Set up multi-tributary models, an example in the Patuxent River

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Virtual

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Annapolis

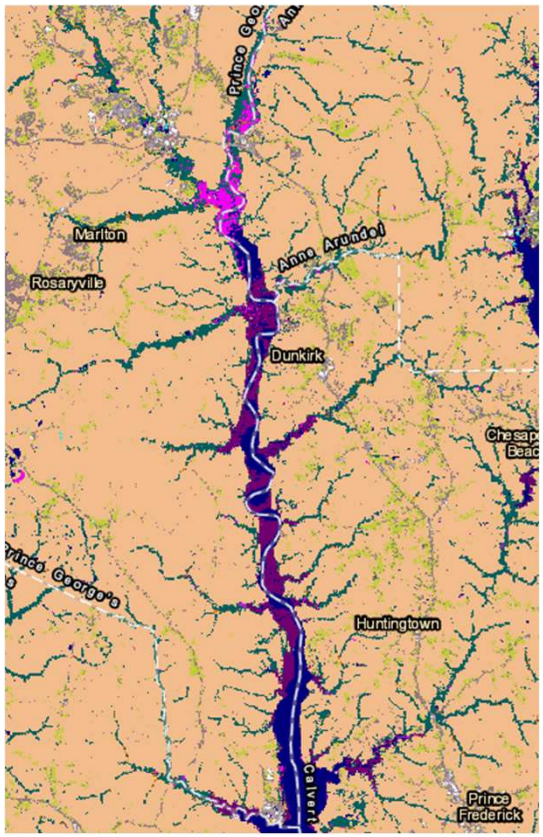
Predicted 6ft surge

No hurricane

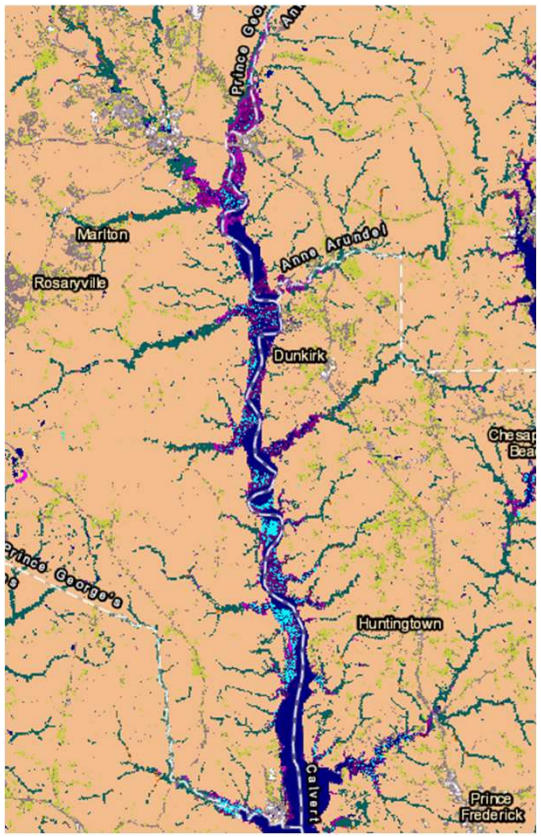
Not SLR

NOAA predicted salt marsh migration up to 10 ft meters of sea level rises, Patuxent River

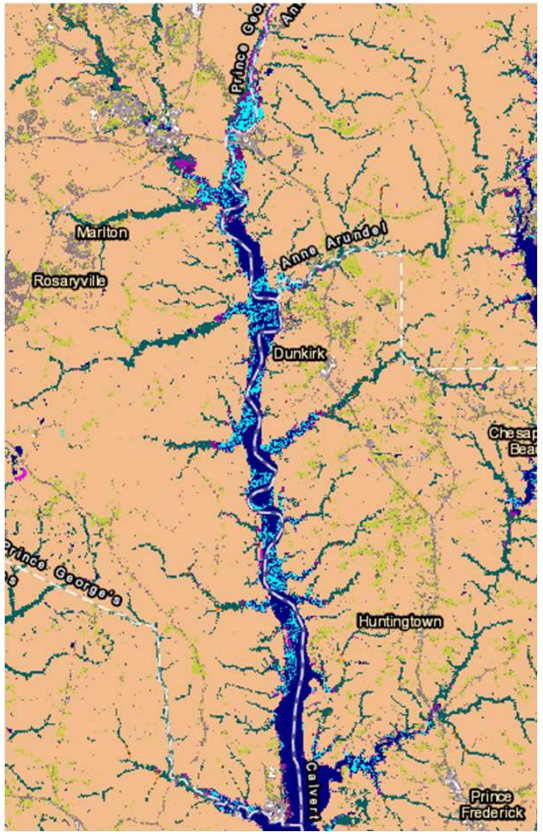
0 ft



1 ft

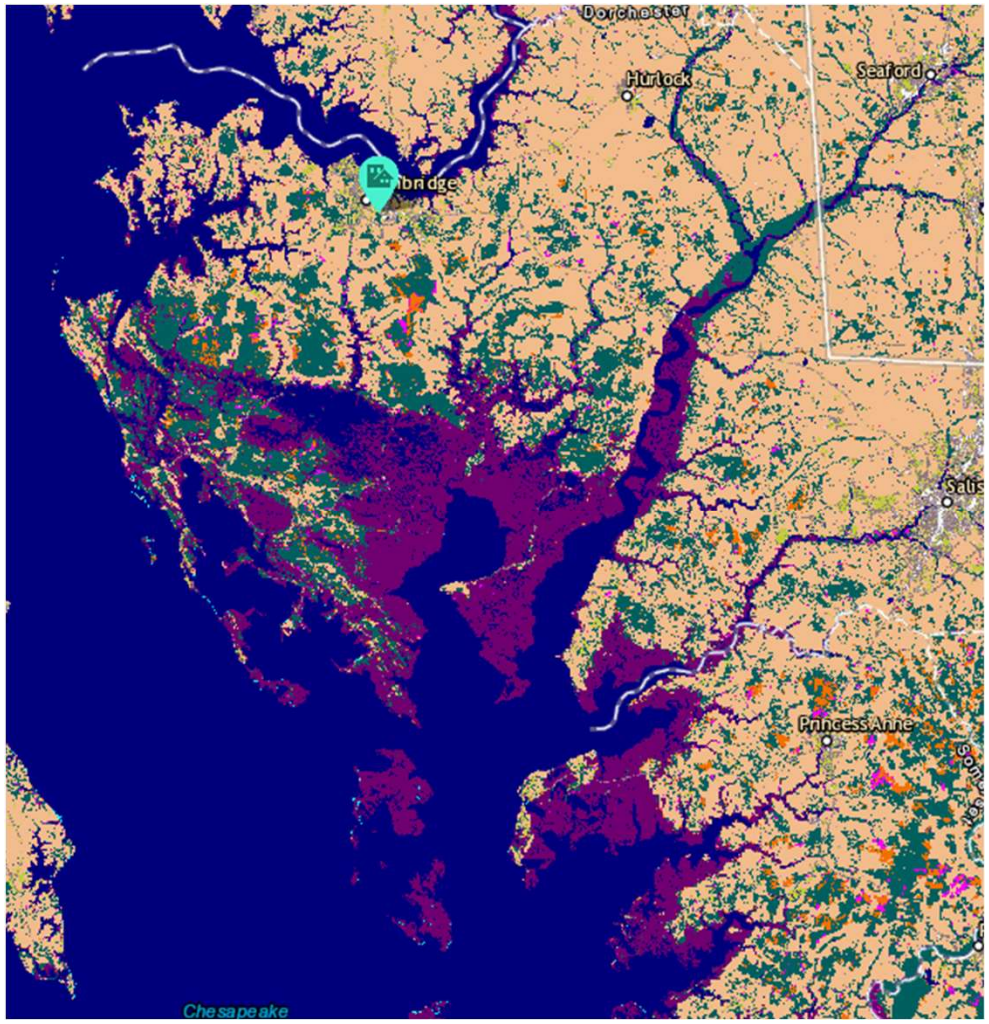


2 ft

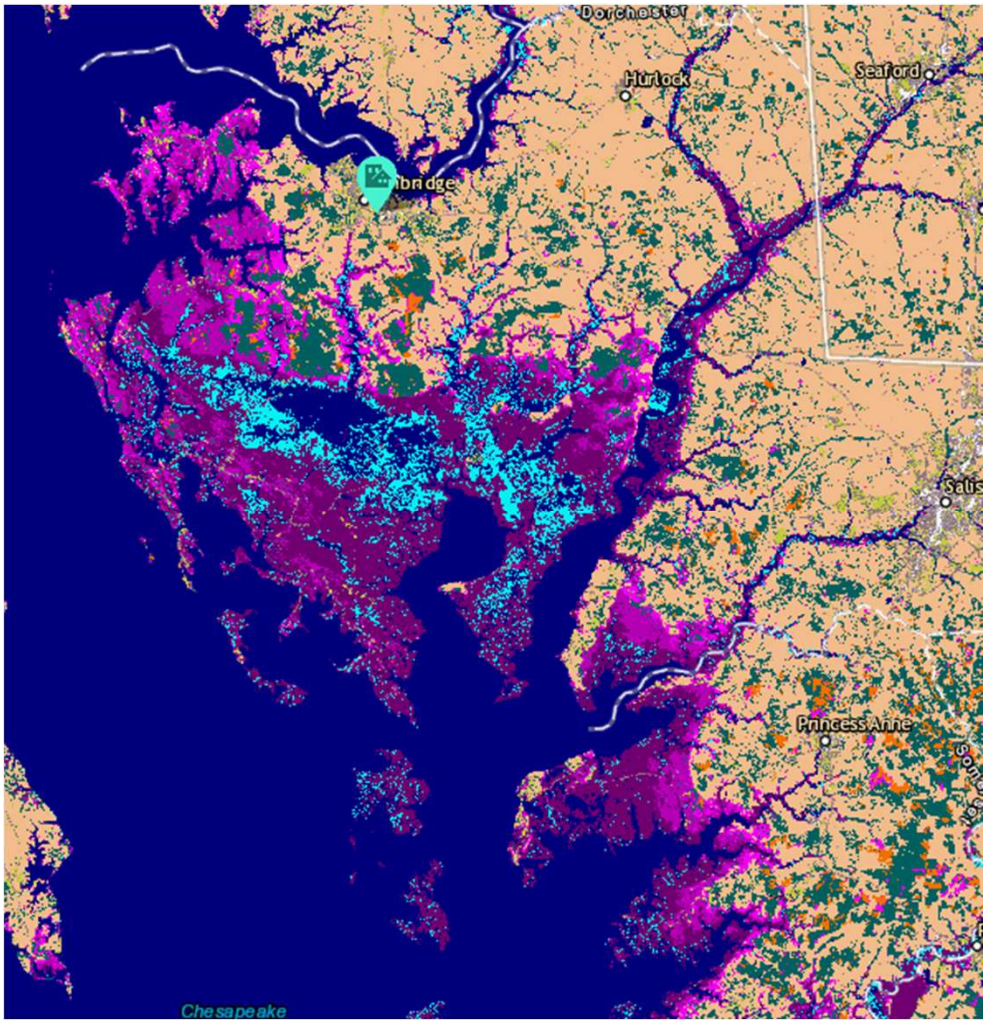


Eastern Shore

Present

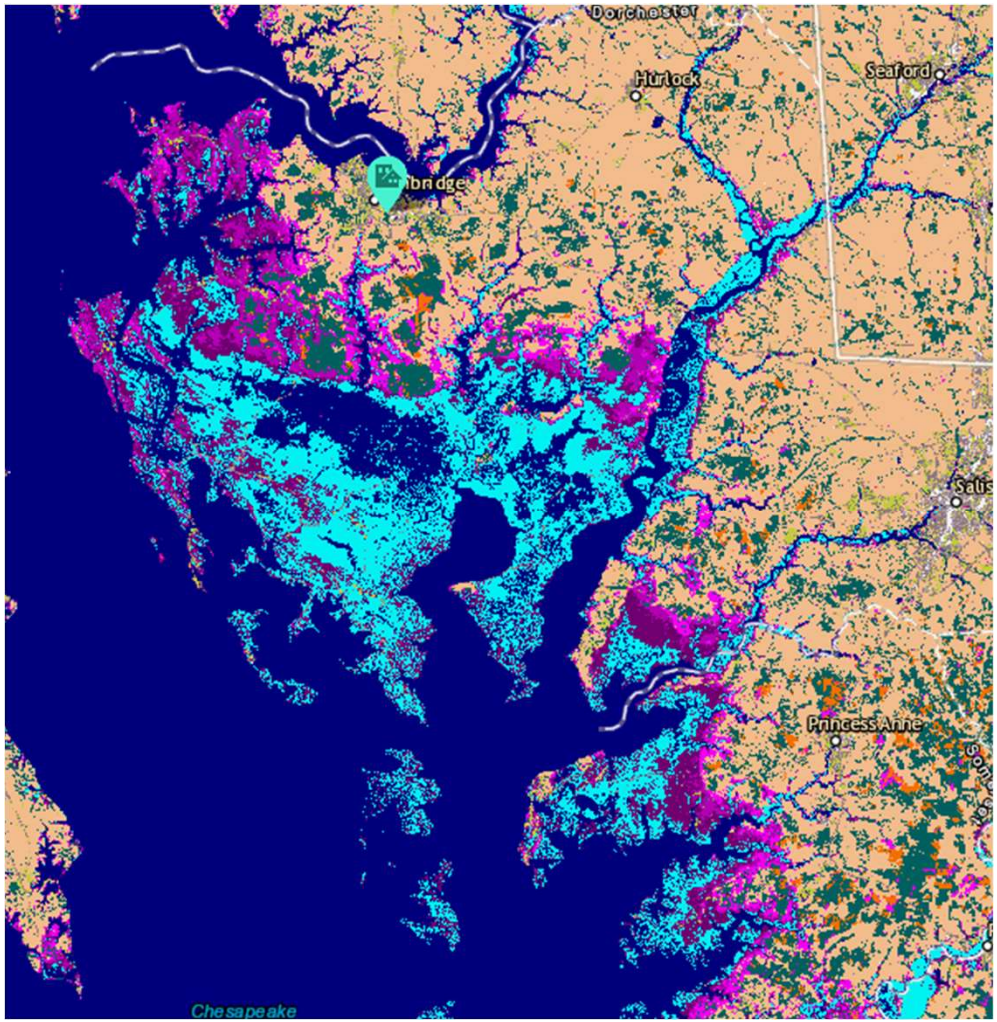


1 ft with 4 mm/yr. acrretion.

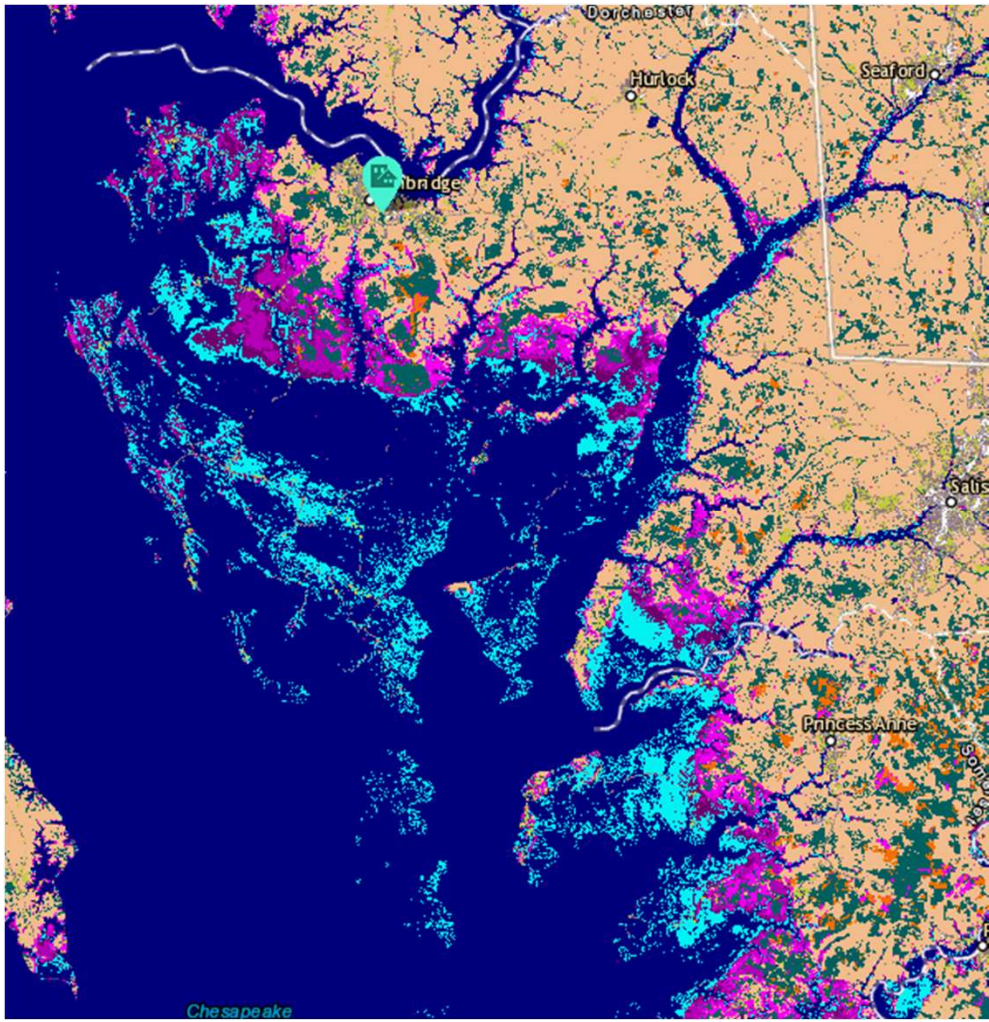


Eastern Shore

2ft



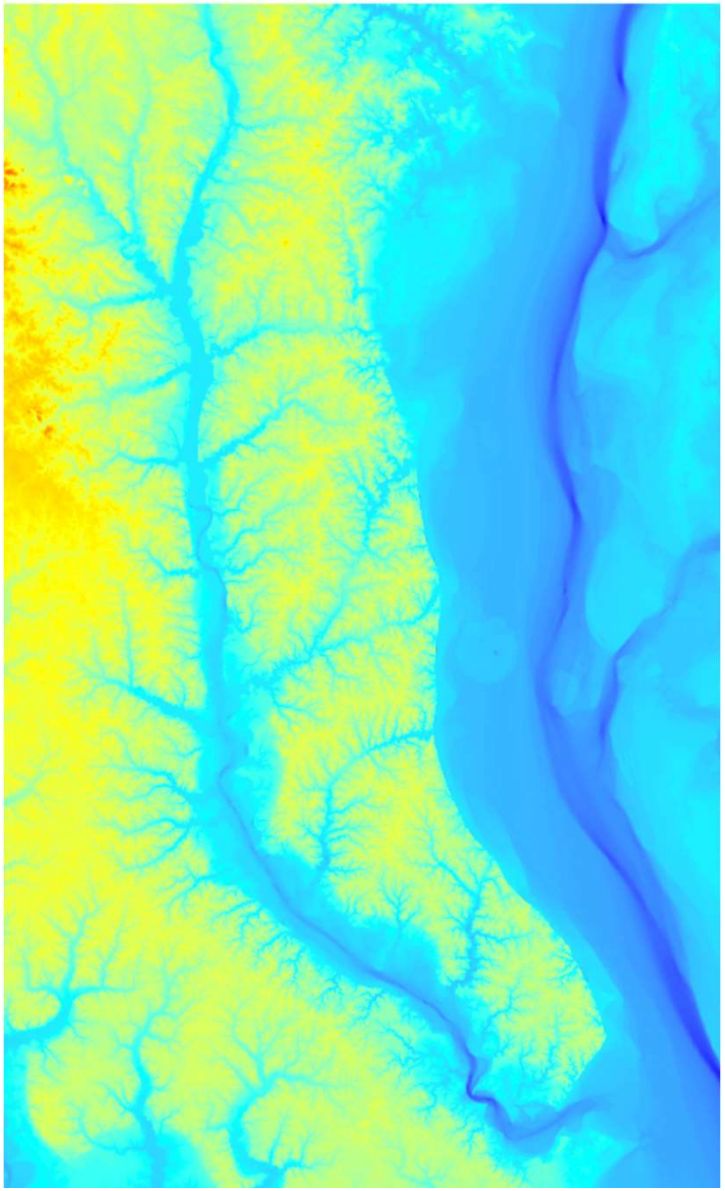
3ft



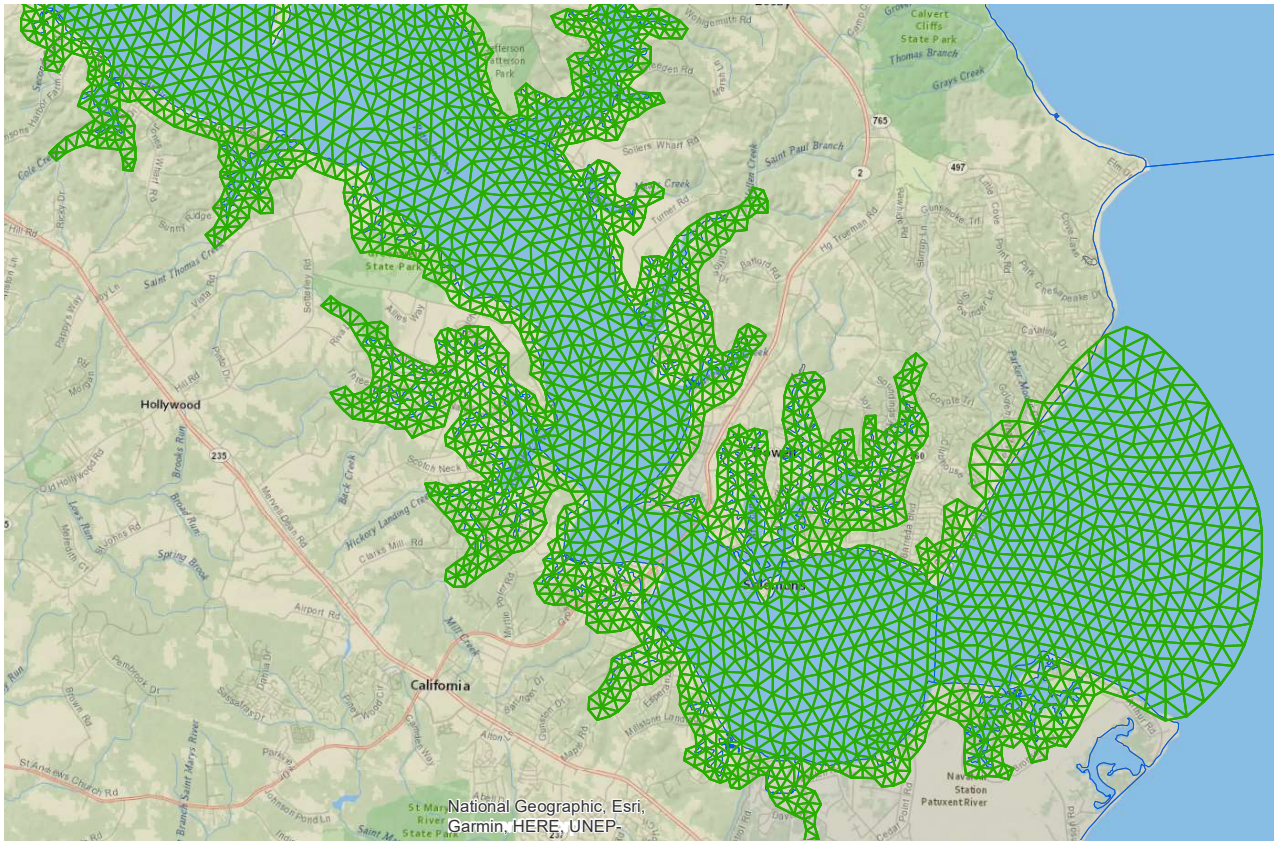
Bathymetry at Patuxent (-50.7 to 116 meters)

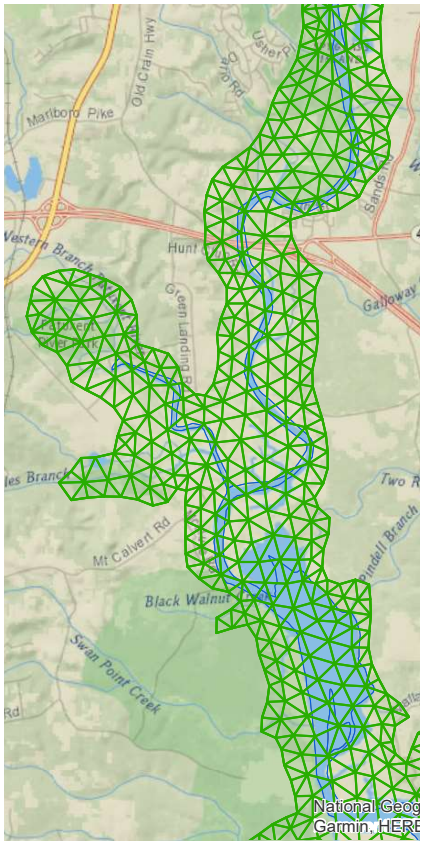
USGS webpage: https://topotools.cr.usgs.gov/topobathy_viewer/dwndata.htm.

To what extent the simulation should go?
A little bit wider does not hurt.
A little bit narrower can lead to regret at some point down the line.



Following NOAA's practice, up to 3m above sea surface.
200 m resolution at the coast, 300m resolution in the main channel and 400 m at the open boundary; 12863 cells vs 205 in CH3D

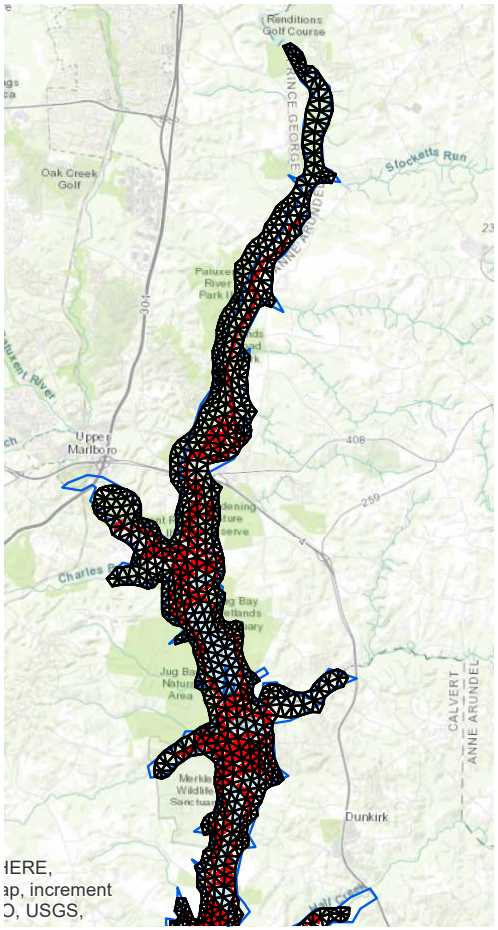




This grid survived three tests without regret.

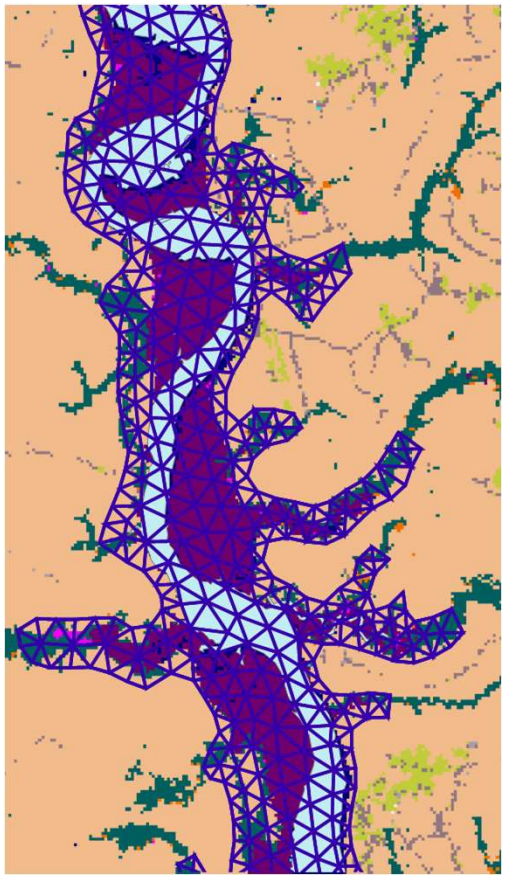
(1) A group of NOAA working on fishery habitat in the Patuxent was satisfied with the simulation domain.

(2) Andy's new coastline.

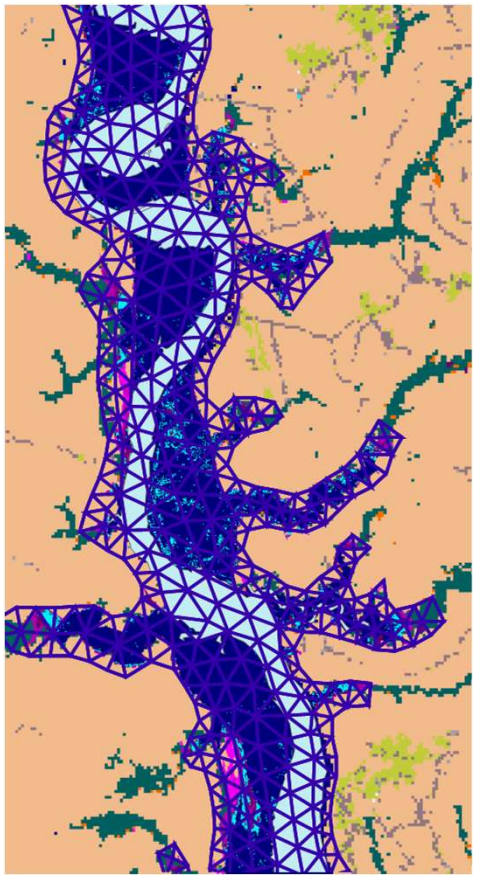


(3) Wetland coverage.

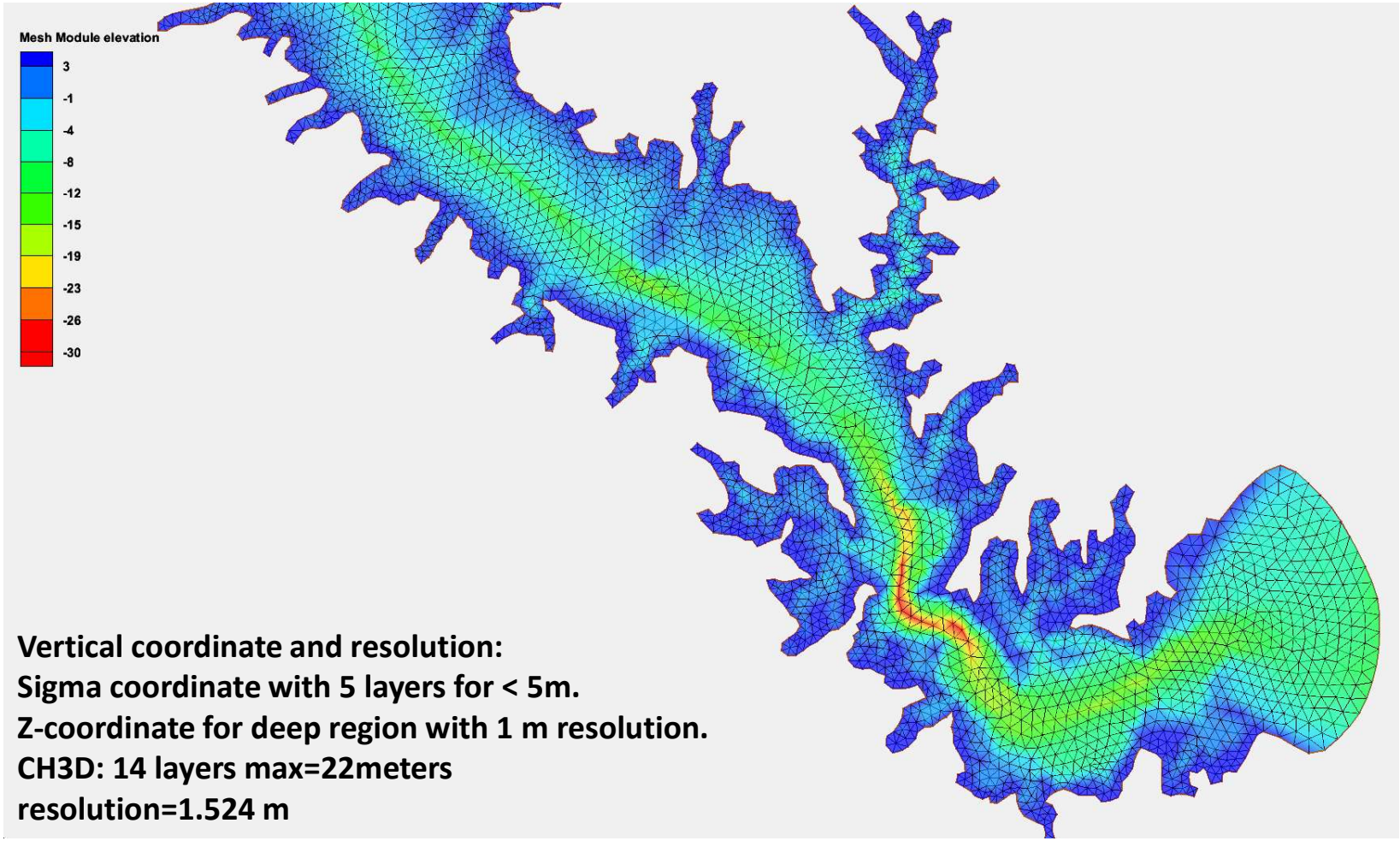
Present tidal wetland



3ft SLR tidal wetland



Bathymetry interpolation using the nearest neighbor method

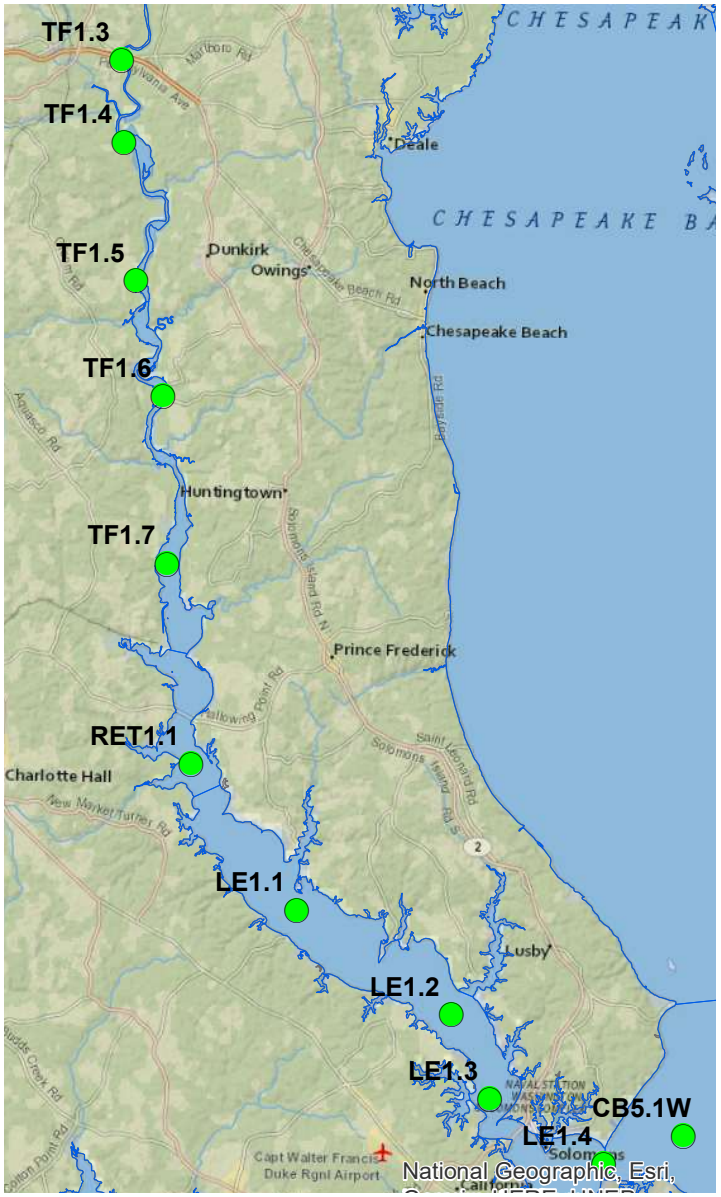


Vertical coordinate and resolution:
Sigma coordinate with 5 layers for < 5m.
Z-coordinate for deep region with 1 m resolution.
CH3D: 14 layers max=22meters
resolution=1.524 m

Preliminary result of T and S 1991

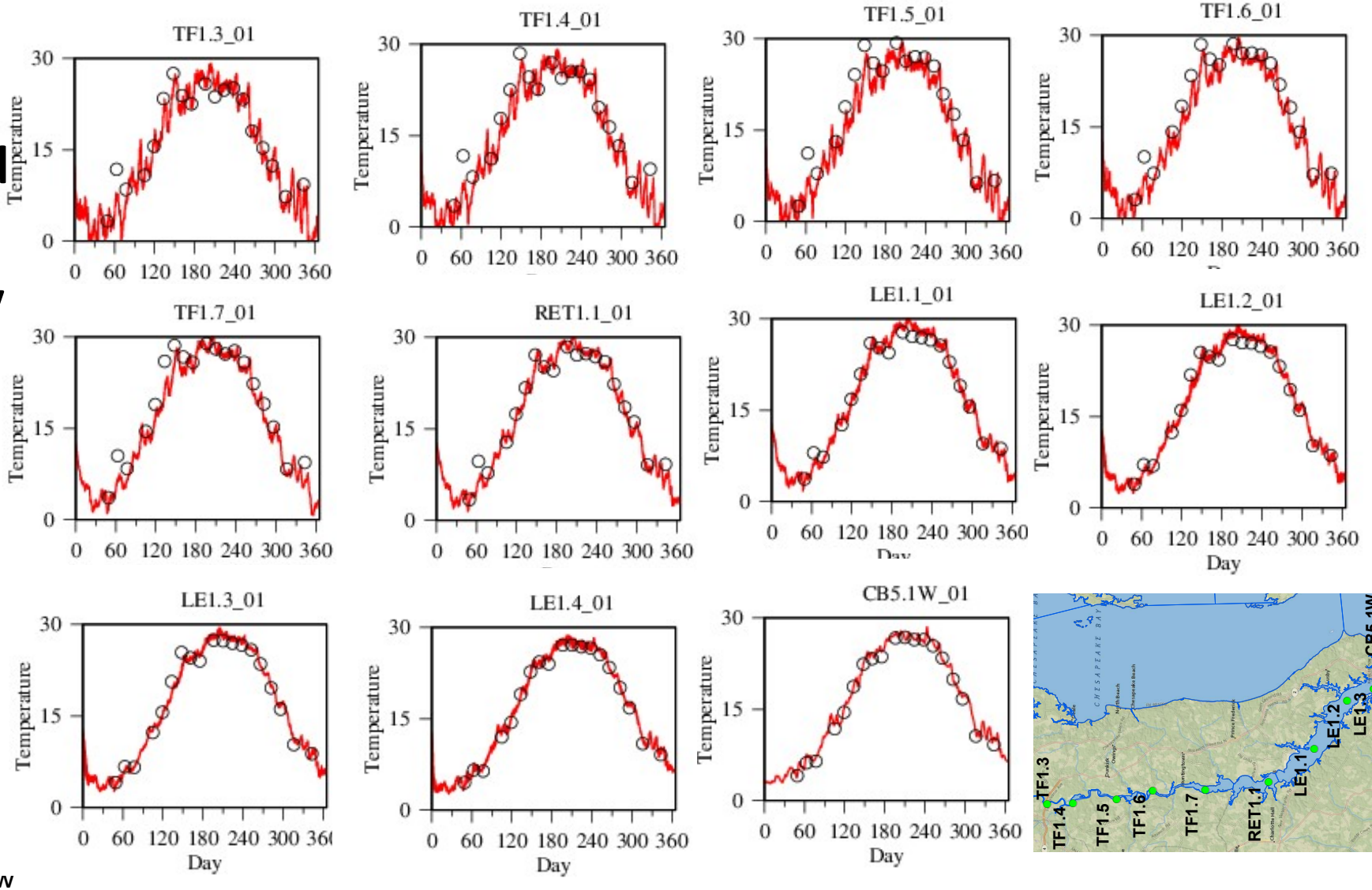
Run 1: Coupled with CH3D

Run 2: Stand alone with open boundary from observation



CH3D-simulated open boundary

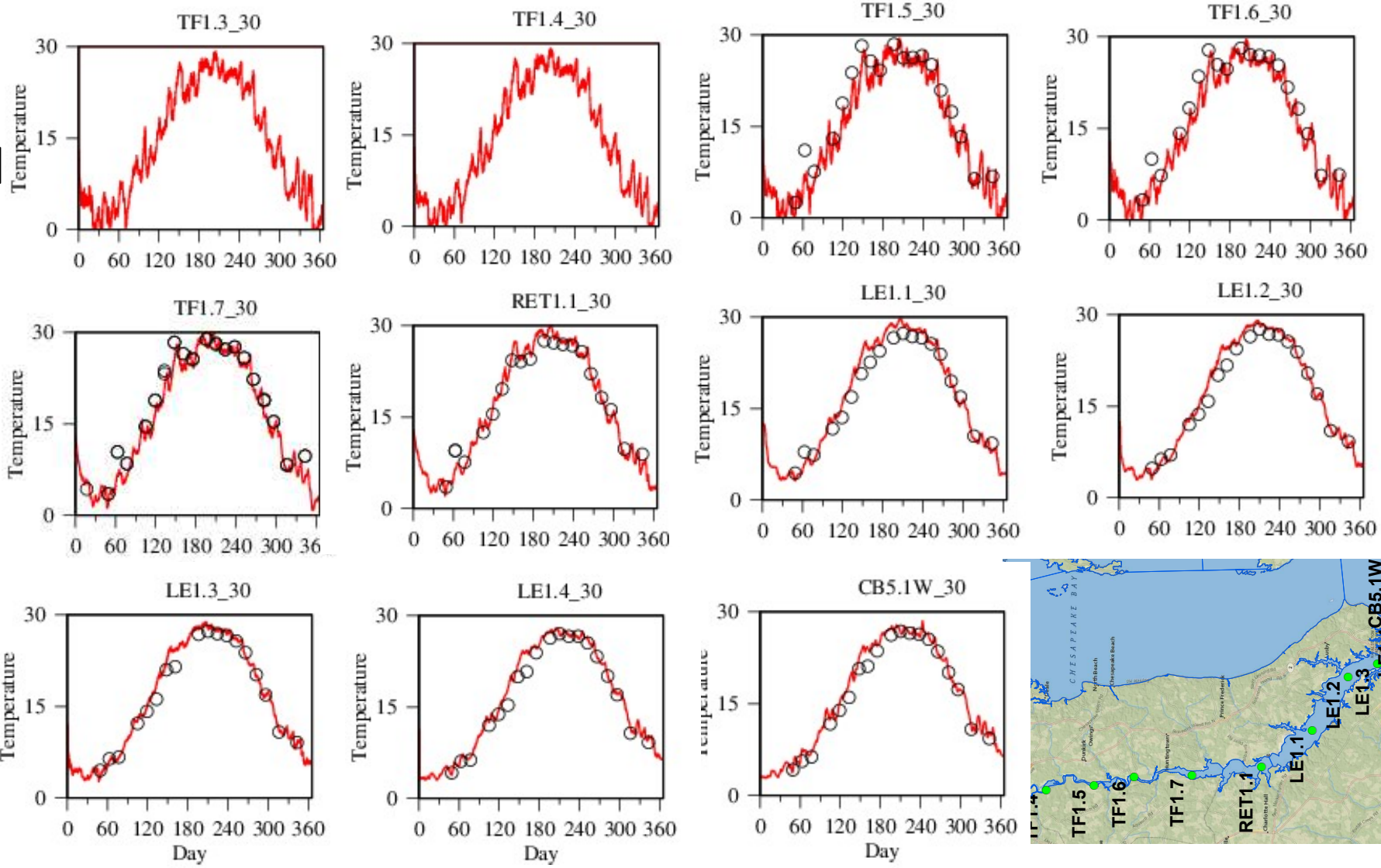
Surface T



20211215CH3Draw

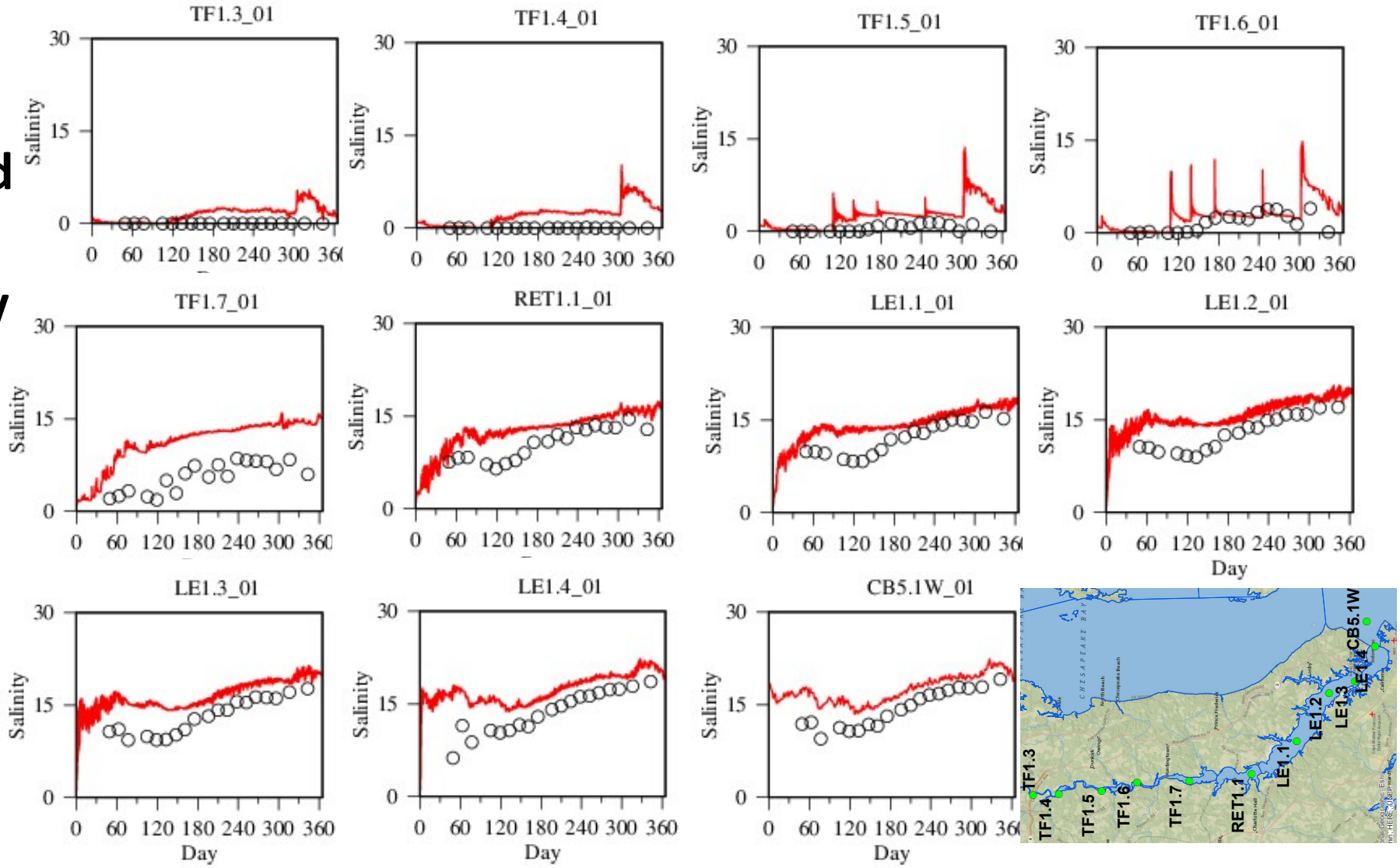
CH3D-simulated open boundary

Bottom T



CH3D-simulated open boundary

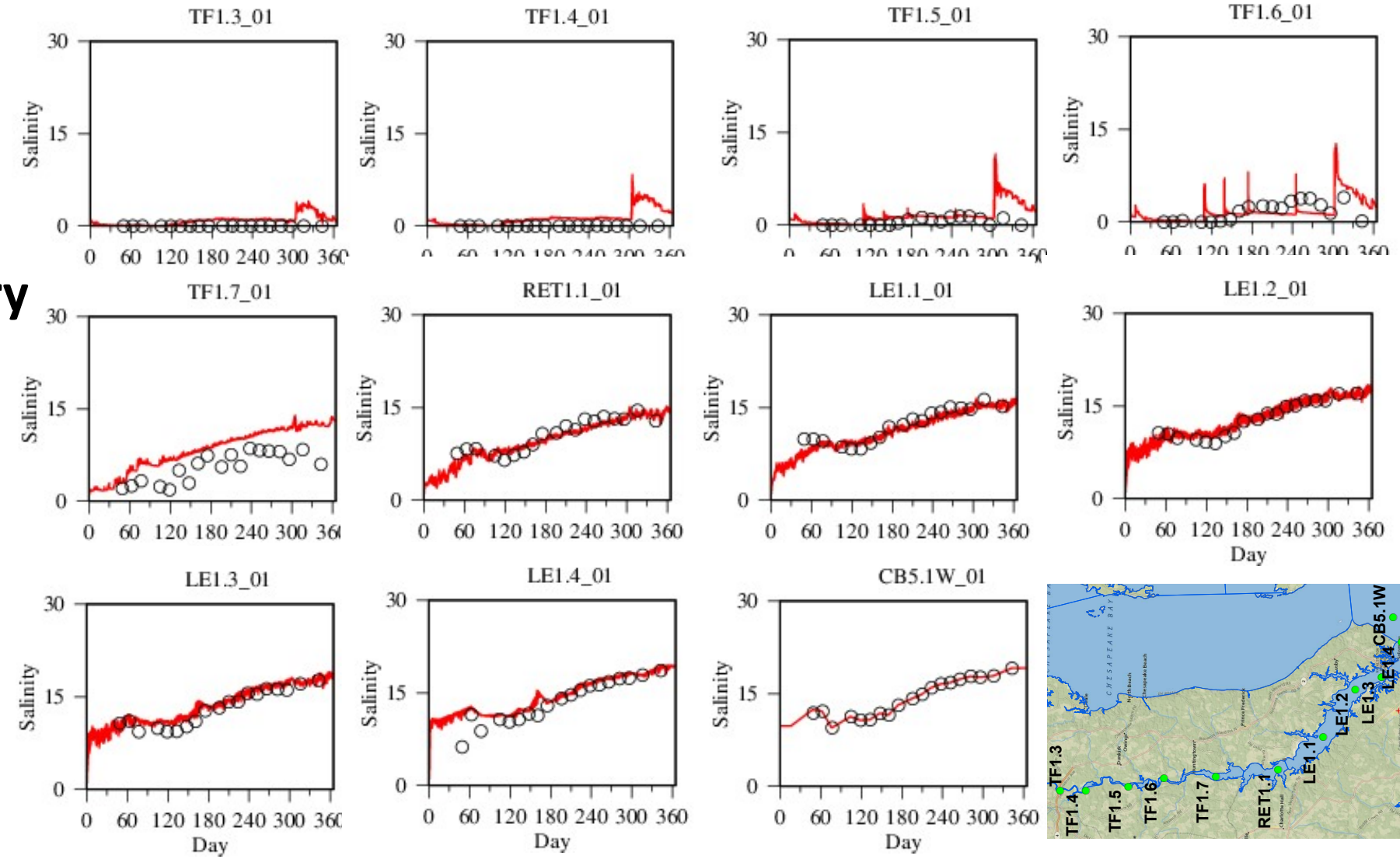
Surface Salinity



20211215CH3Draw

Data-based open boundary

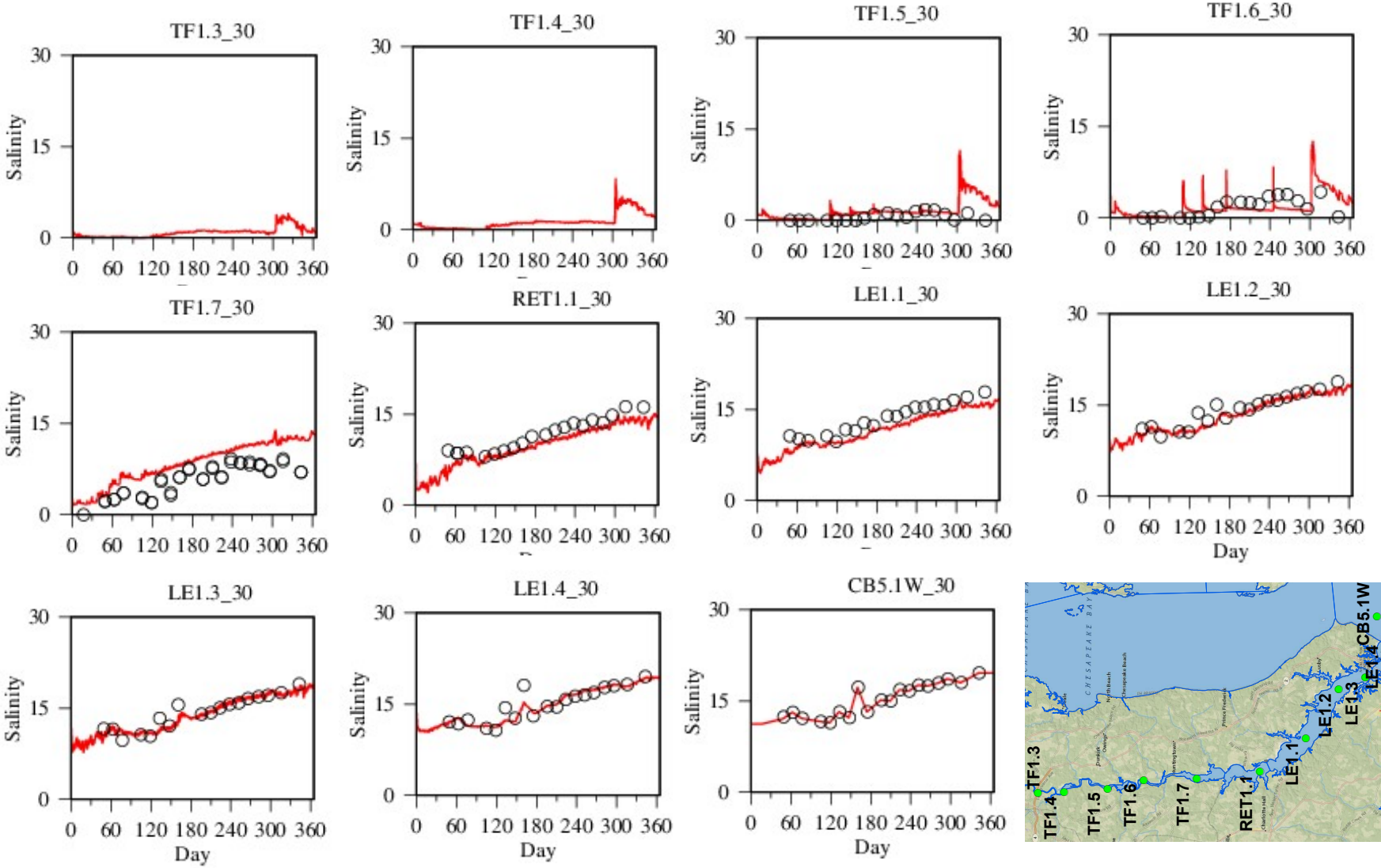
Surface Salinity



20211219

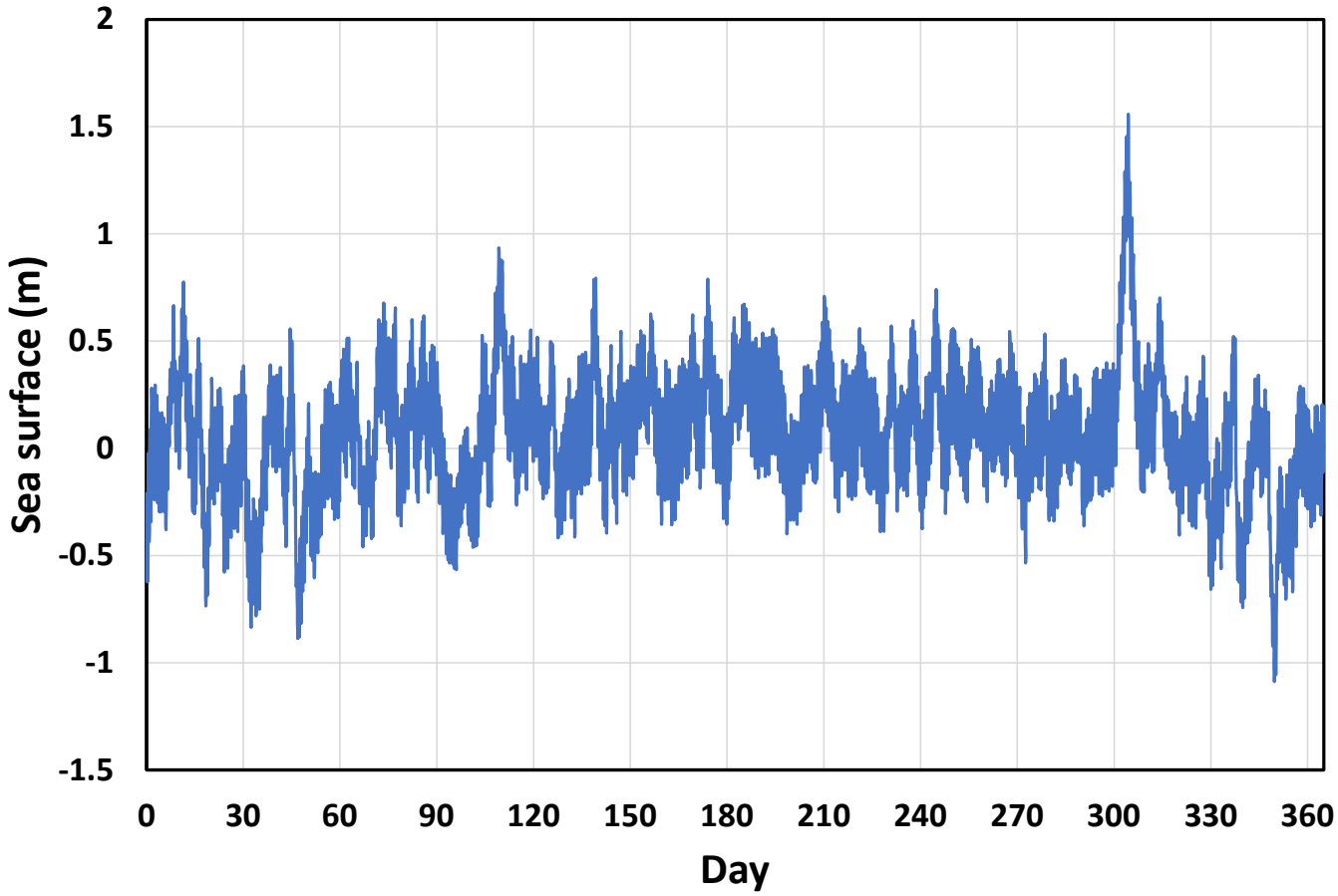
Data-based open boundary

Bottom Salinity



20211219

Boundary sea surface elevation at the Patuxent mouth from CH3D 1991



Summary

- **Simulation domain extended to 3 m above sea surface to cope with sea level rise, salt marsh migration and other potential concerns.**
- **Sigma coordinate with 5 layers in shallow areas (< 5m) and Z-coordinate for deeper region with 1-m resolution in the vertical.**
- **Open boundary close to a monitoring station which can provide boundary conditions in case needed.**