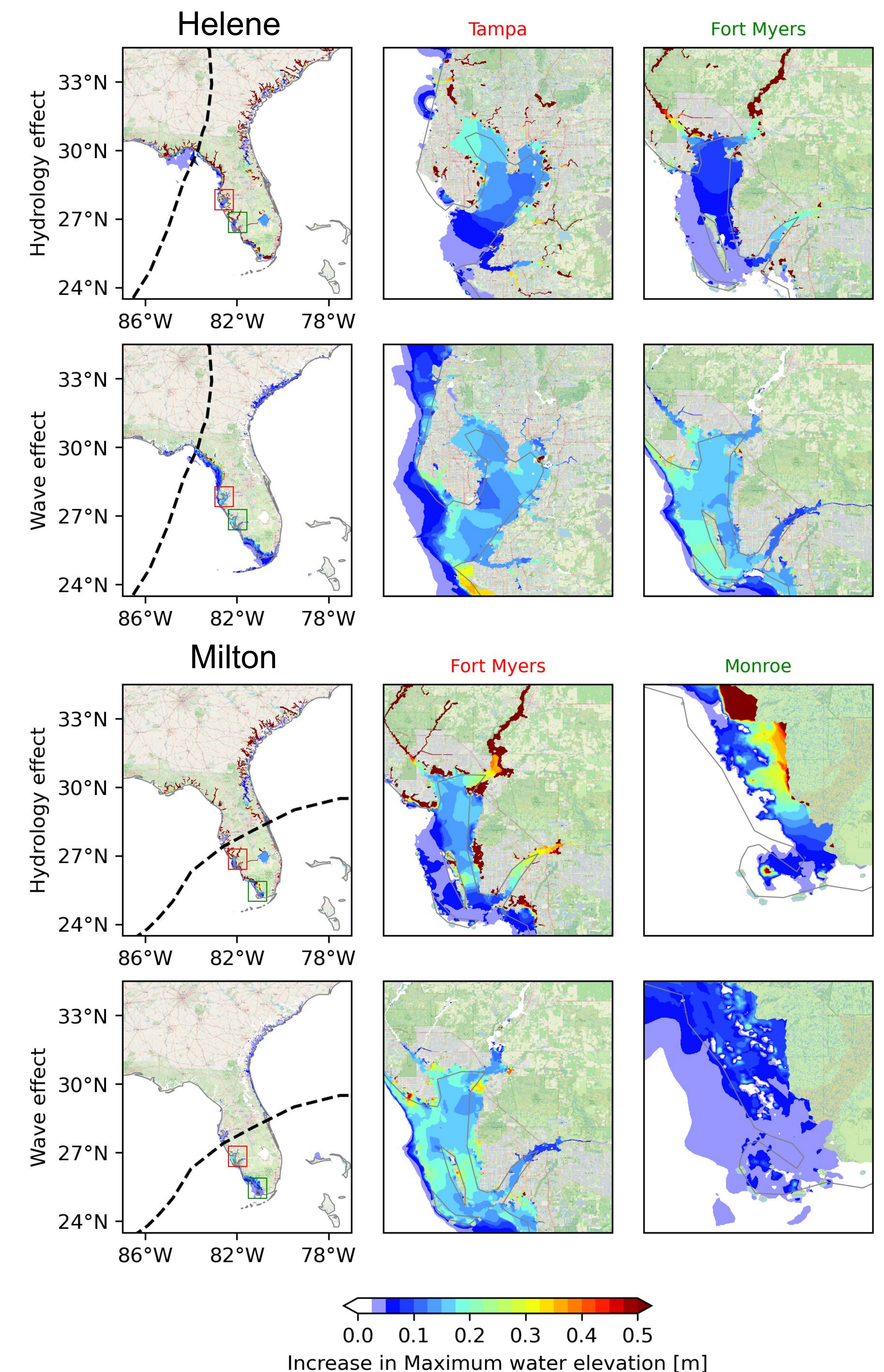
Isolated effects on maximum elevation

Figure 3. The effect of inland hydrology and wave couplings on maximum water elevation simulation of hurricanes Helene and Milton.