Modeling of Future Flood Risks with Sea Level Rise and Mitigation Measures: A Case Study in West Haven, CT, USA

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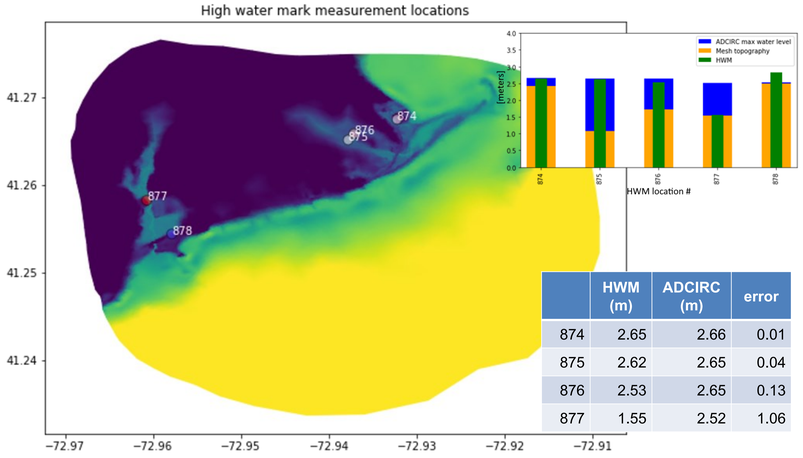
Background

- Urban areas along the coastal line of Connecticut, USA are prone to flooding, especially with the projection that sea level could be up to 20 inches (0.5 m) higher than the national tidal datum in Long Island Sound by 2050.
- Mitigation measures, such as flood control structures and raised roadways, could protect Connecticut's vulnerable infrastructure from severe flooding.
- The goal of this work is to simulate the same extreme flood event under a set of road raising designs in West Haven, CT (using ADCIRC) and analyze how the flood extent changes.



	HWM (m)	ADCIRC (m)	error
874	2.65	2.66	0.01
875	2.62	2.65	0.04
876	2.53	2.65	0.13
877	1.55	2.52	1.06

Fig. 1 ADCIRC model domain and locations of the High Water Mark (HWM) in West Haven, CT. Insert: comparisons of modeled max water level and HWM.

Model setup

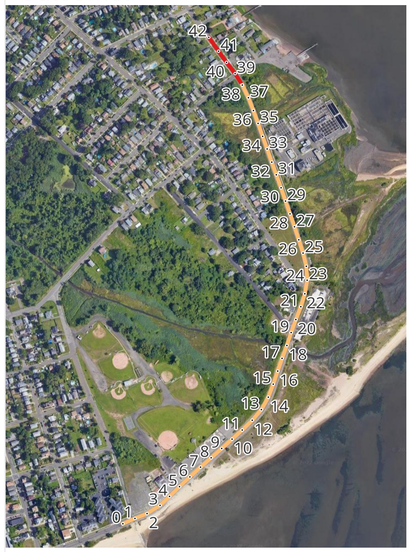
- An ADCIRC model domain with minimum resolution of 5 m was created for West Haven, CT (Fig. 1).
- A realistic simulation of Superstorm Sandy was performed, and the modeled flooding compares well with High Water Mark data collected by USGS during Superstorm Sandy near the road of concern with errors less than 0.13 m.

Road raising scenarios

We modeled the flood extent and flood depth during a 100-year storm event with 20 inches of sea level rise.

- **No Change option:** the original profile representing the current road profile as of August 2021 (Fig. 2).
- **Road Raising Scenarios** (Fig. 3)**:** For each scenario, we considered two cases: raising only the city-proposed portion (yellow), and with the extended portion (red).
  - **Scenario 1:** the low-lying portions of the road is raised to a constant elevation of 9 feet. The results indicate little to no reductions in flood extent .
  - **Scenario 2:** the city-proposed plan profile (elevation range 10-15 ft). The results indicate notable reductions in flood extent, especially with the extended portion also raised to the averaged elevation of the city-proposed plan.
  - **Scenario 3:** the marked street has a constant elevation of 11 feet. The results indicate notable reductions in flooding compared to the No Change option when the city-proposed portion is considered, and nearly eliminated flooding with the extended portion also considered.

Scenario 3 with the extended portion has the best flood reduction outcome.



No Change option:

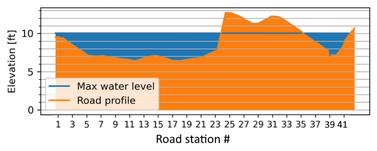
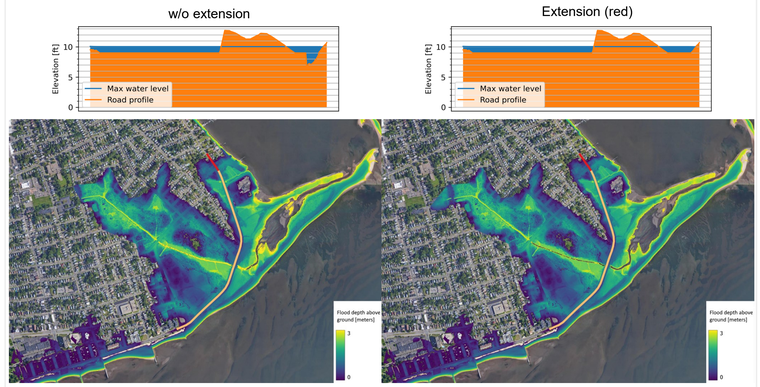
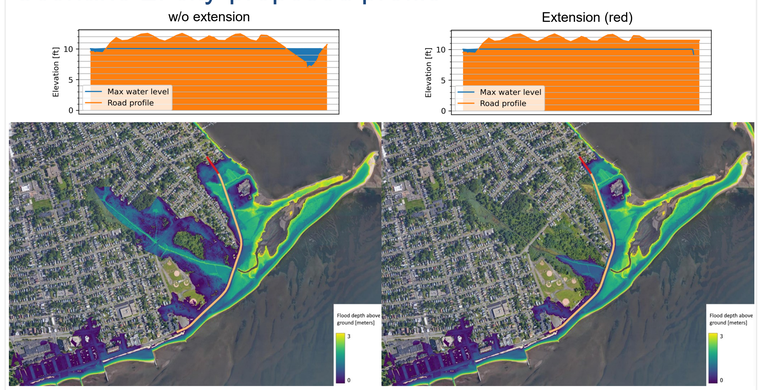


Fig. 2 Left: The portion of 1st Avenue and Beach Street in consideration for raising. Right: Profile of Beach Street and 1st Avenue used in modeling the Current Scenario(upper), and the resulting map of flood depth and extent (lower).

Scenario 1: elevate road to 9 ft



Scenario 2: city-proposed profile



Scenario 3: elevate road to 11 ft

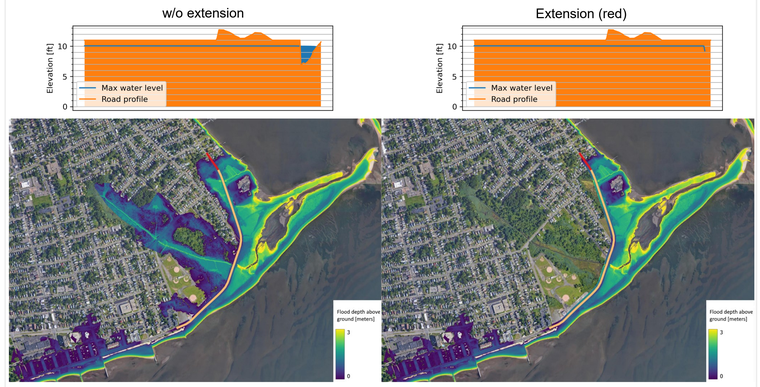


Fig. 3 Profile of Beach Street and 1st Avenue used in modeling Scenarios (upper), and the resulting map of flood depth and extent (lower).

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