AI/ML in CBW Management

STAC April 2026 Topical Meeting Synthesis

The Chesapeake Bay Program (CBP) Scientific and Technical Advisory Committee (STAC) held a virtual topical meeting on April 30, 2026, focused on the landscape of artificial intelligence (AI) and machine learning (ML) in environmental science and management of the Chesapeake Bay Watershed. This meeting was convened to consider where AI/ML can be meaningfully and responsibly implemented to support Chesapeake Bay decision-making, management, monitoring, and communication, and what conditions need to be in place for that implementation to be useful and credible.

Disclaimers:

1. STAC acknowledges the many concerns about ethical and environmental impacts of AI usage, including water and energy usage, land use, and potential community impacts.
2. Though used interchangeably, the terms artificial intelligence and machine learning have distinct definitions.

Speakers in the first panel highlighted where AI/ML is already being applied, where it appears most promising, and where its value for Chesapeake Bay work is still uncertain. Speakers in the second panel looked how AI may be used in real-world settings, alongside the risks, limits, and conditions that should shape its use. A short talk between the panels explained the undergoing development of an AI for identifying best management practice (BMP) opportunities on farms. Presentations were followed by breakout discussions. Panel recordings can be viewed on the meeting webpage.

Application and Potential

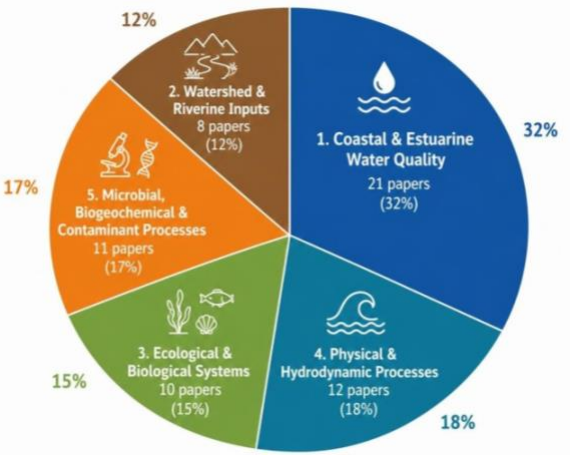

Figure 1. Distribution of AI/ML applications across major environmental domains. Data collected from a literature review (62 papers total) conducted by Zhang prior to the STAC workshop on AI/ML. Graphic created using AI.

Sciences within the Chesapeake Bay watershed have applied AI/ML in a variety of ways, including prediction and forecasting, gap filling and data reconstruction, pattern recognition and classification, process inference and driver attribution, scenario analysis and decision support. The distribution of AI/ML applications within recent Chesapeake Bay publications is shown in Figure 1. From aerial and satellite imagery, AI is used to map land cover and land use, habitats and wetlands. Insight gained from AI/ML application is informing the Chesapeake Assessment Scenario Tool (CAST), the development of the Phase 7 Watershed Model, and planning for future conservation and restoration activities.

Areas in which AI/ML application has great potential in Chesapeake Bay watershed include scaling the detection on BMPs from pilot projects to the watershed, identifying nutrient trend attribution, and predicting coastal flooding and sea level rise. The STAC workshop *Leveraging Artificial Intelligence and Machine Learning to Advance Chesapeake Bay Research and Management* produced four recommendations: (1) strengthen data infrastructure and integration for AI/ML applications; (2) leverage AI/ML for Chesapeake Bay tidal and non-tidal regions restoration and decision support; (3) promote transparency and engage managers and stakeholders; and (4) build collaboration and capacity.

Responsible Implementation

As with the advancement of all technologies, there are tradeoffs with the use of AI/ML that must be considered.

In discussions from the 2026 Bay in the Balance conference (Royer), the practitioner community acknowledges challenges for the applications of AI/ML that garner excitement. While geospatial AI might be able to identify and prioritize agricultural and urban locations to focus conservation efforts, the visualization tools must remain accurate and cannot diminish the conservationist's efforts to learn the lay of the land or build relationships with farmers and producers. Some are anticipating AI having the capability to streamline the conservation funding delivery system, in which many current projects need to applying for and managing multiple funding programs; however, the funding landscape changes quickly – often dramatically – and can be hyper-specific to place, practice, and other parameters that an AI/ML program may not be equipped to navigate.

State and federal agency staff who review public comments in the environmental rulemaking process (Erickson) hope that AI/ML can help them save time, reduce errors and bias, and better consider public perspectives. Staff hesitate to apply AI/ML due to ethical concerns with environmental impacts and protecting personally identifiable information, technical concerns about loss of nuance and context and lack of transparency, implementation concerns for the process change and lack of agency guidance on AI use, and professional concerns such as legal liability and fear of job loss. Those using AI primarily used chatbots to pull summaries or themes from comments. The most avid user views AI as an indexing tool.

> "I want to be clear about this. **I don't use AI to read the letters** and tell me what's in them. **I use it as kind of like an indexing tool**, if you will, that tells me if you're looking for this, **this is where to go find it.**"
>
> Quote from Erickson's interviews

The Digital Water department at Hampton Roads Sanitation Department (HRSD) are working on applying ML to optimize the control of nitrogen removal processes at their wastewater treatment plants (Bott). Feedback controllers are integral in the processes but the standard method of tuning controllers is through trial and error. Digital Water is combining ML into existing models to solve the complexity of tuning feedback controllers and in some projects, is running a digital twin to the mechanical process. HRSD is also building a staff assisting AI agent which has access to operation and management manuals, real time and historical data, lab data, operator data, and more. Addressing employee concerns about job loss, HRSD has undertaken an initiative to eliminate operator shift work.

Key Considerations in AI/ML Use

AI/ML models are interpolators, not extrapolators

Manual feedback and validation is needed to ensure accuracy

High-quality and abundant training data is required for AI applications to be useful

Recommendations

1. Model adoption should be informed by skill AND by insight. Need continued feedback and validation by humans
2. Environmental scientists need training in AI tools AND in how to interrogate them: understanding uncertainty, diagnosing failure modes, recognizing when a model is extrapolating.
3. Data scientists need ecological and management context to build tools that are actually useful.
4. Continued investment in field data is necessary for keeping AI-derived products relevant.

Results of a Topical Meeting

The CBP STAC manages a series of virtual topical half-day meetings through the year. This topical meeting was conducted by STAC, and this short summary represents a rapid turnaround overview.