# Progress in the development of a cross-scale US East Coast model

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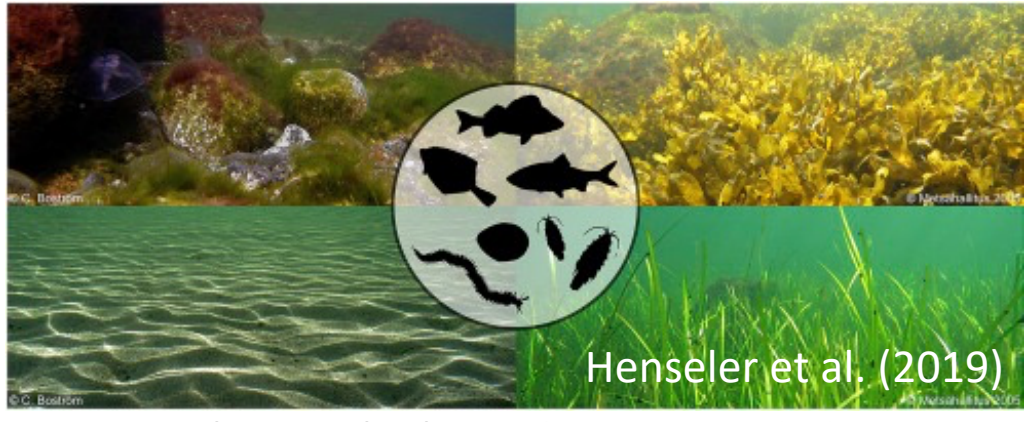
**Wetland** → **Estuary** → **Ocean**

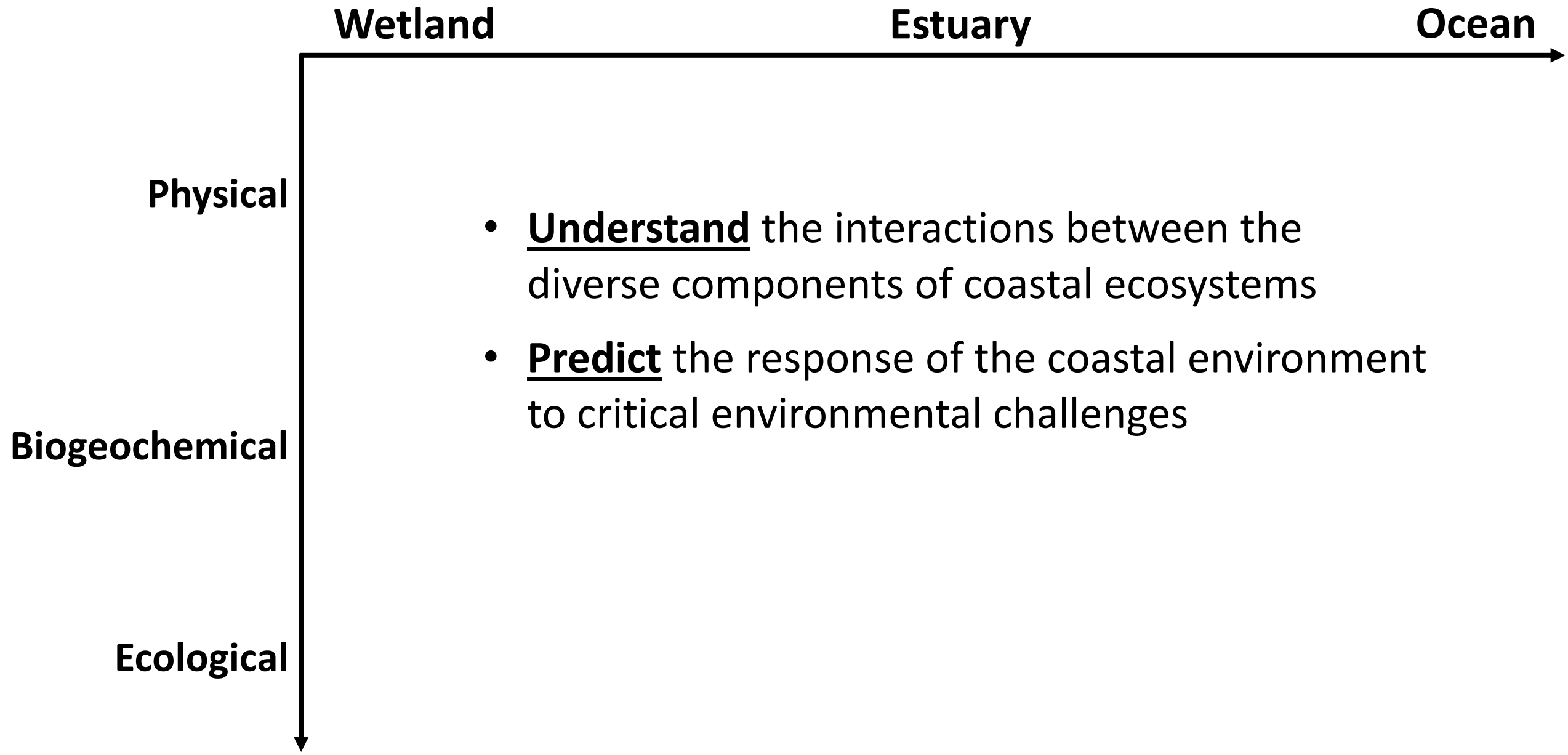

Resource management: agriculture, fishery, and drinking water


Human impacts: nutrient loading and pollution

Coastal resilience: sea-level rise, shoreline erosion, and coastal flooding


Ecological abundance and diversity



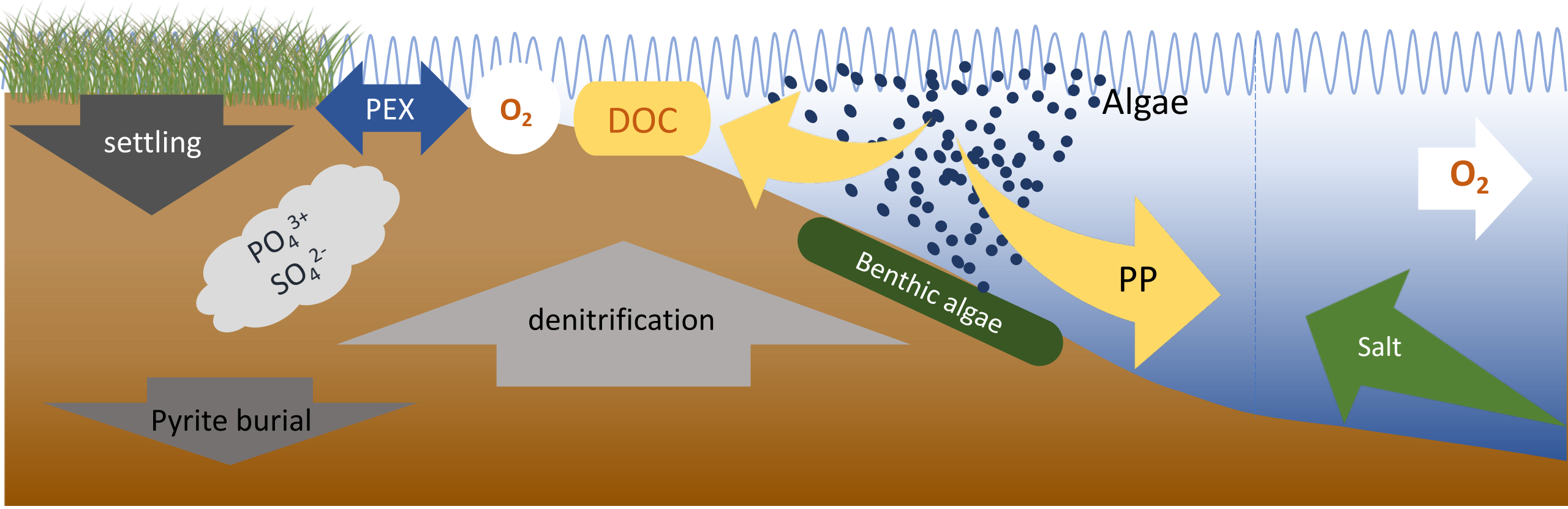

- **Understand** the interactions between the diverse components of coastal ecosystems
- **Predict** the response of the coastal environment to critical environmental challenges

# Relevant research questions

| | Wetland | Estuary | Ocean |
|---|---|---|---|
| | Tidal dynamics | Saltwater intrusion | Sea-level rise / Global warming |
| **Physical** | Coastal inundation<br>Wetland evolution<br>Shoreline erosion | Residence time<br>Porewater exchange<br>Bioturbation | Particle transport<br>Marine heatwave<br>Water connectivity |
| **Biogeochemical** | Organic matter burial<br>Sediment diagenesis<br>Gas emission<br>Alkalinity generation | Eutrophication<br>Hypoxia<br>Nutrient cycling<br>Sediment diagenesis | Element export and cycling (e.g., carbon, alkalinity, and nitrogen) |
| **Ecological** | Ecological functions of tidal marsh, mangrove, and benthic fauna | Primary production of phytoplankton, SAV, and benthic algae | Harmful algal bloom<br>Fish larvae transport<br>Food web |

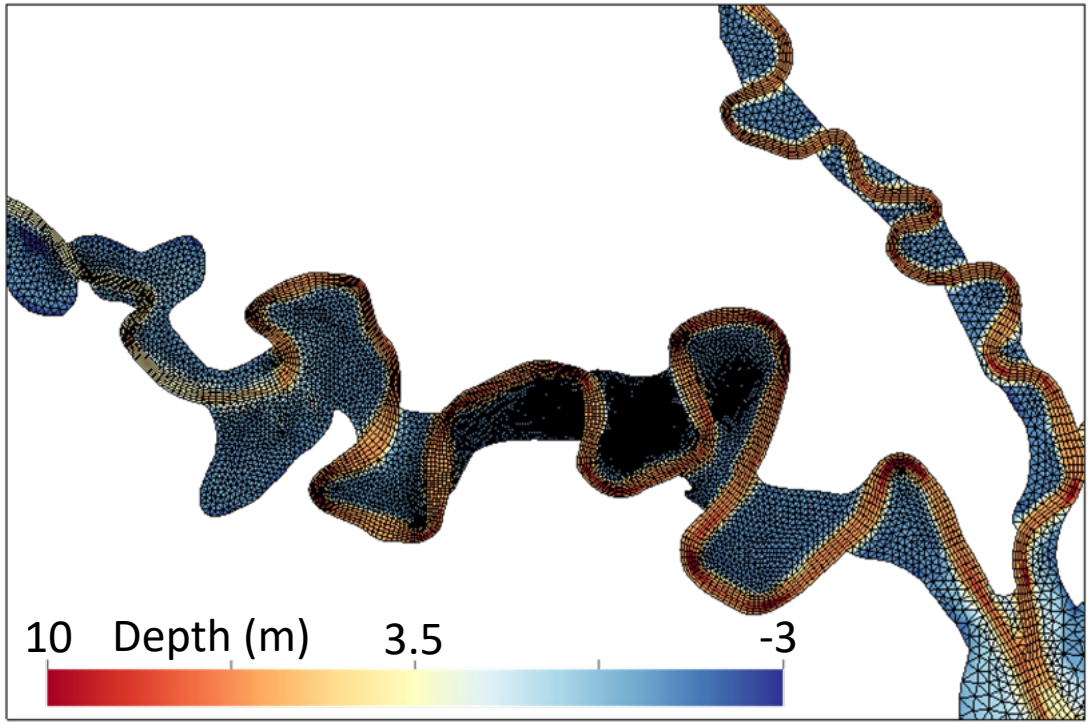
# Relevant research questions

- How do the oceanic processes and atmospheric loadings impact the estuarine biogeochemical processes?
- What is the relationship between residence time of shallow water embayment and element fluxes?

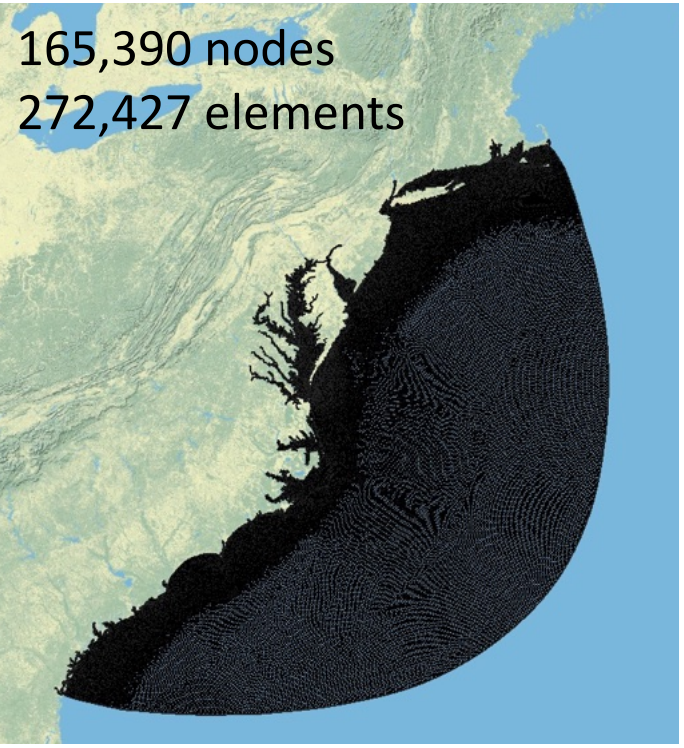


# Motivations to develop a cross-scale model with SCHISM

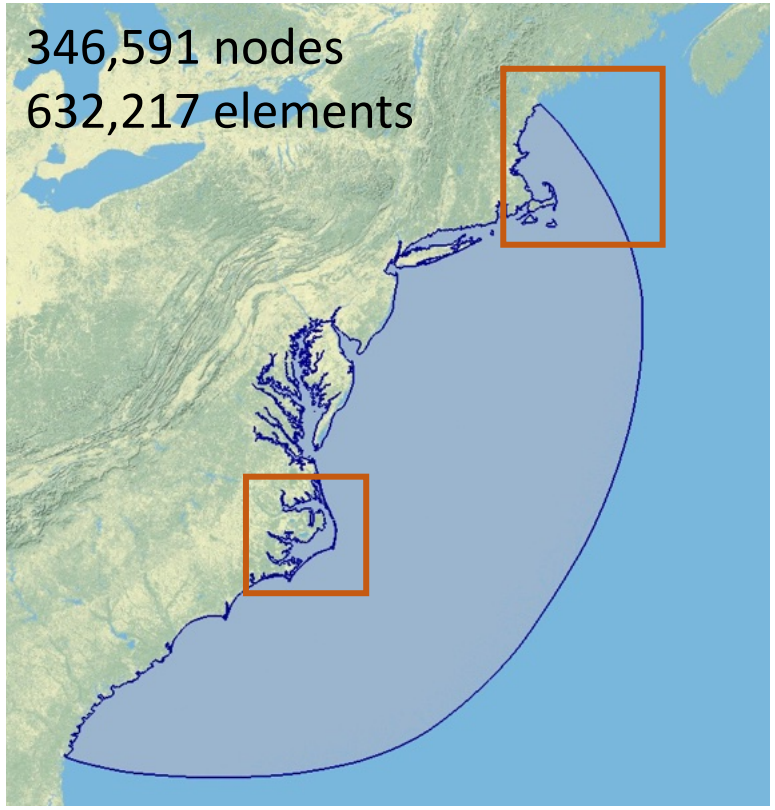
- Unstructured grids >> geometry features
- Hybrid vertical coordinate system
- Stable >> wetting and drying process
- Efficient >> local refinement with no decrease in time step



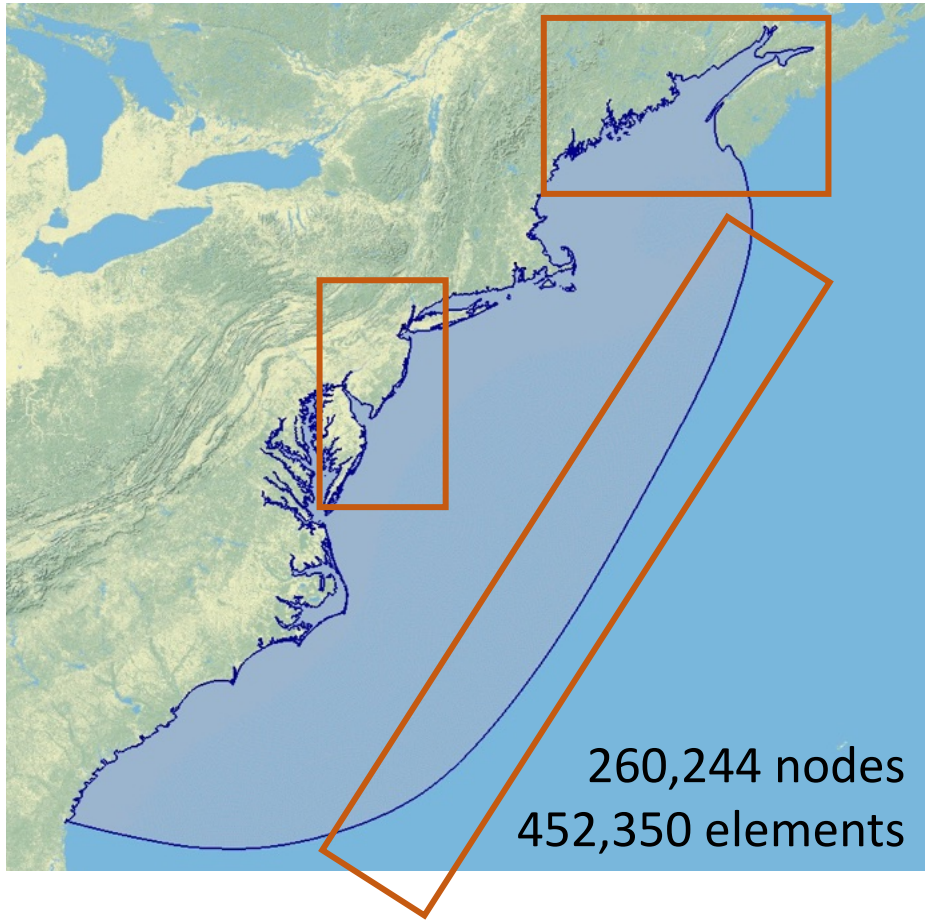
# Recent updates on grids




Version 0

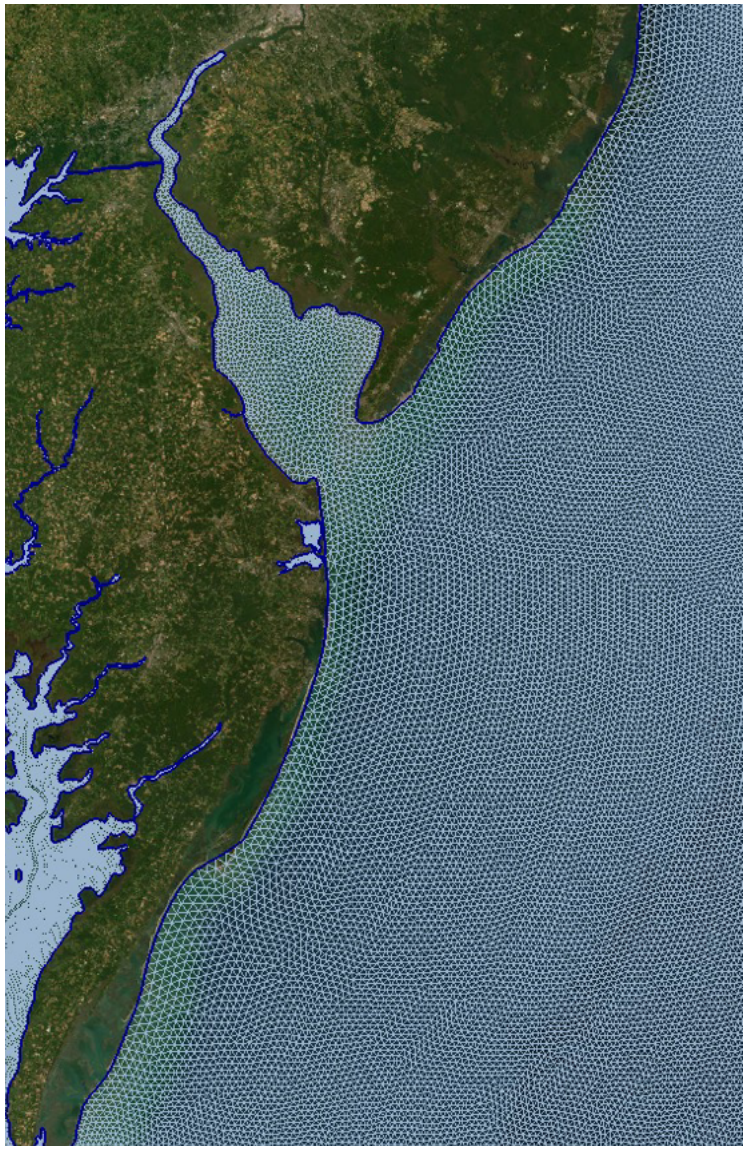


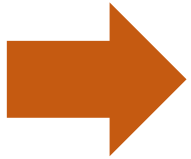

Version 1

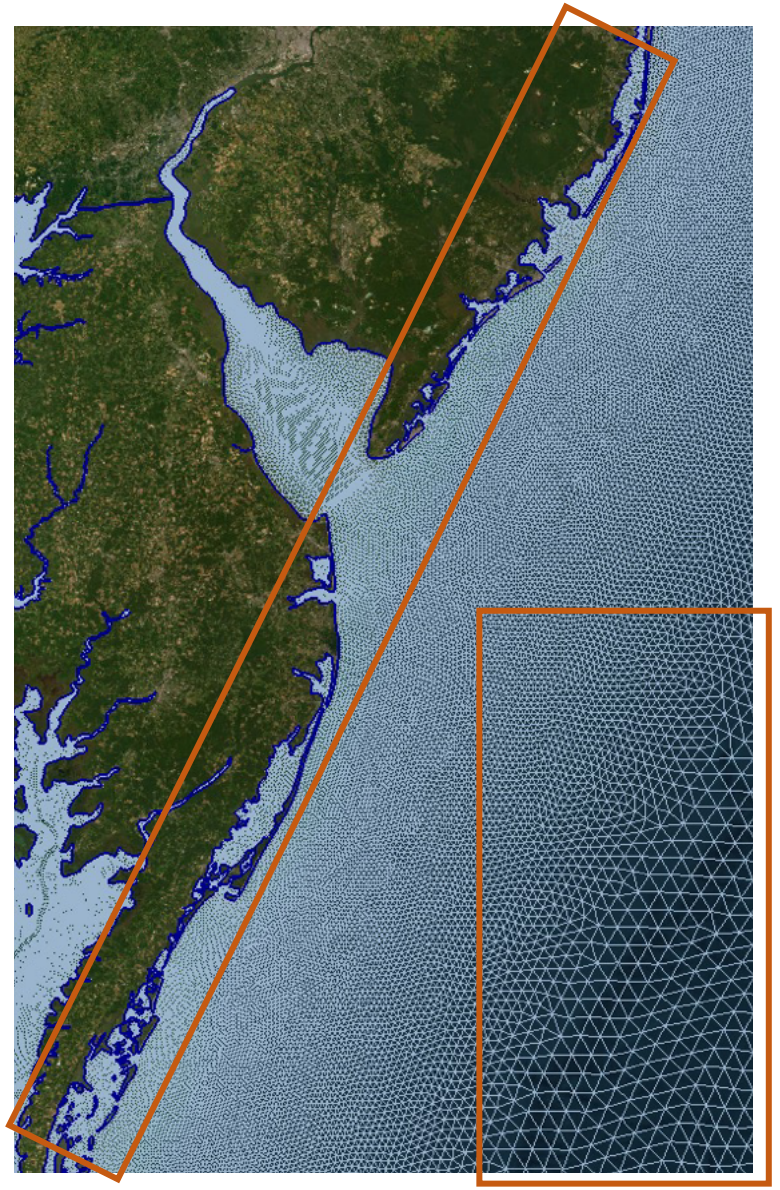



Version 2

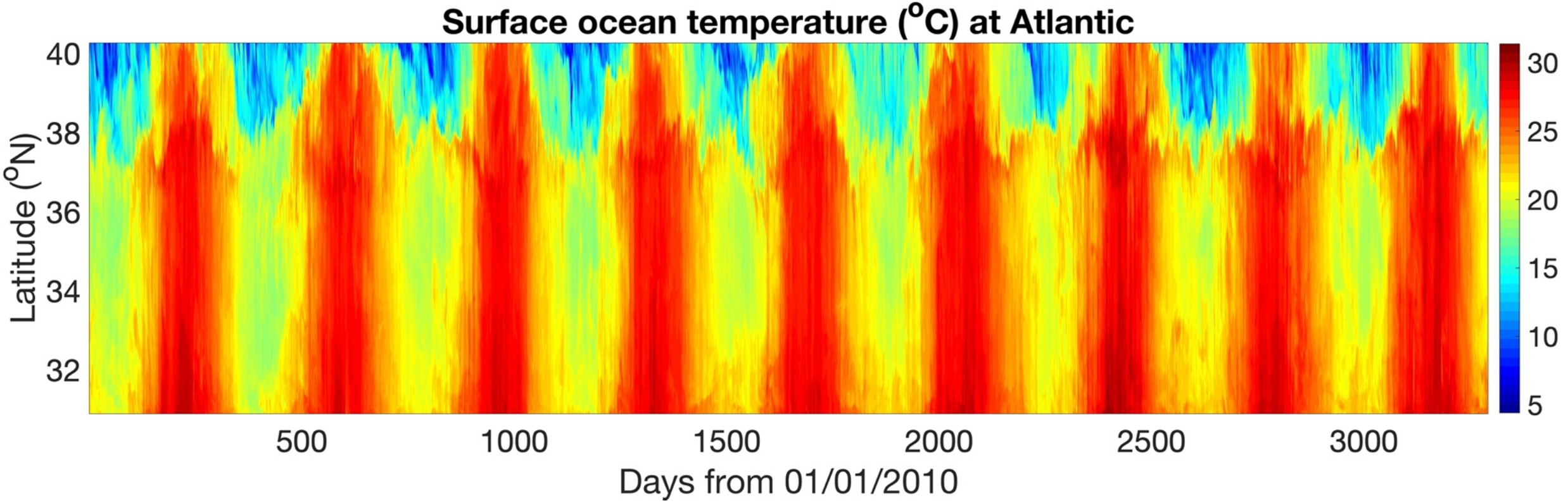
# Sample details



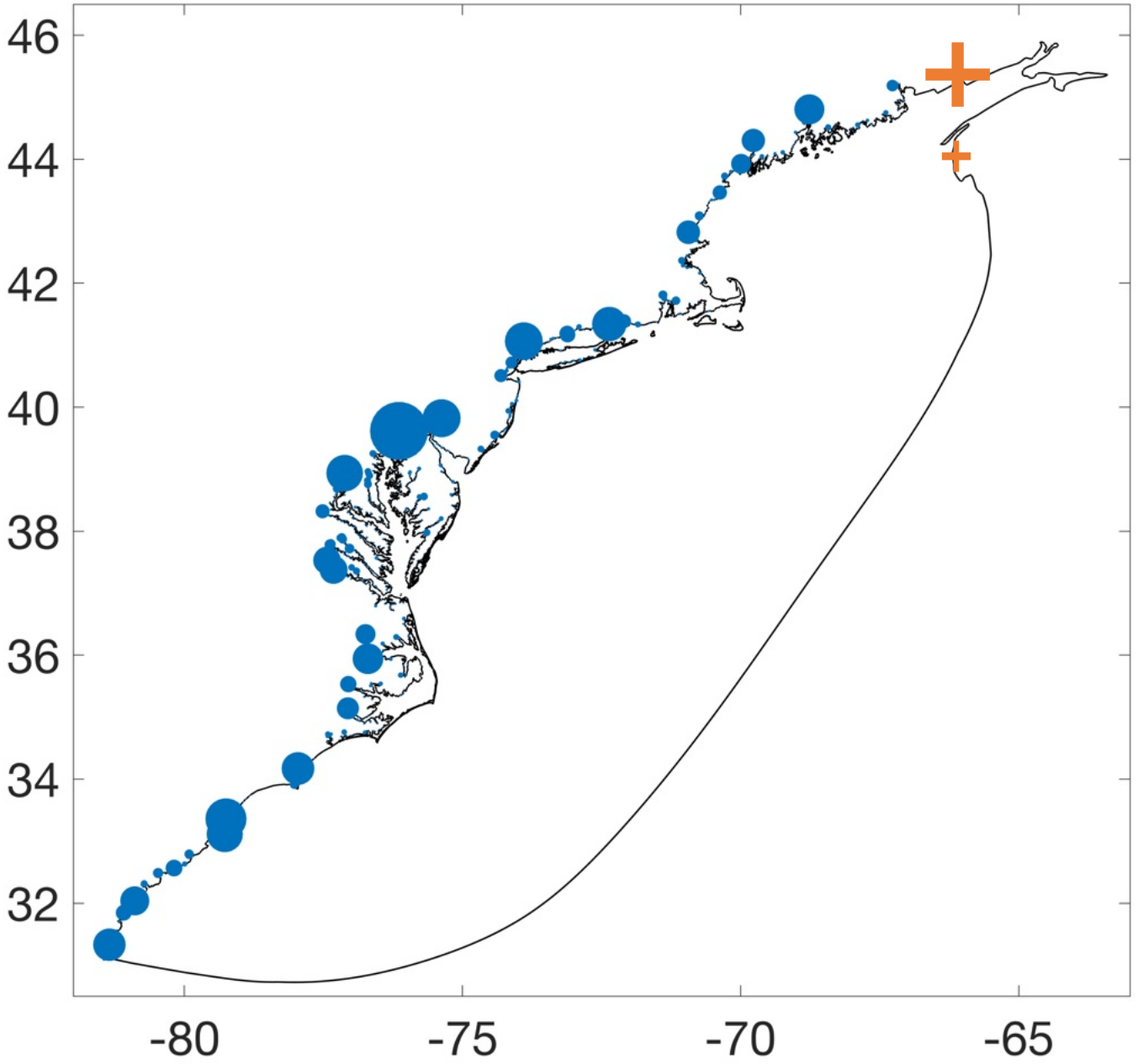




# Temperature at ocean boundary

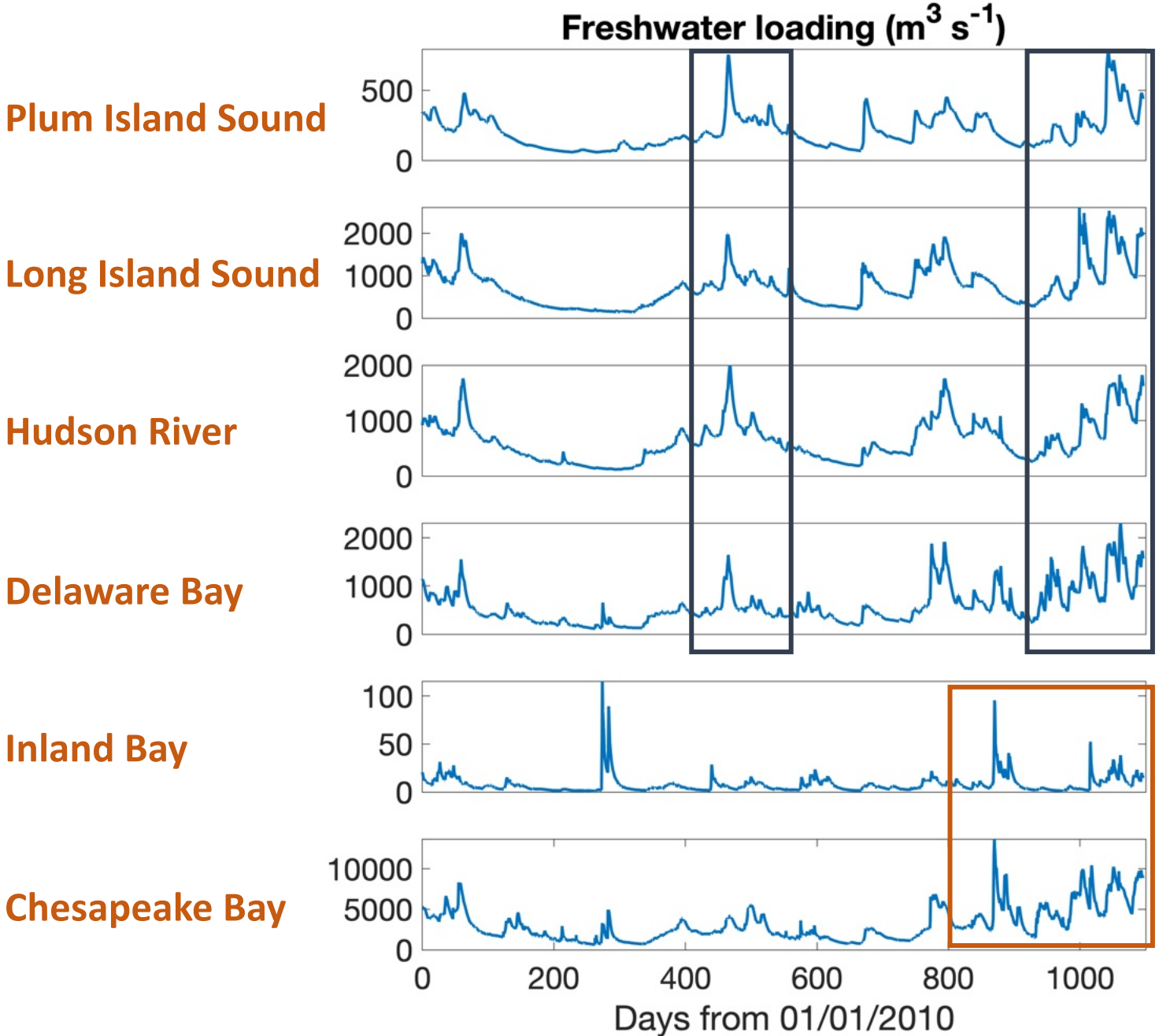


# Freshwater loadings

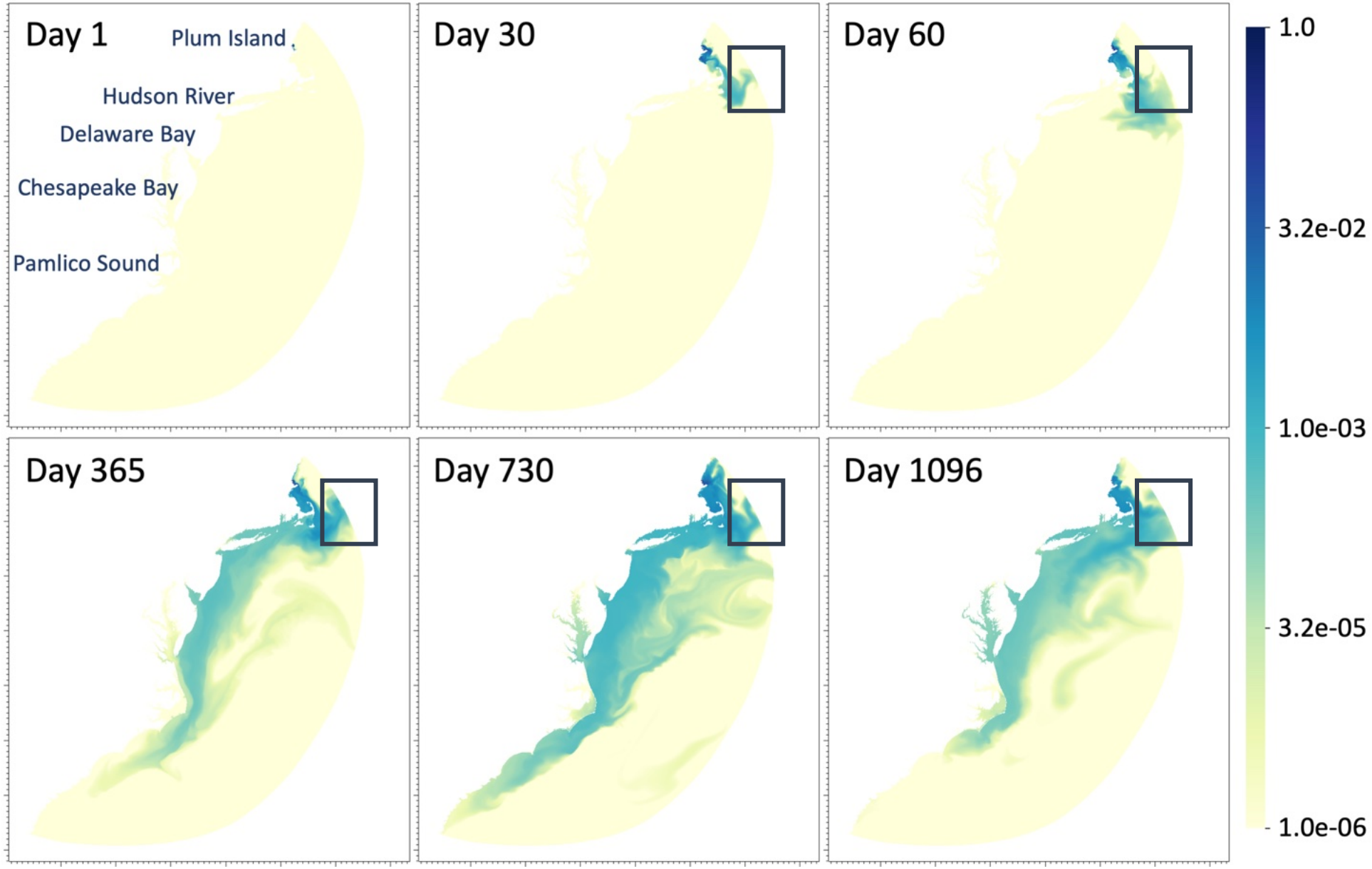



1. Plum Island Sound
2. Boston Harbor
3. Narragansett Bay
4. Long Island Sound
5. Hudson River
6. Barnegat Bay
7. Delaware Bay
8. Inland Bay
9. Chincoteague Bay
10. Chesapeake Bay
11. Albemarle-Pamlico Sound
12. Cape Fear River
13. Winyah Bay
14. Southeast Coast
    - Charleston Harbor
    - Wadmalaw River
    - Savannah River
    - Altamaha River

# Freshwater loadings



# Tracer distribution sourced from Plum Island – old version, different years



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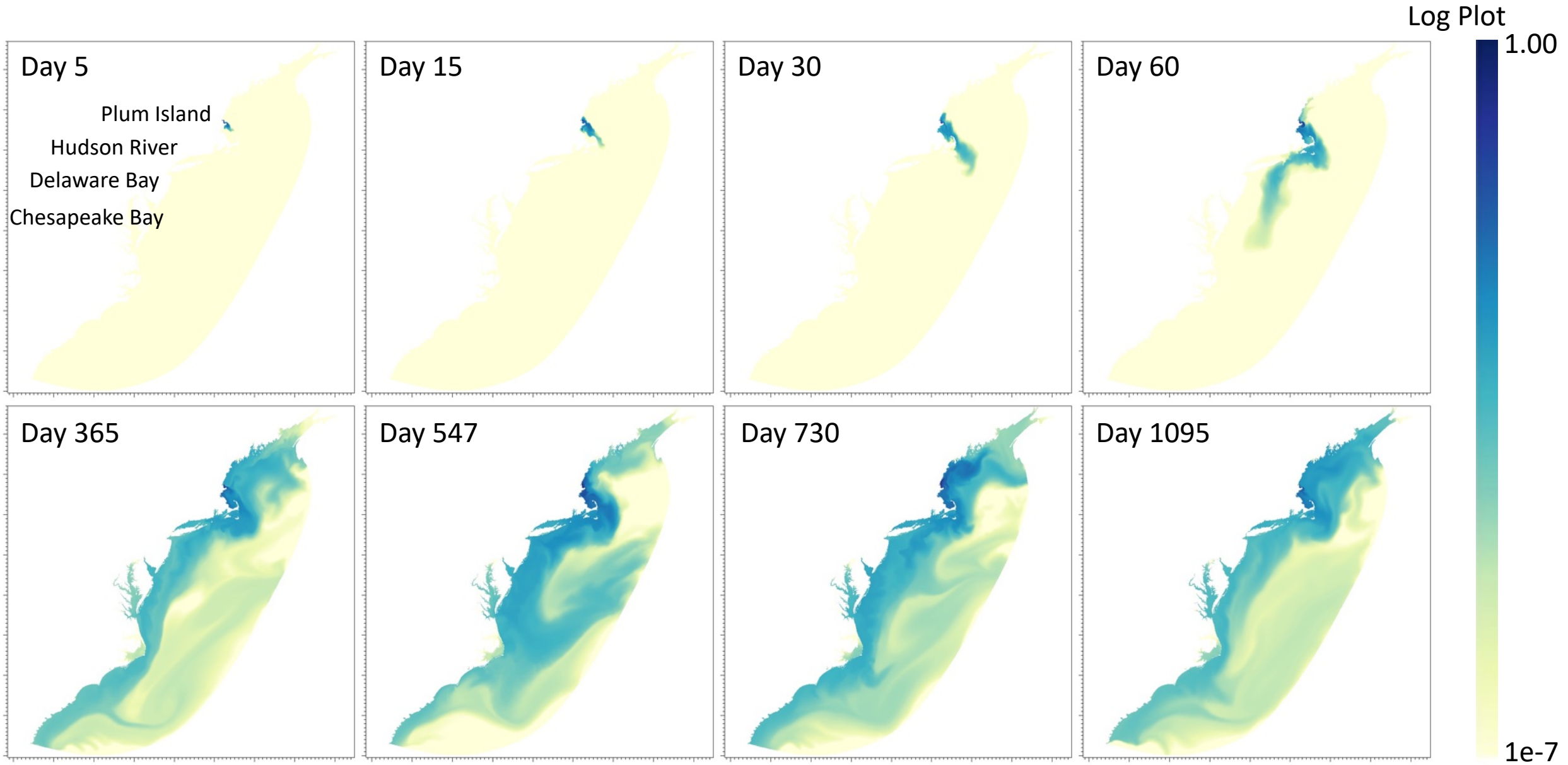
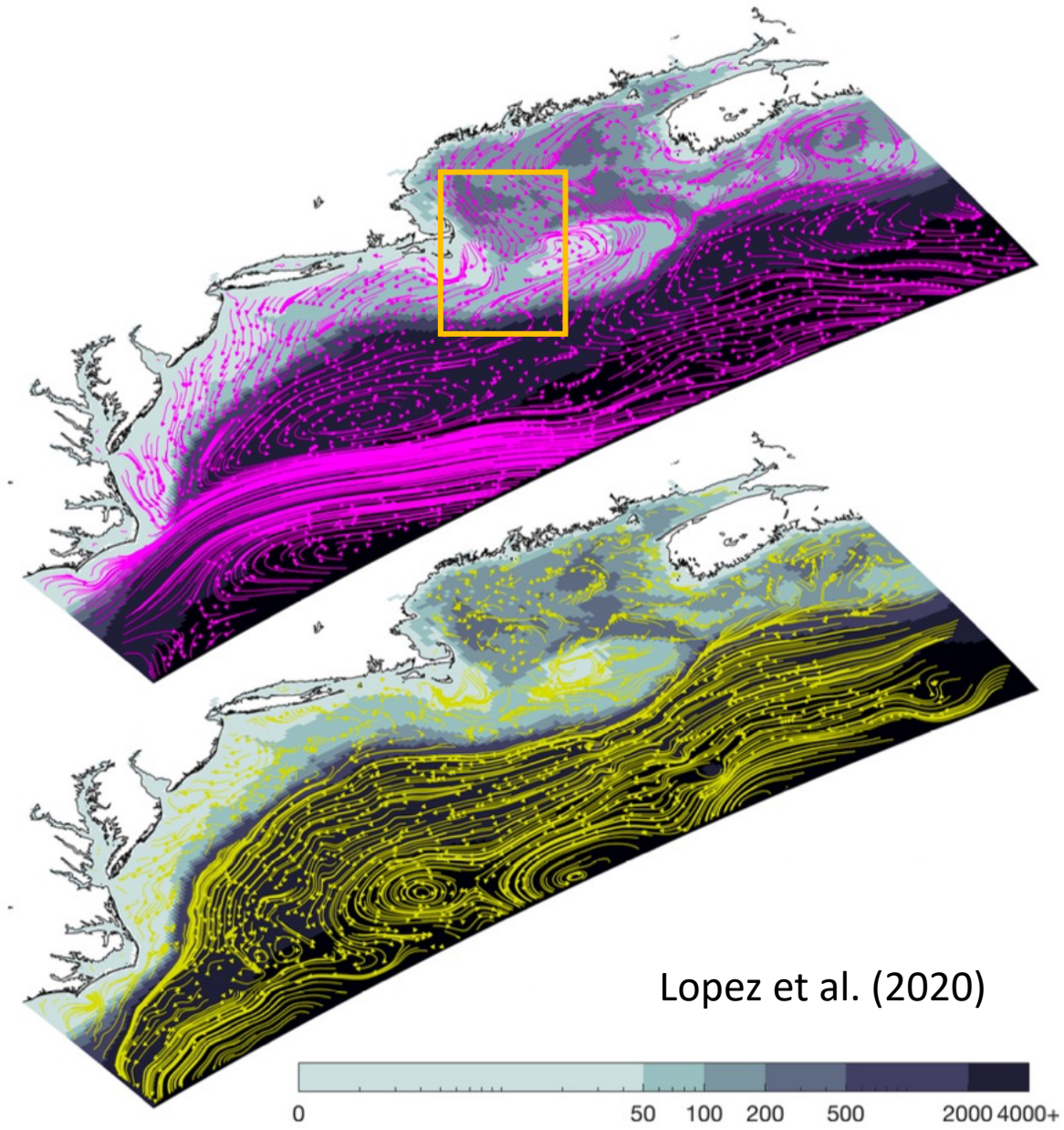
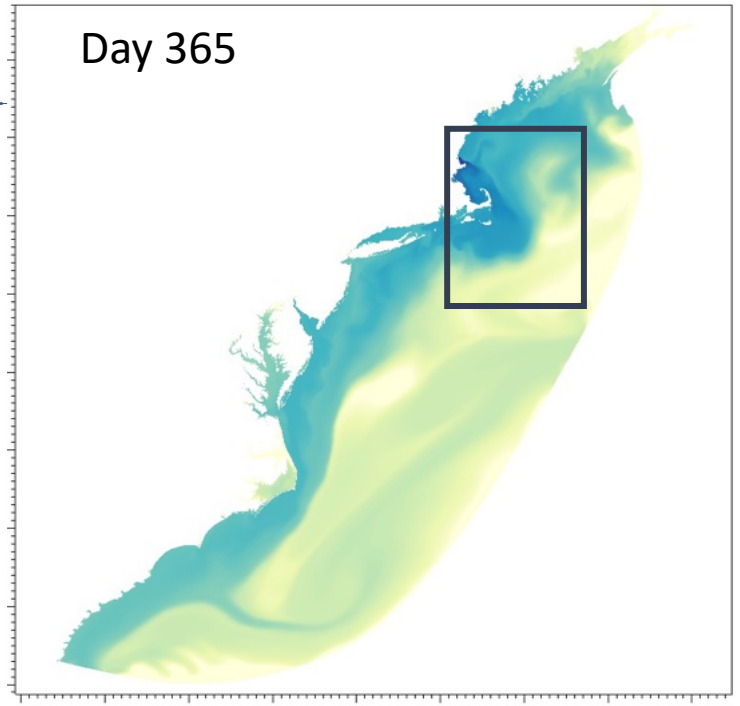
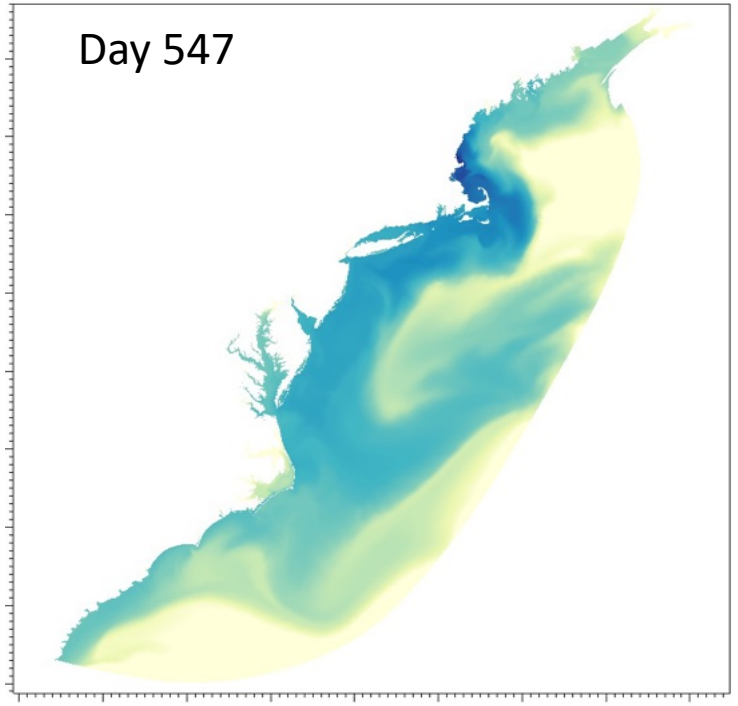


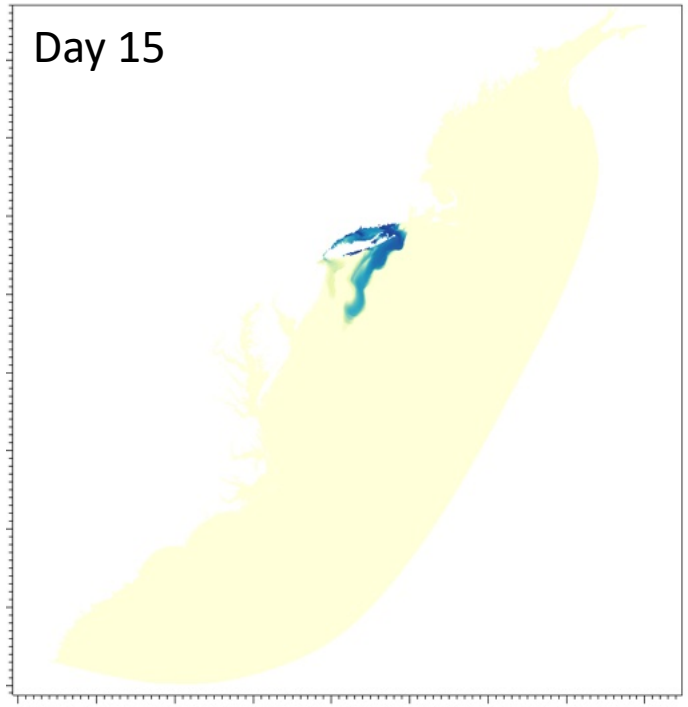
# Plum Island source from new version

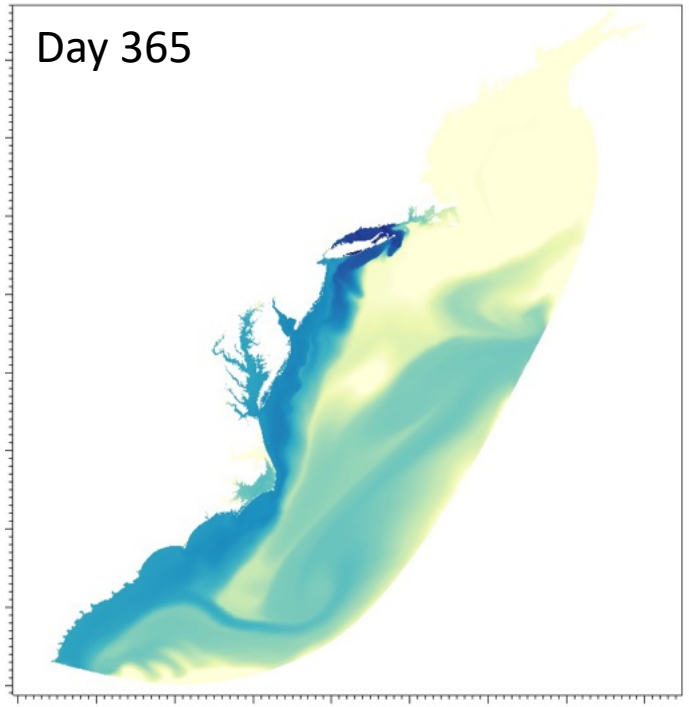


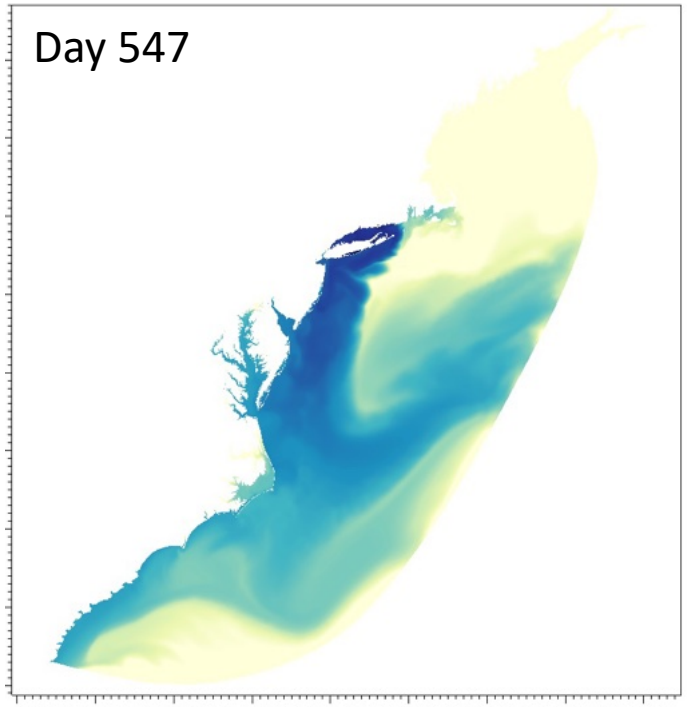



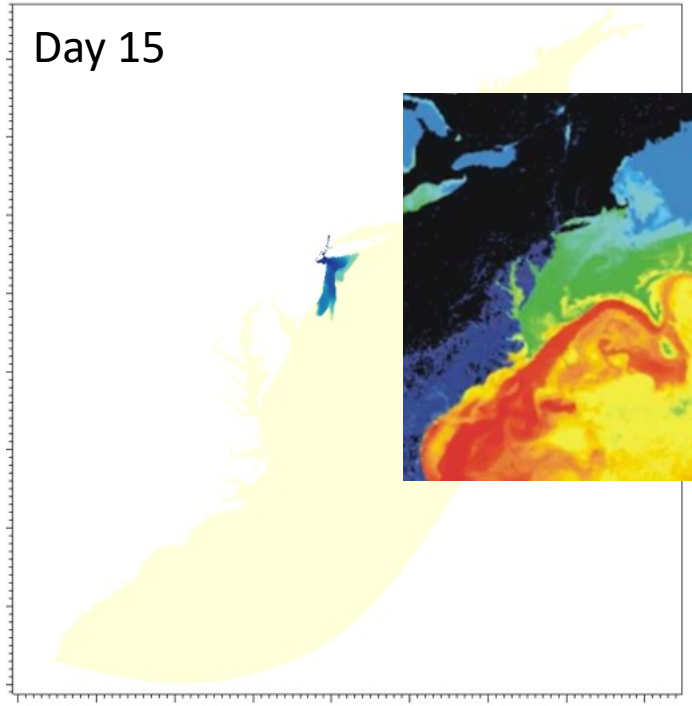
**Long Island Sound**



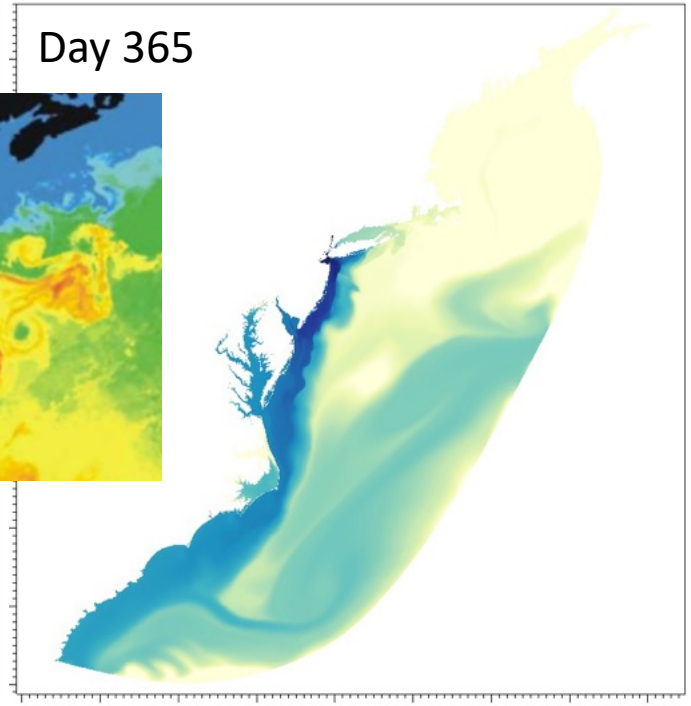



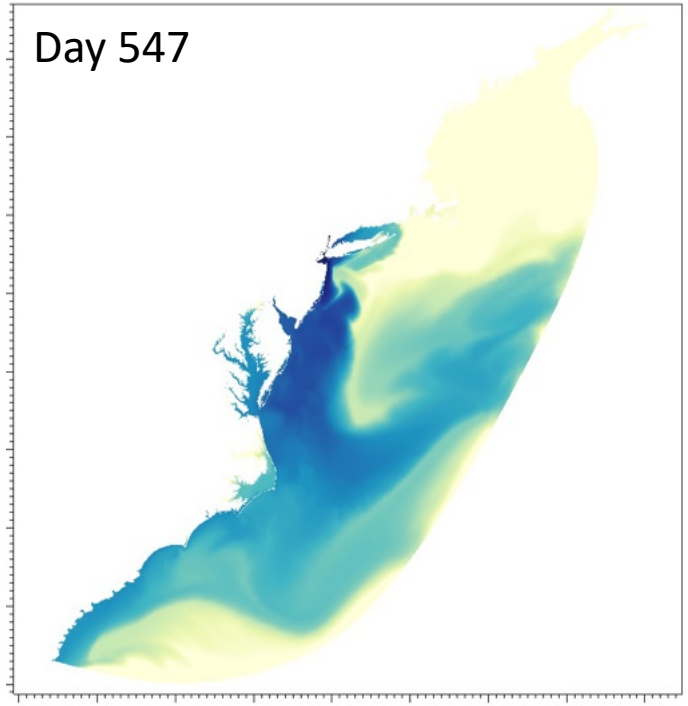




**Hudson River**

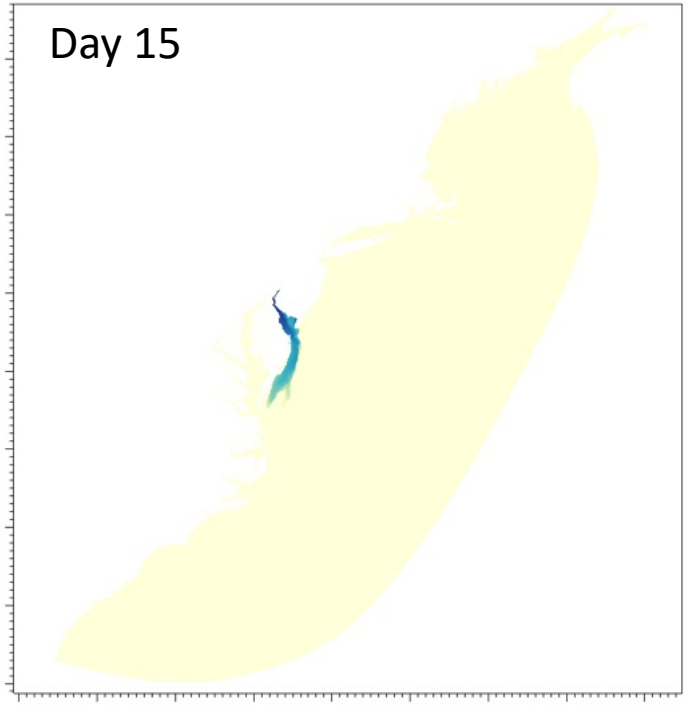


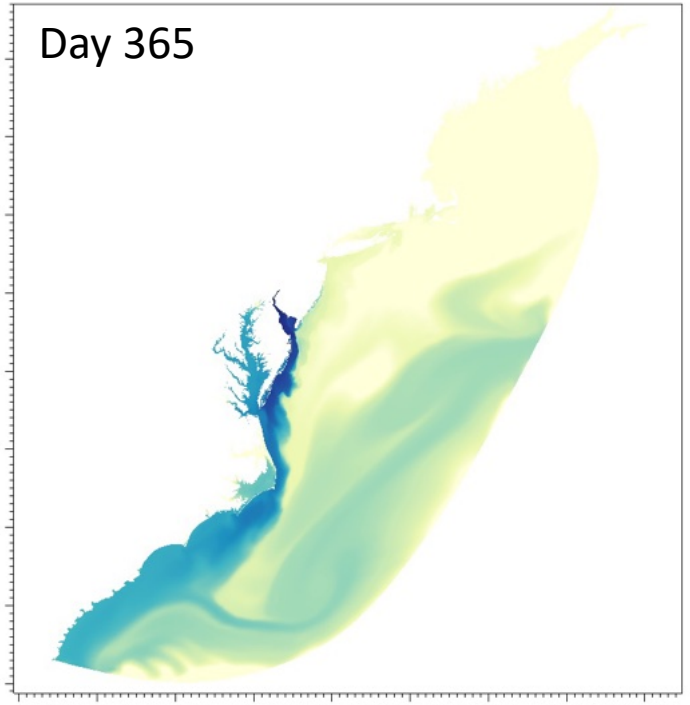


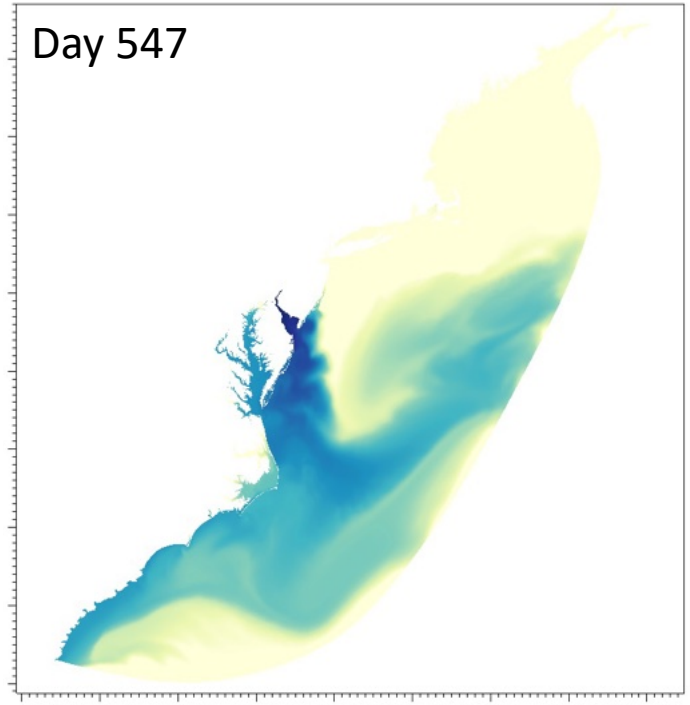



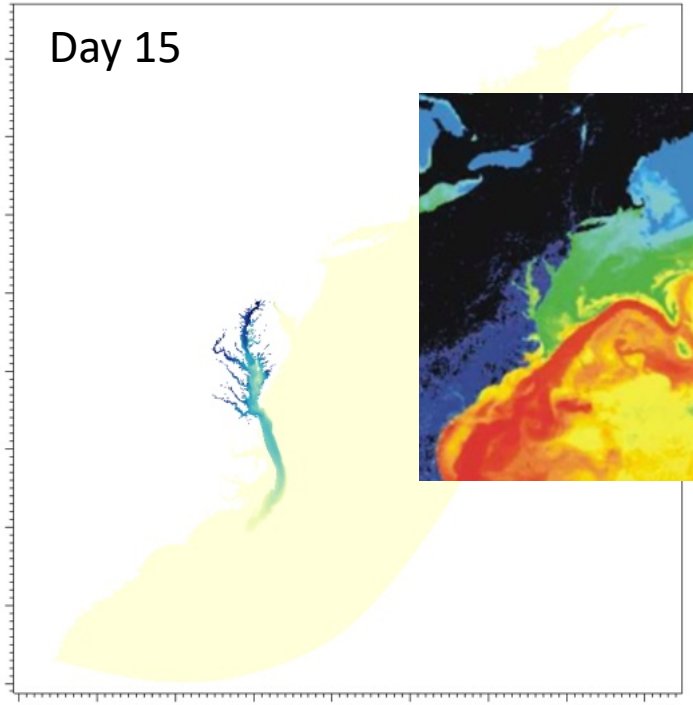
**Delaware Bay**



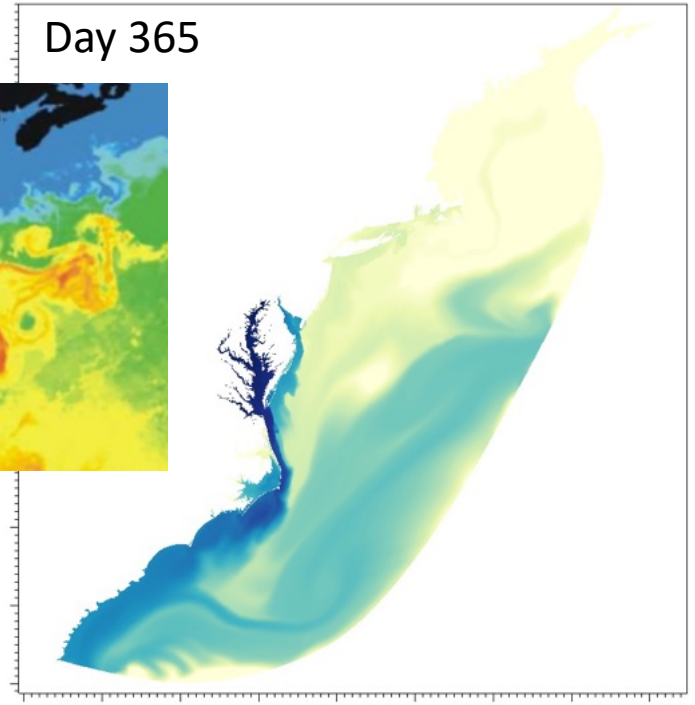



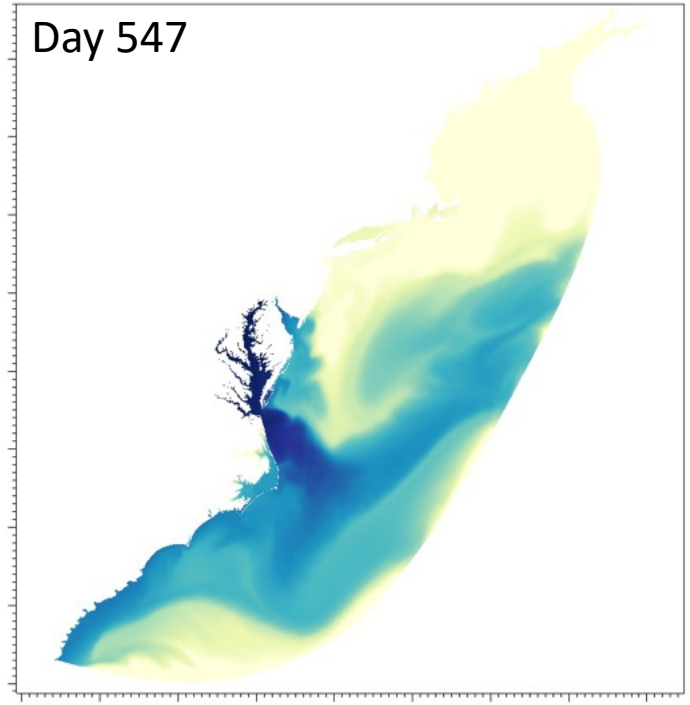




**Chesapeake Bay**

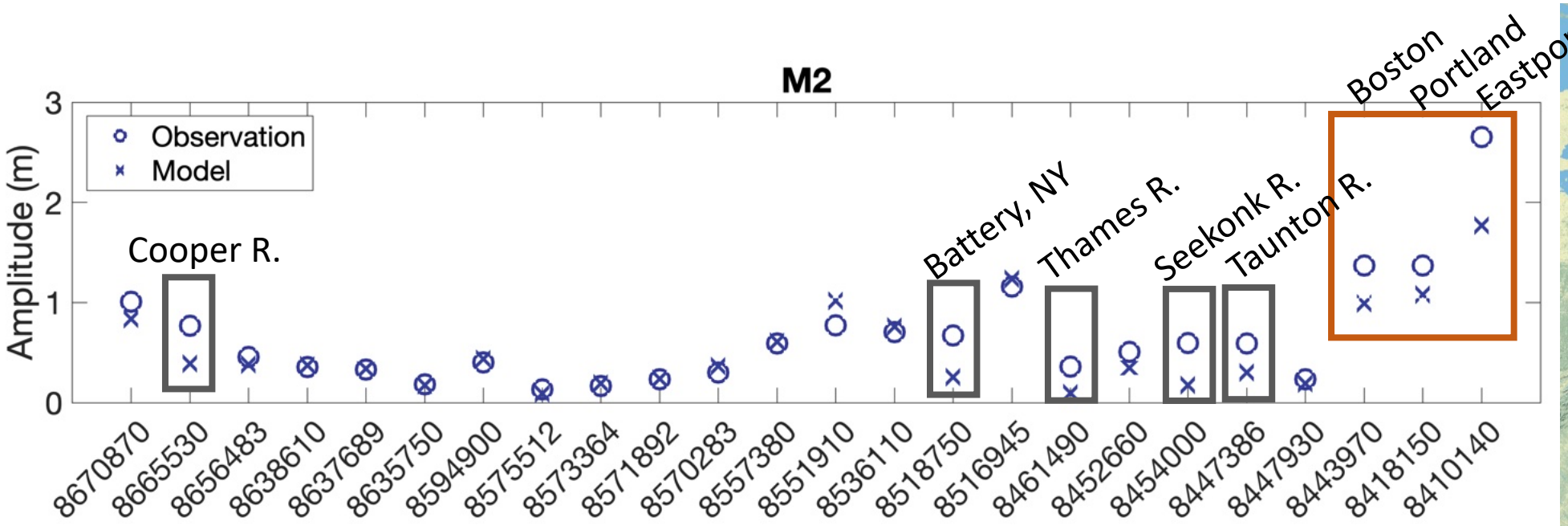


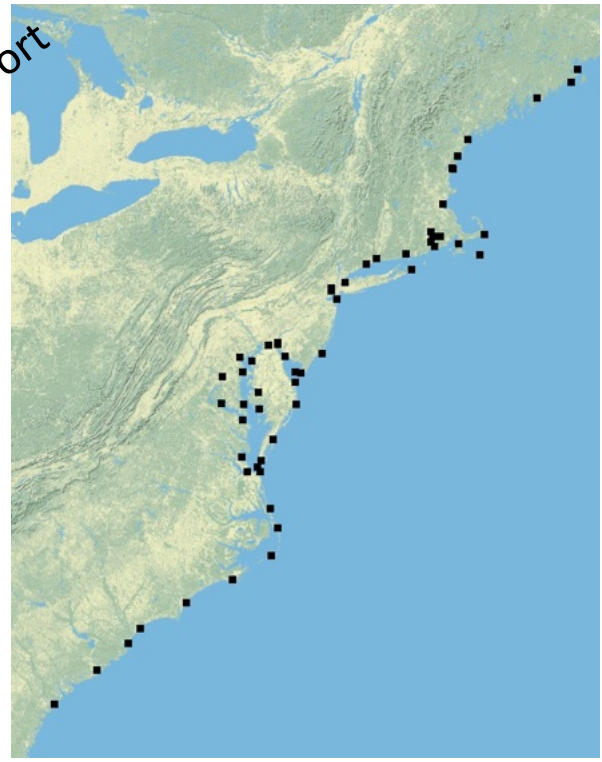


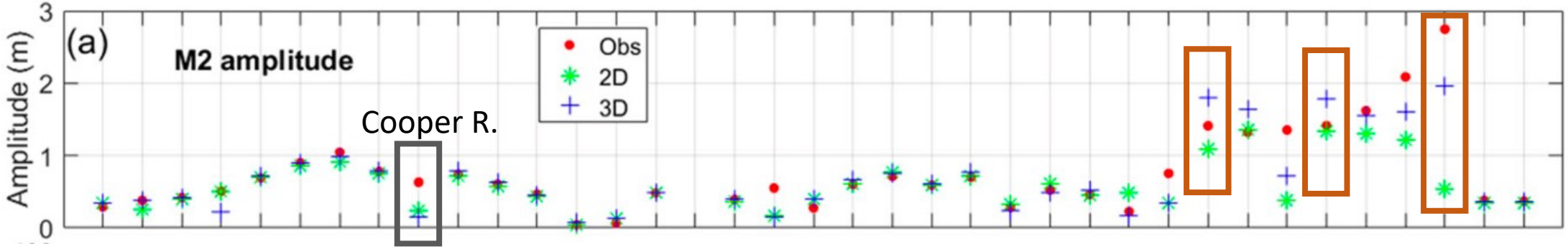



# Assessments of tide simulations

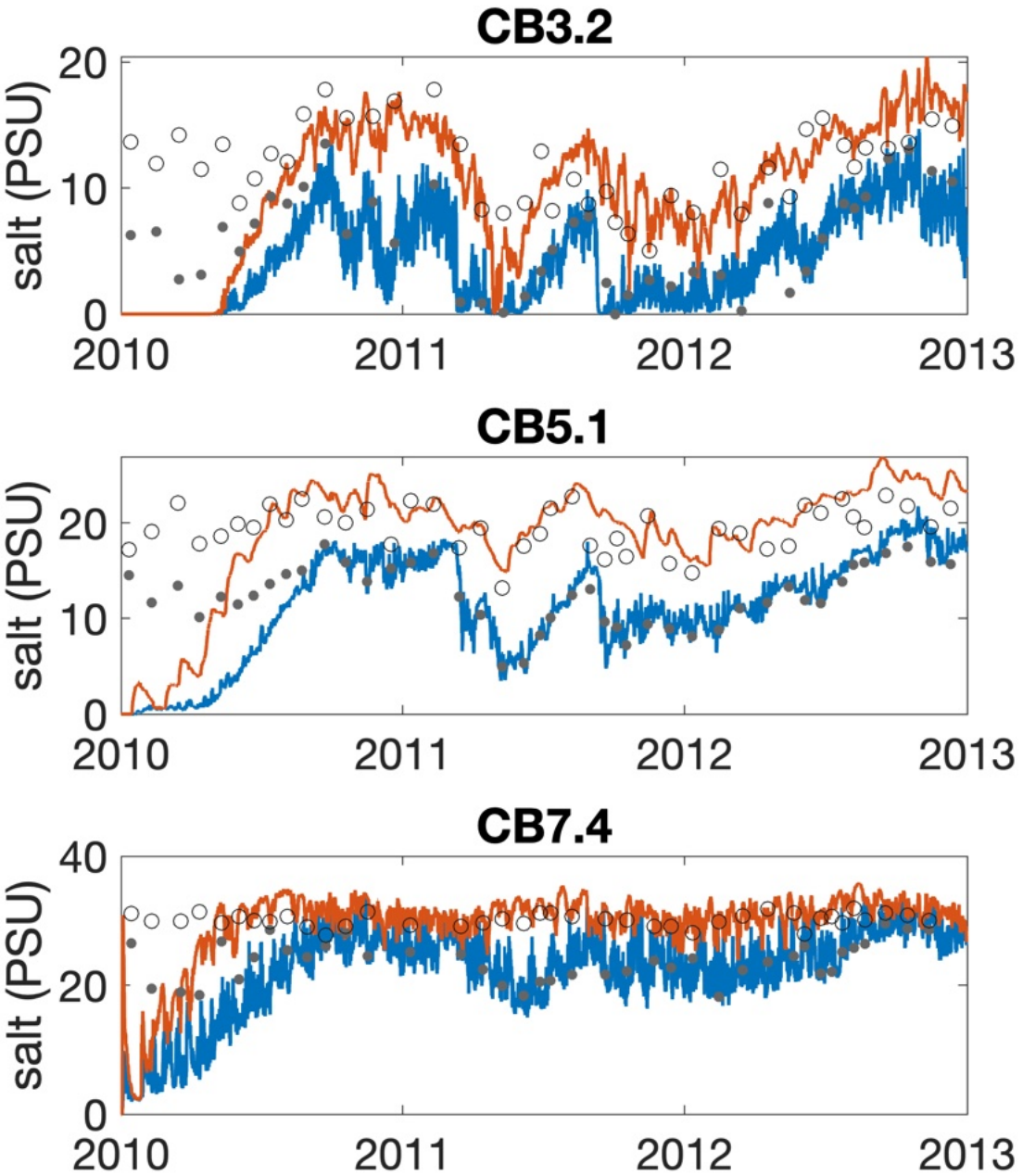


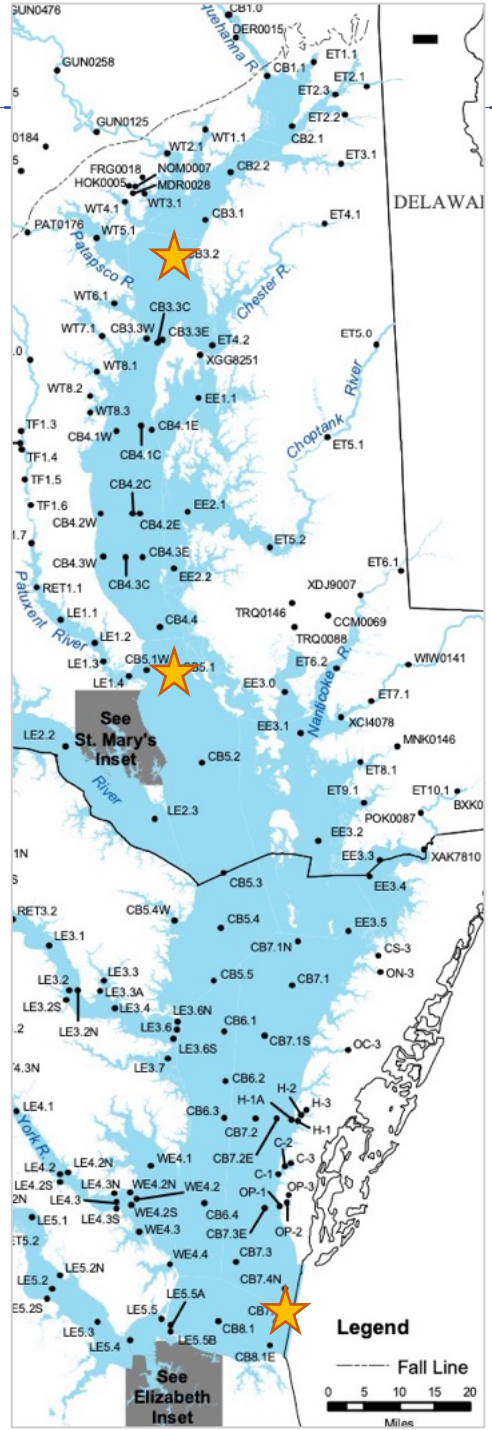






Huang et al. (2022)

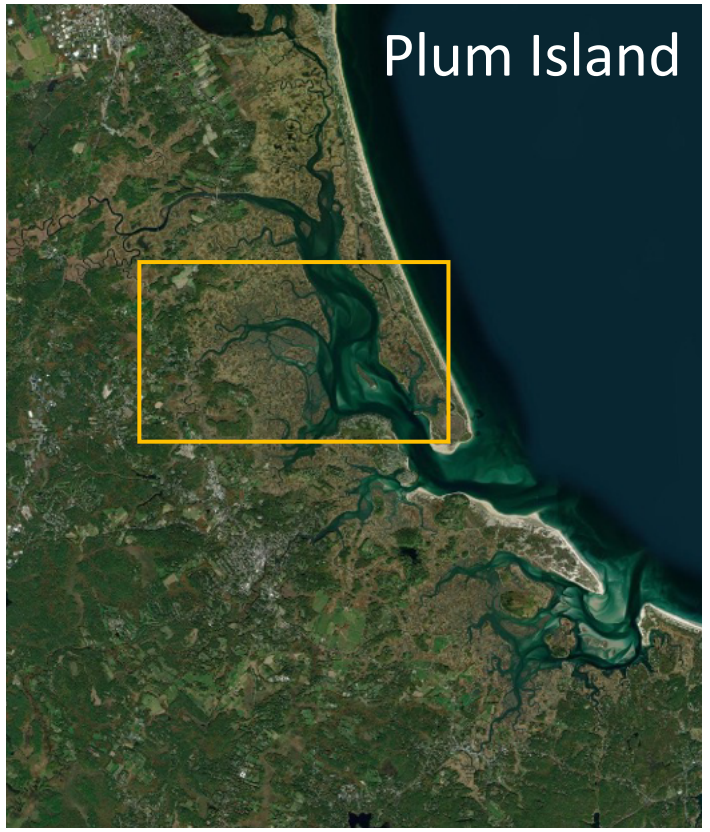
# Assessments of salinity simulations



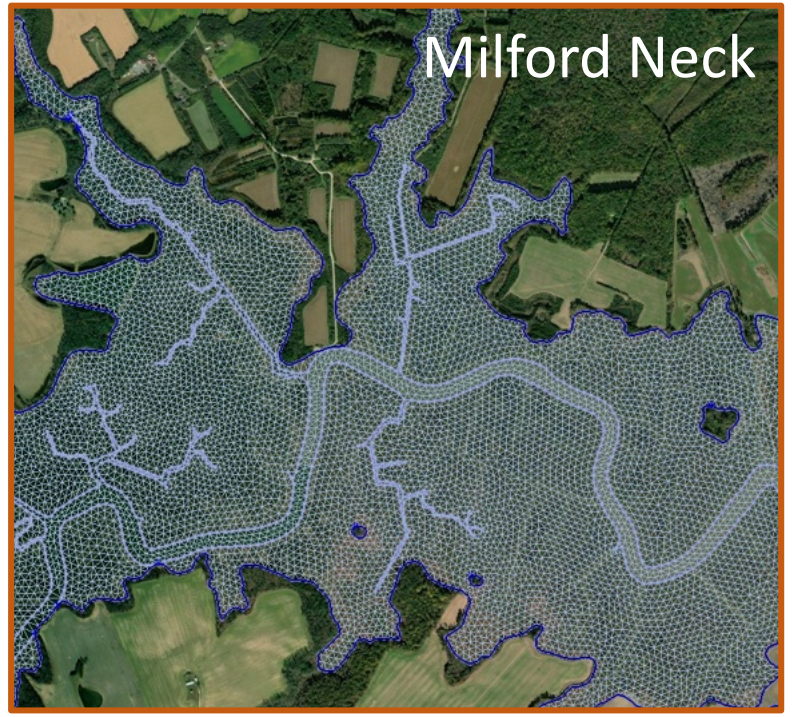




About 100~200 days to spin up in the Chesapeake Bay

# Next step: seamless cross-scale US East Coast domain






Model grid at marshes with distinguished channels and creeks.