Application of Multiple Models to Support Chesapeake TMDL

Modeling Workgroup

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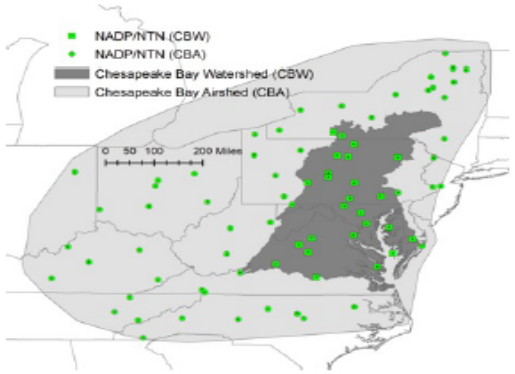
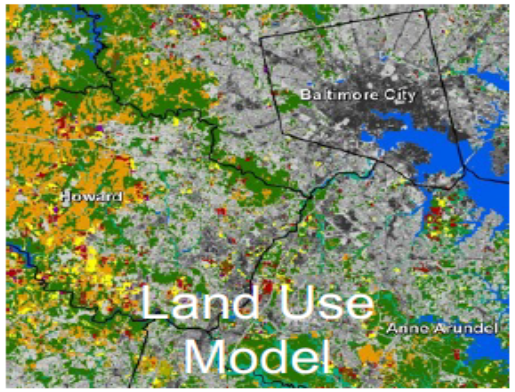
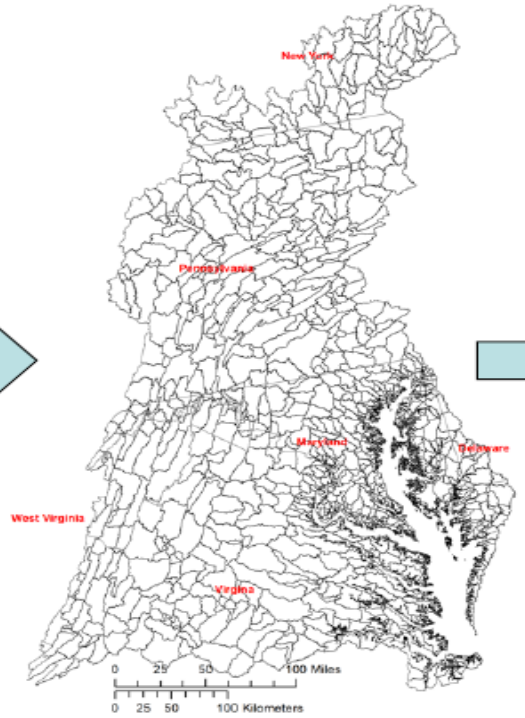
The CBP Climate Change Assessment

Airshed Model

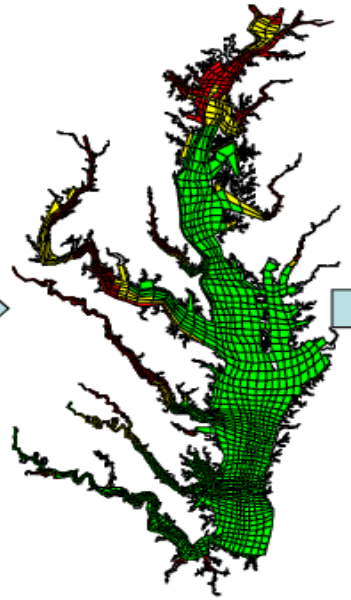




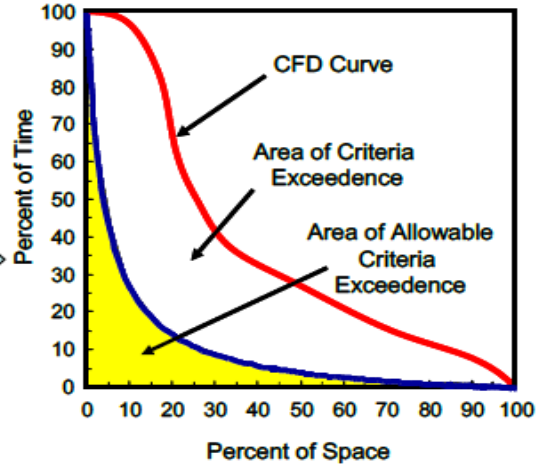
Watershed Model



Tidal Water Quality Model



Criteria Assessment Procedures



Effects

Nutrient and sediment targets for CBP State and Federal Partnership

Allocations

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Overview of the Main Bay Model (MBM) and Multiple Tributary Model (MTM) Workplan: Interim Development Phase (2023-2024)

Calendar Year		2023				2024				2025			
Calendar Quarter		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Year		Year 2				Year 3				Year 4			
Task 2 Interim MBM and MTM Development (2023 – 2024)	Task 2												
2-1. Initiate MTM activities (Q1-Q2: 2023).	Task 2.1												
2-2. Kick-off joint meetings of MBM and MTM Teams with Mod WG (Q1-Q2: 2023)	Task 2.2												
2-3. Conduct full initial calibration and verification of hydrodynamic and WQ model output (Q3-Q4: 2024).	Task 2.3												
2-4. Address important knowledge gaps in ICM (All Qs: 2024).	Task 2.4												
2-5. Begin completion of work to improve shallow water dynamics in MBM (All Qs: 2024).	Task 2.5												
2-6. Begin completion of work to improve shallow water dynamics in MTMs (All Qs: 2024).	Task 2.6												
2-7. Completion of work on basic living resource linkages of refined chlorophyll, wetland, and SAV simulation an	Task 2.7												
2-8. Completion of work using MBM and MTMs to better resolve CBP problem segments (All Qs: 2024).	Task 2.8												
2-9. Completion of work examining CC influence on SAV, shallow water, & phenology of CC watershed loads an	Task 2.9												
Task 3 Final MBM and MTM Development (2005)	Task 3												
3-1. Provide a fully operational MBM that meets the needs of CBP (Q2-Q3: 2025).	Task 3.1												
3-2. Finish documentation on the software package in a report that will include detailed documentation on model st	Task 3.2												
3-3. Demonstrate feasibility and utility of using a state of the science UG model to better estimate Chesapeake WQ	Task 3.3												
3-4. Transfer the software package to CBPO for operational testing, and work with CBPO personnel to test the mo	Task 3.4												
3-5. All MBM and MTMs fully operational (Q4: 2025).	Task 3.5												

Overview of the MBM & MTM: Final Model Development (2025)

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		2025			
Calendar Year					
Calendar Quarter		Q1	Q2	Q3	Q4
Project Year		Year 4			
Task 3 Final MBM and MTM Development (2005)	Task 3				
3-1. Provide a fully operational MBM that meets the needs of CBP (Q2-Q3: 2025).	Task 3.1				
3-2. Finish documentation on the software package in a report that will include detailed documentation on model st	Task 3.2				
3-3. Demonstrate feasibility and utility of using a state of the science UG model to better estimate Chesapeake WQ	Task 3.3				
3-4. Transfer the software package to CBPO for operational testing, and work with CBPO personnel to test the mo	Task 3.4				
3-5. All MBM and MTMs fully operational (Q4: 2025).	Task 3.5				
3-6. Conduct full review of al MBM and MTMs with CBP technical and management groups and with STAC (All	Task 3.6				
3-7. Review all recent studies related to Bay WQ processes and work with CBP and Mod-WG to identify key miss	Task 3.7				
3-8. Provide estuarine models, analysis tools, and initial scoping scenarios, final code version and other materials	Task 3.8				
3-9. Finalize work to improve shallow water dynamics in MBM (Q1-Q2: 2025).	Task 3.9				
3-10. Finalize work to improve shallow water dynamics in MTMs (Q1-Q2: 2025).	Task 3.10				
3-11. Finalize work on basic living resource linkages of refined chlorophyll, wetland, and SAV simulation and pot	Task 3.11				
3-12. Finalize work using MBM and MTMs to better resolve CBP problem segments (Q1-Q2: 2025).	Task 3.12				
3-13. Finalize work examining CC influence on SAV, shallow water, and phenology of CC watershed loads and tic	Task 3.13				

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MBM and MTM Review (2026) and Application (2027)

		2026				2027			
Calendar Year									
Calendar Quarter		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Year		Year 5				Year 6			
Task 4. MBM and MTM Review (2026) and Application (2027)									
4-1. Provide final estuarine models, analysis tools, model documentation and other materials to CBPO (Q1:2026).									
4-2. Improve the CBP management decisions through the successful application of developing quantitative assessments c									
4-3. Provide initial (2026) and final (2027) scoping scenarios, analyses, and other materials to support Chesapeake prot									
4-4. Develop user-friendly interfaces with model software and technical transfer training so that a variety of stakeholder									
4-5. Develop and apply 2035 CC and all other management MBM and MTM scenarios as determined by CBP decision r									
4-6. Document the findings and recommendations in the final report (Yr 6: 2027).									
4-7. Provide final TMDL scenario simulation results to address the needs and requirements of CBP decision makers and									

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MBM and MTM Continuous Activities (2022 - 2027)

		2026				2027			
Calendar Year									
Calendar Quarter		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Project Year		Year 5				Year 6			
Task 5. Continuous Activities	Task 5								
5-1. Support the Modeling Workgroup, WQGIT, and other technical and management/policy CBP groups as needed (All	Task 5.1								
5-2. Host a dedicated web site for the new Main Bay Model (MBM) (All Qs: 2022 2027 with final deliverable Q3 202	Task 5.2								
5-3. Submit annual reports with detailed documentation on model structure, major code changes, validation, and calibrat	Task 5.3								
5-4. Disseminate research findings & experiences via 1-2 journal papers/year (All Qs: 2022-2027).	Task 5.4								
5-5. Coordination/collaboration meetings among MBM and MTM Teams (All Qs: 2023-2027 coincident with CBP Mod	Task 5.5								

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MBM and MTM Outcomes

1. Reduced nitrogen, phosphorus, and sediment delivered to tidal Bay waters appropriate to respond to 2035 and future climate change in order to achieve Bay water quality standards.

2. Amount of habitat restored as represented by achievement of the Chesapeake living-resource-based water quality standards and direct simulation, e.g., oysters, SAV, or linkages to higher trophic levels, e.g., finfish.

3. Improved knowledge about the critical load of nutrients that the Chesapeake Bay would have under 2035 and future climate change via ensemble simulations.

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).

Motivation for Development and Application of MTMs

Improving CBP Science, Analysis, and Implementation for Chesapeake Climate Change Impacts. The MTMs will fully integrate and dovetail into the MBM by increasing the CBP science teams looking into Chesapeake water quality issues. Over the course of the project, five MTM modeling teams will apply a fine scale grid in the tributaries that will share the same unstructured model codes, water quality state variables, and watershed and airshed loading as the MBM. The MTM teams will improve Chesapeake Bay shallow water simulations of dissolved oxygen, chlorophyll, suspended solids, and water clarity in order to better understand the impacts of alternative management strategies on water quality and living resources in the tidal Chesapeake Bay. In addition, the MTMs will be able to utilize the CBP investment in shallow water continuous monitoring for the first time in the Chesapeake TMDL. The MTMs will augment the MBM in a collaborative investigatory approach with the MBM team collaborating and coordinating with the five MTM teams on a monthly basis over the entire project period. Under this structure the MBM and MTM teams will learn from each other in understanding and simulating newly developed shallow water nutrient dynamics and processes, improving both the MBM and the MTMs and the estuarine restoration implementation work they support.