Assessing the effects of sea level rise on Plum Island Estuary marshes using a hydrodynamic-marsh modeling tool

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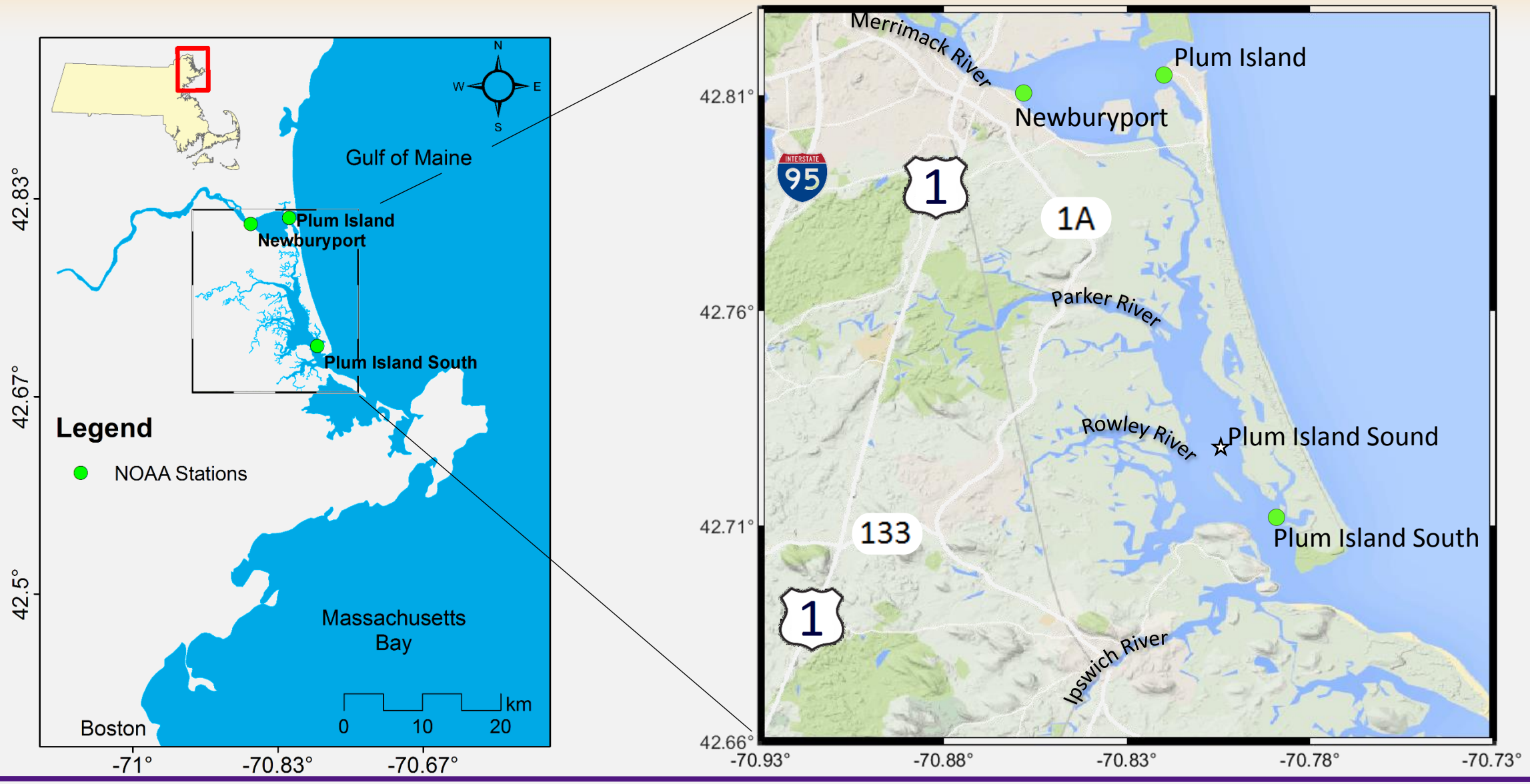
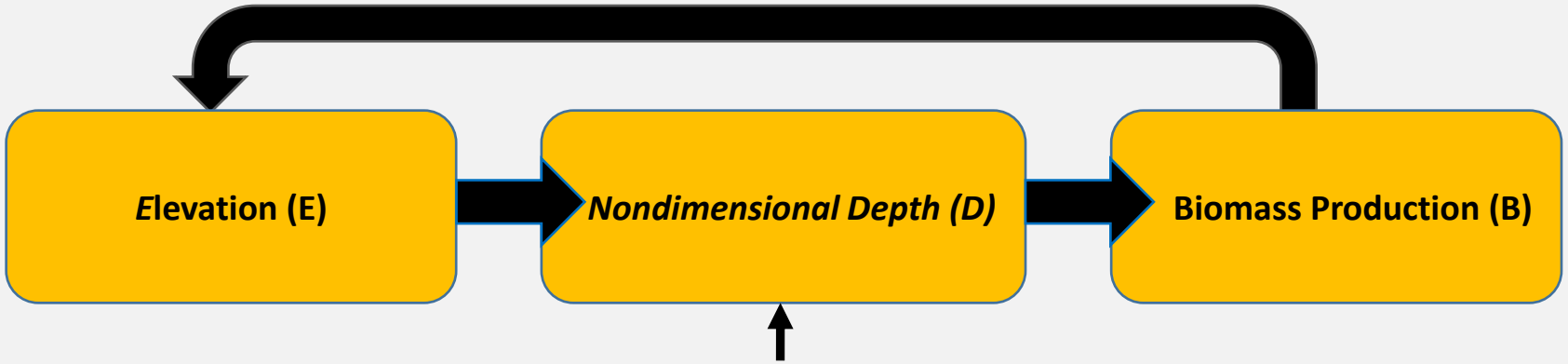
Outline

- Study Area: Plum Island Estuary (PIE), Massachusetts
- Methodology
- Results
- Conclusions

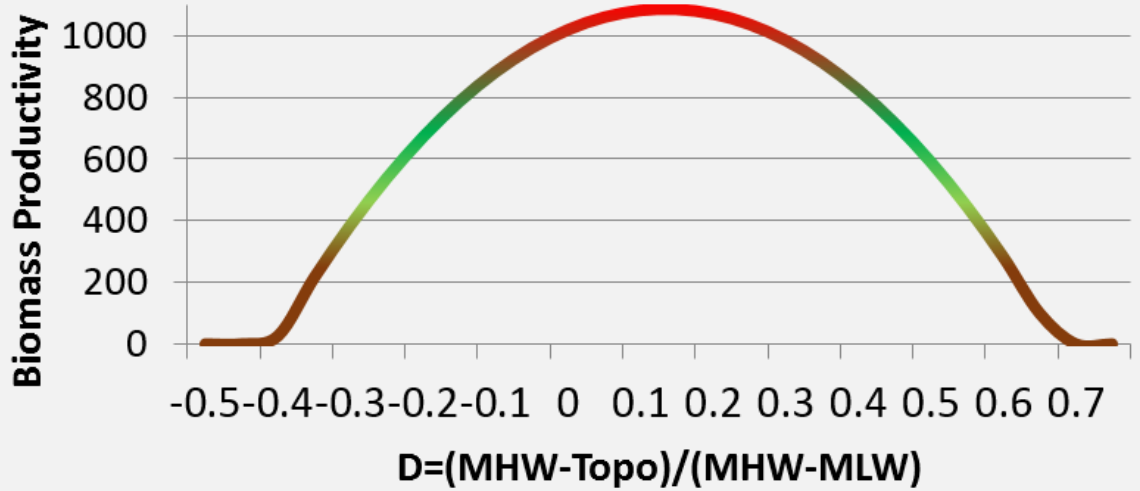
PIE marshes and tide gauge locations



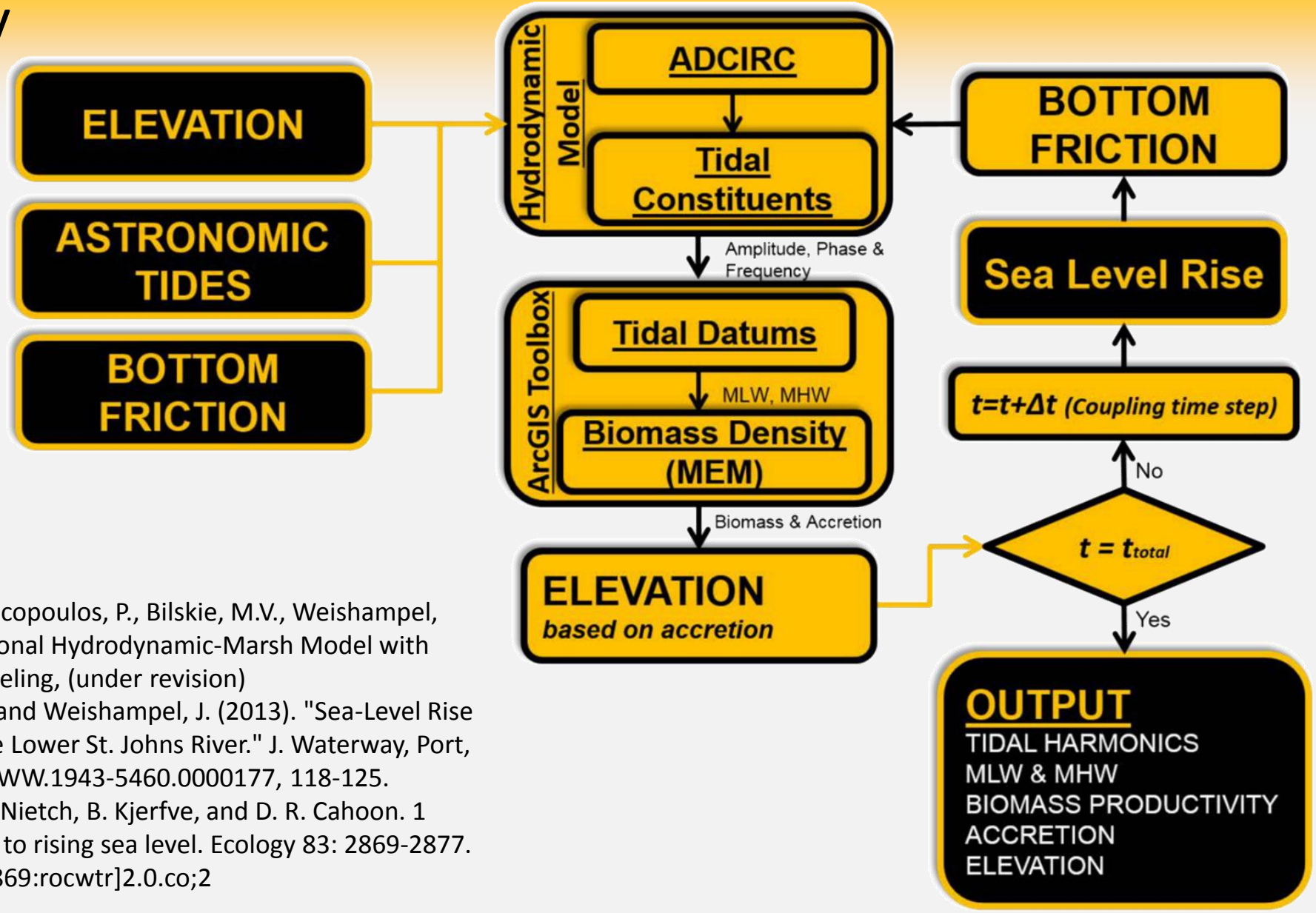
Marsh Equilibrium Model (MEM)



$$B = aD + bD^2 + c \quad ; \quad D = \frac{(\mathrm{MHW} - E)}{(\mathrm{MHW} - \mathrm{MLW})}$$



Methodology



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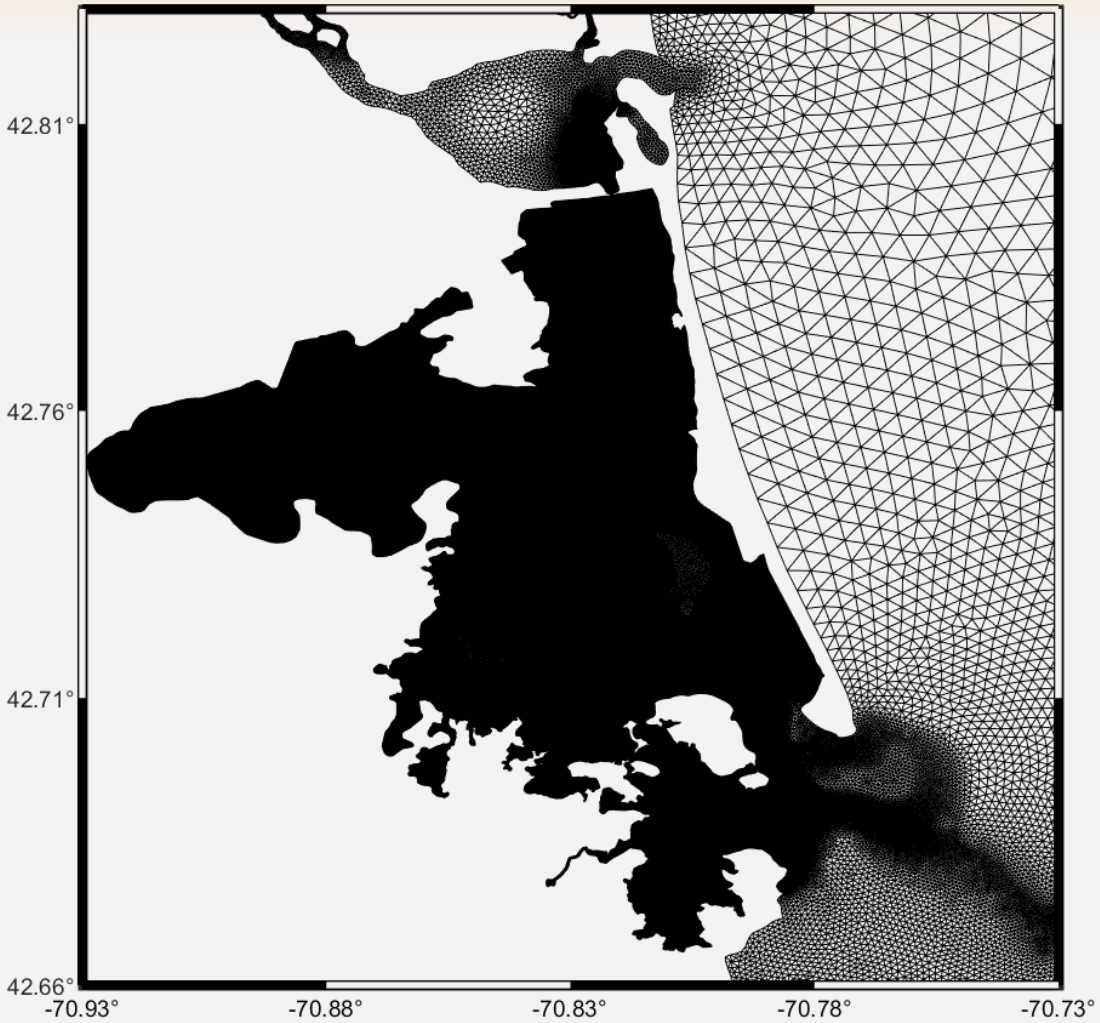
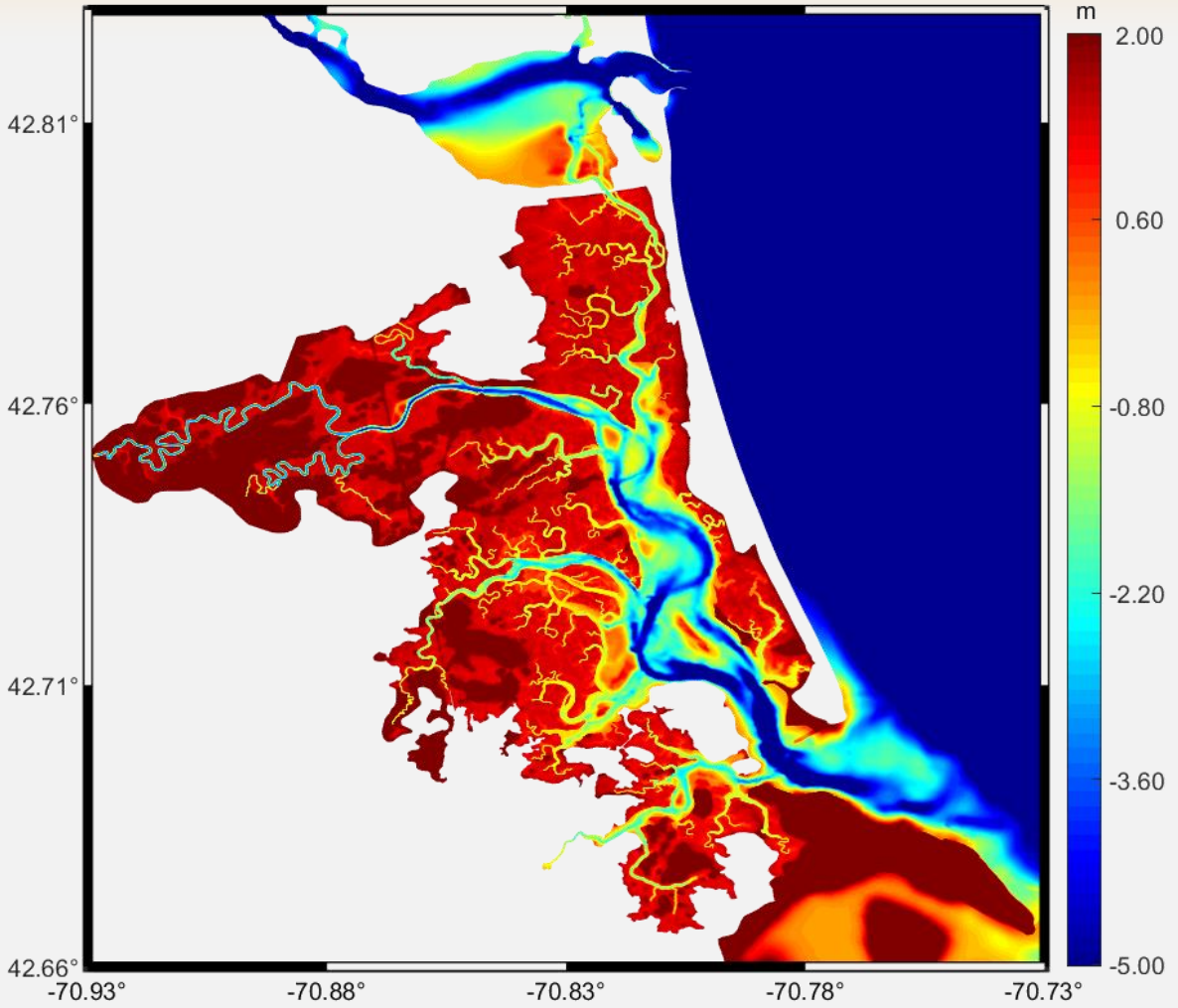
- Hagen, S., Morris, J., Bacopoulos, P., and Weishampel, J. (2013). "Sea-Level Rise Impact on a Salt Marsh System of the Lower St. Johns River." J. Waterway, Port, Coastal, Ocean Eng., 10.1061/(ASCE)WW.1943-5460.0000177, 118-125.
- Morris, J. T., P. V. Sundareshwar, C. T. Nietch, B. Kjerfve, and D. R. Cahoon. 1 2002. Responses of coastal wetlands to rising sea level. Ecology 83: 2869-2877. doi:10.1890/0012-9658(2002)083[2869:rocwtr]2.0.co;2

ADCIRC mesh for PIE model

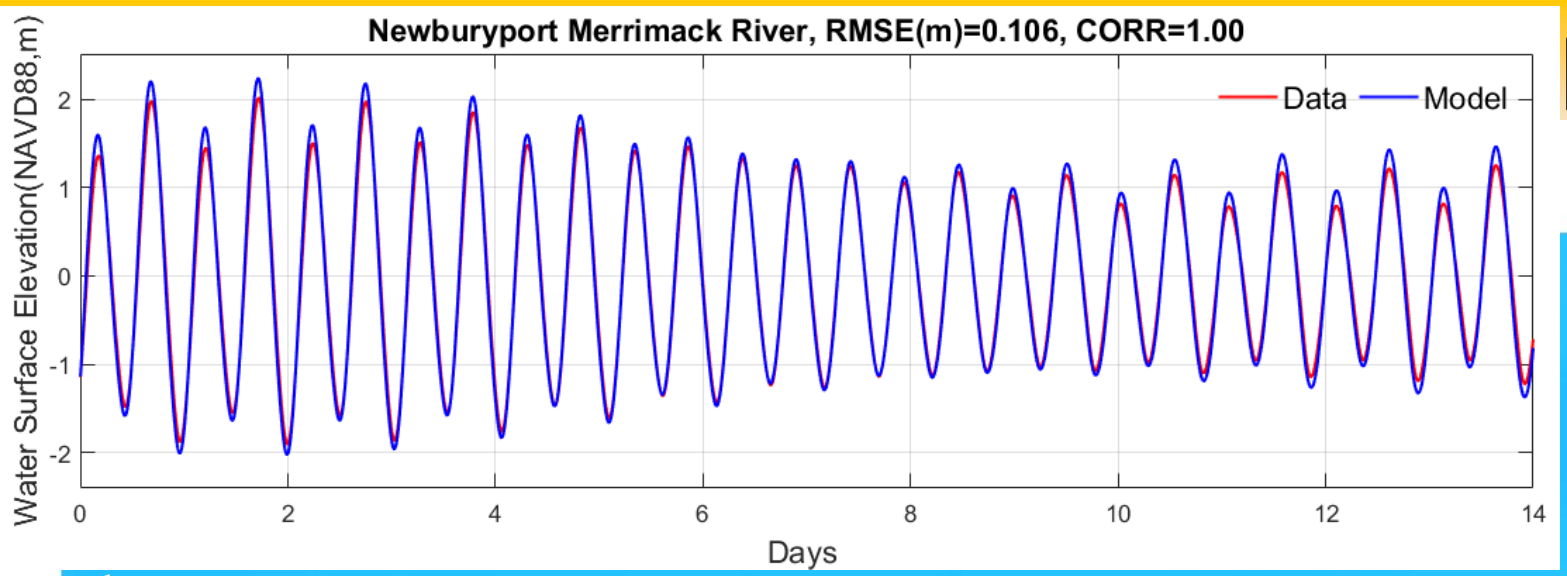


Mesh resolution ~10-20 m within the tidal creeks and marsh platform

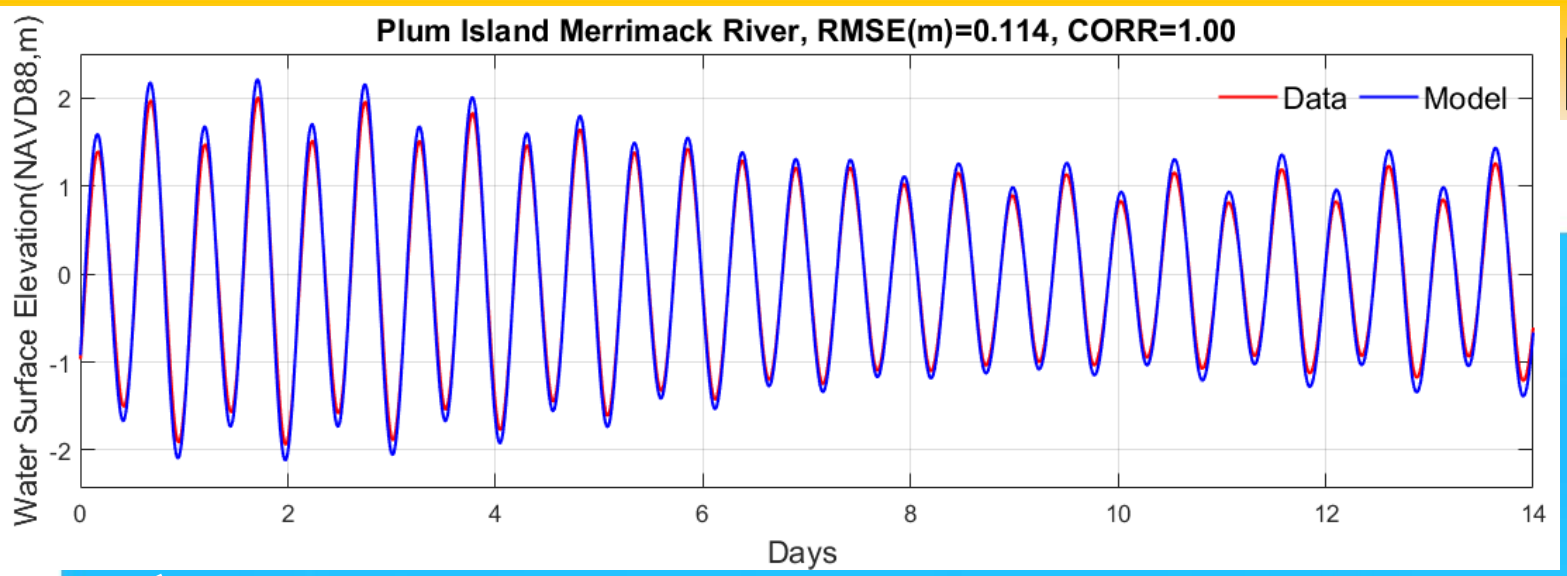


Model bathymetry (m, NAVD88)

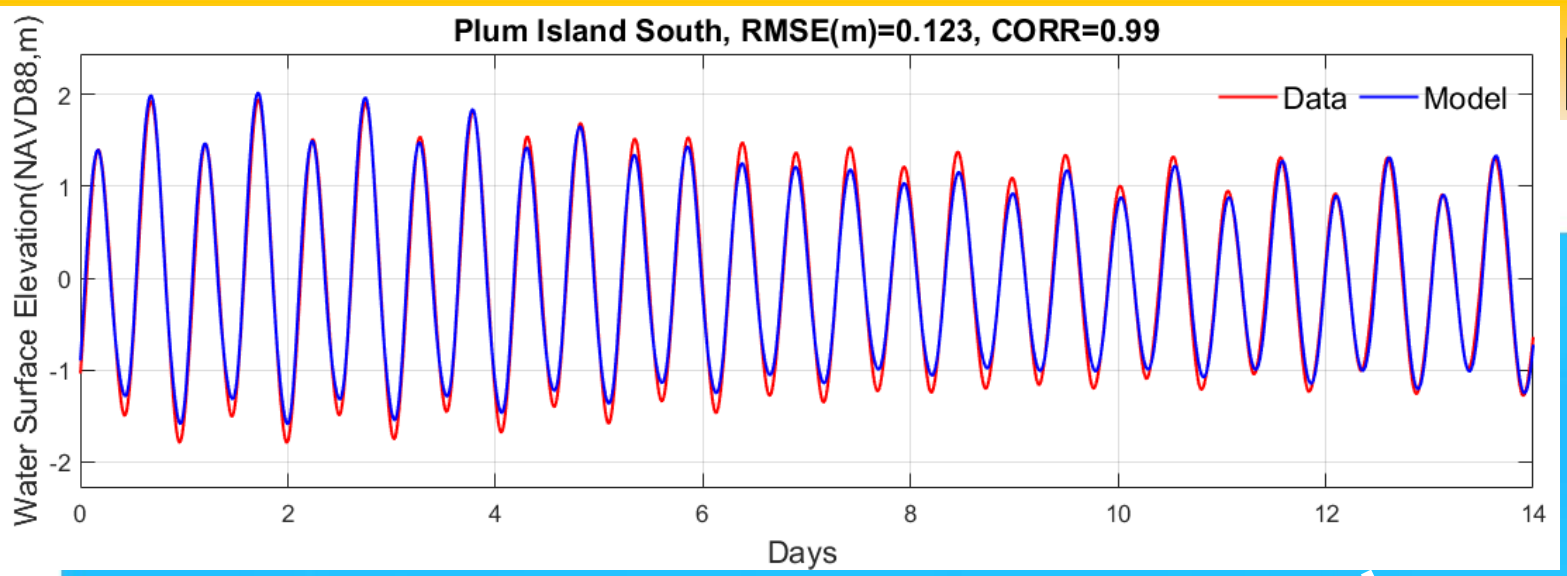
Model Validation



Model Validation

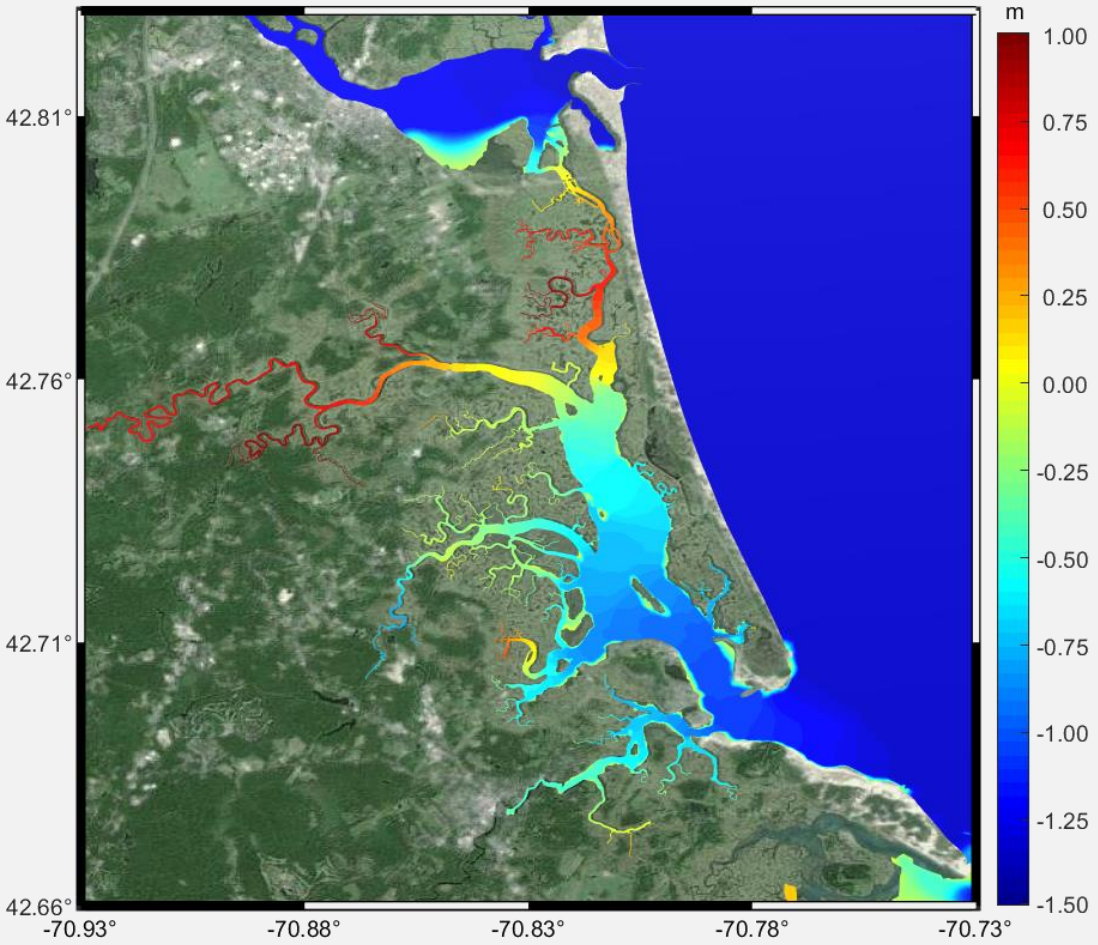


Model Validation

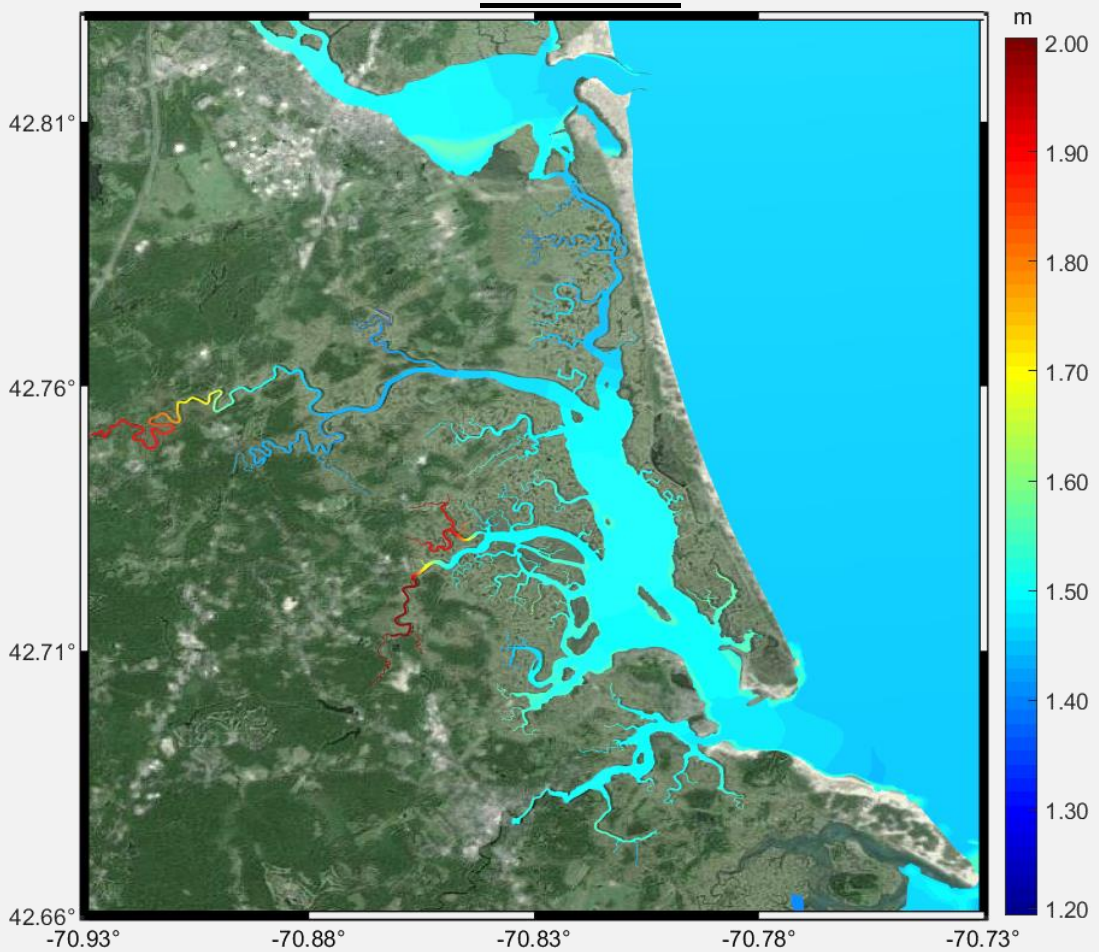


Present day MLW and MHW

MLW

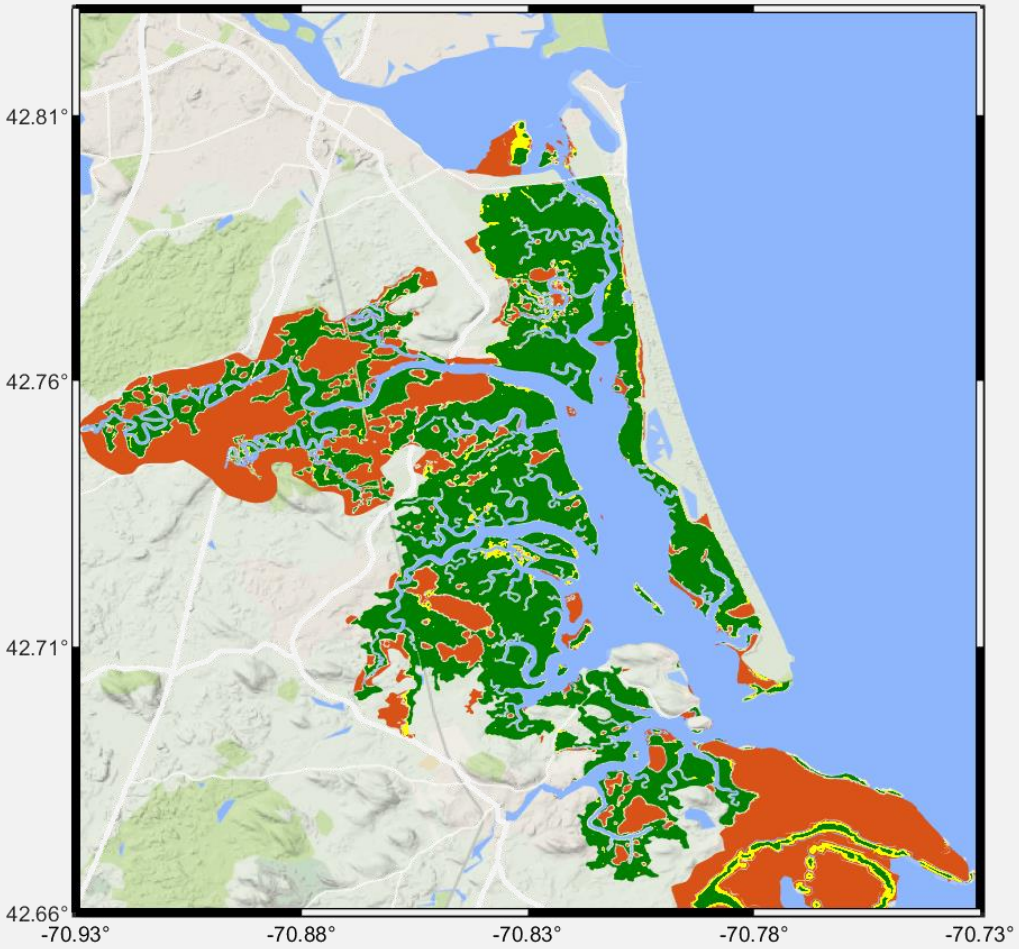


MHW



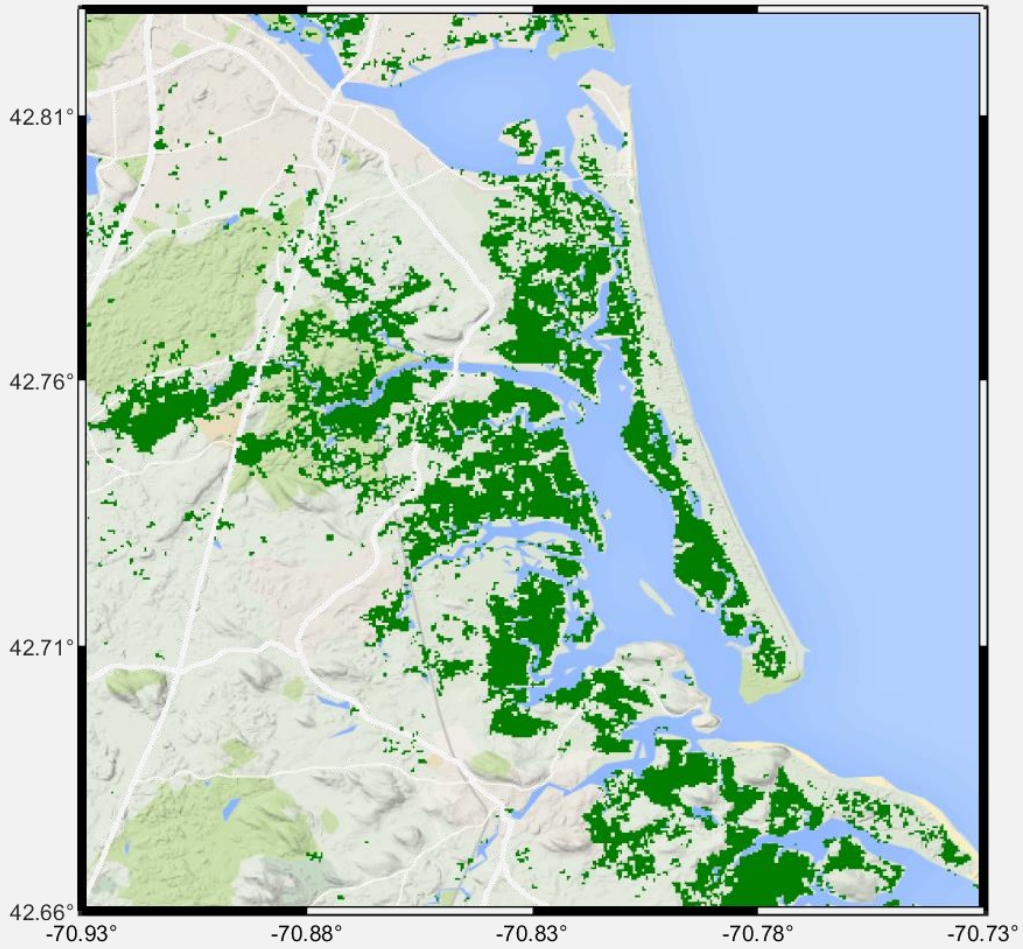
Biomass density vs land cover data

Biomass distribution



Low Medium High

Land cover data



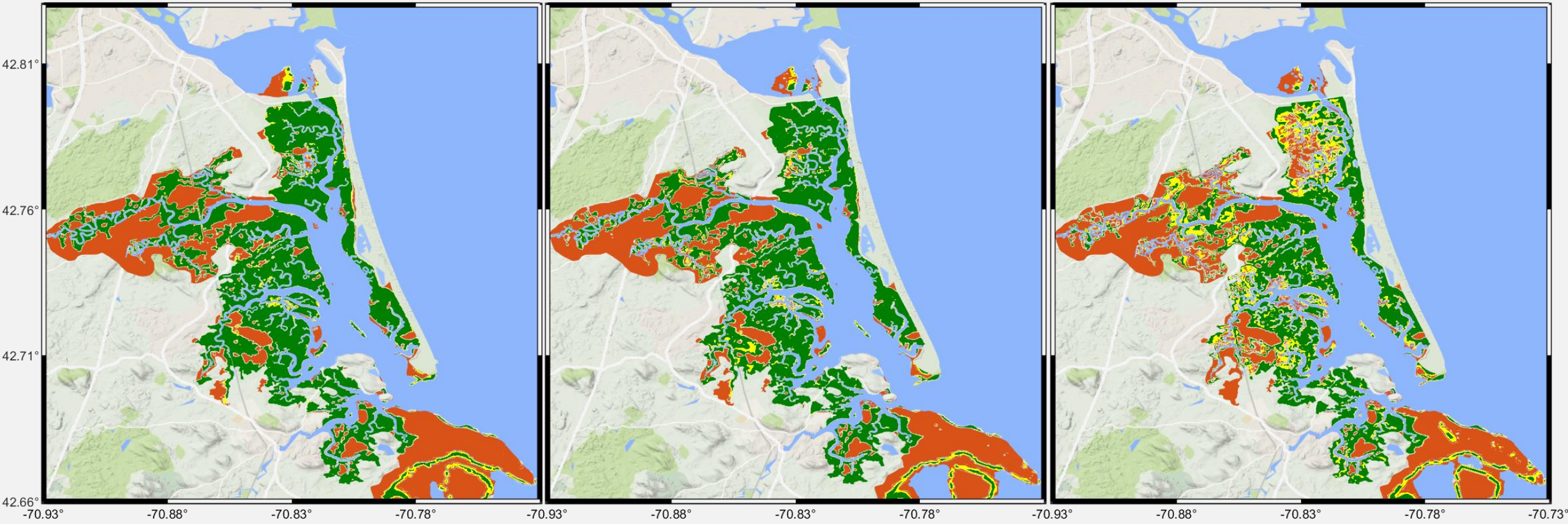
Inter-tidal vegetation

Biomass density

Present day

20 cm SLR

50 cm SLR



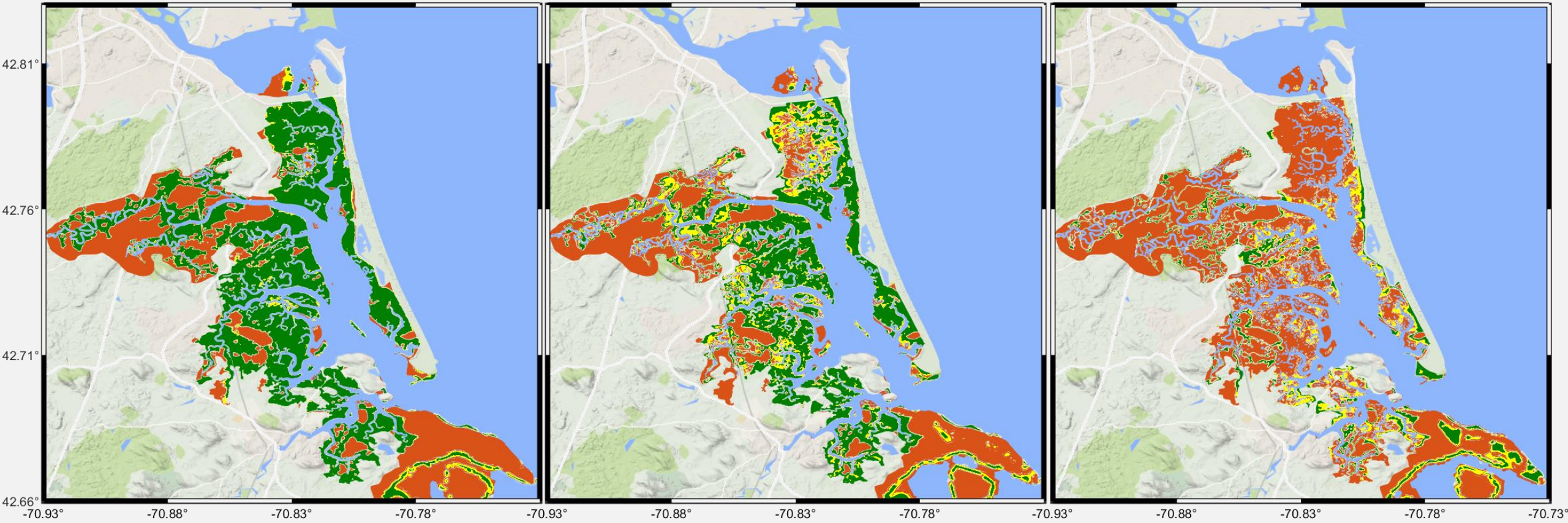
Low Medium High

Biomass density

Present day

50 cm SLR

120 cm SLR



Low Medium High

Conclusions

- Model validation resulted in less than 3% error at three locations.
- Biomass distribution at present day compares favorably to land cover data.
- An integrated hydro-marsh model assesses the complex dynamics of salt marsh vegetation and projects the impacts of possible future SLR.

Future Work

- Hydrodynamic marsh equilibrium model for locations:
  - Forsythe NWR, NJ,
  - John H Chafee NWR, RI and
  - Inlets of Chesapeake Bay to Ocean City MD

Acknowledgments

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR
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Sea Grant Louisiana
UNIVERSITY OF CENTRAL FLORIDA 1963
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