

Phase 7 Main Model and Multiple Tributary Models of the Chesapeake Bay

Water Quality Goal Implementation Team

March 23, 2026

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Chesapeake Bay Program
Science, Restoration, Partnership



Clean Water Act as Amended Section 117 (b)(2)(B)

“(B) FUNCTION. -- The Chesapeake Bay Program Office shall ...

(i) [implement and coordinate] science, research, modeling, support services, monitoring, data collection, and other activities that support the Chesapeake Bay Program;

(iii) [assist] the signatories to the Chesapeake Bay Agreement in developing and implementing specific action plans [to]...

(I) improve the water quality and living resources in the Chesapeake Bay ecosystem;”

CBP Modeling provides the tools to make the plans to “improve the water quality and living resources in the Chesapeake Bay ecosystem.” The Phase 7 Models are the latest development of a long line of watershed, airshed, and estuarine models.





Modeling Workgroup & Modeling Team Core Values

The Modeling Workgroup and Team provides the Chesapeake Bay Program partnership state-of-the-science decision-support modeling tools that are built through community and participatory principles. The Modeling Team and Modeling Workgroup adhere to the core values of:

Integration - Integration of most recent science and knowledge in air, watershed, and coastal waters to support ecosystem modeling for restoration decision making.

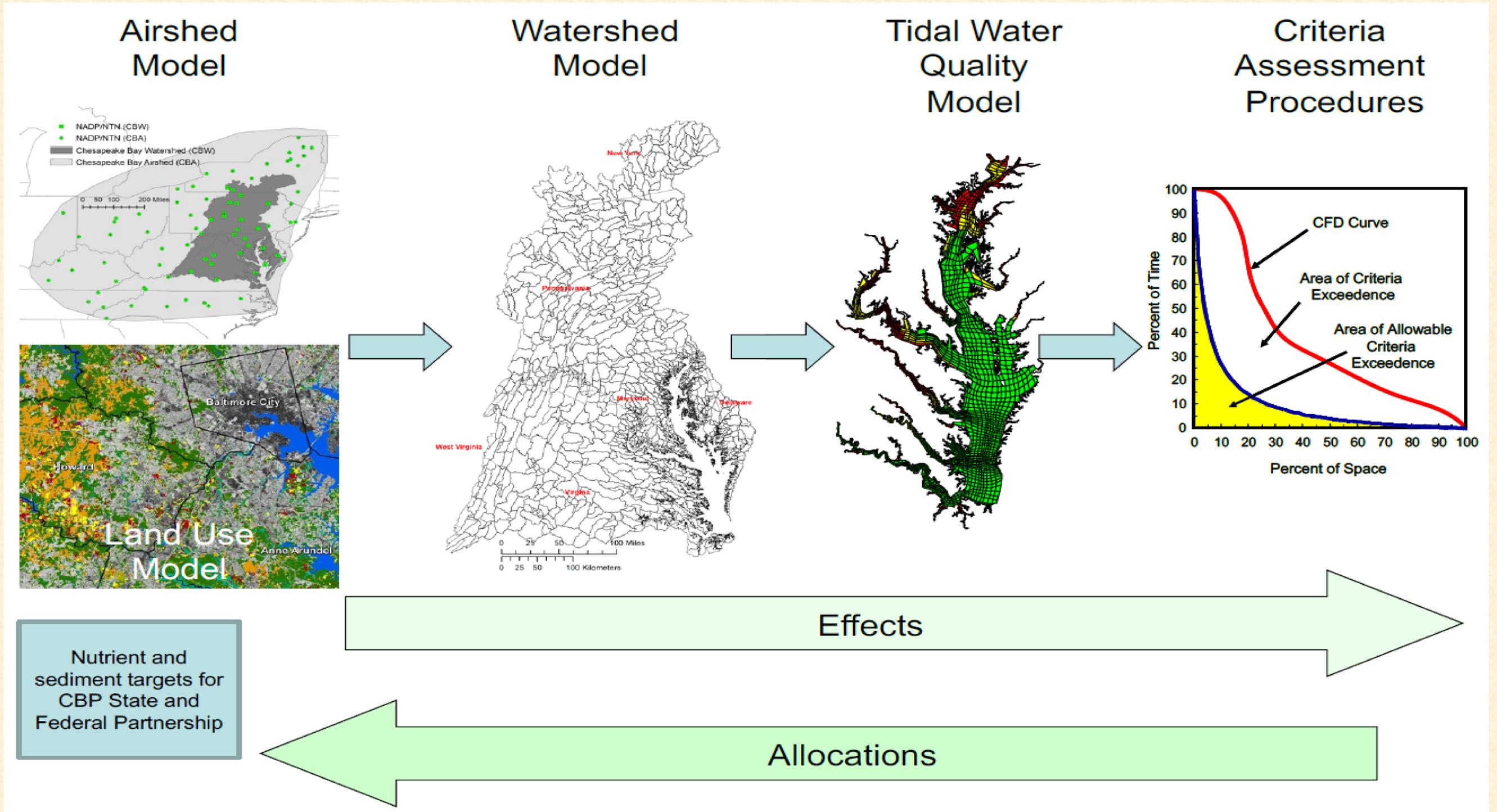
Innovation - Embracing creativity and encouraging improvement in the development and support of transparent and robust modeling tools.

Independence – Making CBP modeling decisions on the basis of best available evidence and using the most appropriate methods to produce, run, and interpret models, independent of policy considerations.

Inclusiveness - Commitment to an open and transparent process and the engagement of CBP partners that results in strengthening the Partnership's decision-making tools.



How the CBP Makes a Plan – Broad View



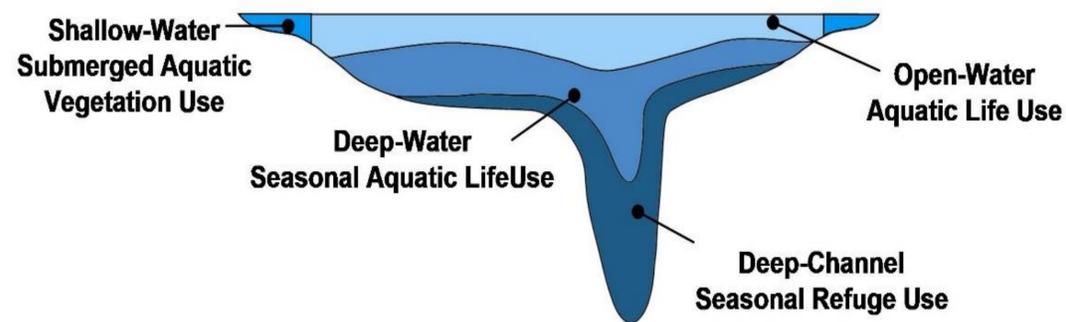
The overall Phase 7 suite of CBP is similar to the Phase 6 suite of Airshed, Land Use, Watershed and Bay models but all with refined inputs and expanded spatial and temporal scale.



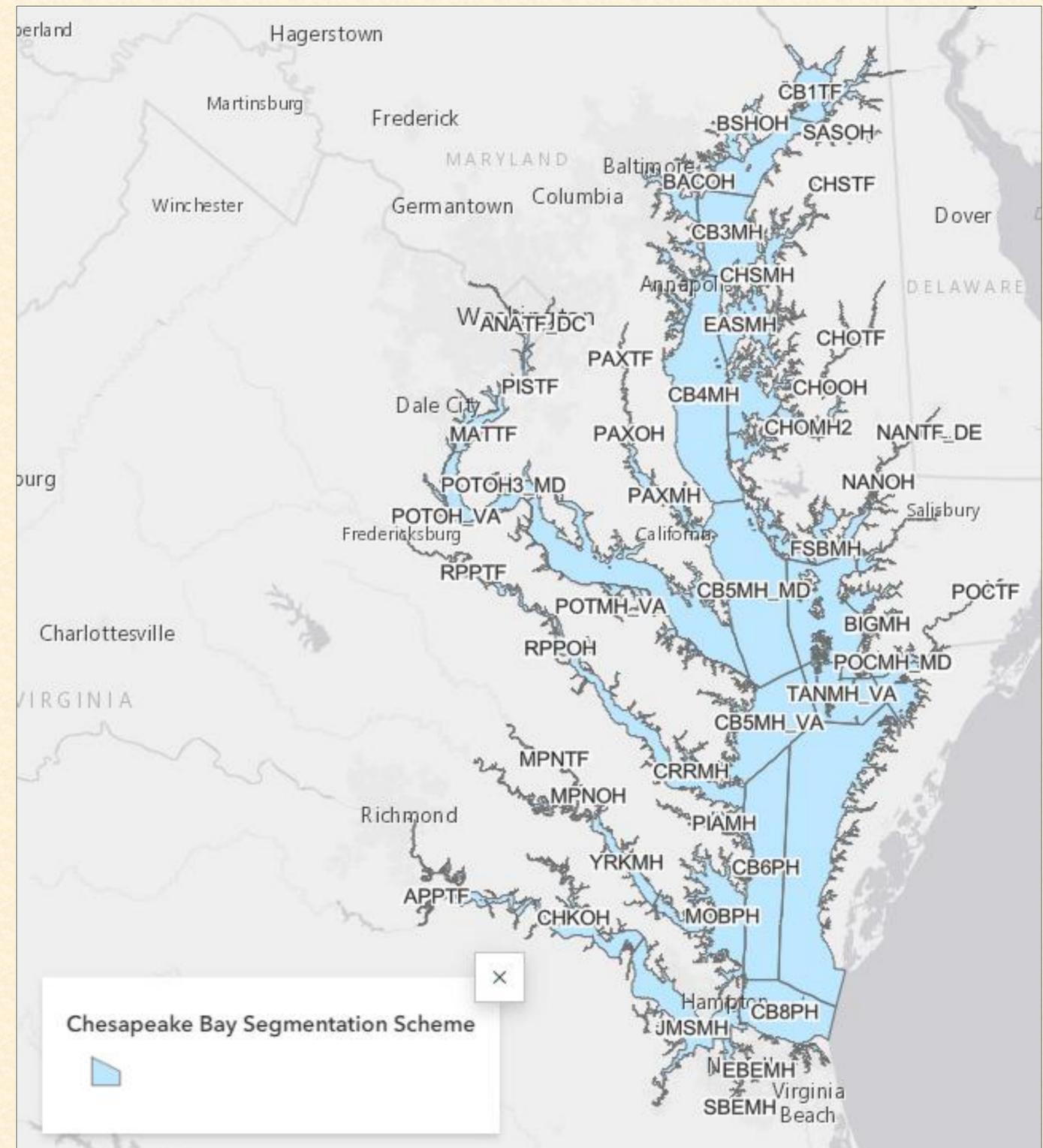
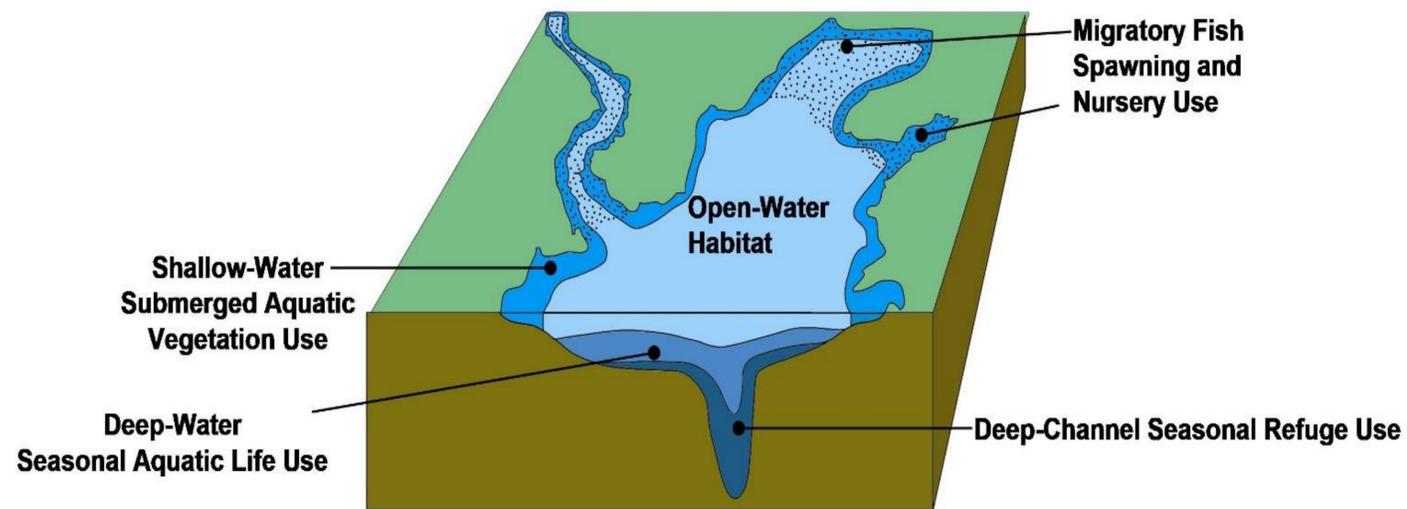
Restoring Chesapeake Water Quality & Living Resources

Goal: Meet living resource-based water quality standards in 92 segments of the tidal Chesapeake Bay.

A. Cross Section of Chesapeake Bay or Tidal Tributary



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





Key Guidance From PSC and STAC

PSC directive to represent future (2035 and beyond) environmental conditions on Bay water quality.

2020 PSC Guidance to CBP:

Understand the Science: Continue efforts to improve understanding of science and refine estimates of pollutant load changes due to 2035 changing environmental conditions ... [and] update targets (if warranted).

Followed STAC technical guidance as closely as possible:

STAC Guidance to Modeling Workgroup:

Shenk, G., M. Bennett, Z. Easton, M. Friedrichs, R. Hood, J. Keisman, L. Linker, R. Najjar, R. Sabo, and C. Stock.. (2025). [*A Path Forward in Considering Future Environmental Scenarios in Chesapeake Bay Restoration Efforts*](#)

Shenk, G., M. Bennett, D. Boesch, L. Currey, M. Friedrichs, M. Herrmann, R. Hood, T. Johnson, L. Linker, A. Miller, and D. Montali. (2021). [*Chesapeake Bay Program Climate Change Modeling 2.0*](#).

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*](#)

МВММ



Many Collaborators with Deep Coordination

- The Main Bay Model lead, Joseph Zhang has put together a well-coordinated set MBM and MTM collaborators that meet on a weekly basis and monthly basis, respectively, to coordinate work and problem solve technical issues.

The MBM collaborators are: Joseph Zhang, Jian Shen, Zhengui Wang, and Wenfan Wu – VIMS; and Richard Tian – UMCES; with support from Gopal Bhatt – Penn State; and Carl Cerco – Arlluk Technology Solutions, LLC.

In addition, the MTM collaborators include: Jeremy Testa, Larry Sanford, Amir Azarnivand and Jian Zhao – UMCES; and Harry Wang, Marjy Friedrichs, Pierre St-Laurent, Breanna Maldonado, Karinna Nunez – VIMS; and Qubin Qin – East Carolina University

- There is a constant, ongoing, weekly interaction among Phase 7 Watershed Model and Phase 7 MBM teams to use both model systems to better diagnose and improve both the Phase 7 Watershed Model and MBM/MTM performance.

Seventeen active collaborators from five different institutions in MBM and MTM development.

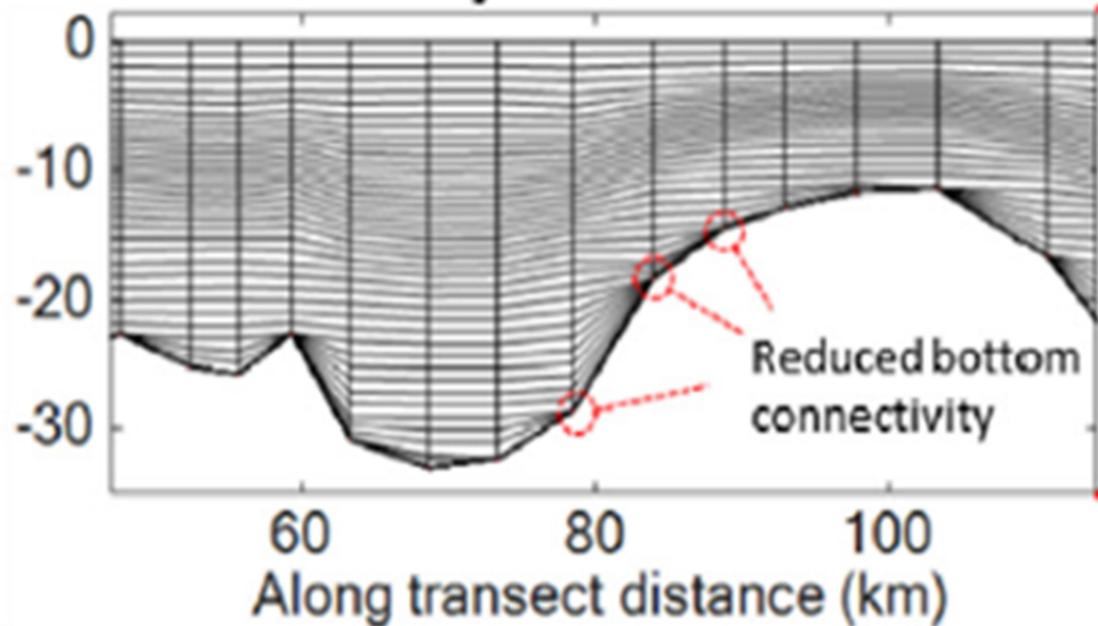
Shallow Water



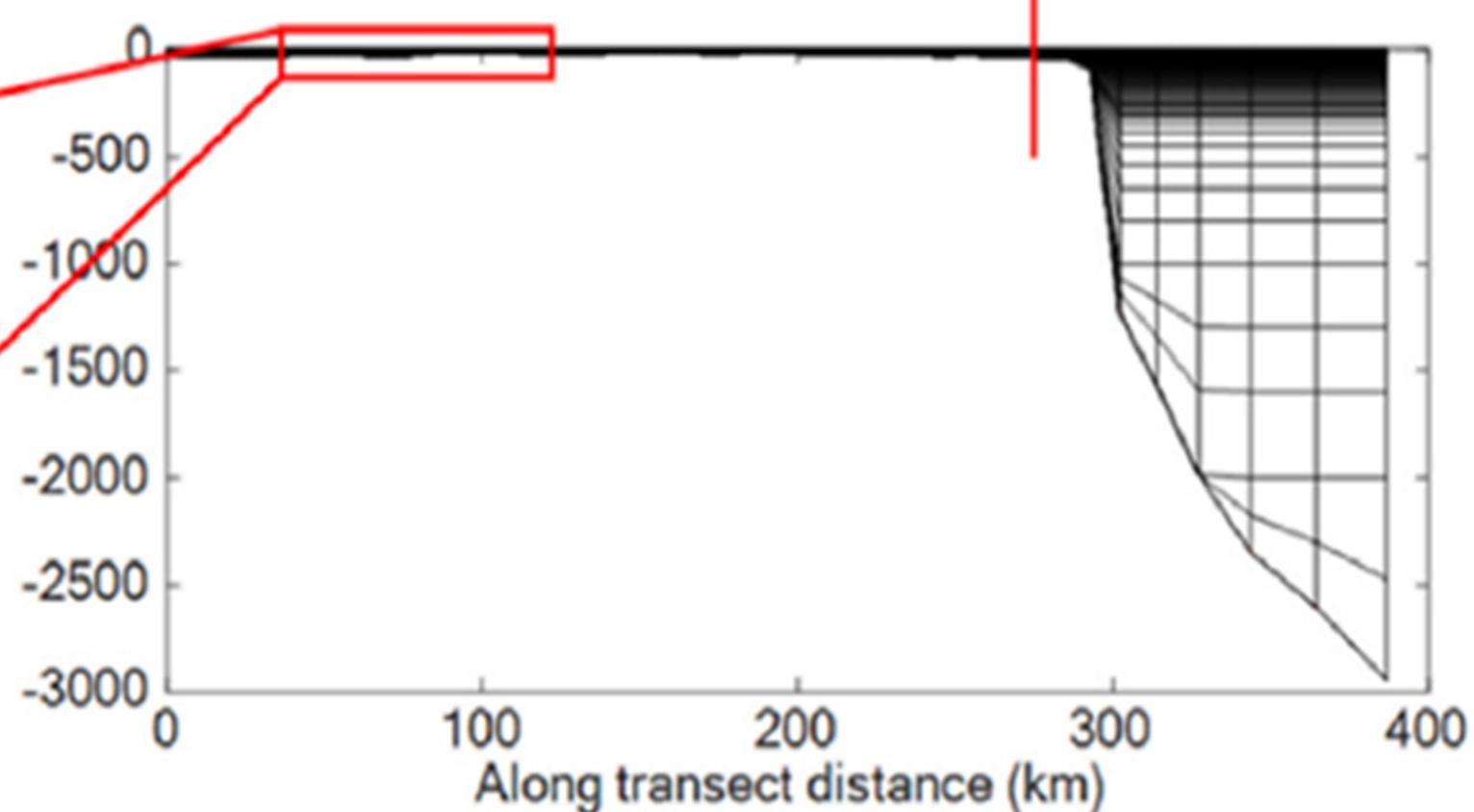
Shallow Water Simulation: Structure and Scale

- All previous Phase 6 water quality code (ICM) of tidal wetlands, oysters, SAV, and other components preserved in the Phase 7 MBM but now based on a state-of-science SCHISM unstructured model grid.
- Finer 3D cell scale of about a 10-fold increase with 56k cells in Phase 6 vs. 949k cells in Phase 7 SCHISM.
- First layer Phase 6 simulation was 2 m verses a minimum of ~0.2 m in a 2 m depth with SCHISM and at least a 1 m surface layer depth throughout.

(e) Zoomed-in view of the model grid inside estuary



(d) Model grid: Estuary ← Ocean

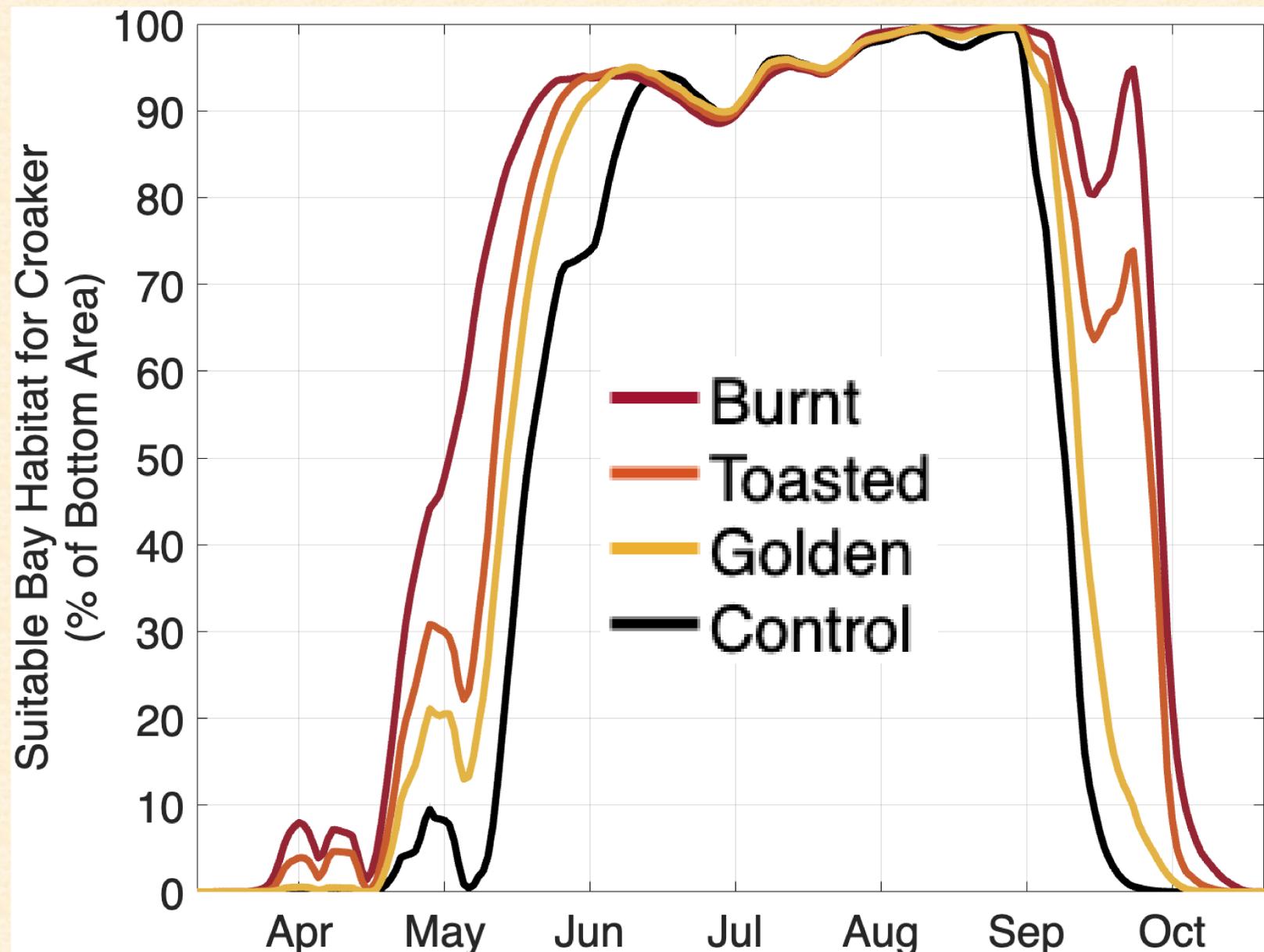




Shallow Water Simulation: Living Resources

Assessment of key fish species sensitivity to water quality and how the water quality changes under future higher temperatures, watershed flows, and loads is possible in Phase 7.

- Climate change increases duration of suitable habitat in the Bay, due to warmer temperatures in both spring and fall.
- With a slightly warmer climate, Croaker's suitable habitat window is longer (~3 weeks).
- With more emissions, the window is even longer (~5-6 weeks).

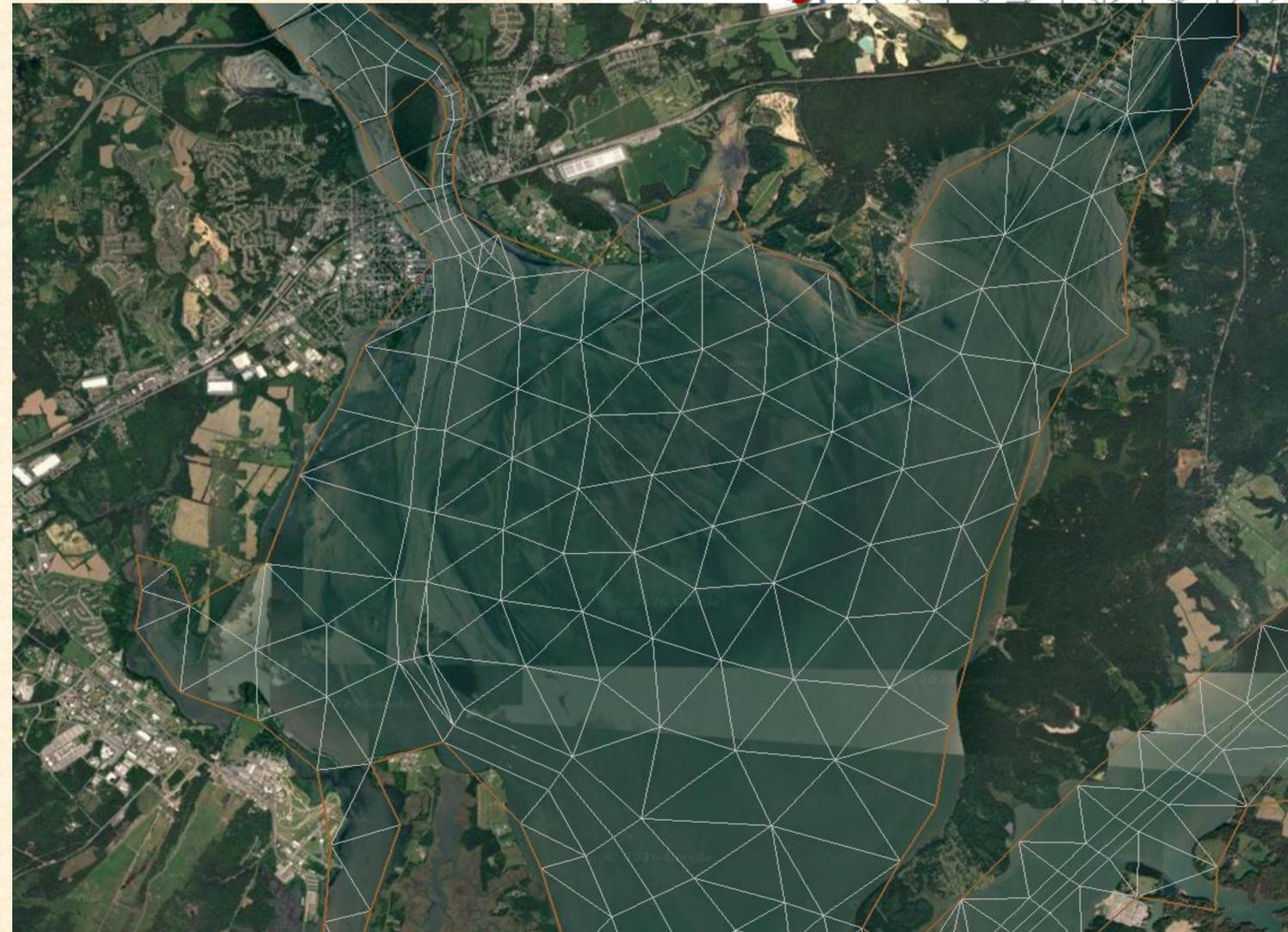
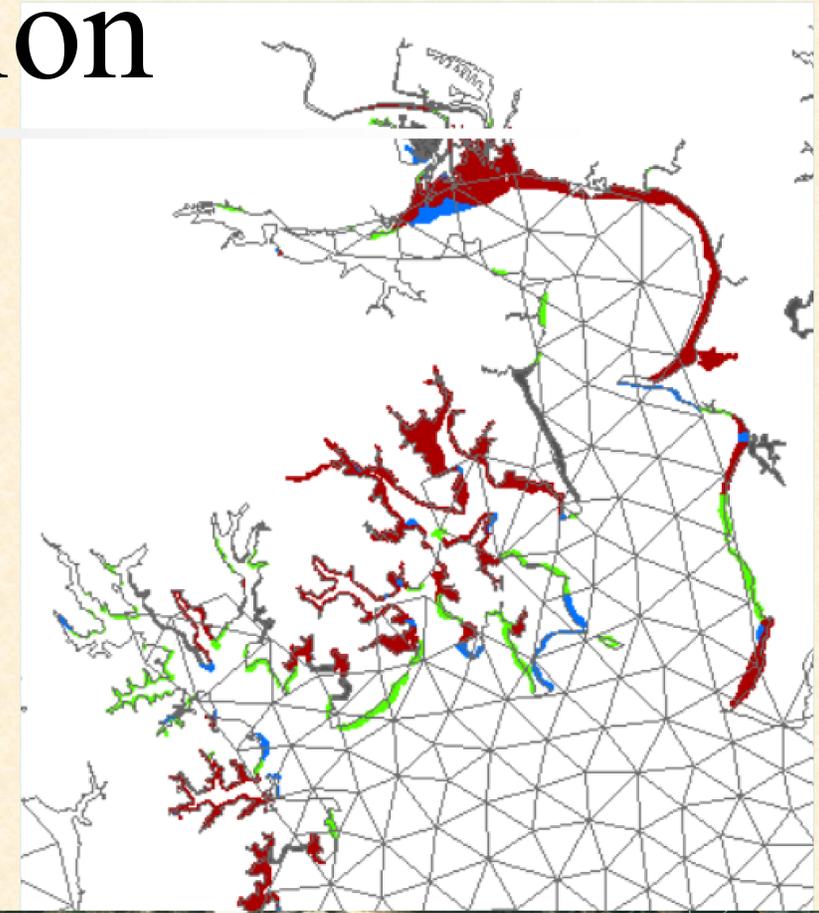


Source: Forecasting the effects of climate change on juvenile Atlantic Croaker in the Chesapeake Bay
Colin Hawes, Mary Fabrizio, Marjorie Friedrichs, Pierre St-Laurent, Troy Tuckey (VIMS) Vaskar Nepal (Western Illinois University) Aaron Bever (Anchor QEA) October 2025 Modeling Quarterly Review



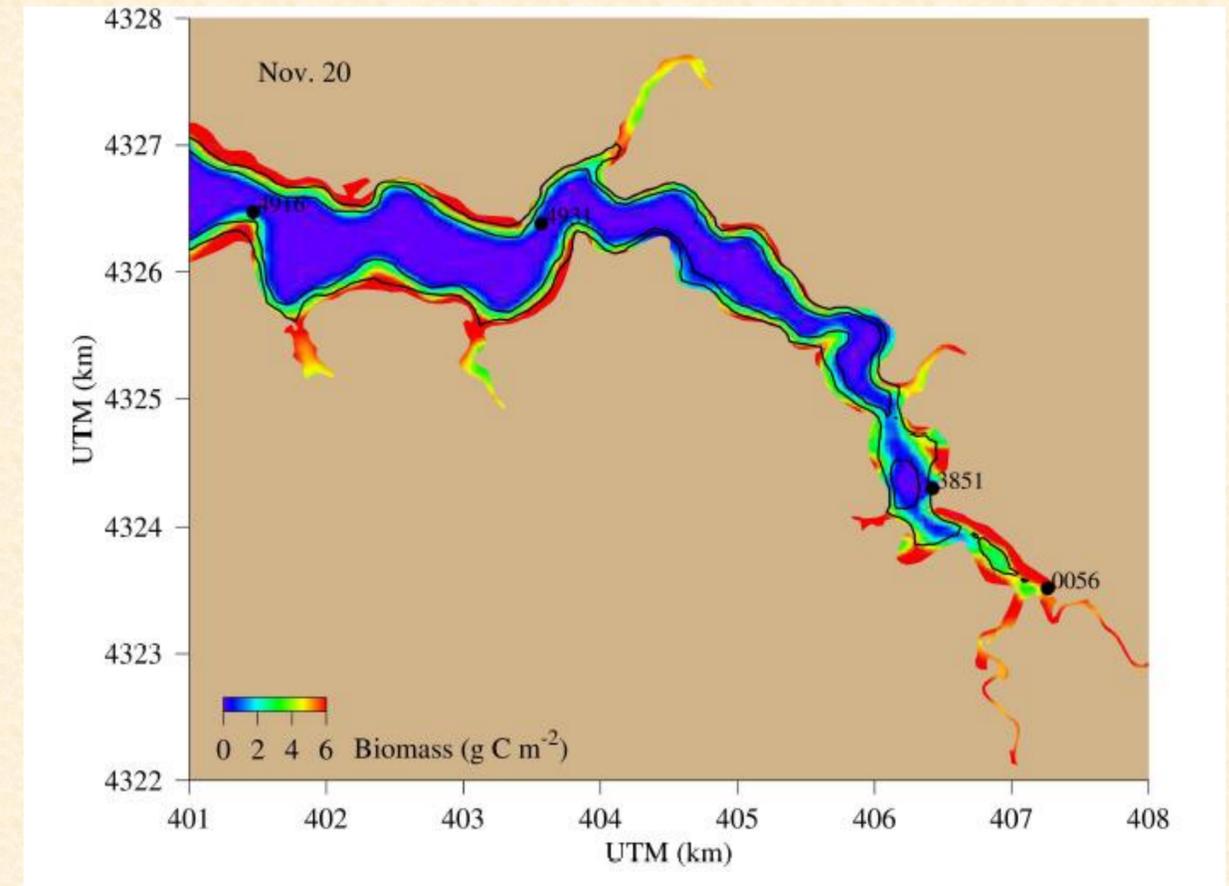
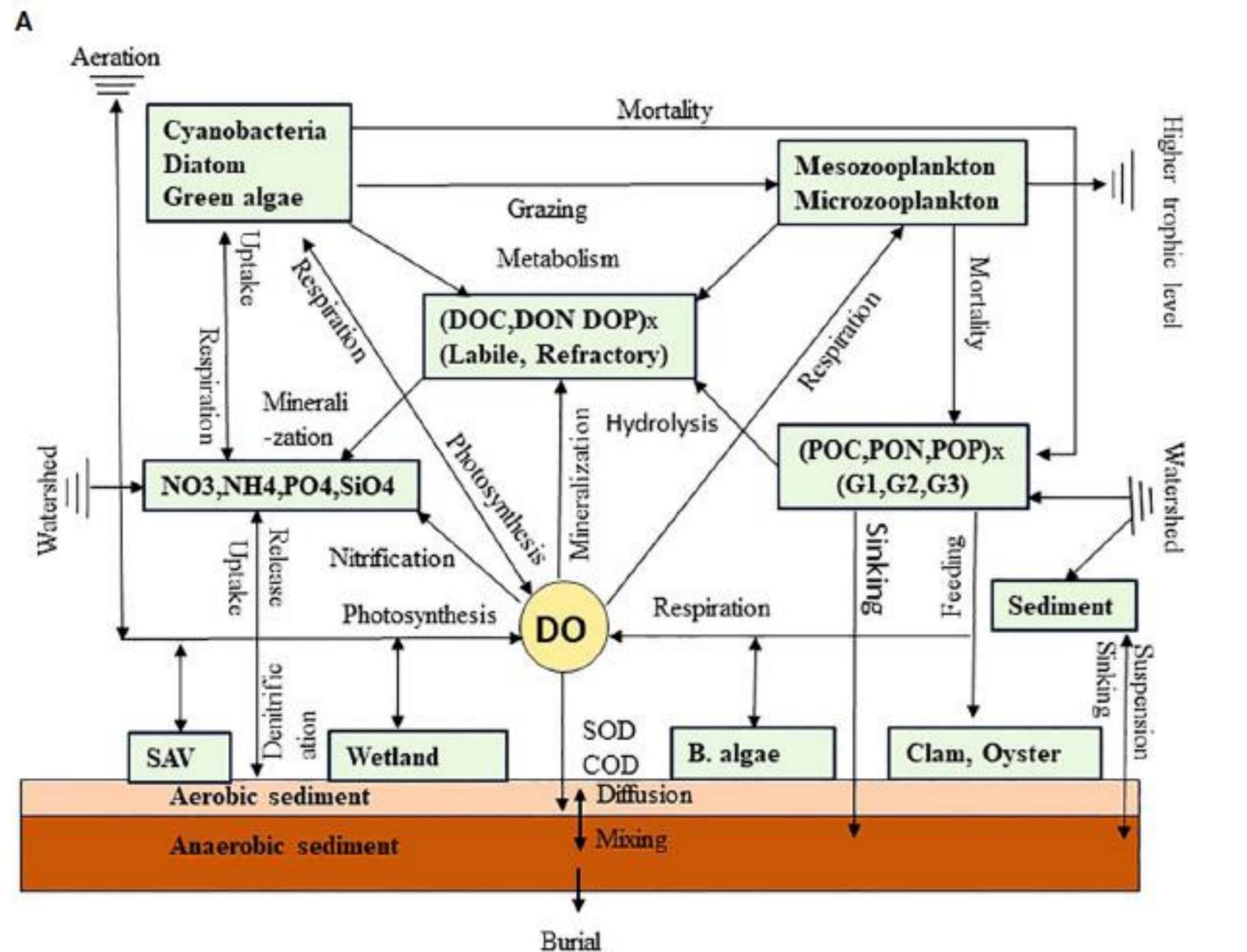
Shallow Water – SAV Simulation

- Refined the grid in large SAV areas
 - Use cell fraction for smaller SAV beds.
 - Determine the SAV seeding area for each grid element and estimate the percentage area for SAV in each grid based on VIMS SAV survey data.
- Determine the SAV seeding area for each year and used it as the seeding area for model inputs.
- Refined shallow water simulation depths may improve SAV simulation and clarity assessment.





Shallow Water – Benthic Algae Simulation



Spatial distribution of simulated Corsica R. benthic microalga abundance (g C m⁻²) on Nov. 20. The two black lines are the 1- and 2-m bathymetry, and black dots are the four observation stations.

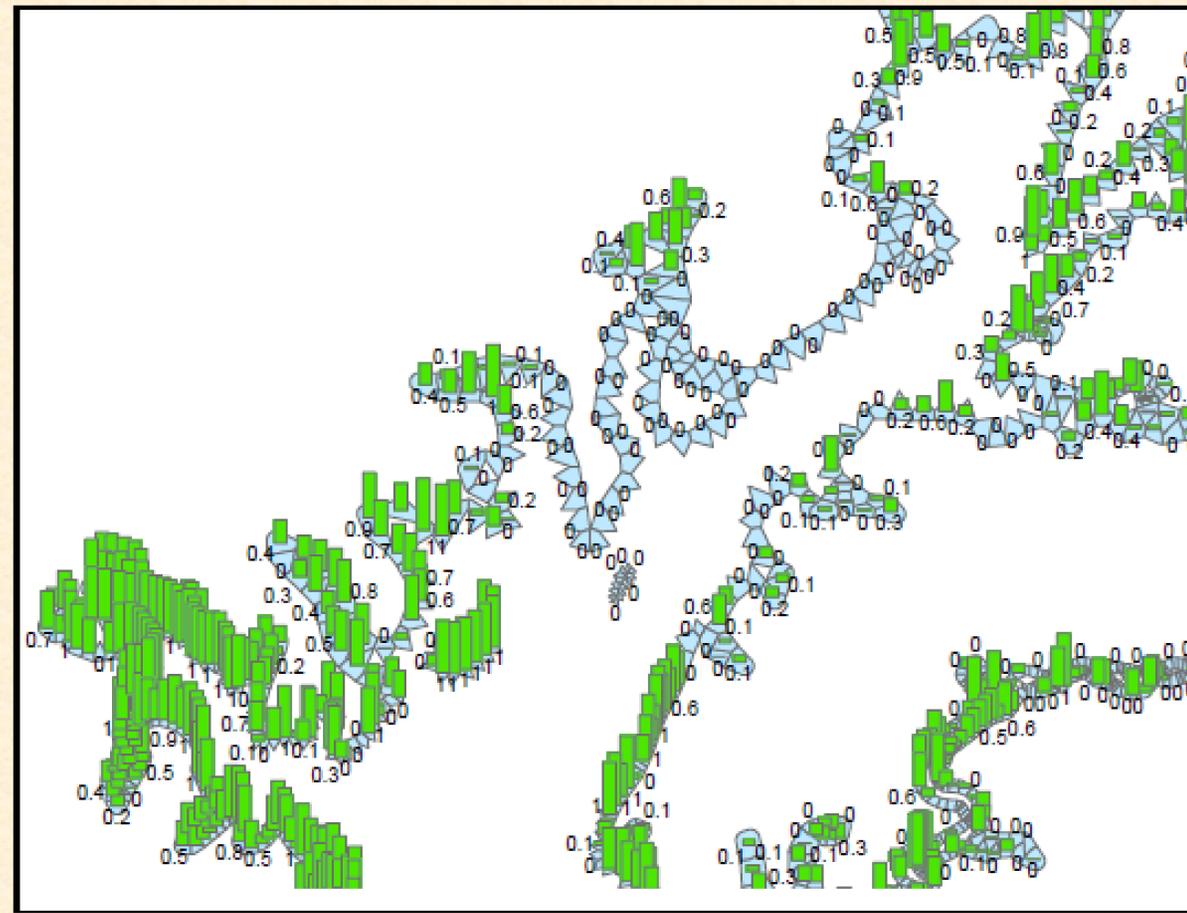
Structure of shallow water simulation in the MBM. Benthic algae complete with phytoplankton and are necessary to get the correct algal biomass in shallow water.

Source: Tian R, Cai X, Cerco CF, Zhang JY and Linker LC (2024) Simulation of benthic microalga impacts on water quality in shallow water systems, Corsica River, Chesapeake Bay. *Front. Mar. Sci.* 10:1295986. doi: 10.3389/fmars.2023.1295986

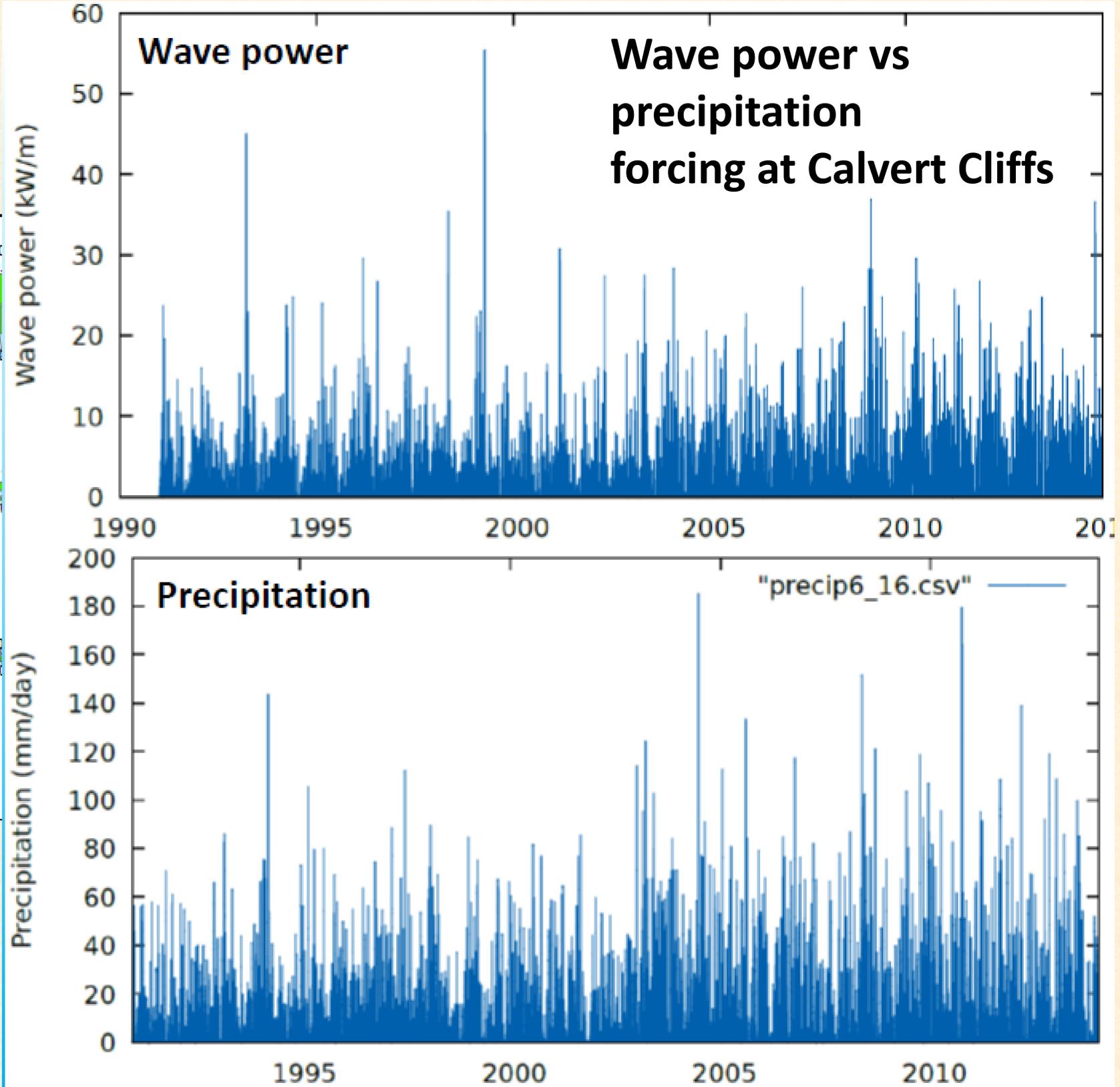


Shallow Water Simulation – Shoreline Erosion

Better shoreline erosion load estimates of nutrients and sediment with a wave power model of shoreline erosion.



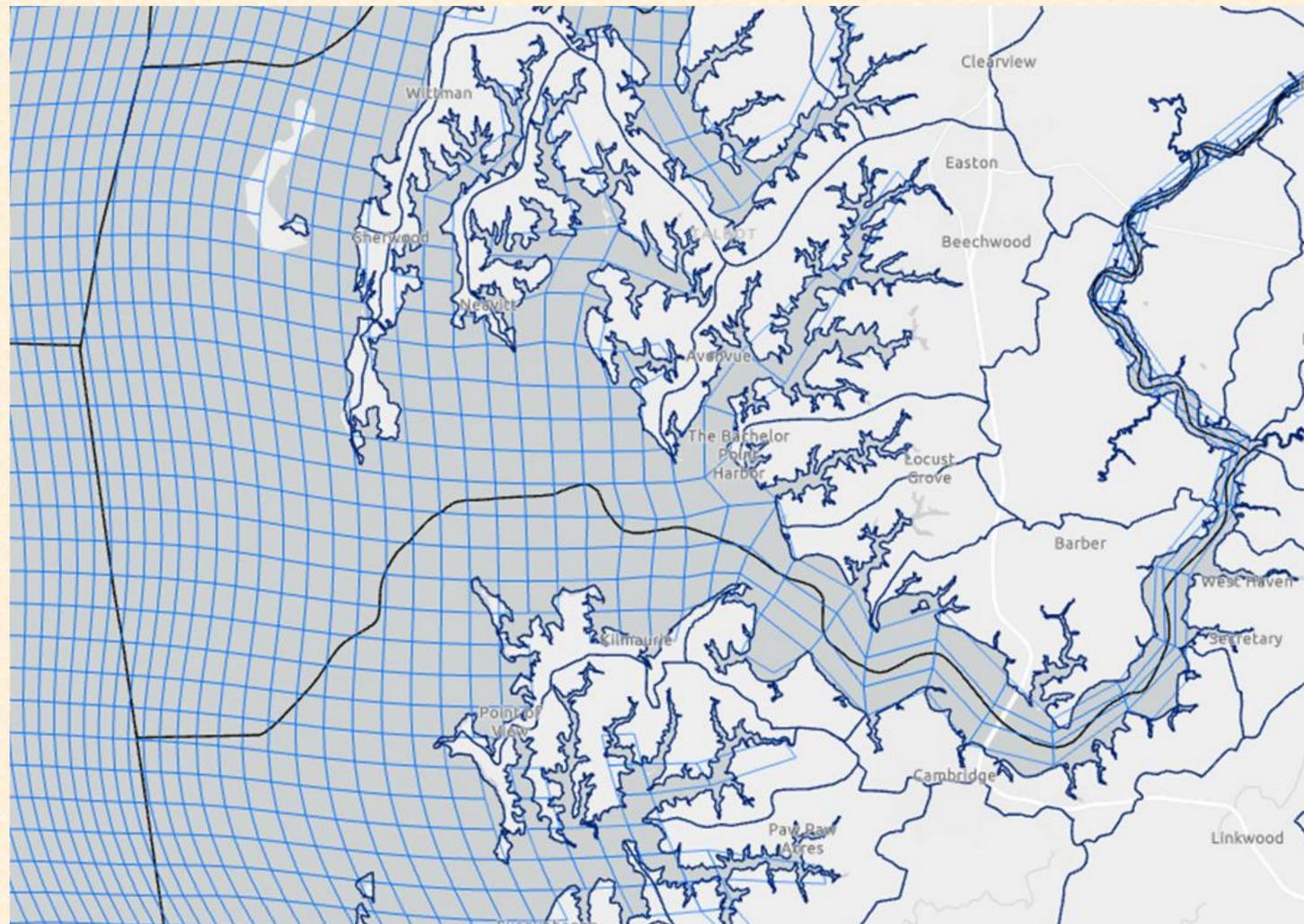
Shore erosion estimates include shoreline protection shown above, shoreline height, and other considerations.



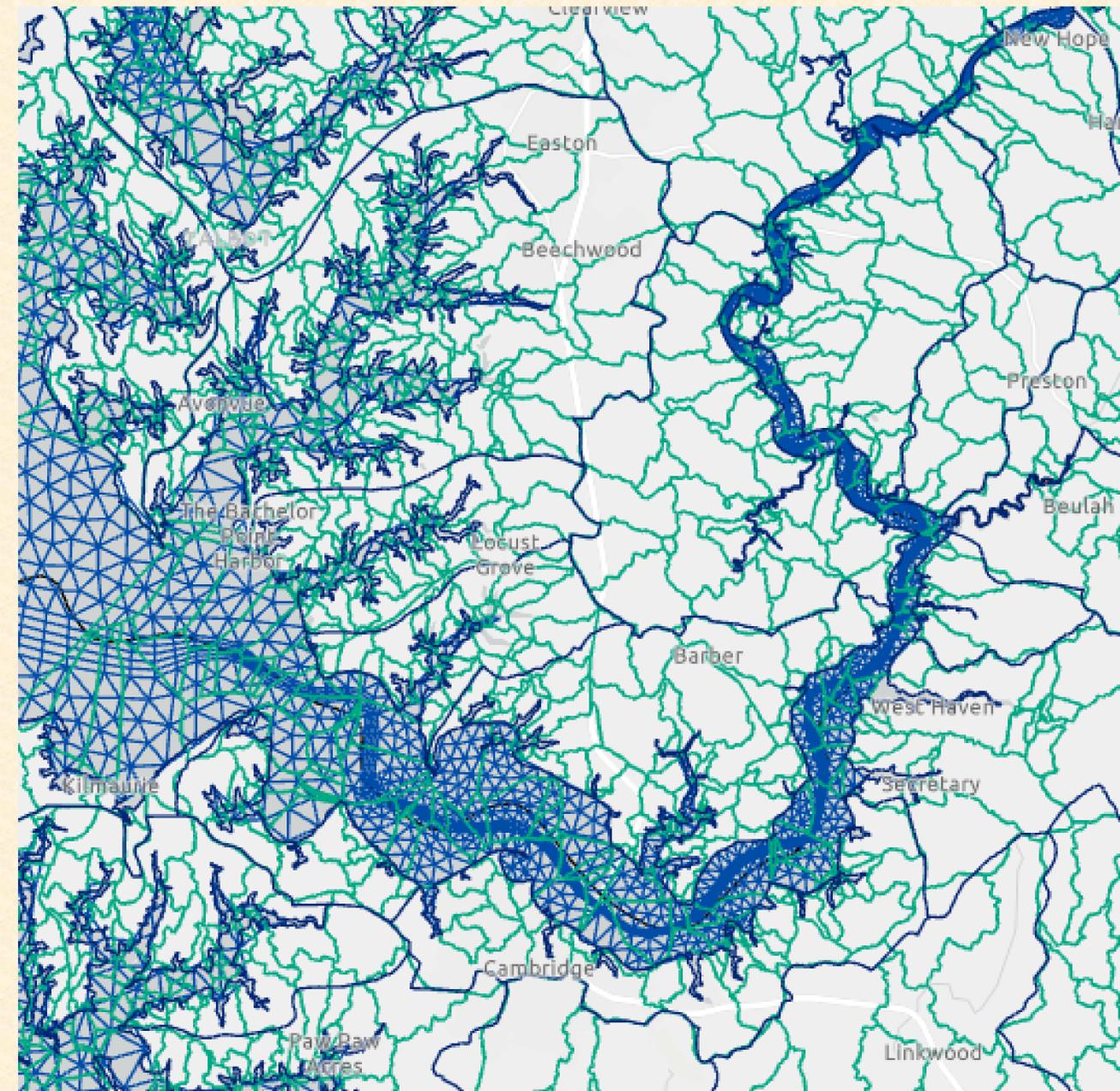


Shallow Water Simulation

Finer segmentation of broad land use categories at an NHD level of about one square mile in Phase 7 compared to the approximate 50 square mile segments of Phase 6.



Showing the Phase 6 Watershed Model finest level grid, the land-river segments and the Phase 6 Bay Model grid.

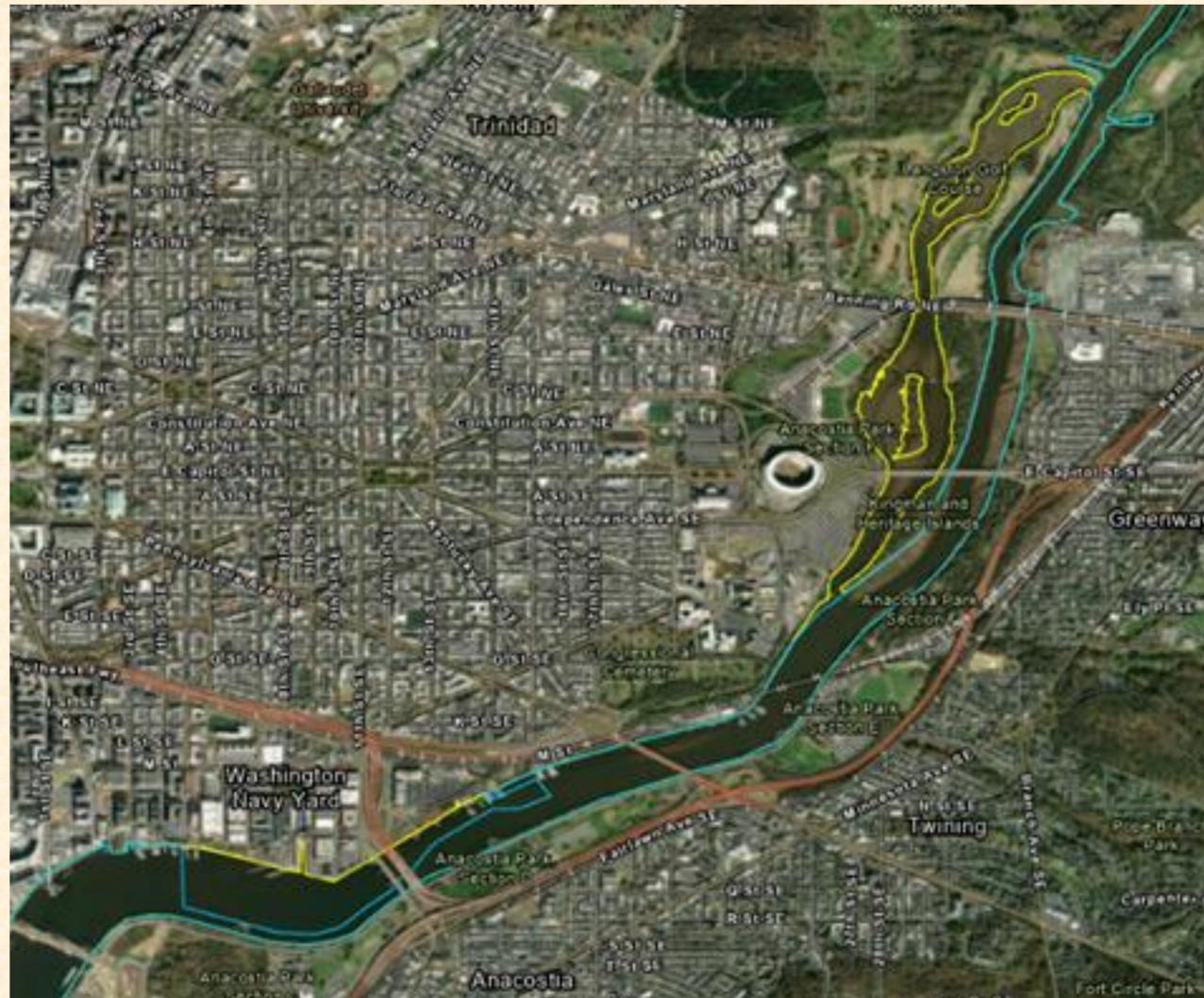


Showing the Phase 7 Watershed Model finest level grid of NHD+ segments and the Phase 7 Bay Model grid.



Better Delineation of Water, Land, and Tidal Wetlands

Better assessment of tidal wetland area and associated attenuation of nutrients and sediment and influence on adjacent tidal waters and refinements with a high-resolution tidal shoreline delineating Chesapeake tidal waters, tidal wetlands, and fastland.



Anacostia River with a correction in yellow near the bottom of the image, and a channel added in yellow in the top-right corner.



The yellow portion of the Nanticoke River in Delaware was added.

General Improvements to Model Structure, Processes, and Calibration



Phase 7 MBM Refinements: Longer Simulation Period

Longer 40-year period of model simulation in Phase 7 (1985 – 2024) compared to the 30-year simulation period of Phase 6 (1985 – 2014) providing for an improved calibration with an additional observed data including shallow water and vertical array programs.

Phase 1 Bay Model (1987) Steady state summer average loads for 1965, 1984, and 1985: zero years of simulation.

Phase 2 Bay CH3D-ICM Model (1992) 1984 – 1987: 4 years.

Phase 4 Bay CH3D-ICM Model (2002) 1985-2000: 16 years.

Phase 5 Bay CH3D-ICM Model (2010) 1985-2002: 18 years.

Phase 6 Bay CH3D-ICM Model (2017) 1985-2014: 30 years.

Phase 7 Bay SCHISM-ICM Model (current) 1985-2024: 40 years.



Refined Local Bathymetry and Channels

- Refined local bathymetry such as the application of shipping channels in MBM/MTM improves simulation of salt transport and representation of bottom water salinity and DO.

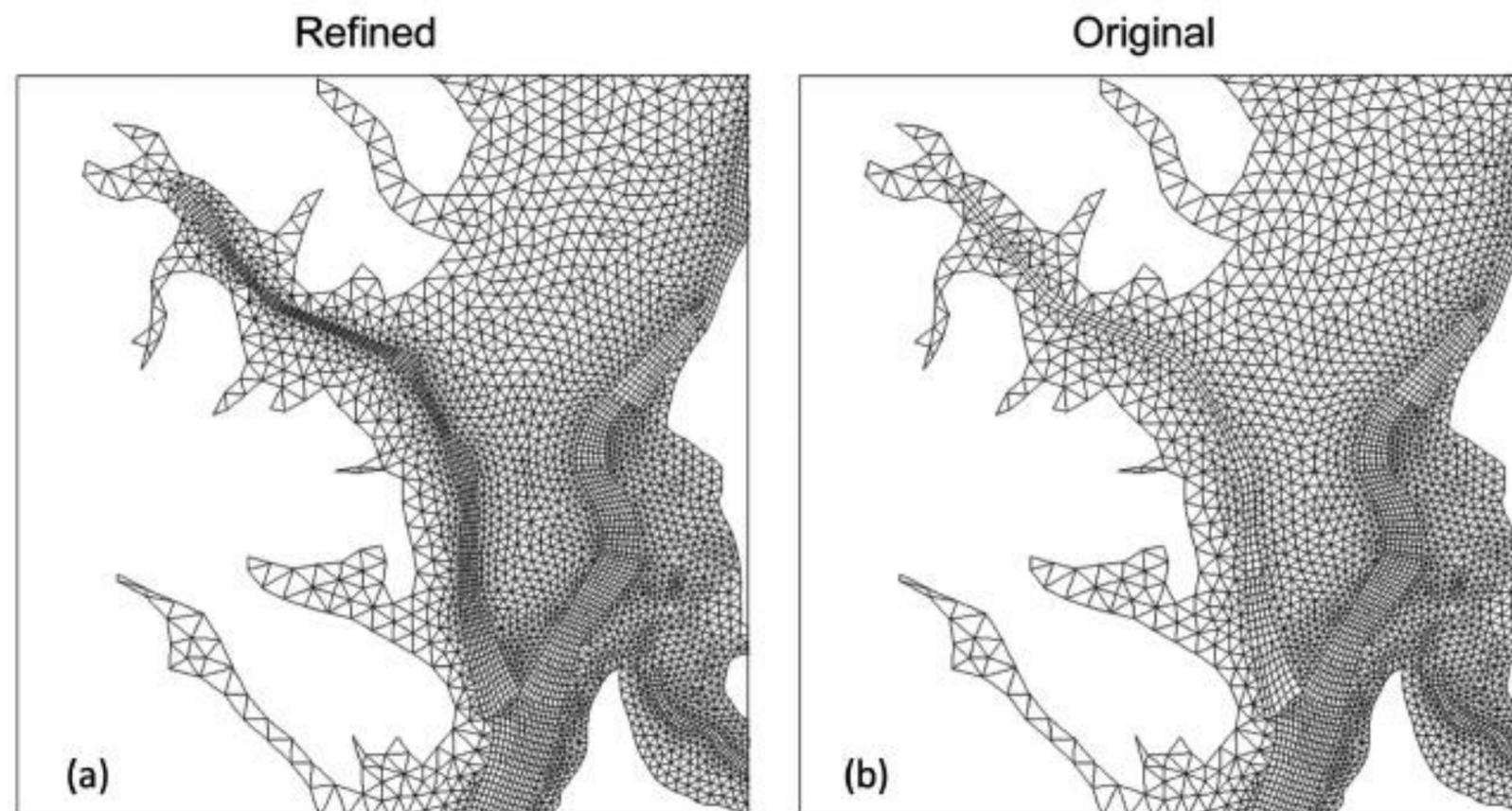


FIGURE 14. Unstructured (a) refined and (b) original mesh from main channel into Baltimore Harbor.

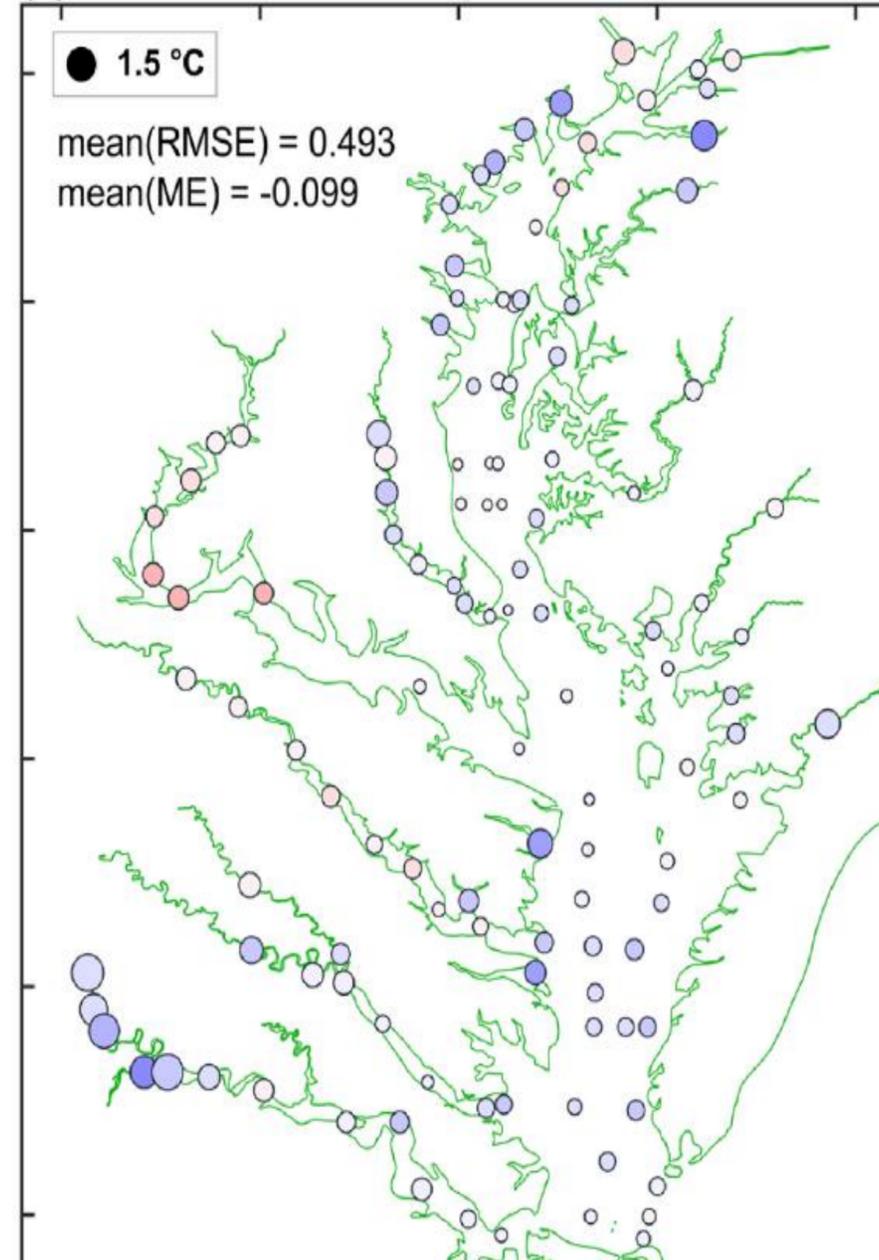
Cai, X., Y.J.Zhang, J.Shen, H.Wang, Z.Wang, Q.Qin, and F.Ye. 2022. "A Numerical Study of Hypoxia in Chesapeake Bay Using an Unstructured Grid Model: Validation and Sensitivity to Bathymetry Representation." *Journal of the American Water Resources Association* 58 (6): 898–921. <https://doi.org/10.1111/1752-1688.12887>.



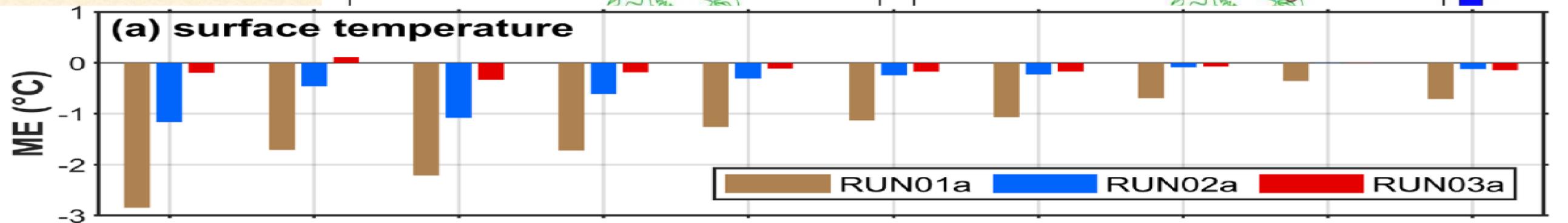
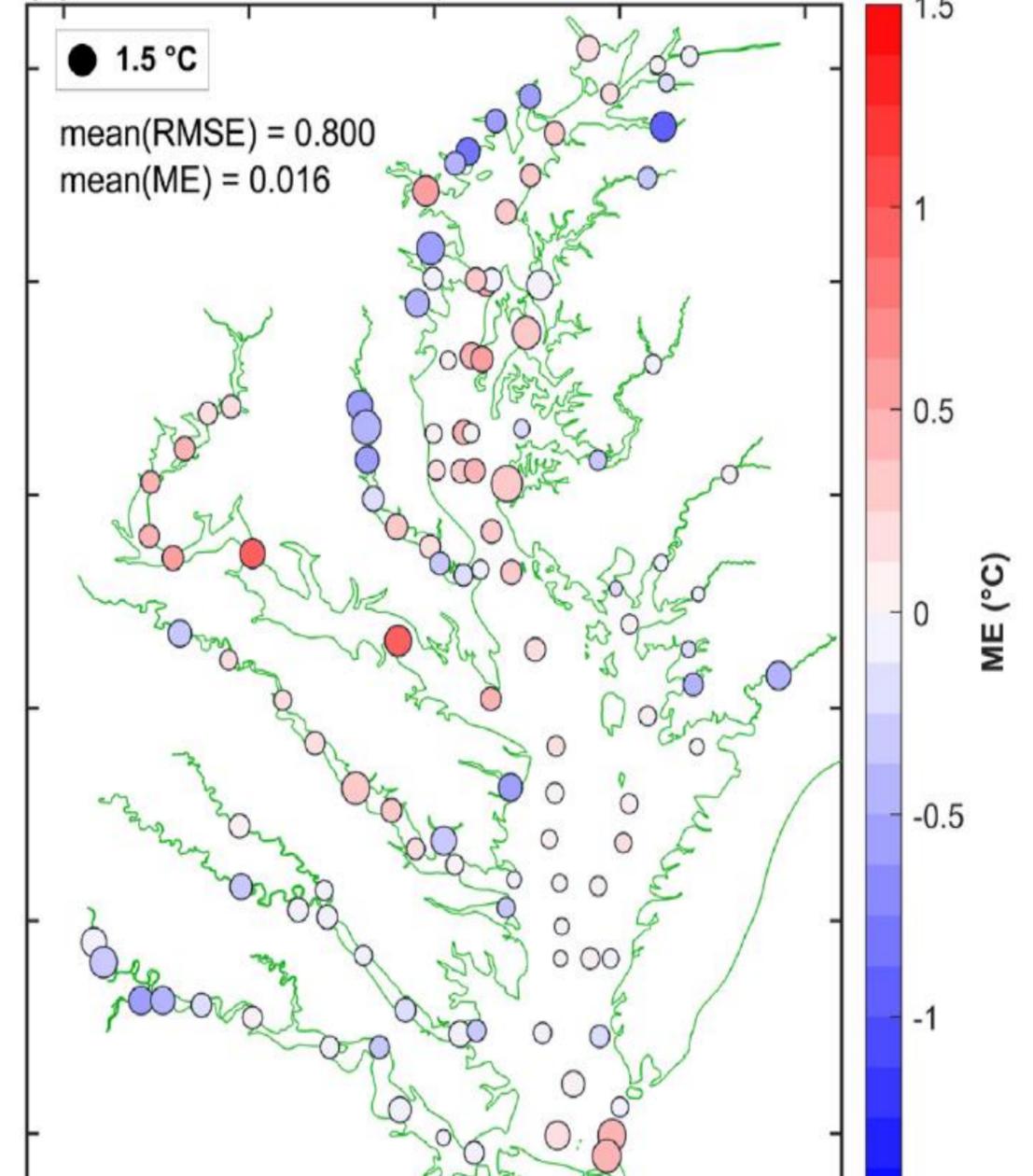
Physically Based Calibration of Temperature

Better tidal water column temperature based on short wave radiation interaction with suspended sediment. Highly turbid water greatly affects the downward penetration of solar radiation, particularly in the upper Bay and tributaries.

(c) RUN03a: surface temperature



(d) RUN03a: bottom temperature

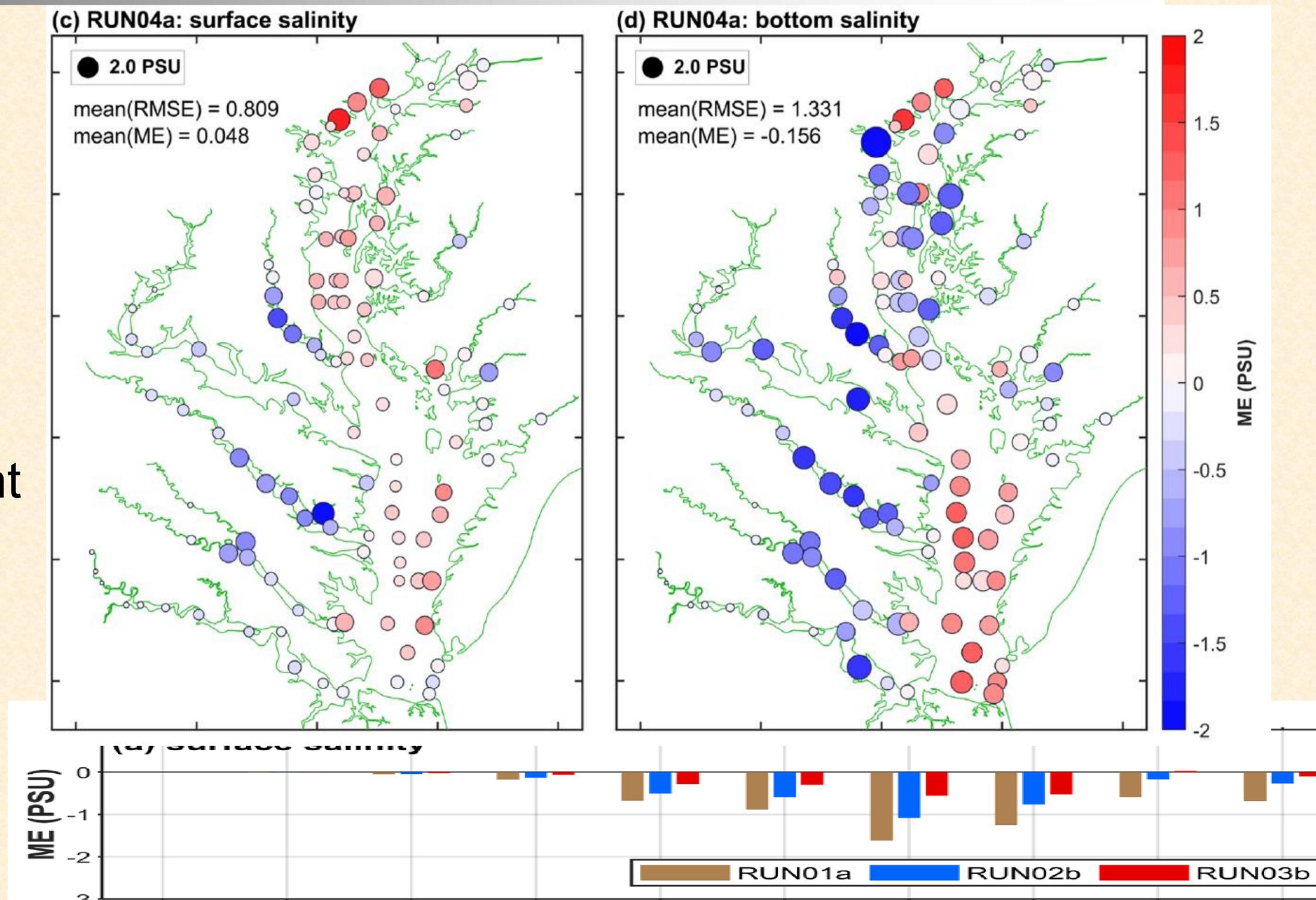


Source: Wu, Wenfan, Zhengui Wang, Y. Joseph Zhang, Jian Shen, Richard Tian, Lewis C. Linker, and Carl F. Cerco. "Improving cross-scale hydrodynamic simulations in the Chesapeake Bay with physically based calibration." *Ocean Modelling* (2026): 102680.



Bottom Sediment Refinement to Salinity Calibration

Improved hydrodynamic simulation of salinity through bottom roughness determined by bottom sediment type (cohesive sediment-less drag and sand/gravel-more drag).



Source: Wu, Wenfan, Zhengui Wang, Y. Joseph Zhang, Jian Shen, Richard Tian, Lewis C. Linker, and Carl F. Cerco. "Improving cross-scale hydrodynamic simulations in the Chesapeake Bay with physically based calibration." *Ocean Modelling* (2026): 102680.



General Improvements – Conowingo Inputs

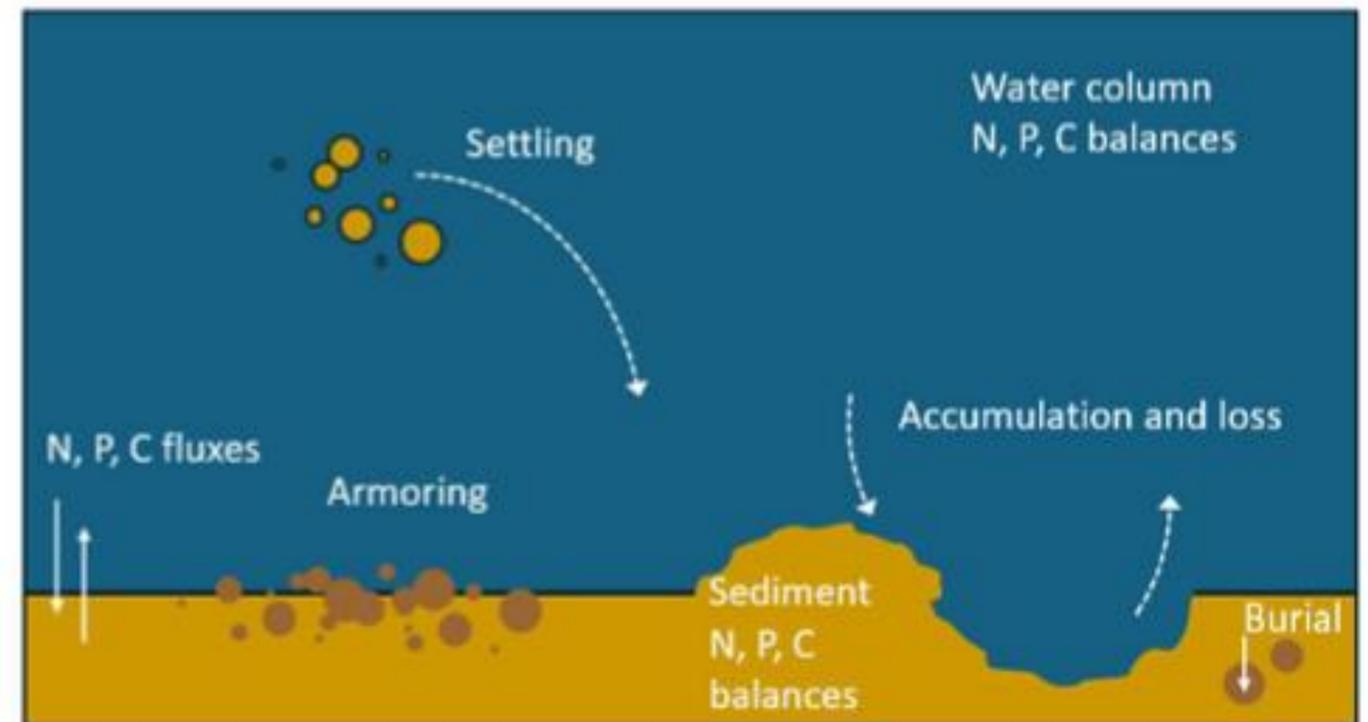
Improved simulation of Conowingo infill in the Dynamic Watershed Model and through the CoE-ERDC 2027 Conowingo Model.



MODEL REQUIREMENTS



- Continuous simulation of the reservoir pool including selected hydrometeorological events; (1991-2000)
- Change in hydrodynamics from reservoir infill of sediments from the CR watershed, and removal of material through dredging
- Biogeochemistry in the reservoir pool, responding to the amount and speciation of nitrogen, phosphorus, and sediment inputs from upstream and bottom sediment
- Biogeochemical changes in sediments, including burial, species changes, and water column exchanges
- Physical changes in sediment characteristics due to erosion, bed armoring, and deposition of sediment and the resulting morphological changes in the reservoir
- Dredging of the reservoir.



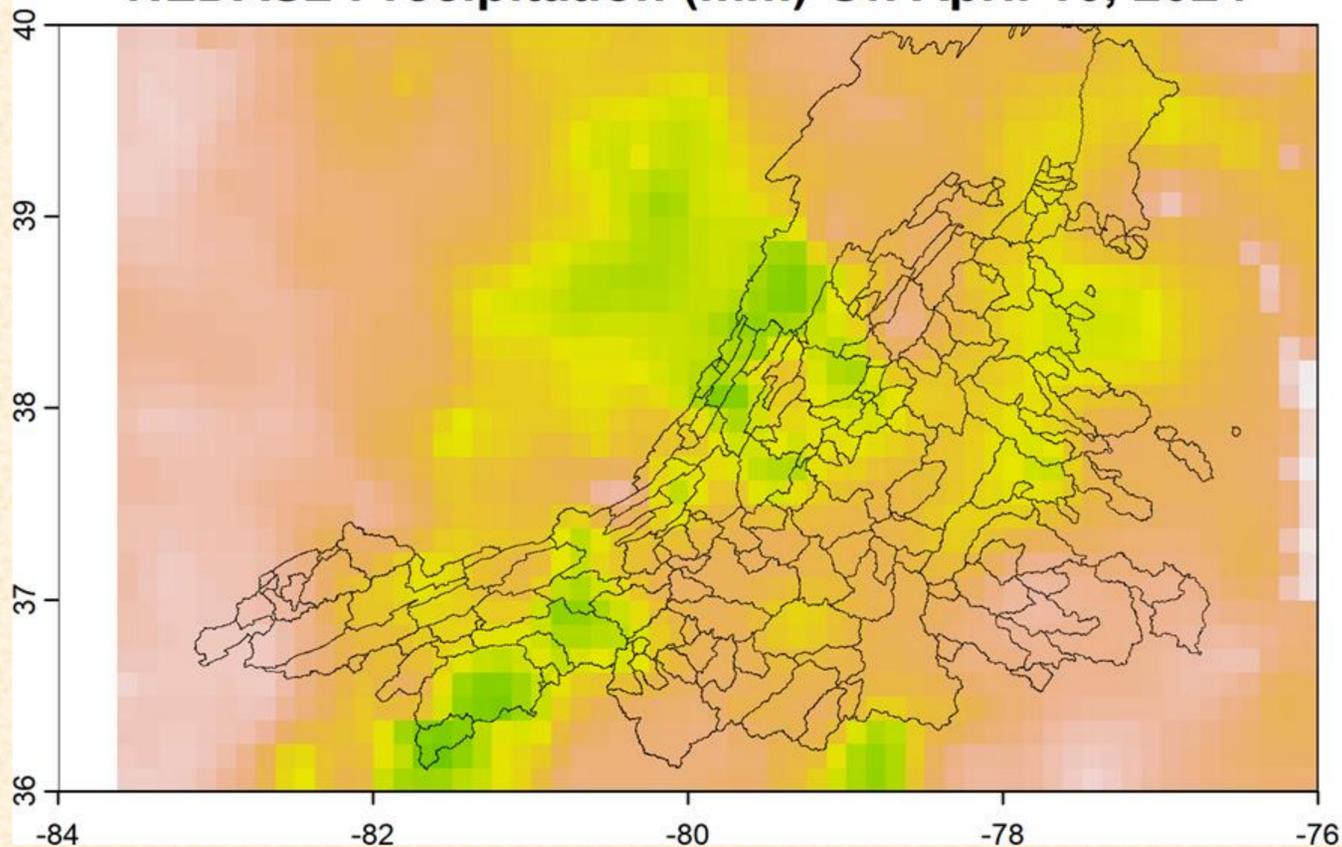
**Inputs Are Important:
Hydrology, Coastal Plain,
Atmospheric Deposition,
and Coastal Ocean**



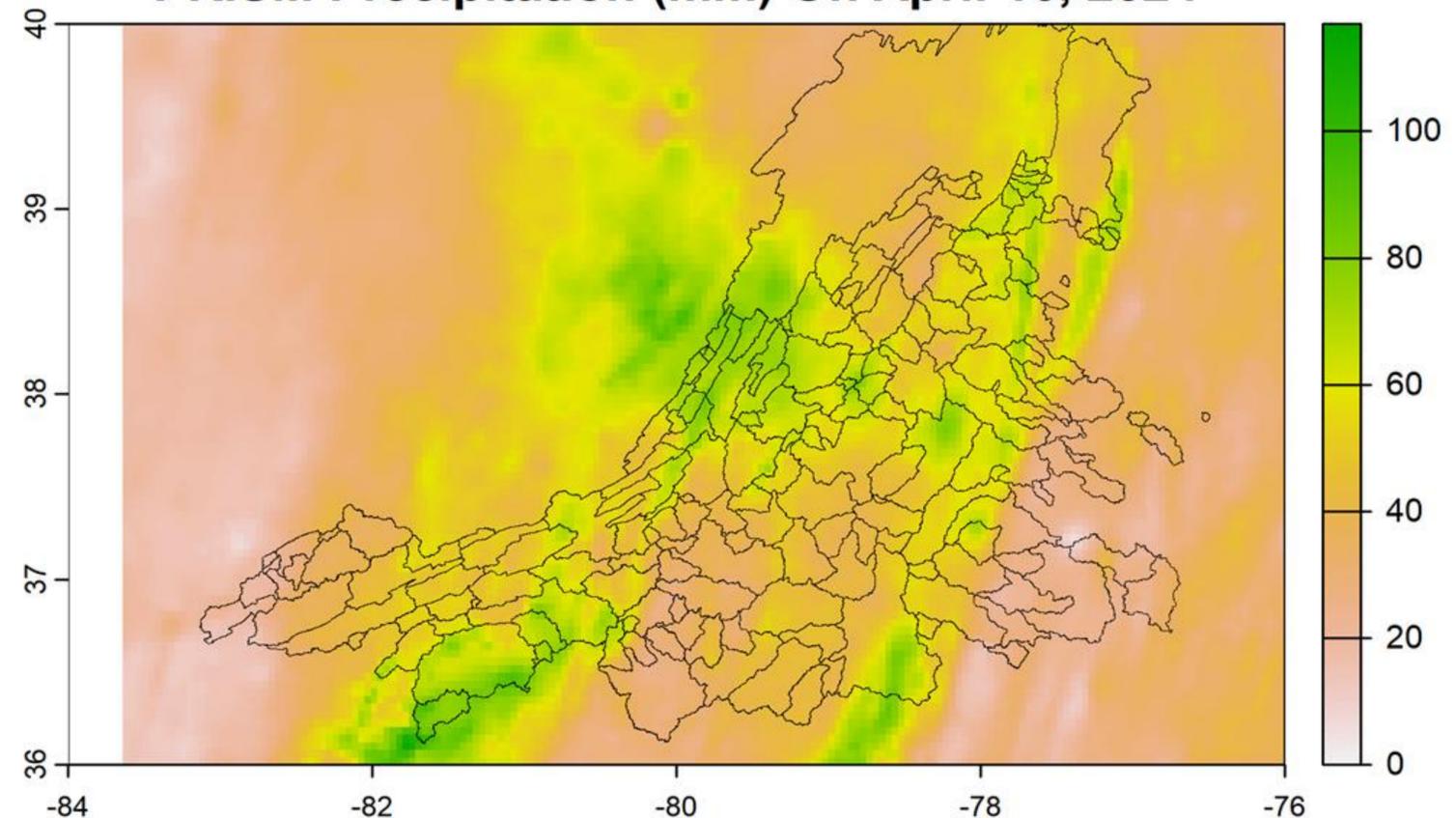
Inputs are Important - Hydrology

Better simulation of flows through use of daily precipitation from PRISM with NLDAS hourly adjustments. This is largely due to the finer resolution of the PRISM data set of 4 km x 4 km resolution compared to NLDAS resolution of 14 km x 14 km resulting in better resolution of ridgeline precipitation and all precipitation generally as well as less bias than Phase 6 PRISM compared to observations.

NLDAS2 Precipitation (mm) On April 16, 2024



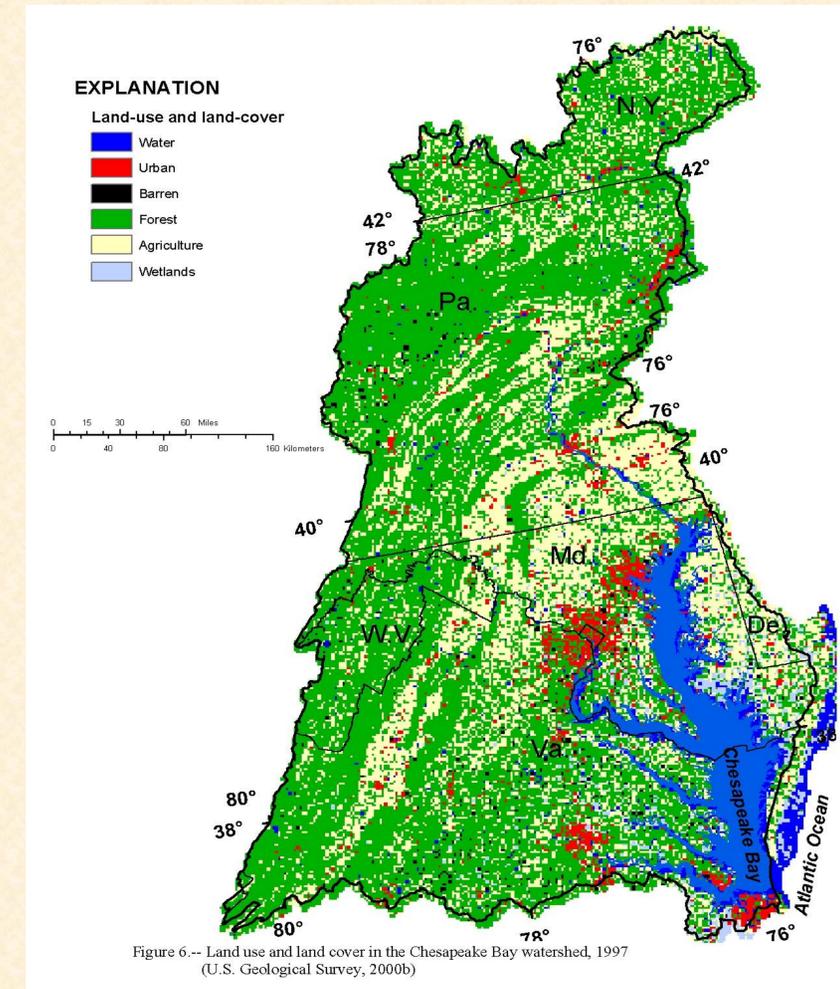
PRISM Precipitation (mm) On April 16, 2024





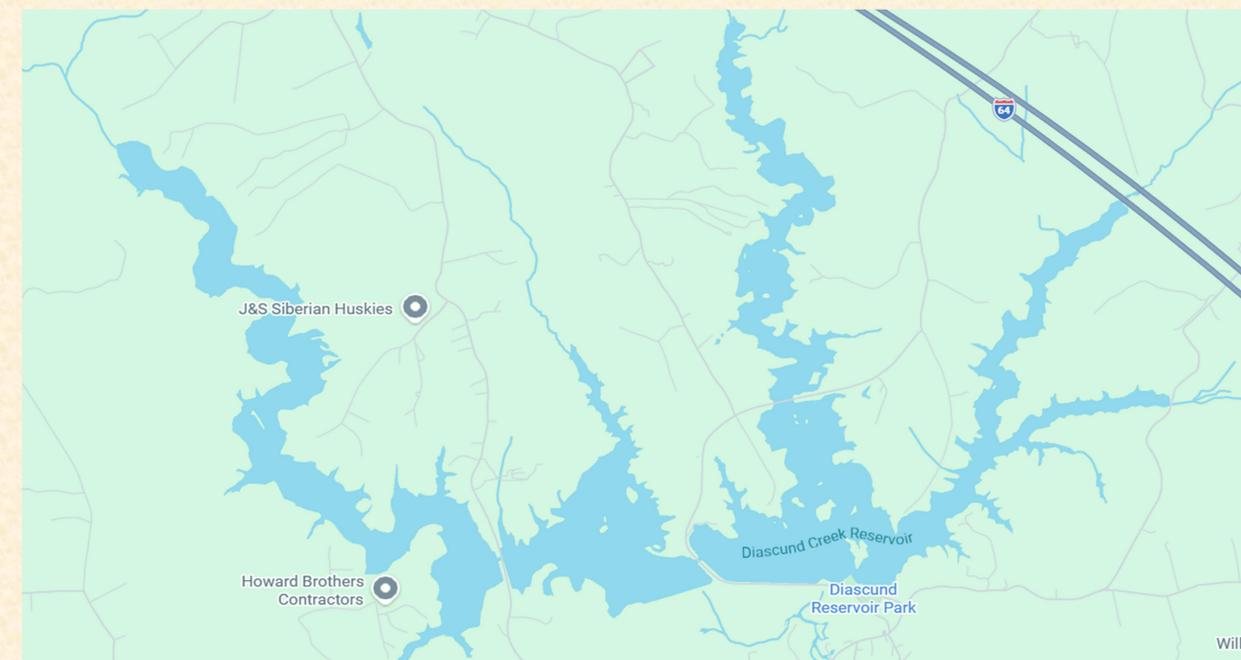
Inputs are Important – Coastal Plain

In the Coastal Plain the Generalized Stream Network (GSN), simulation Inclusion of Coastal Plain reservoirs, and other BFL refinements greatly improve input loads to Bay shallow waters. Although the Coastal Plain physiographic region is only 13% of the watershed it adds 32% of the nitrogen, 33% of the phosphorus, and 52% of the sediment loads* Because of diminished nutrient attenuation close to the Bay, high proportions of urban and cropland loads, and tidal shoreline erosion.



Coastal Plain flow & loads without shoreline erosion:

Flow	Nitrogen	Phosphorus	Sediment	Acres
14%	32%	27%	11%	13%



*Source: Phase 6 separation of 1991-2000 average of delivered loads from point source, non-point source, and tidal shoreline erosion loads.



Inputs are Important – Coastal Plain

Better simulation and calibration of coastal plain nitrogen, phosphorus, and sediment loads to Chesapeake tidal embayments through the first-time assessment of coastal plain loads with tidal monitoring station information.

- **Zhengui Wang (VIMS), Wenfan Wu (VIMS), and Gopal Bhatt (Penn State)** have developed tools for assessing and tracking watershed model outputs and estuarine model performance.

Table: Comparison of Phase 6 and Phase 7 watershed loads in small embayments. Data in parenthesis show RMSD of watershed model loads (Phase 6, Phase 7) as compared to that of immediately downstream tidal monitoring stations.

Embayments	River Impact	Salinity	Ammonia	Nitrate	Phosphate	TN	TP	Sediment
Sassafrass R.	99.5%	1.91	(0.1553, 0.1724)	(2.1799, 1.5663)	(0.0506, 0.0303)	(2.1749, 2.2918)	(0.1157, 0.0708)	(83.4010, 64.0950)
Bush R.	95.9%	0.84	(1.5825, 0.8445)	(2.4744, 2.0285)	(0.1267, 0.1176)	(3.0666, 2.1254)	(0.1737, 0.1249)	(59.0322, 53.9453)
Gunpowder R.	94.7%	1.63	(0.0774, 0.0722)	(1.0177, 0.4990)	(0.0122, 0.0164)	(0.8905, 0.4488)	(0.0471, 0.0442)	(41.6804, 37.5875)
South R.	69.1%	9.84	(0.1297, 0.1260)	(3.9673, 1.0413)	(0.0467, 0.0570)	(3.8474, 0.8997)	(0.0784, 0.0691)	(72.0014, 40.8683)
Piscataway R.	100.0%	0.00	(0.3453, 0.3234)	(5.3081, 3.5262)	(0.0381, 0.0407)	(5.3026, 3.7516)	(0.0702, 0.0805)	(50.1494, 36.6836)
Mattawoman C.	100.0%	0.02	(0.2073, 0.1016)	(4.8008, 1.8416)	(0.4483, 0.1060)	(5.5305, 1.7449)	(0.7417, 0.1505)	(57.9953, 37.4156)
Corrotoman R.	56.6%	14.53	(0.1101, 0.0573)	(1.8100, 0.7028)	(0.0223, 0.0406)	(1.8435, 0.5316)	(0.0785, 0.0431)	(61.3329, 12.5883)
Chickahominy R.	99.7%	1.18	(0.9466, 0.0622)	(5.4596, 0.1991)	(0.0683, 0.0370)	(7.2374, 0.3392)	(0.1628, 0.0585)	(59.5836, 49.2633)
Nanticoke R.	99.8%	0.19	(0.1803, 0.1174)	(2.9407, 1.4765)	(0.0436, 0.0748)	(2.8671, 1.2300)	(0.0962, 0.0807)	(35.9075, 35.1593)
Manokin R.	49.0%	13.87	(1.1536, 0.1188)	(3.7258, 1.3950)	(0.0762, 0.1538)	(4.8577, 1.6415)	(0.1603, 0.1767)	(43.1494, 30.3107)
Big Annemessix R.	47.8%	15.41	(10.0068, 0.2549)	(17.8570, 1.7639)	(0.4463, 0.1978)	(25.9882, 2.5115)	(0.8129, 0.2395)	(85.0987, 19.1356)
Patapsco R.	80.8%	10.42	(3.5302, 3.2289)	(2.9920, 2.4831)	(0.2444, 0.2266)	(6.6460, 5.9269)	(0.3410, 0.3307)	(55.0892, 39.3605)
Anacostia R.	100.0%	0.17	(0.2177, 0.2341)	(2.7501, 0.3297)	(0.0824, 0.0522)	(1.7004, 0.8990)	(0.0571, 0.0756)	(95.3317, 80.2096)
Elizabeth S.	46.9%	19.08	(1.8986, 0.4678)	(4.3389, 1.0248)	(0.8990, 0.2319)	(7.6235, 1.3427)	(1.2829, 0.3256)	(14.6792, 13.5410)
Chester R.	99.3%	0.49	(0.1221, 0.1062)	(1.0766, 1.2225)	(0.0301, 0.0733)	(0.9874, 1.1437)	(0.1563, 0.1110)	(87.0498, 91.7857)
Pocomoke R.	100.0%	0.20	(0.2716, 0.0722)	(0.7283, 0.6284)	(0.0953, 0.0869)	(1.1926, 0.6074)	(0.1445, 0.1108)	(30.9019, 23.7107)

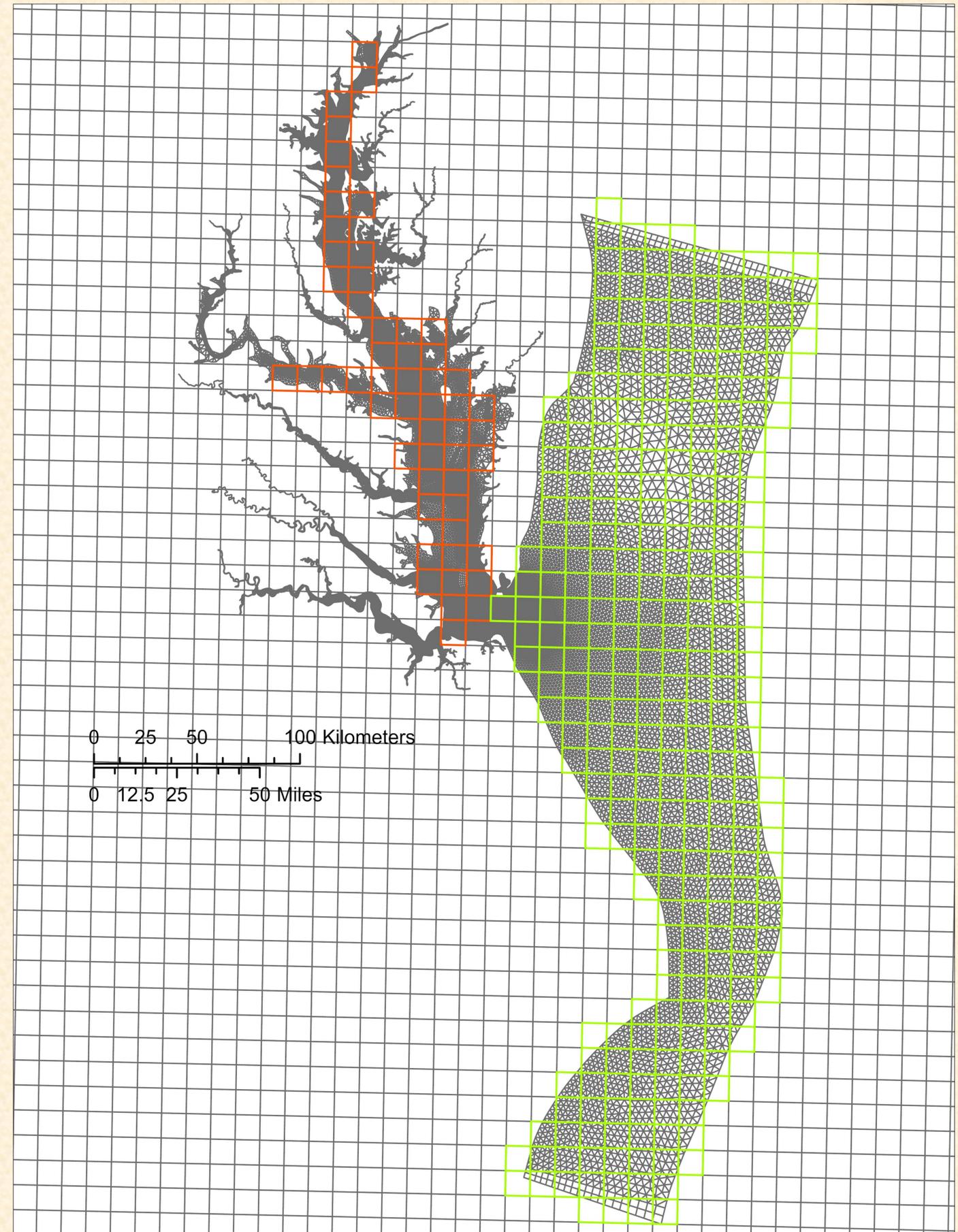
Source: April 2025 Quarterly Review Gopal Bhatt presentation.



Inputs are Important – Atmo Dep Nitrogen

Improved representation of atmospheric deposition of nitrogen to the watershed, tidal Bay and coastal ocean with refined Airshed Model loads particularly for ammonia - later phase of the CMAQ Model and better estimates of atmospheric deposition loads to the watershed and tidal Bay, particularly for more recent years.

- For the first time, a quantification of atmospheric deposition loads to the coastal ocean provided tracking the reduction in atmospheric deposition from 1985 to 2024 and their subsequent reduction of loads into the Bay mouth.

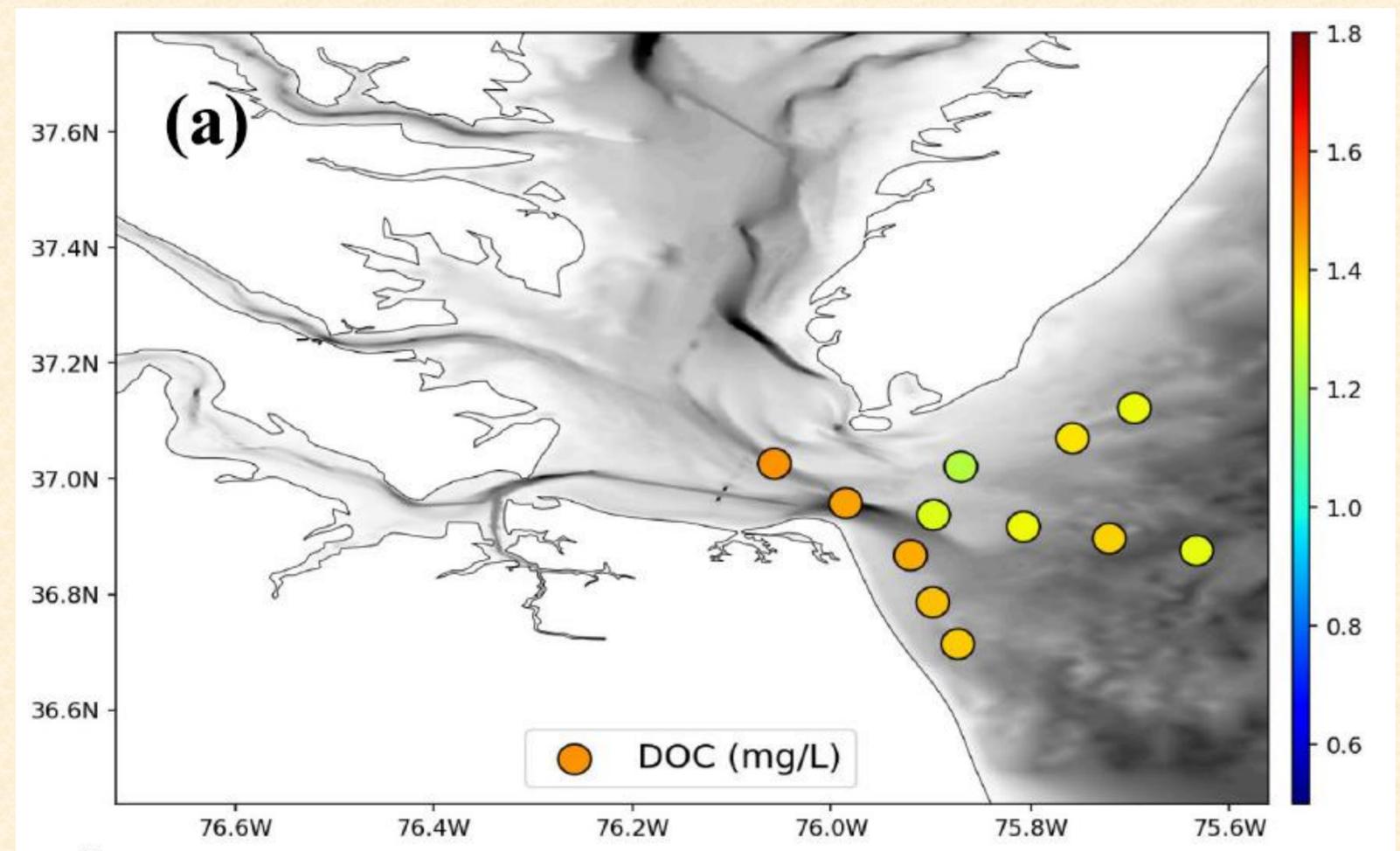




Inputs are Important – Ocean Boundary

The addition of observed concentrations of Dissolved Organic Carbon (DOC) at the ocean boundary improved hypoxia simulation in the lower Bay. In addition, the expansion of MBM domain out into the Atlantic coastal shelf from Delaware Bay to the North Carolina estuaries provides better overall assessments of loads to the Chesapeake from coastal atmospheric deposition, coastal bays in Delaware, Maryland, and Virginia, and Delaware Bay plume and atmospheric deposition to the coastal ocean.

Circles show the mean DOC concentrations averaged over time and depths) collected at 12 stations around the Bay entrance



Source: Wang, Zhengui, Y. Joseph Zhang, Jian Shen, Jeremy M. Testa, Carl Cerco, Lewis Linker, Richard Tian, and Wenfan Wu. "Importance of Estuary–Ocean Exchange on Hypoxia in Mid-Lower Chesapeake Bay." *Estuaries and Coasts* 49, no. 1 (2026): 19.

SCENARIOS



Scenario Operations

- Improved representation of future increased temperatures, rainfall volumes, and intensities in the tidal Bay and adjacent coastal ocean through application of CMIP 6.
- Improved scenario simulation of future groundwater temperatures that will be adjusted to long term annual average air temperature in future environmental conditions.
- Improved scenario handling through “one file” NetCDF linkage of DWSM to MBM, MTMs, and other PI models for faster more efficient scenario and other file passing procedures.

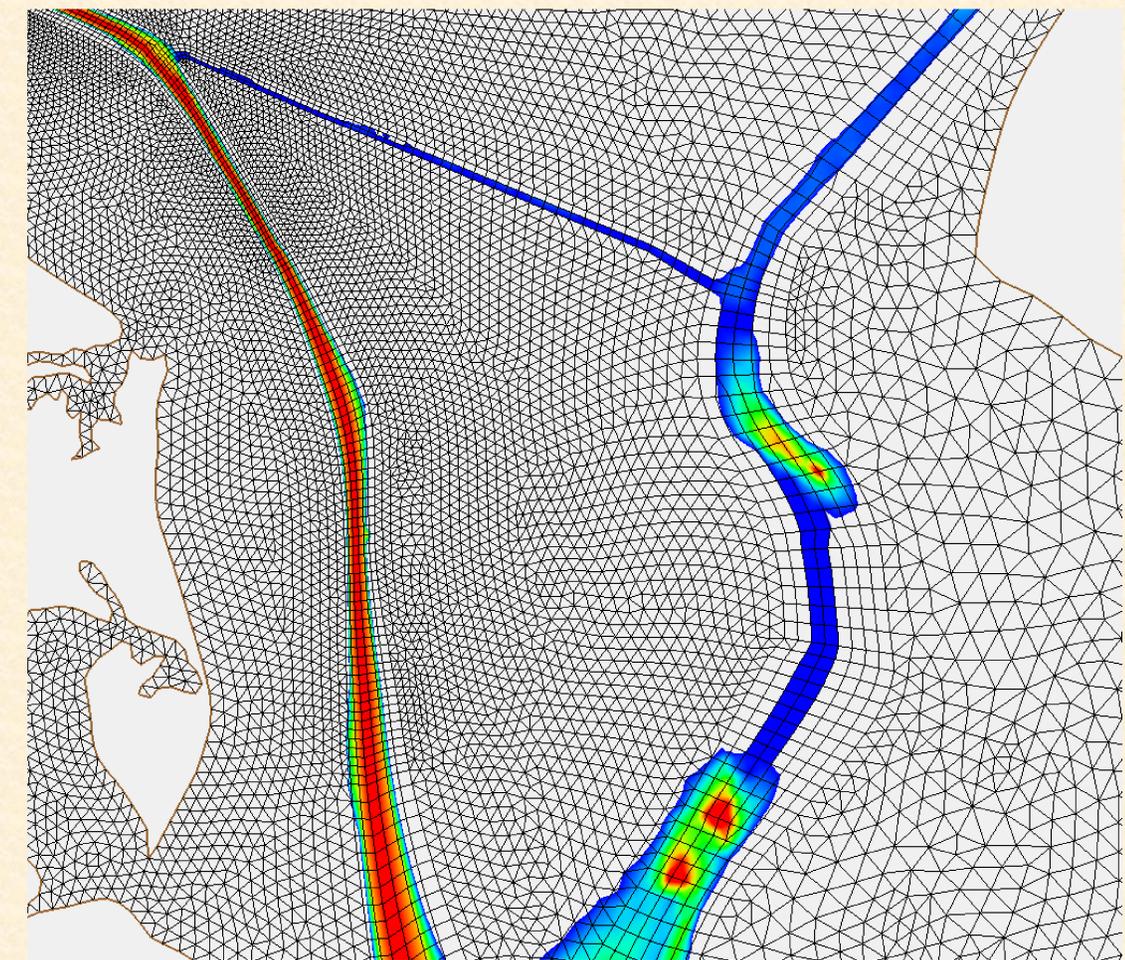
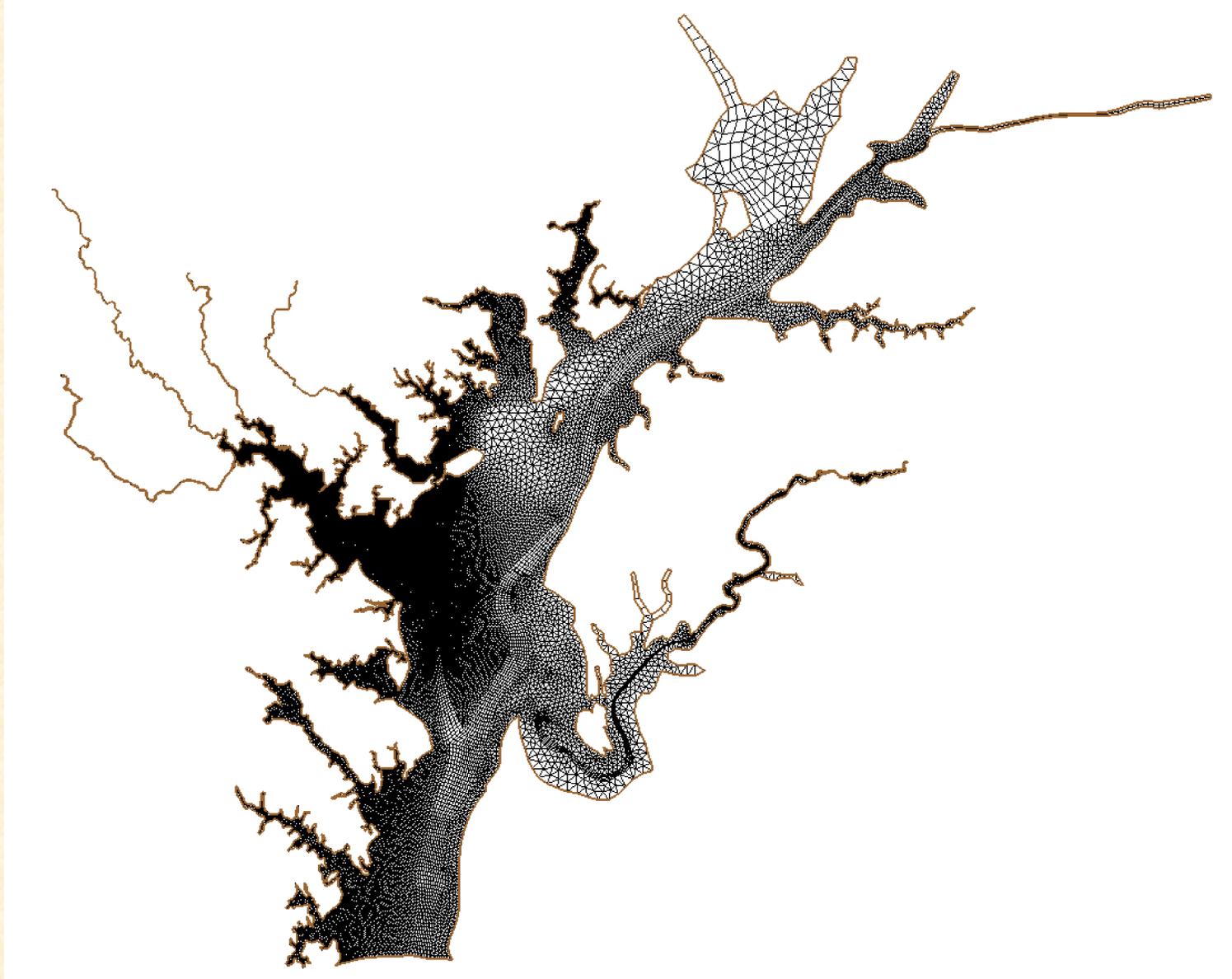
MTMs



MTM – Patapsco/Back

The Patapsco/Back Upper Bay Model covers all of the Chesapeake north of the Bay Bridge and has already been used in the Key Bridge response assessing resuspension of Baltimore Harbor sediment. The PIs are Harry Wang and Jeremy Testa.

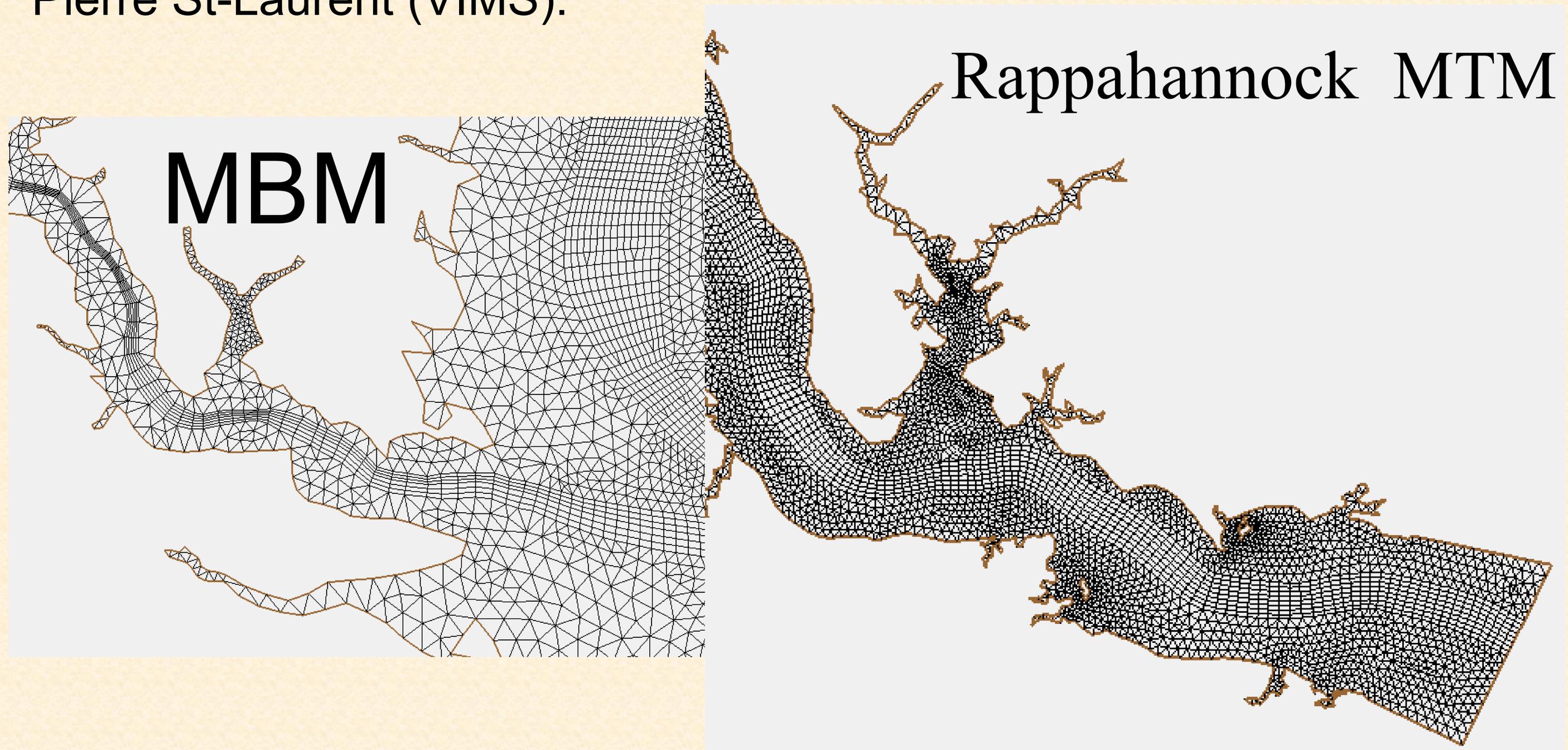
Coupled hydrodynamic, sediment transport, wind wave, water column water quality, and sediment flux models in offline mode were successfully implemented in Patapsco/Back River MTM. Water level, temperature, and salinity were well-represented compared with observations and water quality variables of DO, chlorophyll-a, TN, and TP are within a reasonable range of observation.





MTM - Rappahannock

While still in development with the hydrodynamic model calibration complete the Rappahannock MTM was used to assess tidal freshwater withdraws for a proposed data center. The lead PIs are Qubin Qin (East Carolina University) and Jian Shen (VIMS) with Zhengui Wang and Pierre St-Laurent (VIMS).

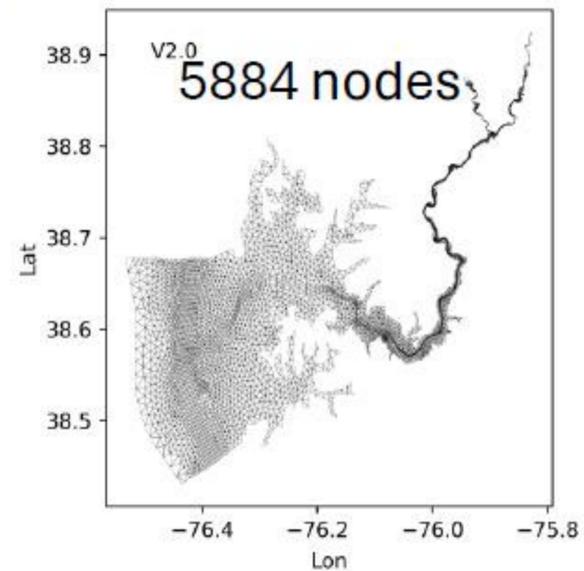
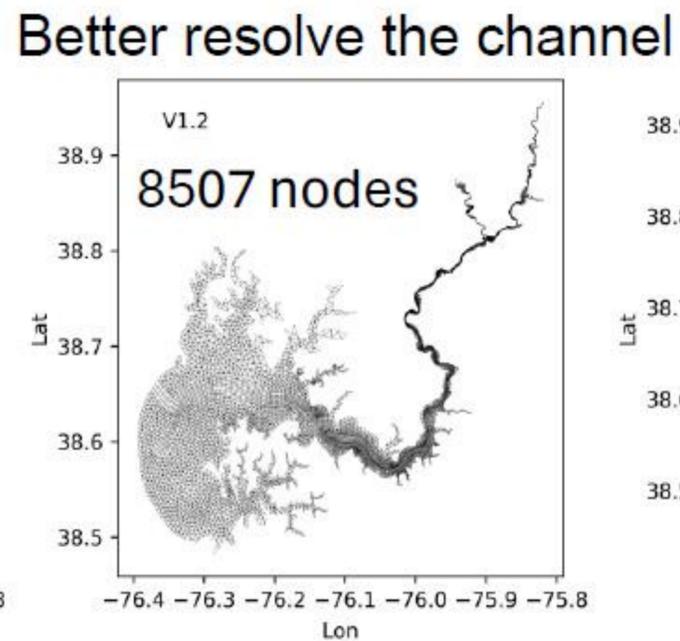
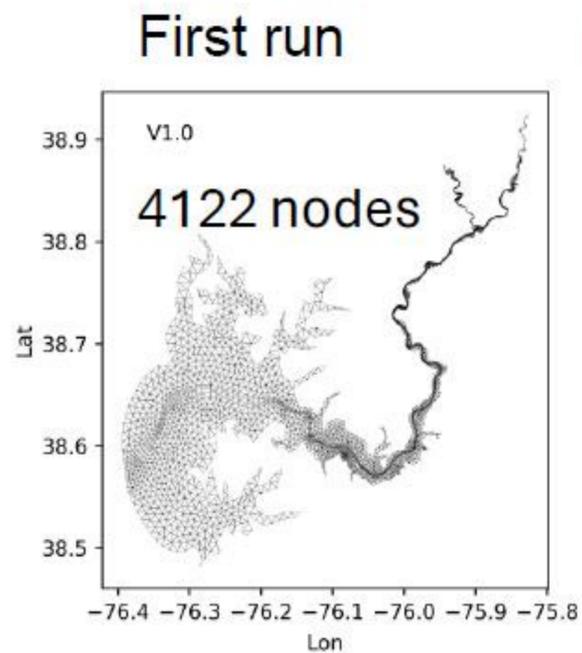




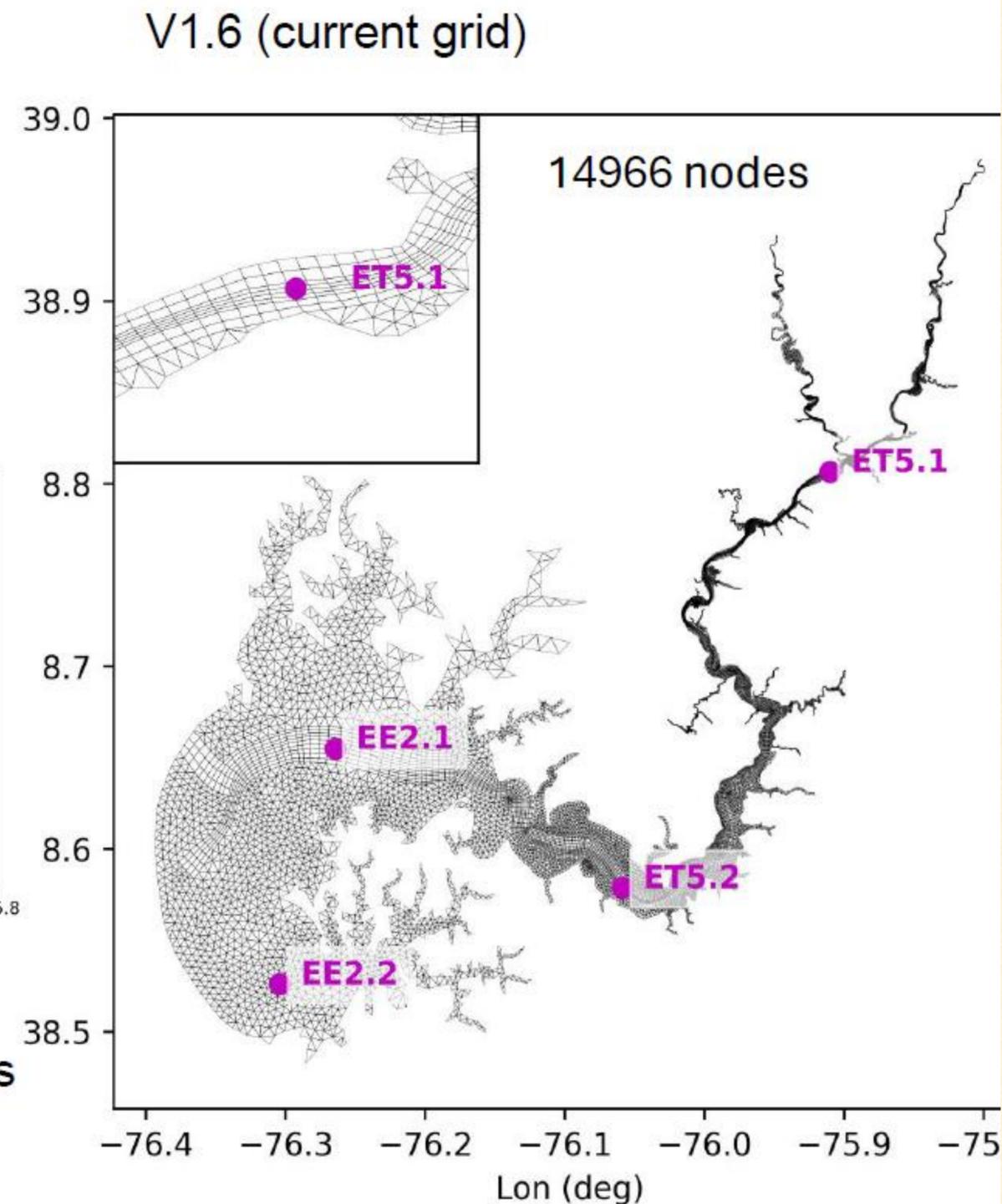
MTM - Choptank

The Choptank MTM, just now starting its water quality calibration, will be particularly useful at examining living resources in the Choptank including oyster sanctuaries and aquaculture. The lead PI is Jian Zhao with William Nardin, Elizabeth North, Larry Sanford, Jeremy Testa (UMCES) and Jiabi Du (Texas A&M).

Different model grids were configured.



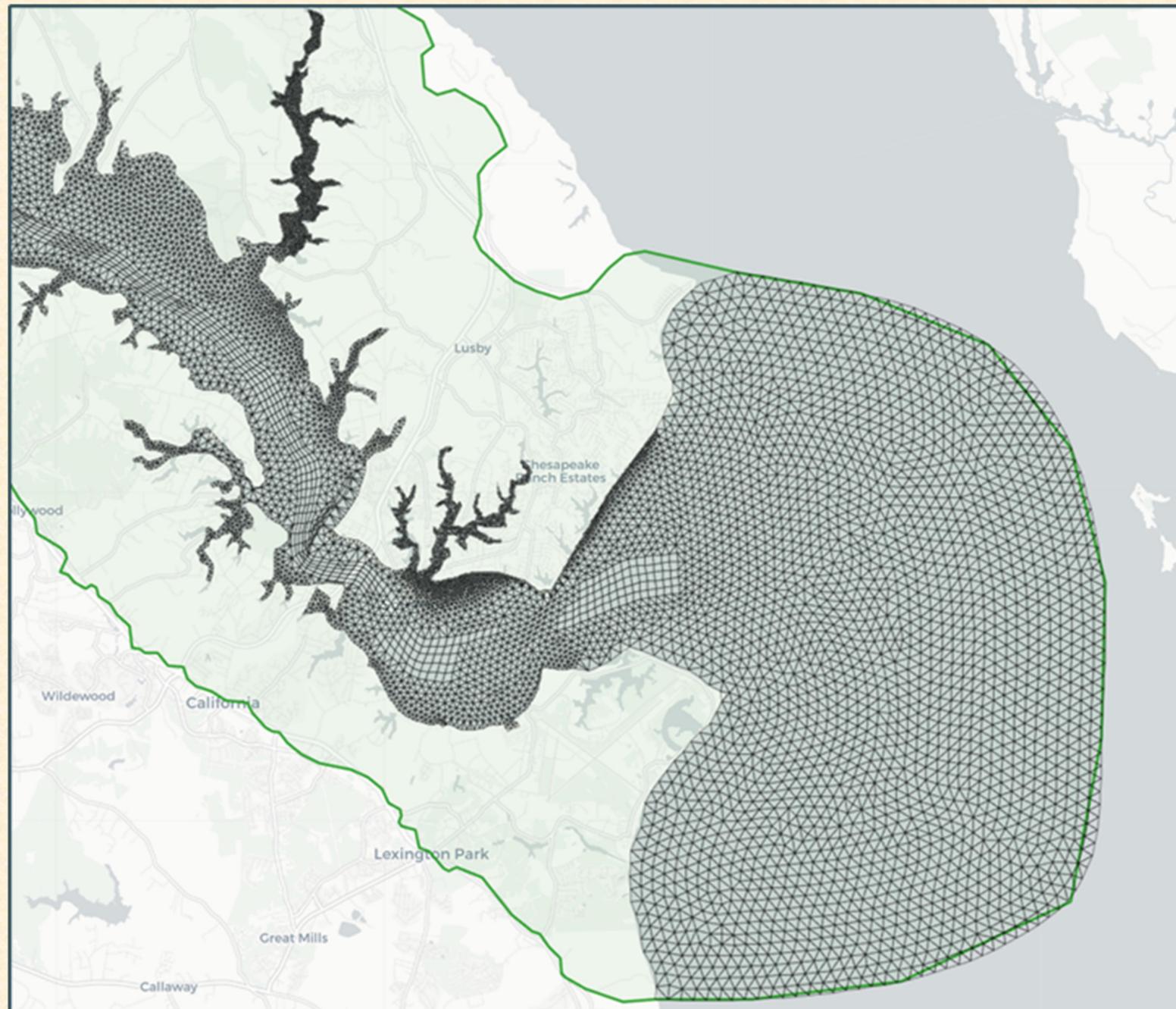
- Based on V1.0
- Two open boundaries





MTM - Patuxent

Amir Azarnivand and Jeremy Testa (UMCES) have recently proposed a Patuxent MTM. They are completing the hydrodynamic calibration with good results.



TRACER



CBP Tracer Analysis History

Tracer analysis has been used in the CBP since the Phase 2 Model in the 1990s.

- Wang, P., L. Linker, R. Batiuk, and W. Lung, 2008. Tracer simulation to analyze channel effect on particle transport in the Chesapeake estuary, ***Estuarine and Coastal Modeling: Proc. Tenth International Conference***, Newport, RI, USA, Nov 5-7, 2007., ISBN 978-0-7844-0990-9, p.744-763.
- Wang, P. L.C. Linker, W.S. Lung, and R. Batiuk, 2002. Analysis of particle transport using particulate tracer modeling. AGU 2002 Spring Meeting. Baltimore, MD.
- Wang, P. and L.C. Linker, 2002. Use of surface and tracer analysis to estimate nutrient and sediment load allocations to the Chesapeake Bay. Watershed 2002 Conference, ***Proceedings of the Water Environment Federation Watershed 2002***. Water Environment Federation, Ft. Lauderdale, FL.
- Wang, P., L.C. Linker, R.A. Batiuk, and G.W. Shenk, 2000. Assessment of impact of storm on point source pollutant transport in an estuary by dissolved tracer modeling. ***Water Quality and Ecosystem Modeling*** Volume 1, Number 1-4, p253-269.
- Linker, L.C., and K. Neumiller, 1994. Transport of Conservative Tracers in the Chesapeake Bay Water Quality Model. Chesapeake Bay Research Conference 1994 - Toward a Sustainable Coastal Watershed: The Chesapeake Experiment. Publication number CRC 149. Chesapeake Research Consortium, Edgewater, MD.



Recent Results in CBP Tracer Analysis

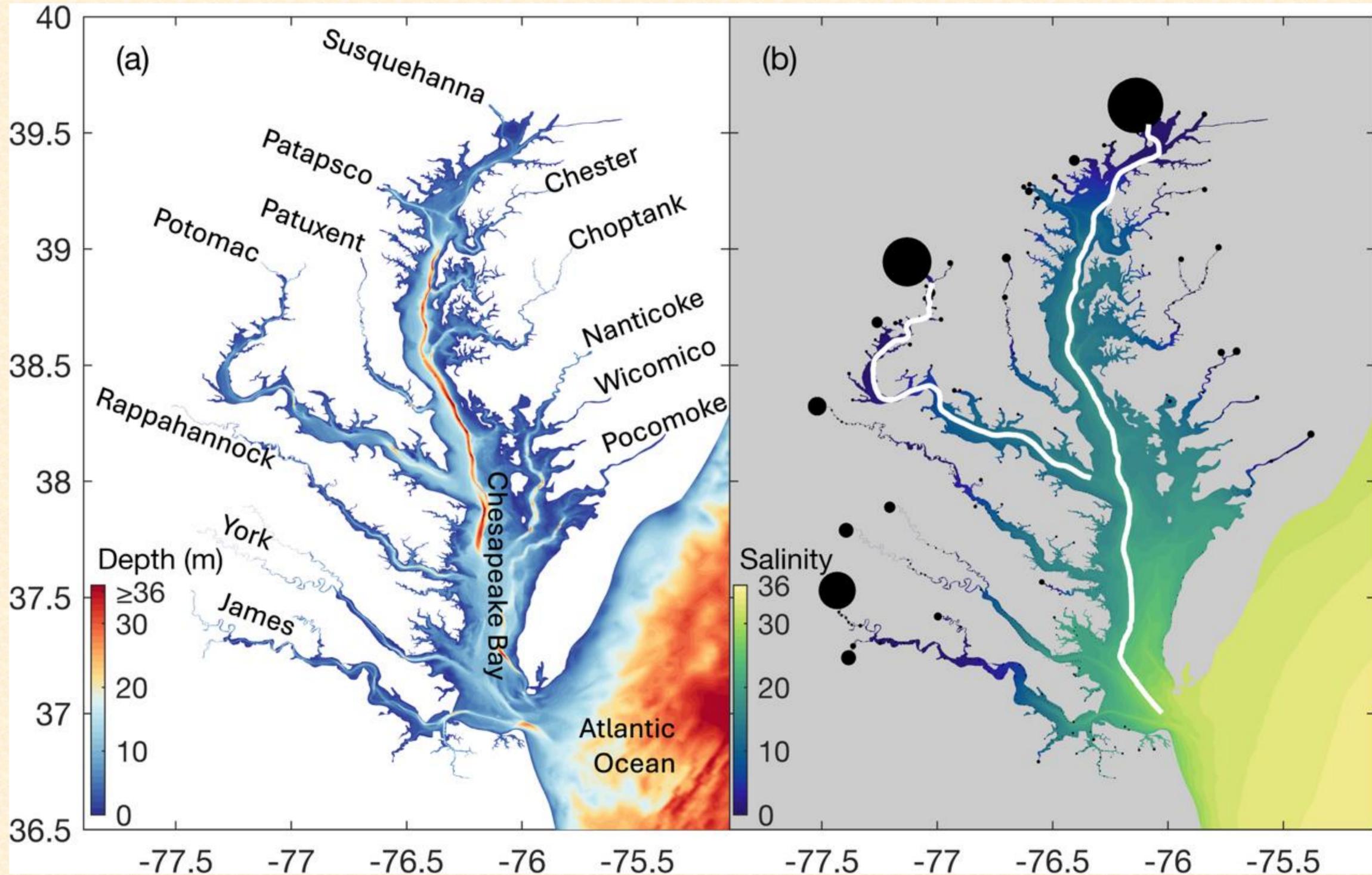


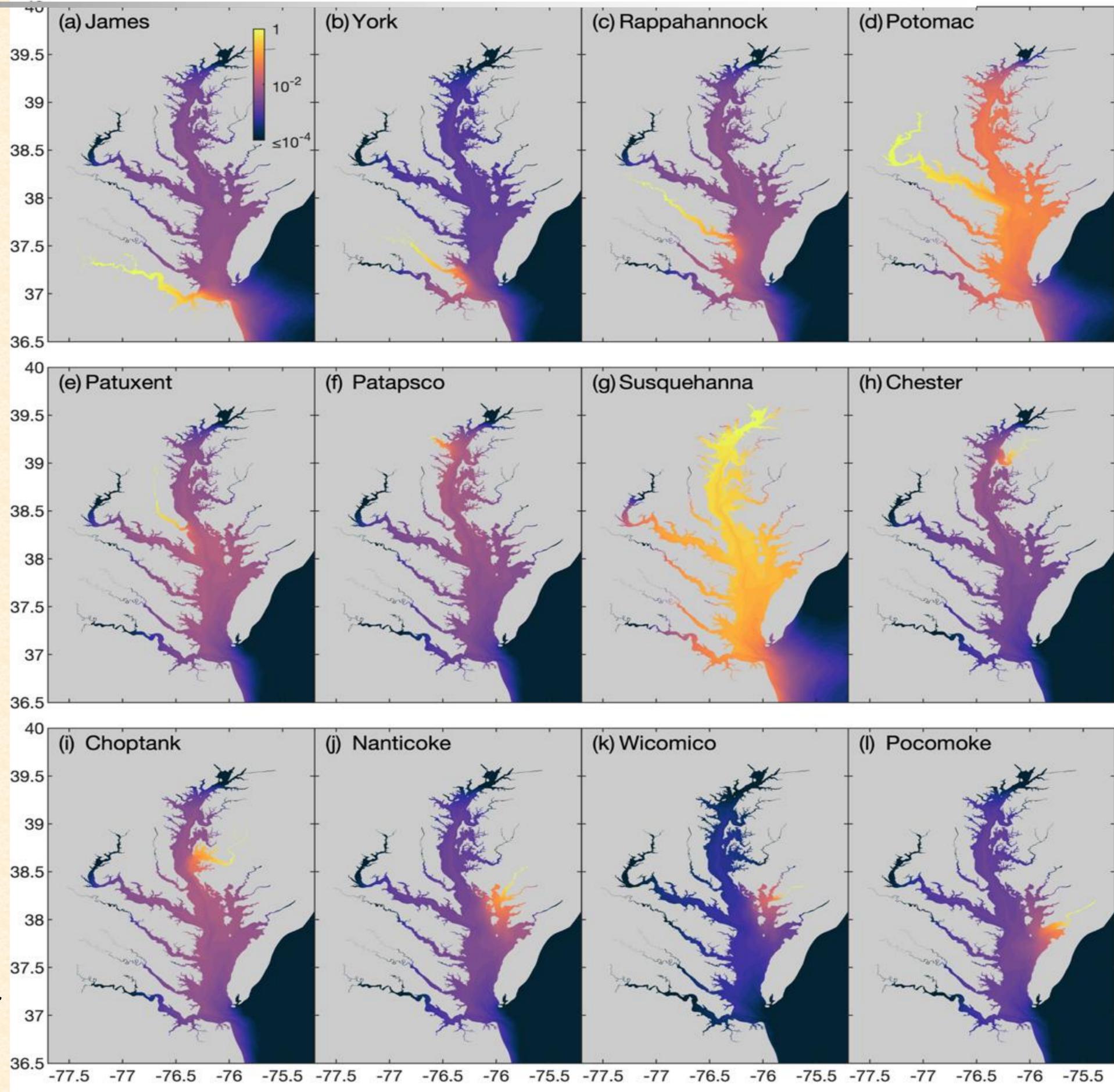
Figure 1. (a) Bathymetric map of Chesapeake Bay and its twelve major tributaries included in his modeling study. (b) Mean depth-averaged salinity and mean river discharges into the Bay over the period 2011–2014, shown as filled circles with areas scaled proportionally to discharge magnitude.

Source: Qubin Qin, Xun Cai, Jian Shen, and Lewis Linker, 2026. Riverine Freshwater Connectivity Between Major Tributaries in Chesapeake Bay AGU In publication.



Recent Results in CBP Tracer Analysis

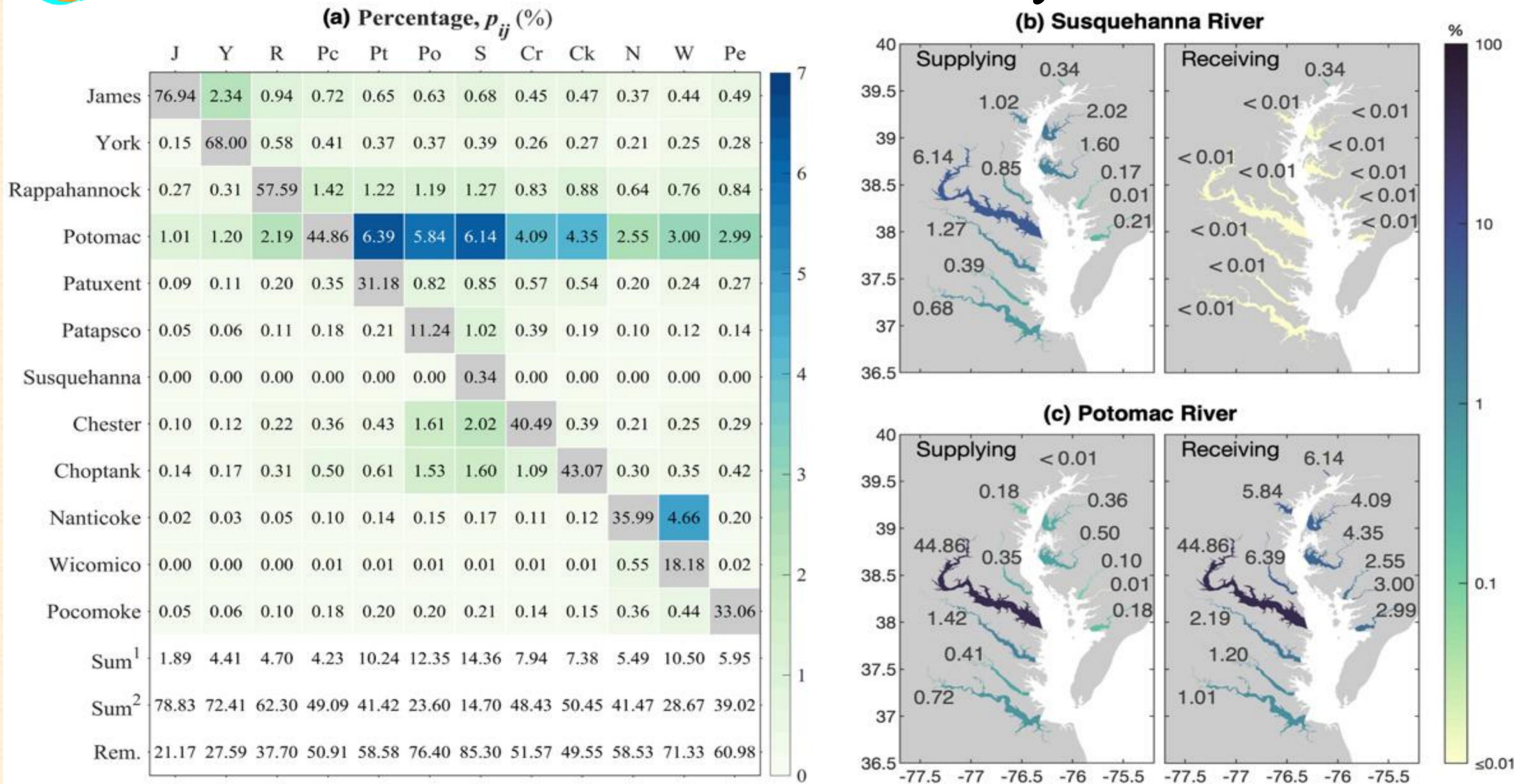
Four-year (2011–2014) average depth-averaged dye concentrations representing freshwater constituents discharged from each of the twelve tributaries.



Source: Qubin Qin, Xun Cai, Jian Shen, and Lewis Linker, 2026. Riverine Freshwater Connectivity Between Major Tributaries in Chesapeake Bay AGU In publication.



Recent Results in CBP Tracer Analysis



(a) Heatmap showing the mean percentage of freshwater from each supplying tributary (x-axis) present in each receiving tributary (y-axis). Sum1 represents the total percentage from the eleven other tributaries excluding the supplying tributary, while Sum2 represents the total percentage from all twelve tributaries. Rem. indicates the percentage of freshwater constituents remaining within the Bay

Source: Qubin Qin, Xun Cai, Jian Shen, and Lewis Linker, 2026. Riverine Freshwater Connectivity Between Major Tributaries in Chesapeake Bay AGU In publication.



Conclusions

- The CBP Modeling develops and applies state-of-the-science integrated environmental models to “improve the water quality and living resources in the Chesapeake Bay ecosystem.”
- The CBP models combine modeling, research, and monitoring to support CBP implementation of environmental management that is environmentally protective and cost effective.
- The CBP modeling tools and analyses are deeply collaborative by design and extensively used in the CBP policy and scientific communities of the Chesapeake watershed and Bay.





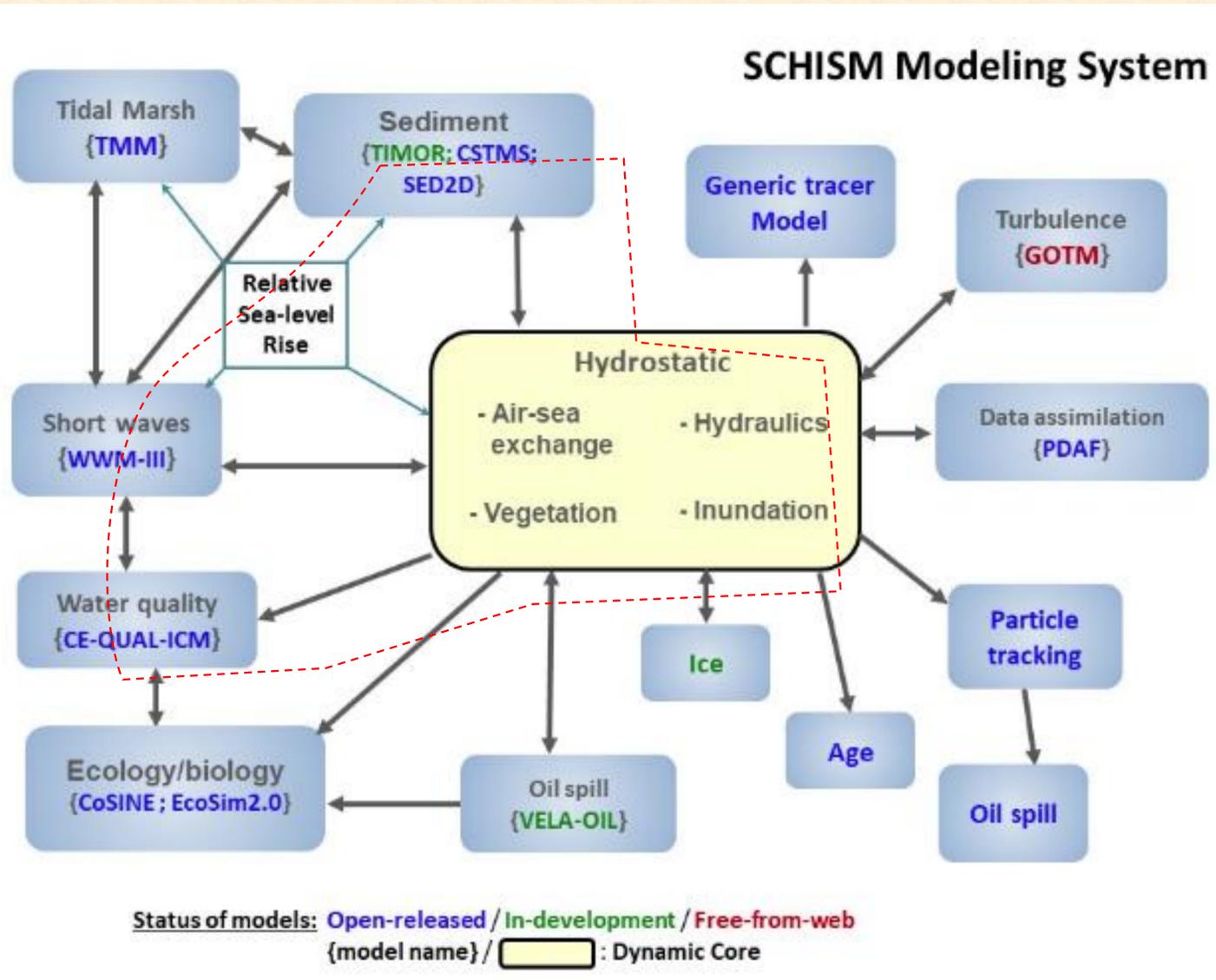
Conclusions *(continued)*

- The Phase 7 suite of models are on track for model development completion in 2026 and starting the year of review in 2027.
- The Dynamic Watershed Model will be largely complete by the July Modeling Quarterly Review and ready for Modeling Workgroup final review at our October Quarterly.
- The Main Bay Model and Multiple Tributary Models will be completed and ready for Modeling Workgroup review at the January 2027 Quarterly.





MBM: Decision Model for CBP Nutrient Targets



MBM consists of several modules of SCHISM system

- Hydrodynamics (including vegetation physics)
- Water quality (ICM, including vegetation biochemistry)
- Waves (WWM)
- Sediment transport (CSTM→SED3D)
- Sea-level rise capability
- For efficiency, MBM will eventually consist of two steps

Step 1 + Step 2:
SCHISM+WWM+SED+VEG+ICM

Step 2

2. ICM + SED

- Read in the saved outputs from Step 1
- With inputs from airshed and watershed models, solve for all WQ state variables, plus (optional) living resources, wetland
- Aim for performance (~10 SYPD) for massive number of simulations
- Explore feasibility for
 - hindered settling
 - Effect of suspended organic matter on the bottom shear stress
 - Algal effect
 - Interaction with the sediment flux module

Step 1

1. Hydro step: fully coupled SCHISM+WWM+VEG
 - Schematized representations of wetland & SAV to control mesh size (mesh resolution can be high locally)
 - Self-consistent physics
 - The most expensive component is the wave module (WWM), and we expect the fully coupled model to run ~2 SYPD even on high resolution
 - This step is done occasionally
 - Save outputs for Step 2: T,S, bottom stress, and other forcing variables (e.g. light etc)