Leveraging Artificial Intelligence and Machine Learning to Advance Chesapeake Bay Research and Management: A review of status, challenges, and opportunities

February 24-25, 2025
SERC, Edgewater, MD

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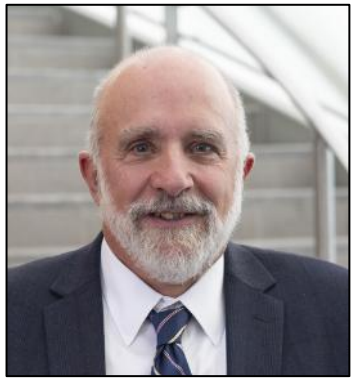

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50+ Workshop Participants (In-person and Virtual)

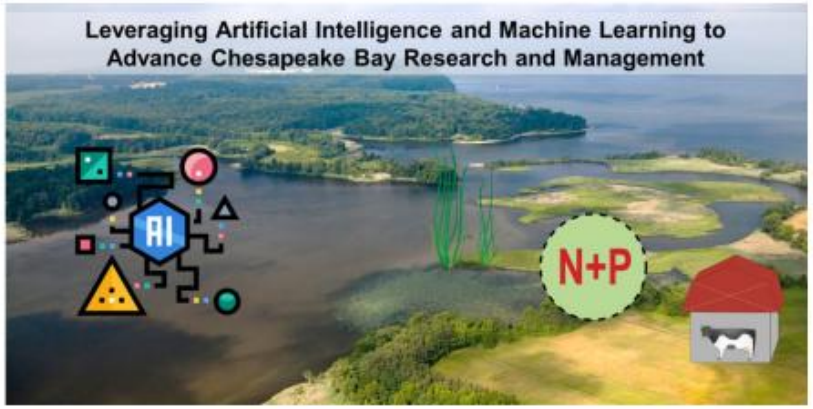
Workshop Objectives

This workshop gathered federal, state, and academic partners to synthesize the **state of the science on AI/ML** approaches, identify research needs, and improve science coordination.

1. **Summarize recent AI/ML applications to the Chesapeake Bay ecosystem and lessons learned**
2. **Identify the challenges and gaps in applying AI/ML approaches to Chesapeake Bay data**
3. **Develop recommendations and identify opportunities for harnessing the power of AI/ML approaches to address Chesapeake Bay issues**

Workshop Report

Leveraging Artificial Intelligence and Machine learning to Advance Chesapeake Bay Research and Management: A Review of Status, Challenges, and Opportunities



STAC Workshop Review
February 24-25, 2025
Edgewater, MD

STAC Publication 25-005

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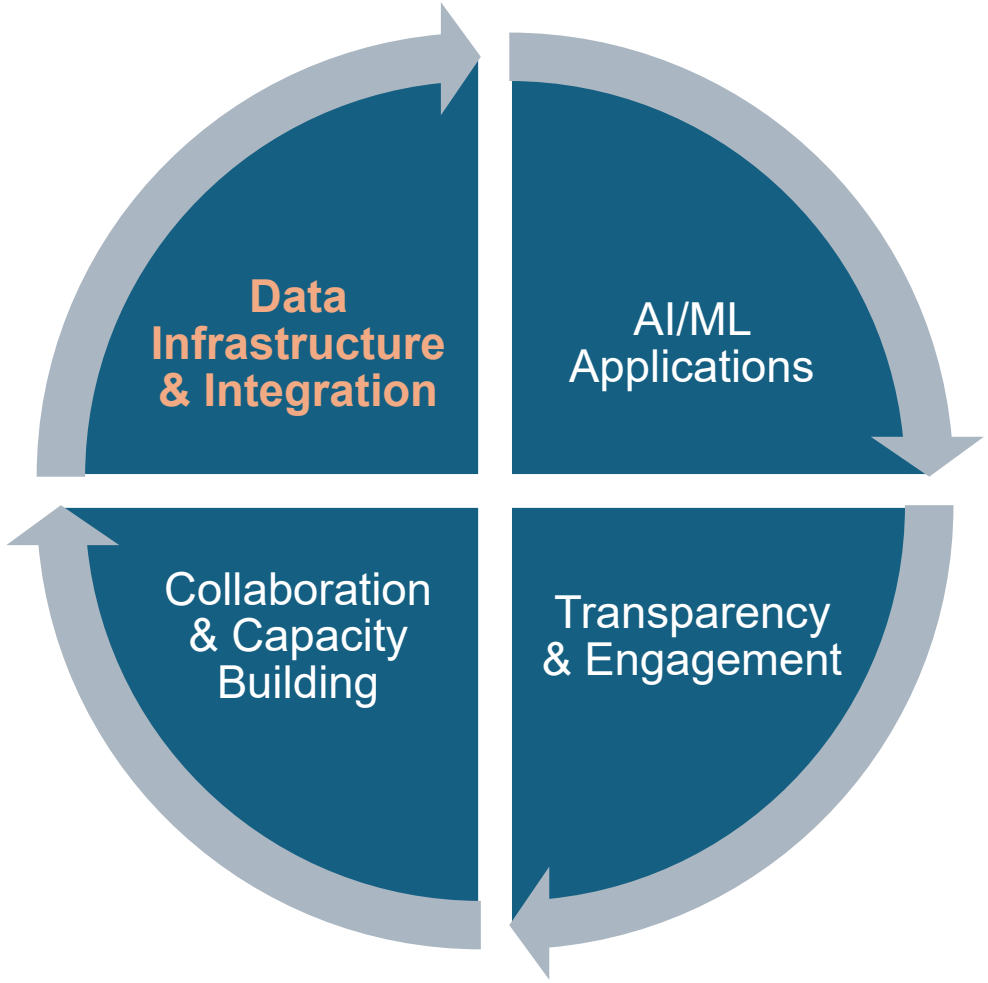
https://www.chesapeake.org/stac/wp-content/uploads/2025/11/FINAL_Leveraging-AI-and-ML_25-005-1.pdf

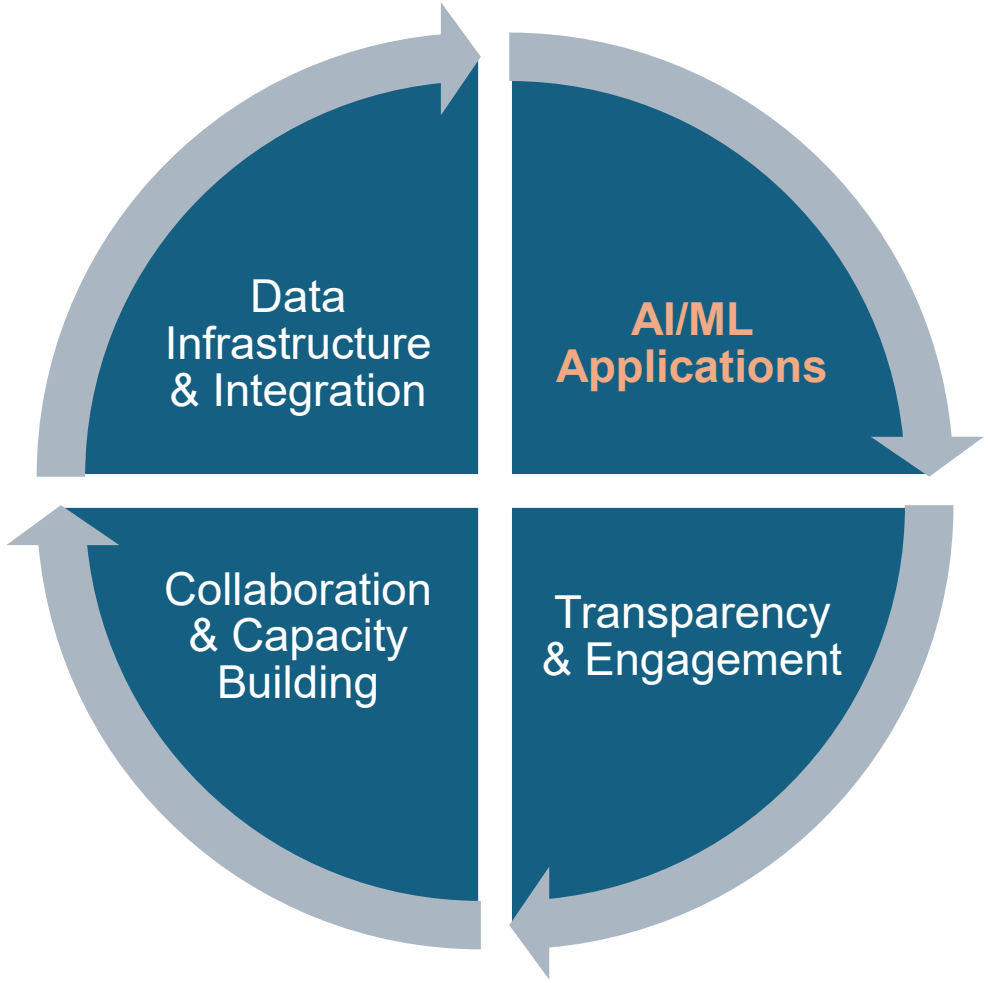
Workshop Recommendations



1. Strengthen data infrastructure and integration for AI/ML applications

- Harmonize spatial and temporal datasets across programs and ensure consistent metadata.
- Leverage diverse datasets, including satellite, in-situ, and high-frequency data, for modeling, monitoring, and filling water quality data gaps. (*MB1)
- Design monitoring and data processing efforts so that resulting products are problem-relevant and can be readily incorporated into AI/ML workflows.
- Build harmonized response and predictor datasets and develop exemplar use cases to guide widespread AI/ML applications. (*MB3)

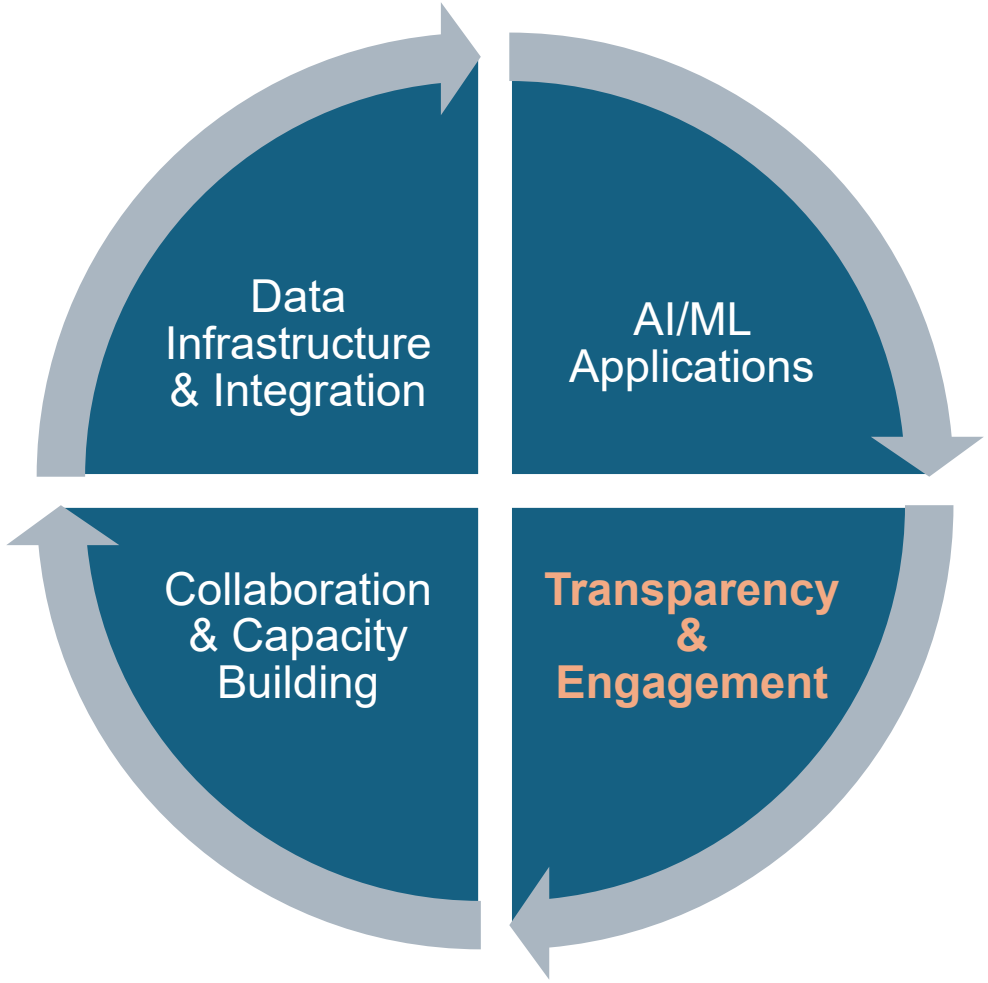
Workshop Recommendations



2. Leverage AI/ML for restoration of Chesapeake Bay tidal and non-tidal regions restoration and decision support

- Use AI/ML to assess restoration practices, evaluate progress, and identify drivers.
- Enhance Watershed and Estuarine Models by integrating AI/ML model outputs and insights. (*MB2)
- Develop accessible AI-driven tools (e.g., Chesapeake-specific LLMs) for scenario planning to help identify management priorities.

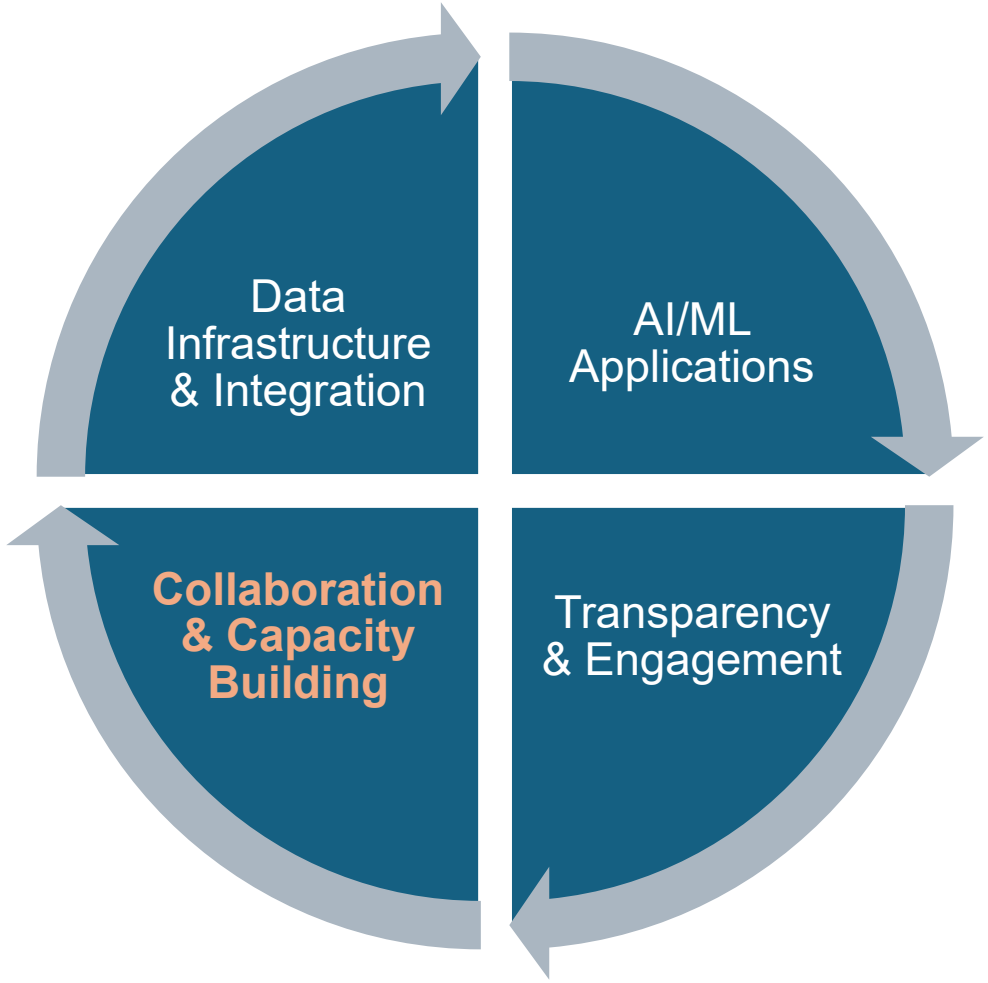
Workshop Recommendations



3. Promote transparency and engage managers and stakeholders

- Advance explainable AI and uncertainty protocols so that results are interpretable and trusted.
- Couple AI/ML with tailored data visualizations to improve interpretability and use.
- Foster close engagement of managers and decision-makers at all stages of AI/ML projects to ensure products align with management priorities and can be effectively applied.
- Use tailored communication strategies to translate AI/ML insights into actionable guidance for restoration planning.

Workshop Recommendations



4. Build collaboration and capacity

- Establish a Chesapeake Bay AI/ML network (e.g., **Ches-BRAIN**) to foster collaboration and conversations and to provide a clear place where managers and others can easily find and connect with AI/ML experts.
- Encourage participatory events such as Hackathons to spark innovation and strengthen cross-sector collaboration.
- Invest in training and literacy programs so that scientists, managers, and decision-makers can effectively use AI/ML tools and outputs.

** Ches-BRAIN: Chesapeake Bay Research with Artificial Intelligence and Networking*

Management Board Response (12/11/2025)

MB Response to STAC AI Publication

The Management Board appreciates the Scientific and Technical Advisory Committee's publication *Leveraging Artificial Intelligence and Machine Learning to Advance Chesapeake Bay Research and Management: A Review of Status, Challenges, and Opportunities*. The publication highlights the critical potential role artificial intelligence and machine learning have in expanding our understanding of environmental change, system dynamics, and predicting conditions in areas with limited monitoring. As STAC pointed out, Artificial Intelligence (AI)/ Machine Learning (ML) represent a potentially transformative tool in environmental research to assess patterns from large, complex datasets that traditional analysis methods cannot.

The Management Board acknowledges STAC's recommendations: strengthening data infrastructure and integration for AI/ML applications; leveraging AI/ML for restoration of Chesapeake Bay tidal and nontidal regions and decision support; promoting transparency and engaging managers and stakeholders; and building collaboration and capacity. While some of the recommendations, such as investing in communication strategies and training and literacy programs for scientists and others, reflect broader socioeconomic efforts to better integrate with AI/ ML, the Management Board recommends that the STAC further investigate the following items as they related to AI/ML and Chesapeake Bay research and restoration:

1. *Leverage diverse datasets, including satellite, in-situ, and high-frequency data, for use in modeling and monitoring applications and filling water quality data gaps* – The Management Board recommends that STAC provide advice on how to expedite the approval process for innovative methods using these data sets and how AI/ ML and leveraging satellite data can allow for a greater efficiency in BMP verification in agricultural and developed land uses.
2. *Enhance watershed and estuarine models by integrating AI/ML model outputs and insights* – The Management Board recommends that STAC provide advice as to how AI/ ML can provide greater precision between modeling, land use/land cover, and monitoring data, especially in communities where data on BMPs remains incomplete.
3. *Build harmonized response and predictor datasets and develop exemplar use cases to guide widespread AI/ML applications* – The Management Board recommends that STAC provide advice and greater specificity on data structures and relationships that need greater attention or improvement to better support AI/ ML models.

The Management Board appreciates this initial review and looks forward to hearing from STAC as they pursue how to understand these issues and how the partnership can leverage AI/ ML to better support Chesapeake Bay research and restoration.

Machine Learning Models to Utilize Hi-Res Data in Water Quality Predictions

Kim Van Meter, PSU

Chaopeng Shen, PSU

Matt Baker, UMBC

Building models to help inform how CAST uses high resolution spatial data.

Beyond land-use and land cover

- Feature selection for P7
- Novel modeling pathways for P8

Building on Workshop recommendations 1 and 4: Strengthening data infrastructure, integrating diverse data sources, harmonizing predictor response datasets, and building collaboration and capacity.