CBP Main Bay Model (MBM) and Multiple Tributary Models (MTMs)

WQGIT Meeting February 26, 2024

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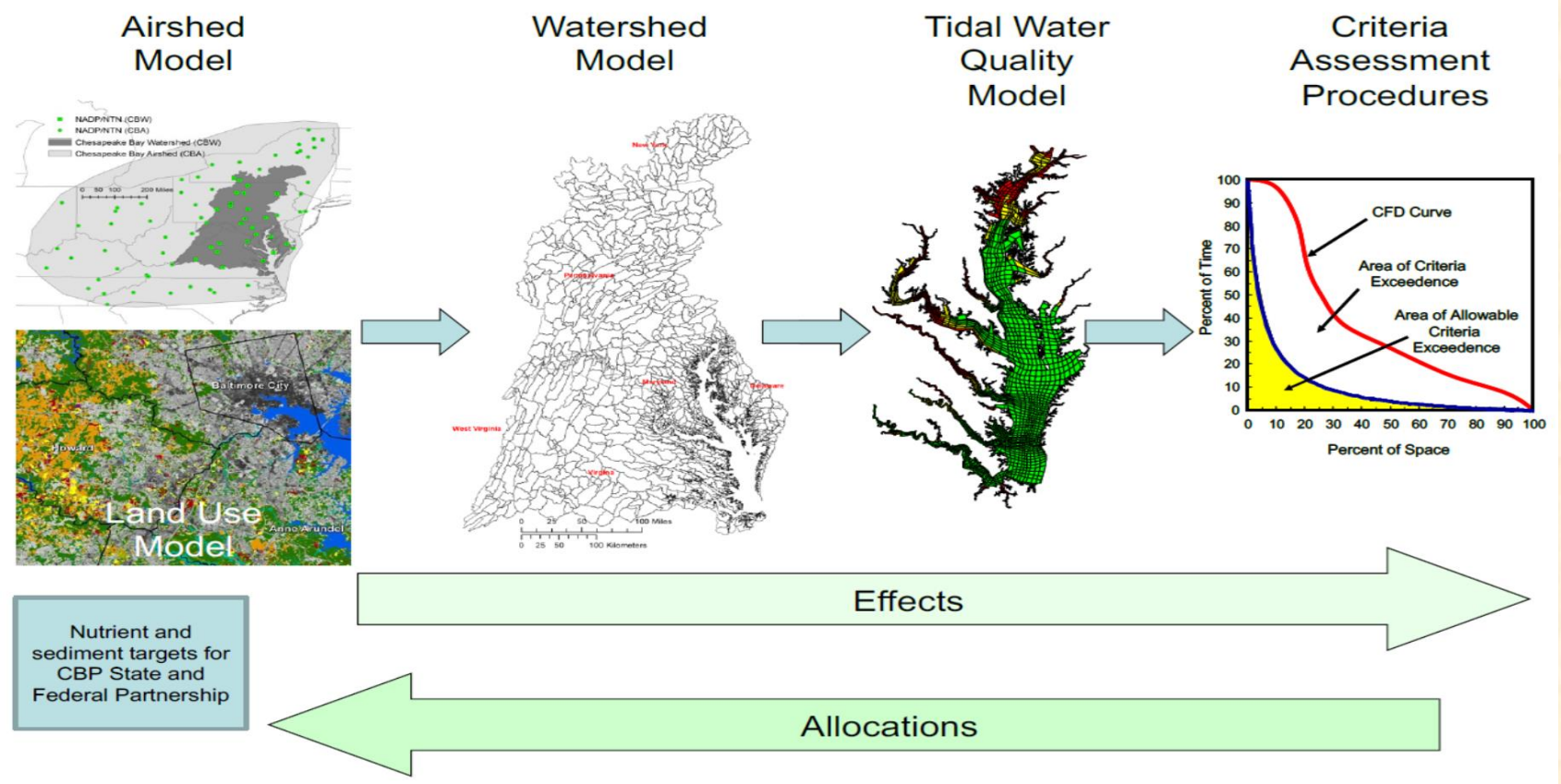

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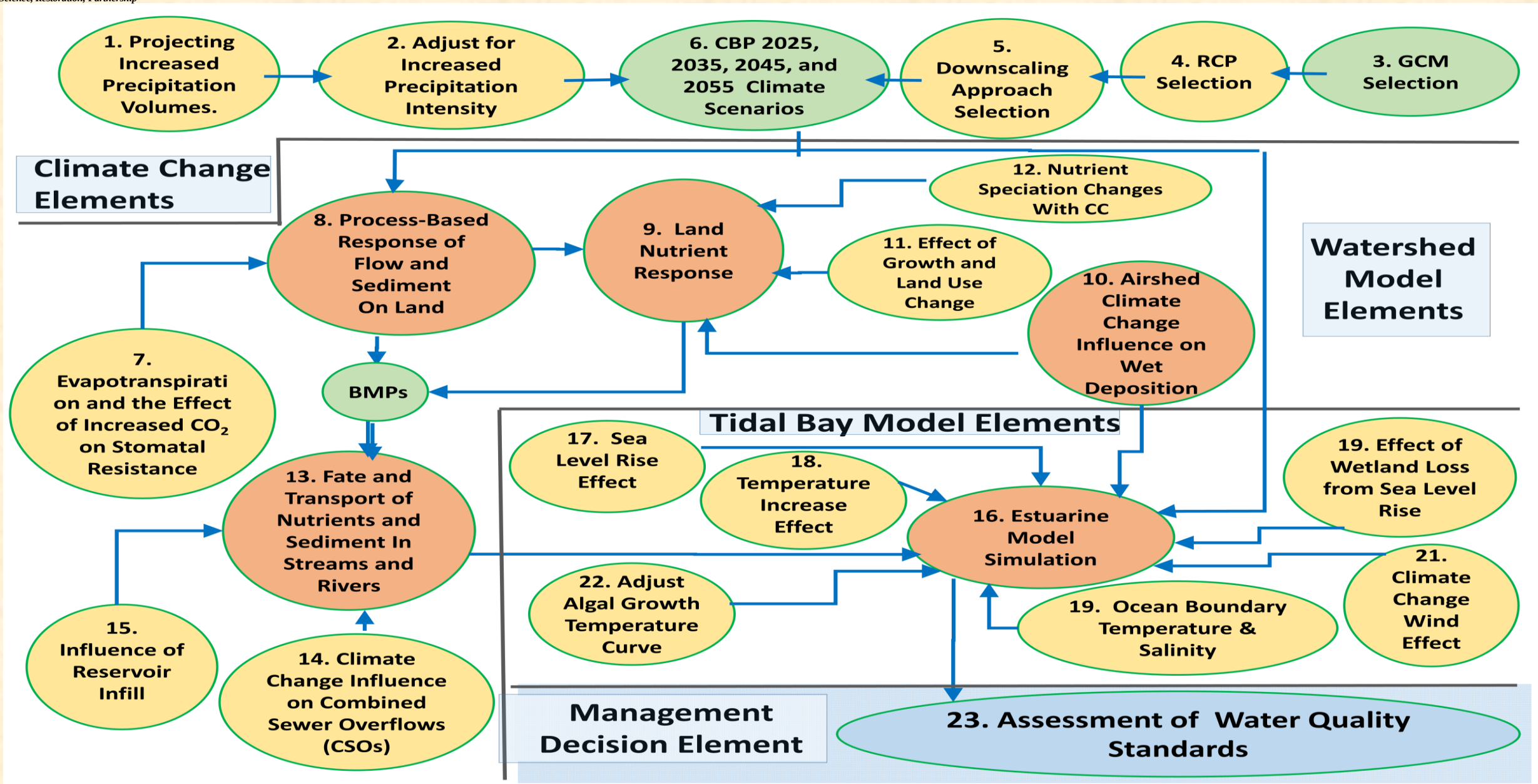
Elements of Chesapeake Water Quality Climate Risk Assessment



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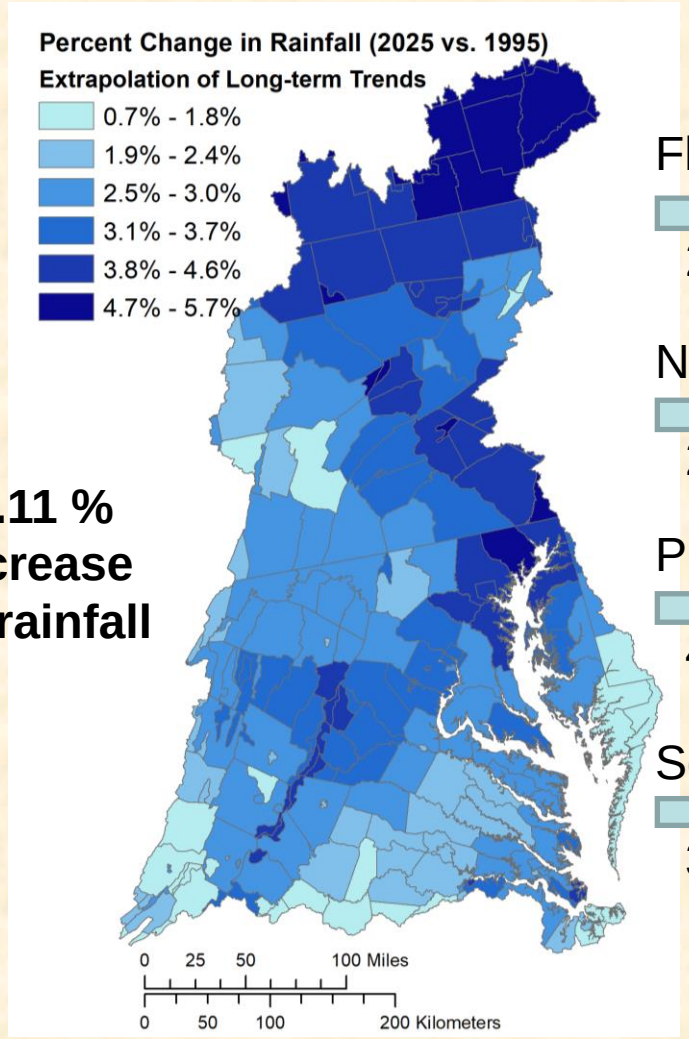
Elements of 2025 Climate Change (1995-2025)



+3.11 % Increase in rainfall

Phase 6 Watershed Model

Flow → 2.4% Increase

Nitrogen Load → 2.6% Increase

Phosphorus Load → 4.5% Increase

Sediment Load → 3.8% Increase

Air-temperature increase: 1.06 °C

Sea Level Rise: 0.22m

Model: CH3D-ICM 400m-1km Resolution

Open boundary: Temperature: +0.95 °C; Salinity: +0.18 psu (Thomas et al., 2017)

Recommendations of STAC's Chesapeake Bay Program Modeling in 2025 and Beyond: A Proactive Visioning Workshop

- Potential future development of the hydrodynamic and biogeochemical models should focus on transition to a hydrodynamic model with an unstructured grid that can provide much greater resolution in the shallow tributaries of the Bay.
- The current living resource simulation in the CBP water quality model, which includes submerged aquatic vegetation (SAV) and oysters, should continue to be developed with the goal of improving these models.
- The CBP partnership models should strive to provide outputs related to local ecosystem services and economic impacts that are of direct interest to local stakeholders.

Hood, R.R., G. Shenk, R. Dixon, W. Ball, J. Bash, C. Cerco, P. Claggett, L. Harris, T.F. Ihde, L. Linker, C. Sherwood, and L. Wainger. 2019. Chesapeake Bay Program Modeling in 2025 and Beyond: A Proactive Visioning Workshop. STAC Publication Number 19-002, Edgewater, MD. 62 pages.

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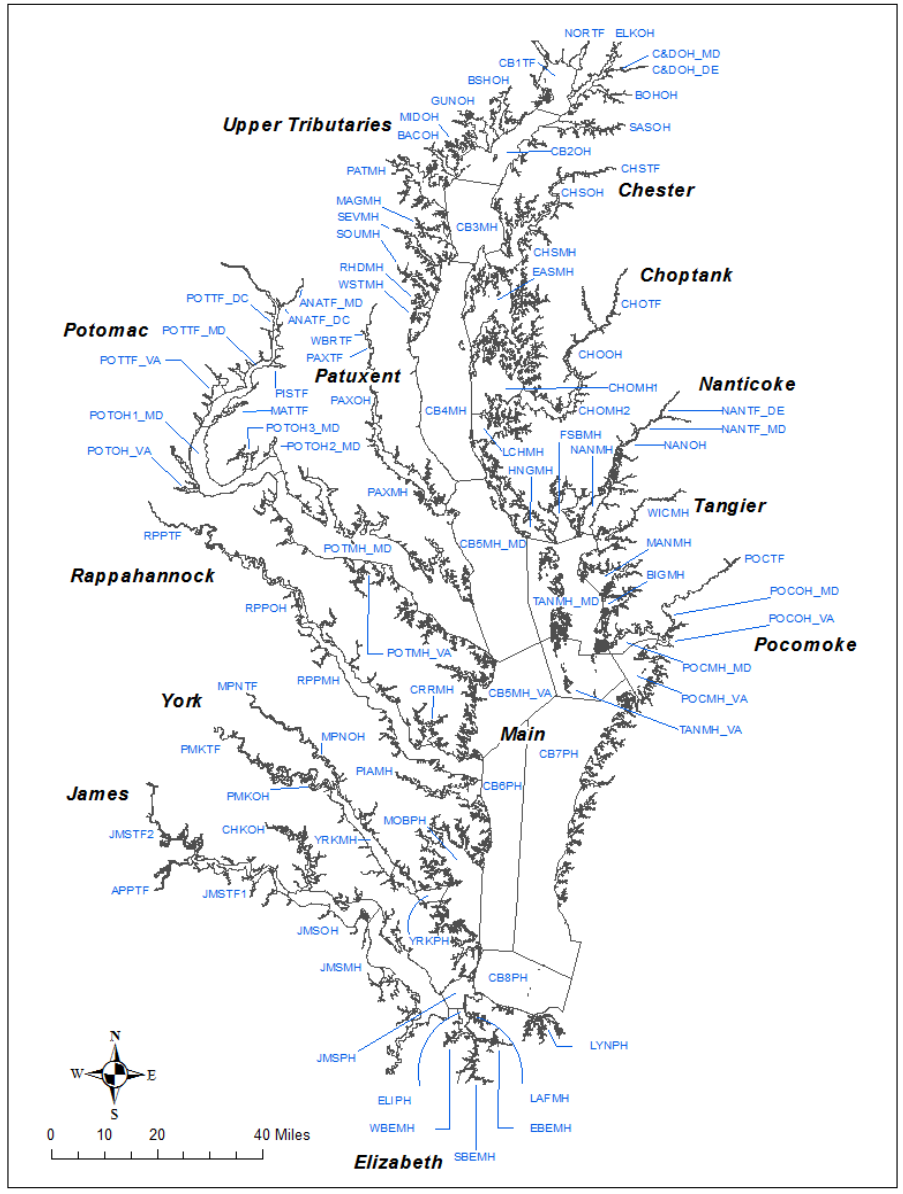
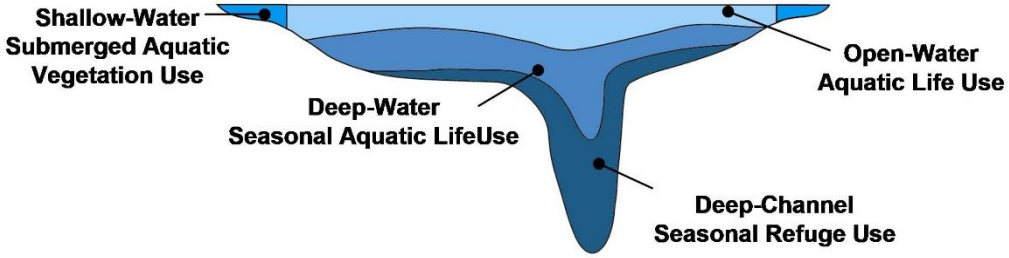
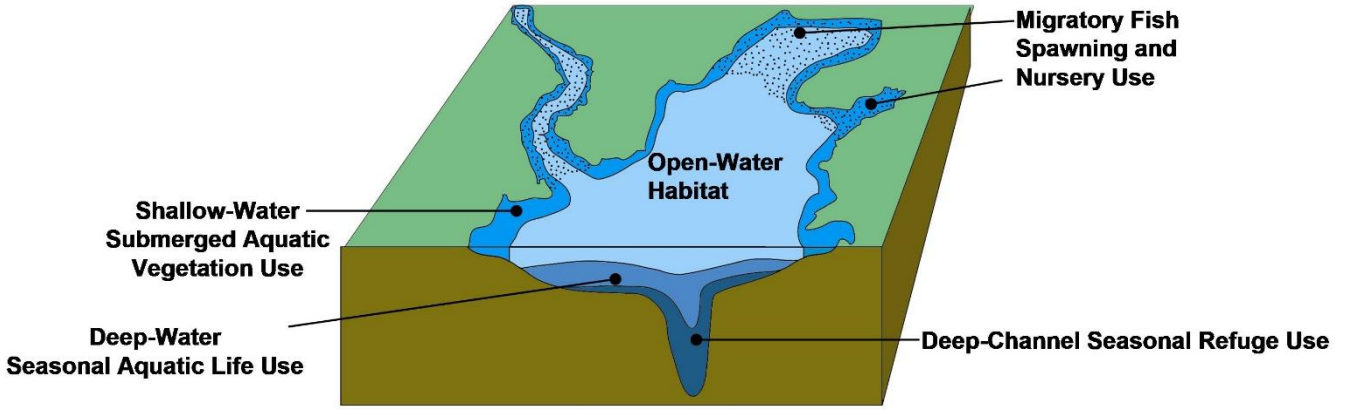
Overview of Bay Designated Uses



A. Cross Section of Chesapeake Bay or Tidal Tributary

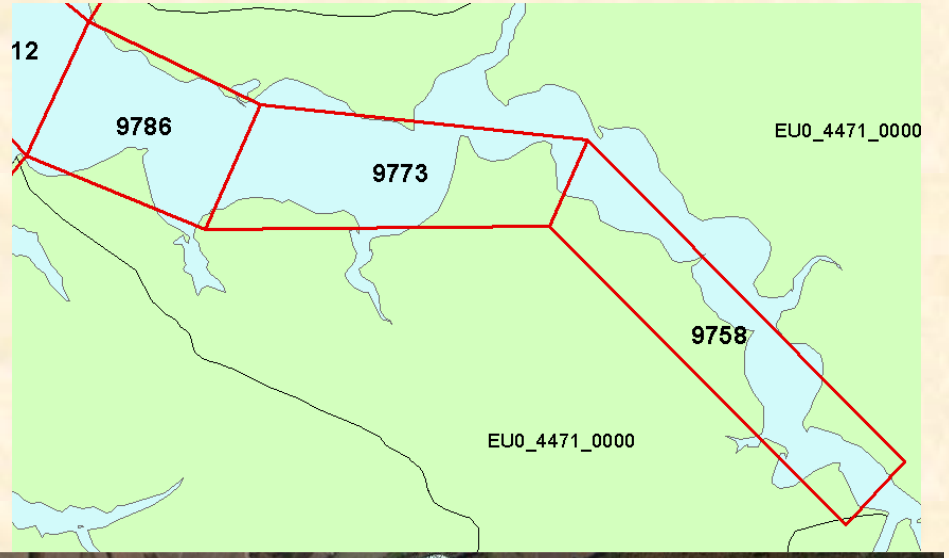


B. Oblique View of the "Chesapeake Bay" and its Tidal Tributaries



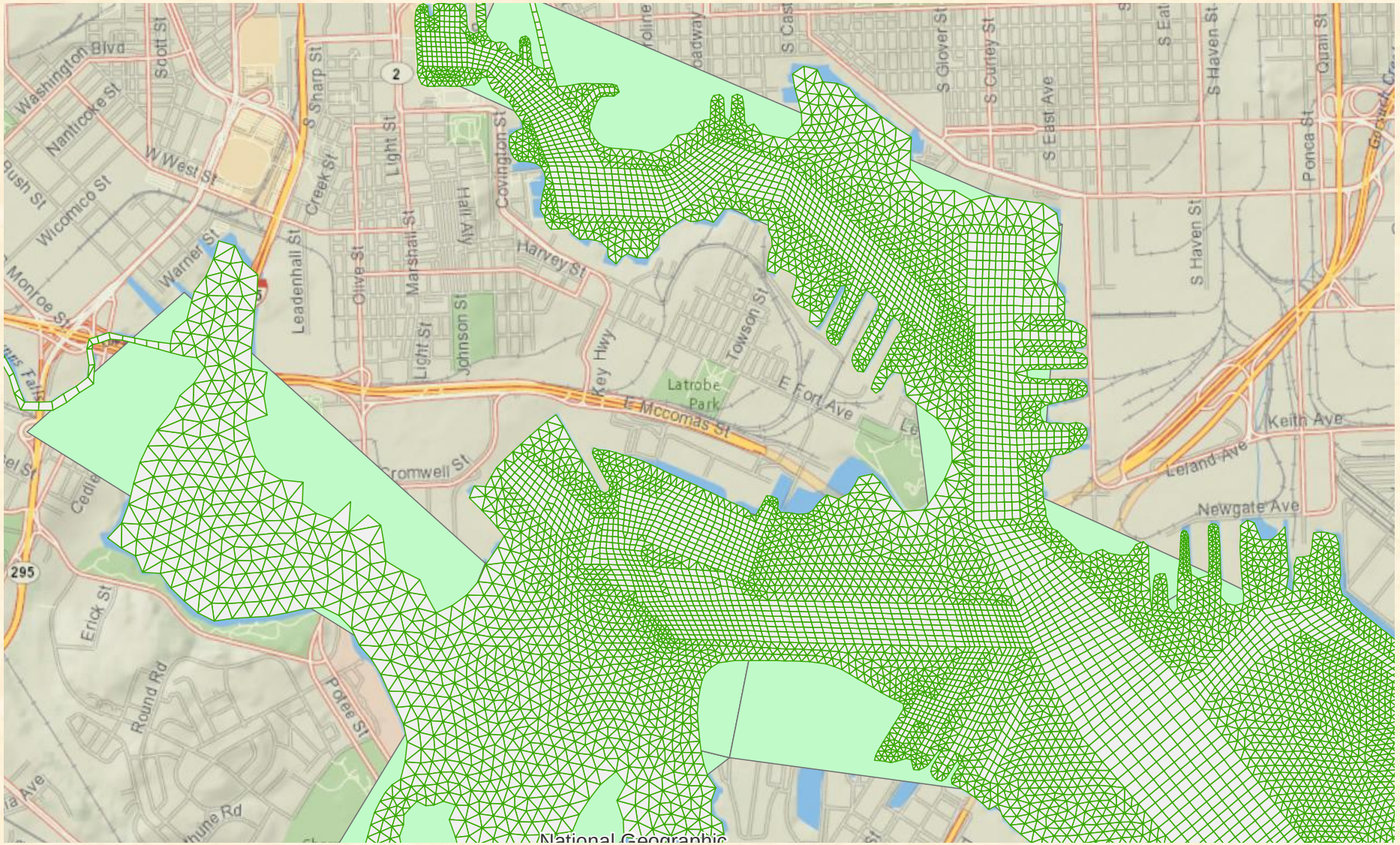
Improved Assessment of Shallow Water Processes: Corsica Test Bed Model

The 2017 Bay Model had a three segment Corsica River. The Corsica River Shallow Water Test Bed for the MBM and MTMs has 5,029 cells with up to 20 m resolution and 5 sigma layers of depth giving the CBP the type of scale needed to simulate sallow water processes.

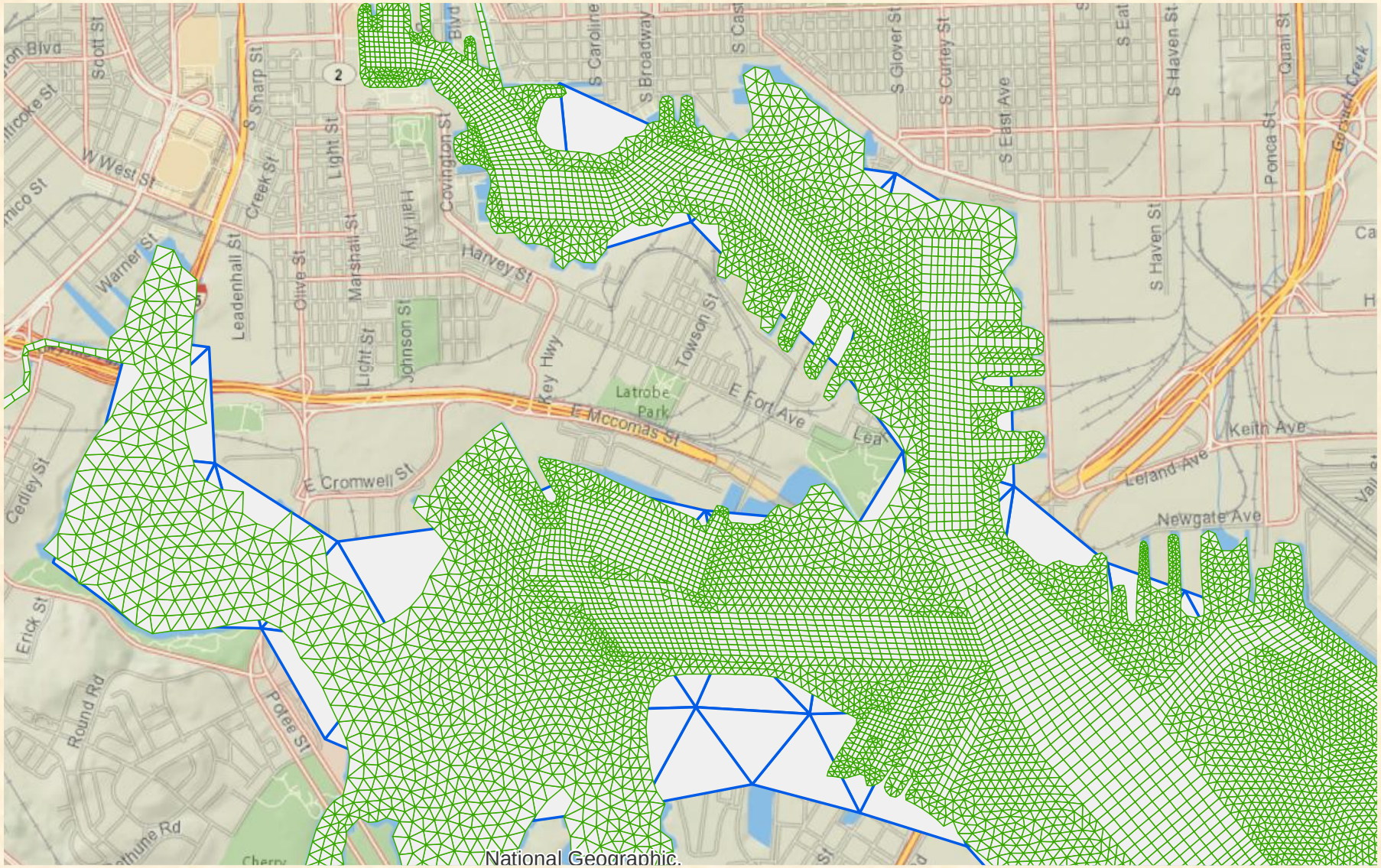


The Watershed Model loading to the Corsica River in 2017 was on an order of a 30 square mile watershed that in Phase 7 will be quantified at about a one square mile watershed.

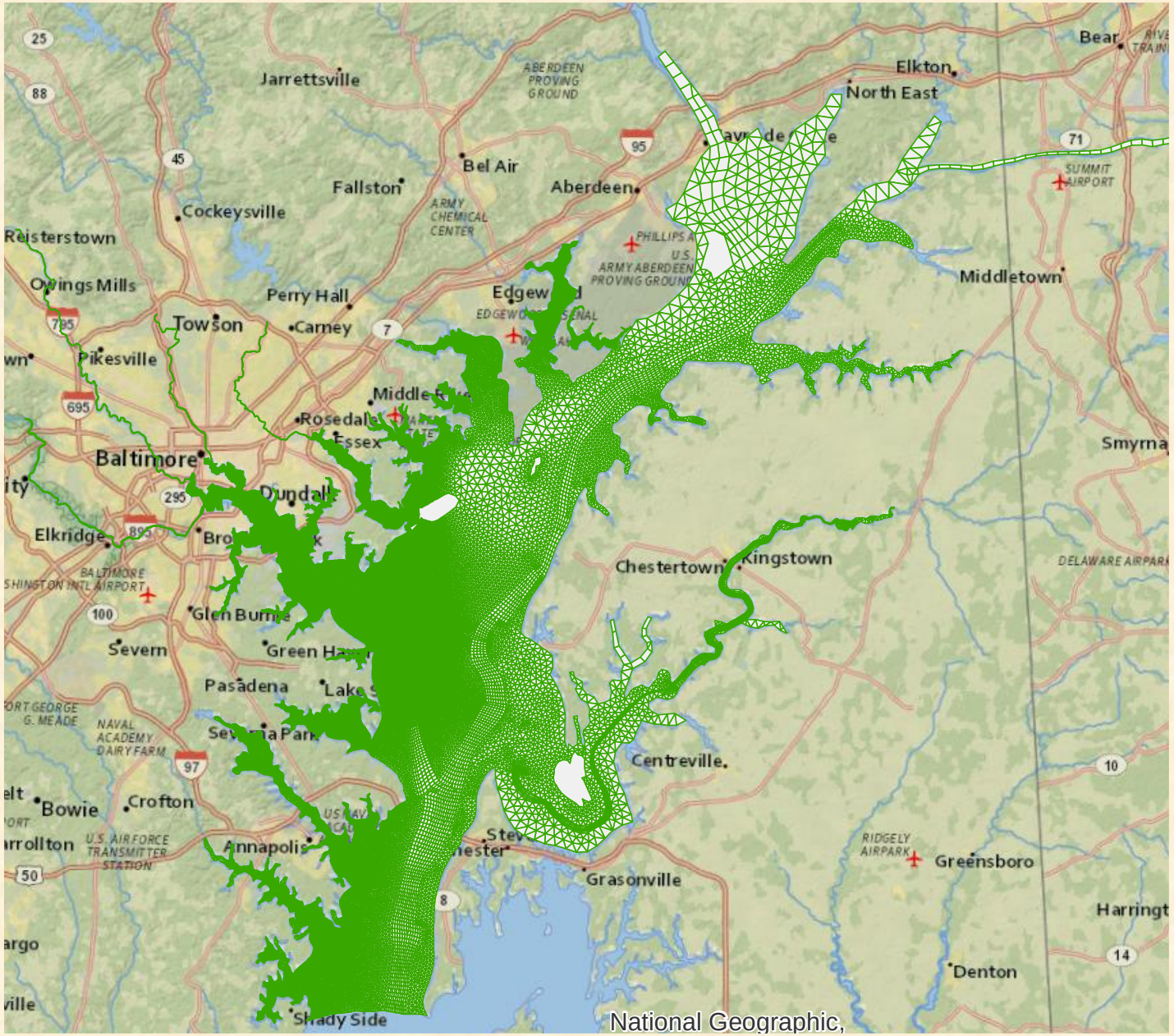
The Corsica Model Test Bed has demonstrated the importance of tidal wetlands, benthic algae, and fine scale hydrodynamics to shallow water quality.



Large quadrilateral cells are CH3D grid



Blue lines are MBM grid



National Geographic,

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Summary of MBM and MTM Advantages

1. Nitrogen, phosphorus, and sediment loads delivered to tidal Bay waters that are scaled appropriately to respond to 2035 and future climate change conditions allowing development of plans to achieve Bay water quality standards in all 93 TMDL designated uses (Bay Segments).

2. Improved estimates of the amount of habitat restored as represented by achievement of the Chesapeake living-resource-based water quality standards, shallow water simulation, and direct simulation of oysters, SAV, and other linkages to higher trophic levels.

4. Improved CBP decision making and leadership in responding to future climate change conditions through a flexible MBM-MTM modeling framework.

5. Providing improved community model and analysis tools to serve both scientific community and stakeholders by supporting a large user community (many eyes).

6. Training of next-generation scientists including graduate students in Bay ecology, hydrodynamics, and biogeochemistry toward increasing scientific capacity for environmental problem solving in the region, by leveraging the education capacity in PIs' home institutes (many hands).