2021 STAC proposal outline:

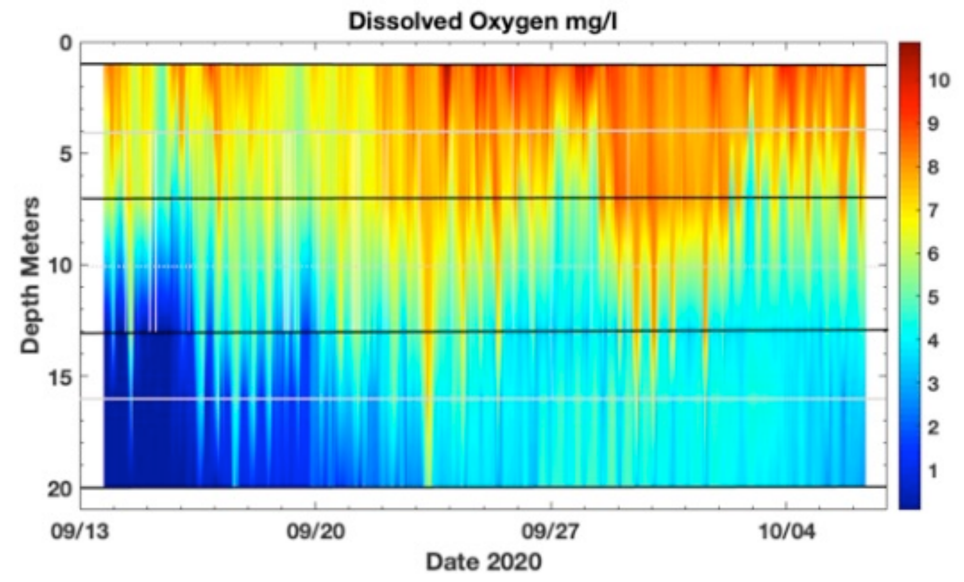
Establishing sustainable, cost effective monitoring and assessment recommendations to fully address Chesapeake Bay TMDL water quality standards assessment

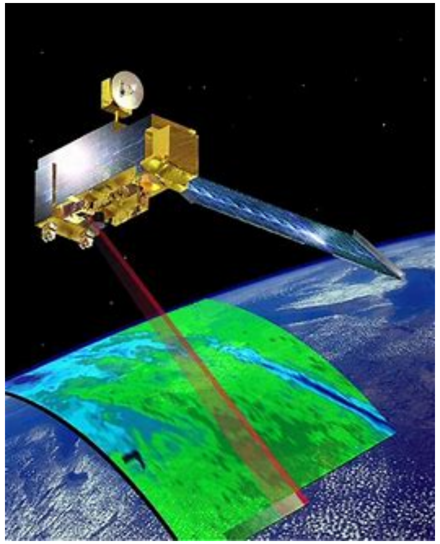
Peter Tango

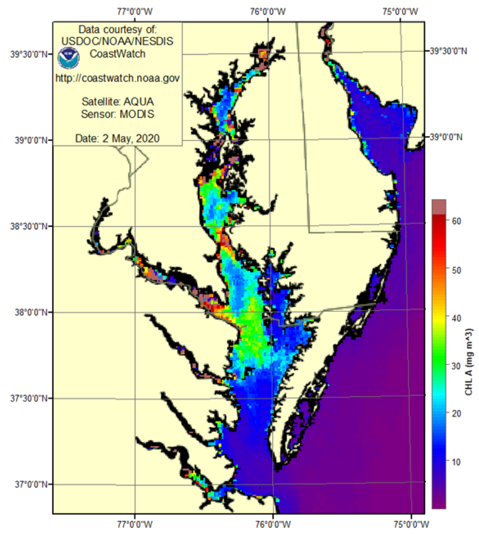
USGS@CBPO

STAC Presentation

12/14/2020







Through the 2014 Chesapeake Bay Watershed Agreement, *the Chesapeake Bay Program has committed to…*

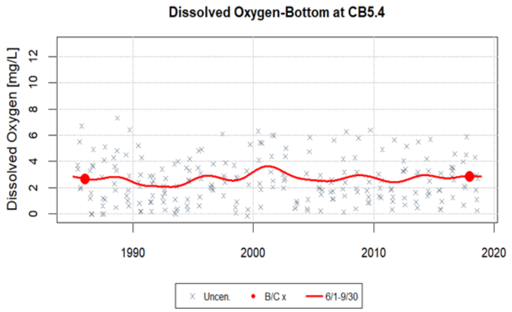
Goal: *Water Quality*

Outcome:

Continually improve the capacity to monitor and assess the effects of management actions being undertaken to implement the Bay TMDL and improve water quality. Use the monitoring results to report annually to the public on progress made in attaining established Bay water-quality standards and trends in reducing nutrients and sediment in the watershed.

Chesapeake Bay Monitoring Programming

Successes and Challenges



- New analysis tools
  - e.g. GAMs, bay models, pilot work with AI/Machine Learning algorithms
- Enhanced communications
  - Bay Barometer, blogs, social media, partner meetings, Data Dashboard
- Implemented CBP's Strategic Science and Research Framework
  - Identify/fill gaps)
- Advanced scientific syntheses completed
  - publications and reports on Bay and watershed science)
- Supported an MOU for using Citizen Science-based data
  - Chesapeake Data Explorer >300,000 data points

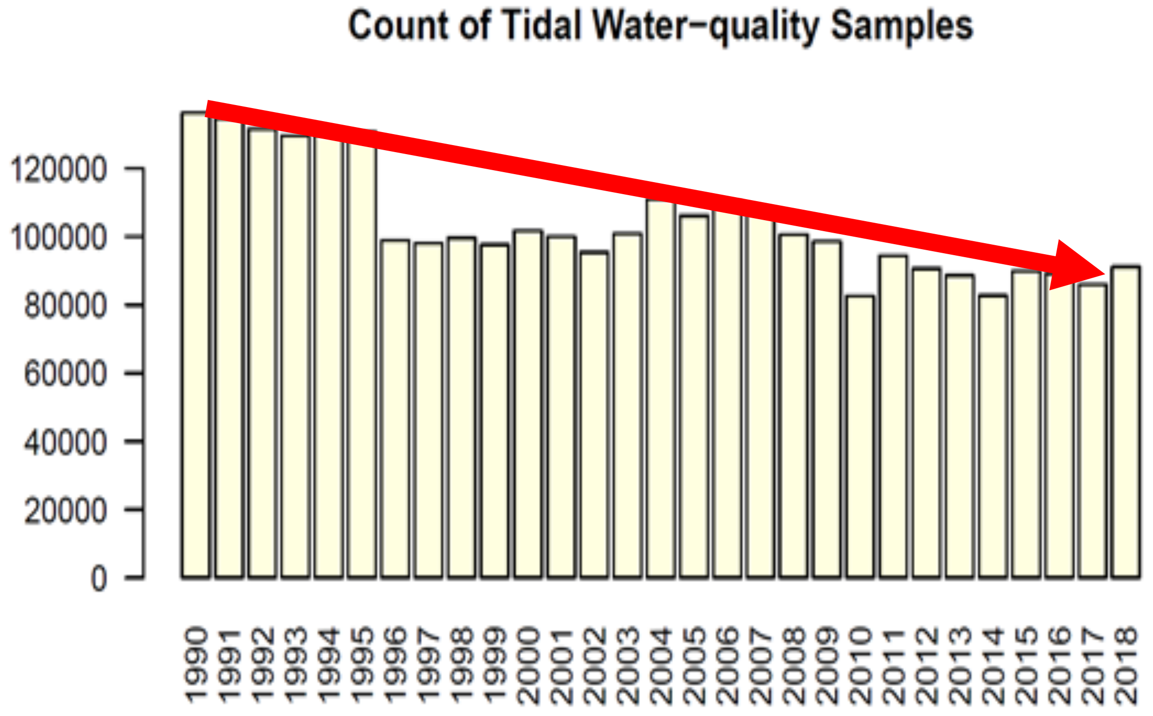
Successes and Challenges

- Unassessed criteria remain a hurdle for delisting decisions of State-adopted water quality standards with our existing framework
- Financial stresses on Bay cruises, SAV aerial survey, NTN
- Contraction of traditional long-term monitoring programming
- Slow pace for expanded assessment of water-quality standards
- Limited non-traditional data use in assessments
- Limited use of new interpretation and interpolation options

= Inability to report on standard attainmen

Designated Use	Dissolved oxygen Criteria Concentration/Duration		Temporal Application
Migratory fish spawning and nursery use	7-day mean ≥ 6 mg/L tidal habitats with 0-0.5ppt salinity		February 1 – May 31
	Instantaneous min ≥ 5 mg/L		
	Open water fish & shellfish designated use criteria apply		June 1 – January 31
Shallow water Bay grass use	Open water fish & shellfish designated use criteria apply		Year-round
Open water fish and shellfish use	30-day mean	≥ 5.5 mg/L Salinity: (0-0.5ppt)	Year-round
		≥ 5 mg/L Salinity: >0.5ppt	
	7-day mean	≥ 4 mg/L	
	Instantaneous min ≥ 3.2 mg/L		
Deep-water seasonal fish and shellfish use	30 day mean > 3mg/L		June 1 – September 30
	1-day mean >2.3 mg/L		
	Instantaneous min ≥1.7 mg/L		
	Open water Fish and shellfish designated use criteria apply		October 1-May 31
Deep channel seasonal refuge use	Instantaneous min > 1 mg/L		June 1 – September 30
	Open water F & S applies		October 1 – May 31

What is our Expected and Actual Progress?

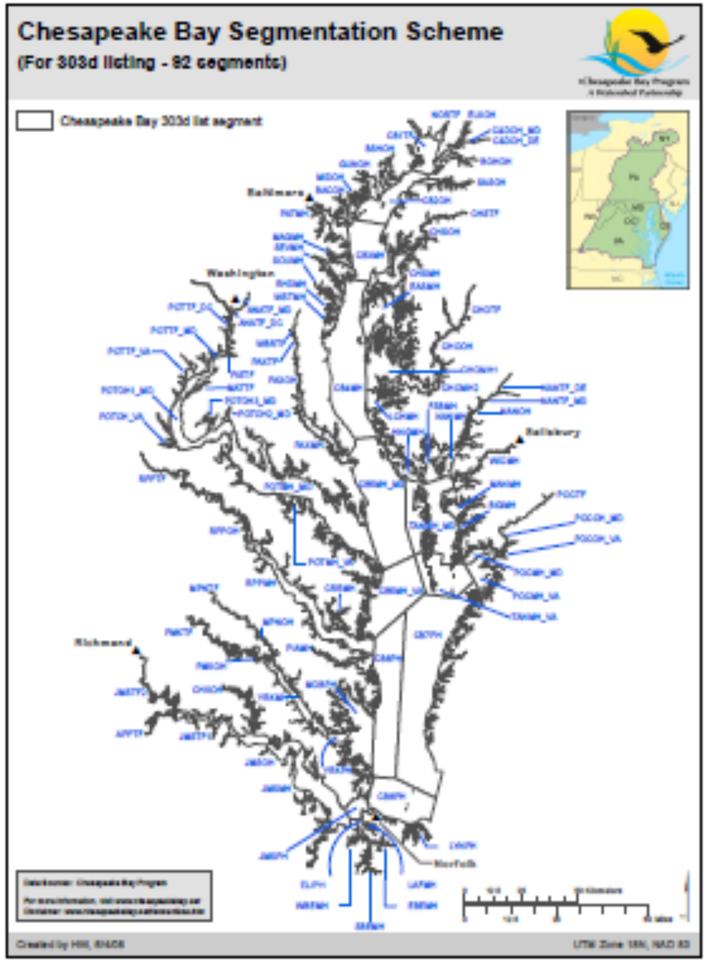


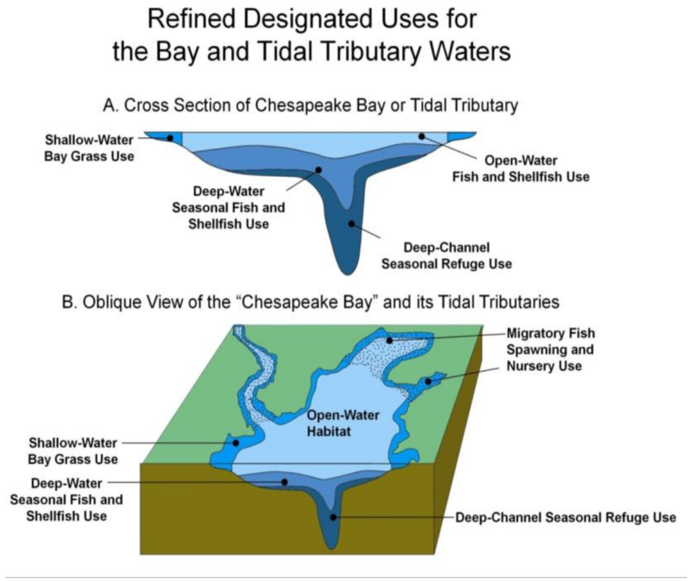
Q. Zhang 2020

Monitoring Capacity: Good/Fair/Poor

- Capacity is highly stressed and declining
- Data collections remain "marginal" for the Bay criteria assessment,"adequate" for the watershed loads estimates

Clean Water Act Water Quality Standards Monitoring and Assessment Issue: A segment must meet **all criteria** in **all applicable designated uses** for a decision on delisting in State water quality standards



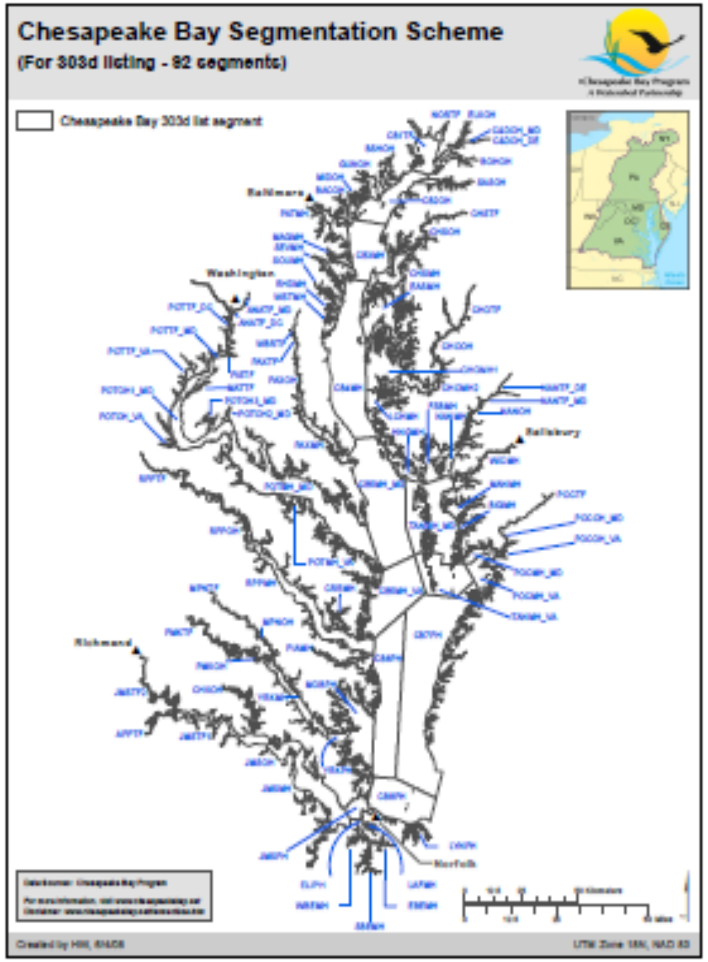


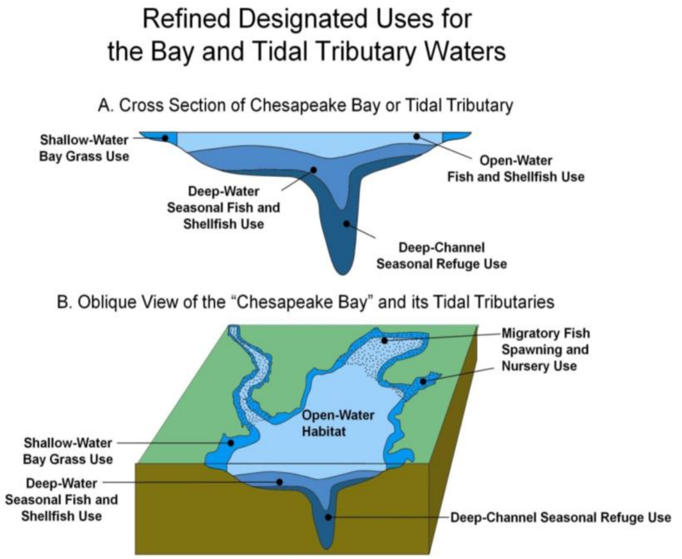
Criteria:
* Dissolved oxygen
* Water clarity/SAV
* Chlorophyll *a*

92

The number of Segments in the Bay

Clean Water Act Water Quality Standards Monitoring and Assessment Issue: A segment must meet **all criteria** in **all applicable designated uses** for a decision on delisting in State water quality standards





Criteria:
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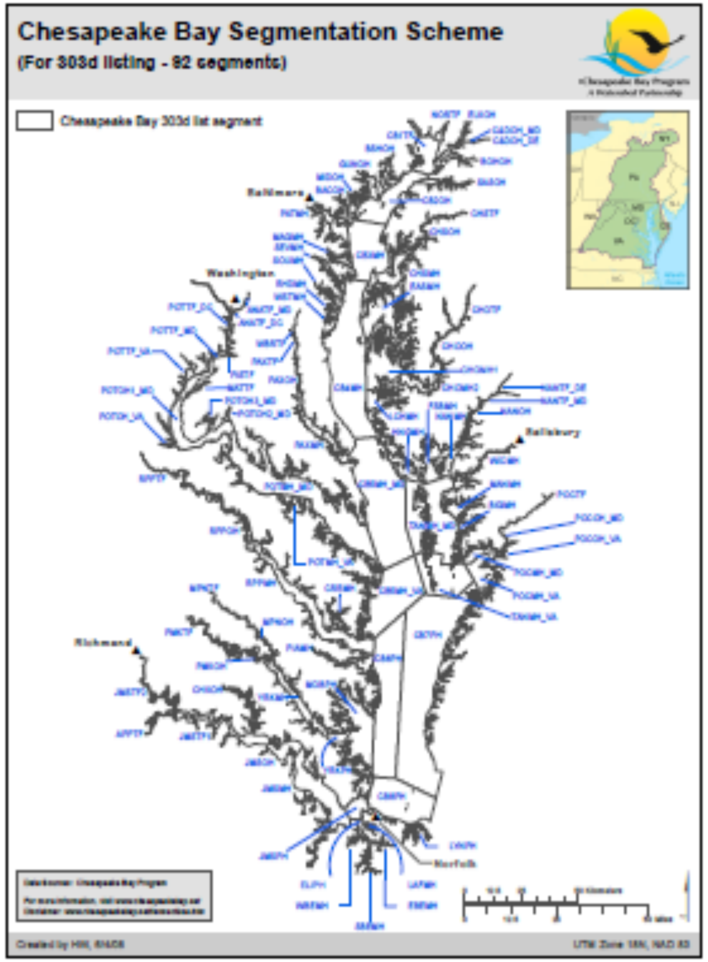
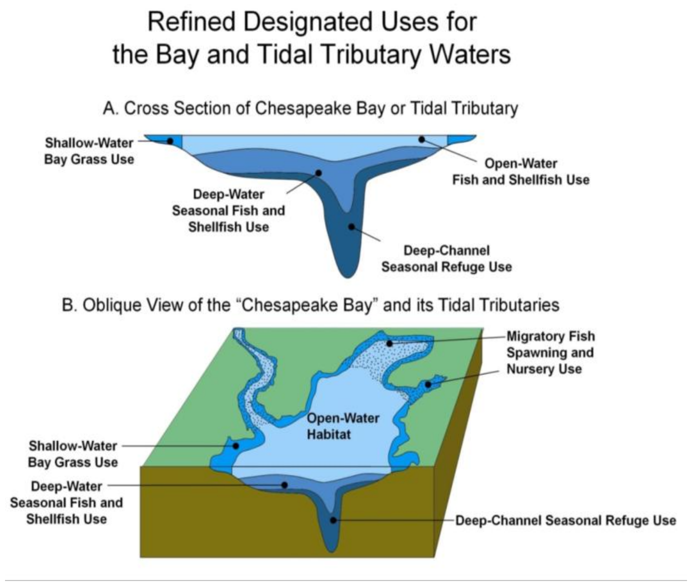
* Water clarity/SAV
* Chlorophyll *a*

92

The number of segments the Multimetric Indicator provides estimates on attainment based on a rules set for evaluating all applicable criteria

Clean Water Act Water Quality Standards Monitoring and Assessment Issue: A segment must meet **all criteria** in **all applicable designated uses** for a decision on delisting in State water quality standards





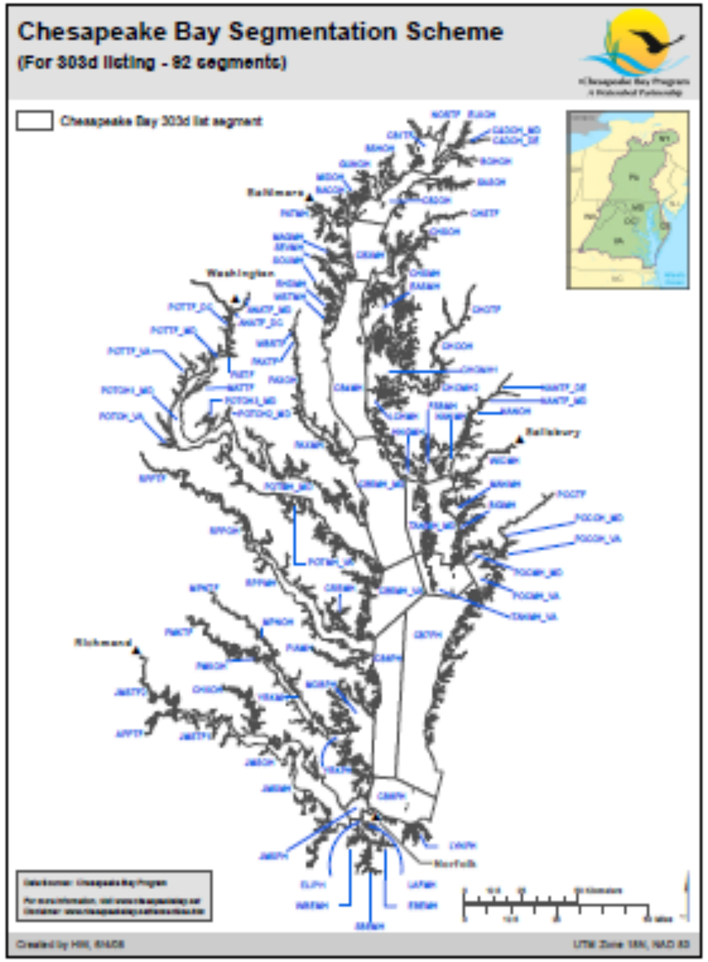
No assessment available for 61% (512 of 838) decisions needed

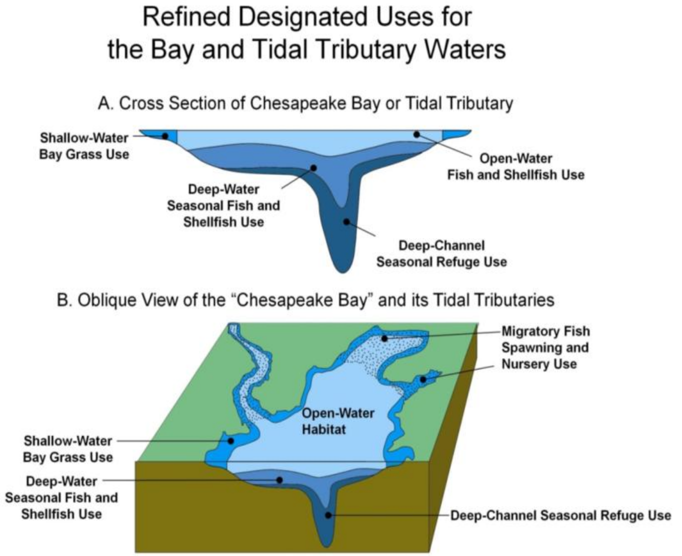
(PT)

0

The number of segments we have full monitoring data accounting for to support all criteria assessments needed to make a delisting decision

Challenge: We have a situation… unresolved for 17 years.





Criteria:
* Dissolved oxygen
* Water clarity/SAV
* Chlorophyll *a*

92

The number of Segments in the Bay

92

The number of segments the Multimetric Indicator provides estimates to evaluate criteria attainment

0

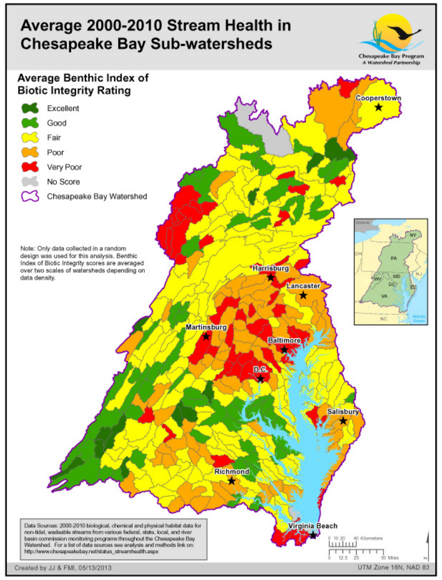
The number of segments we have full data accounting for to support all criteria needed to make a delisting decision

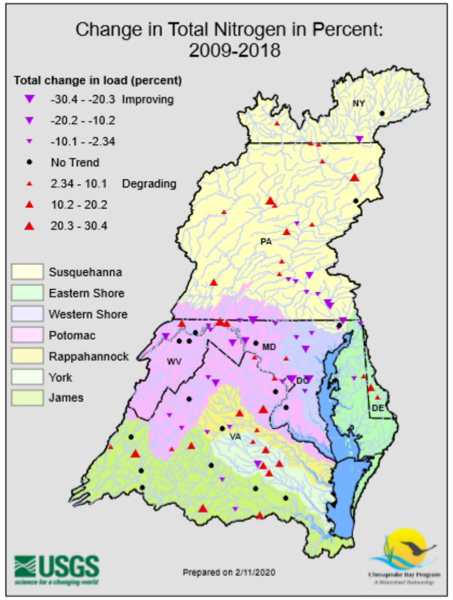
From our Strategic Review System
July 2020 Management Board Meeting presentation

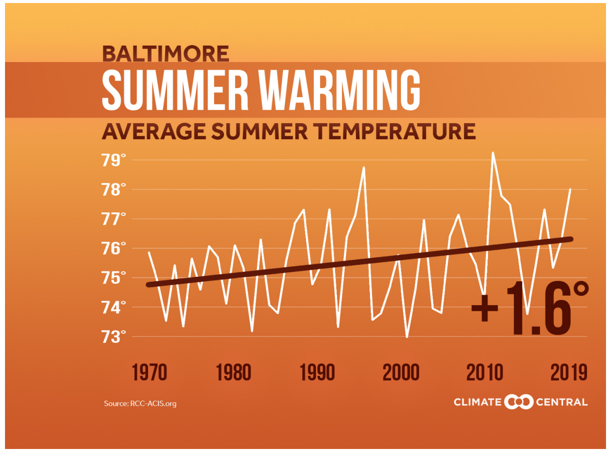
Based on what we learned, we plan to …

Science:

- Further involve jurisdictional technical staff in explaining water quality trends
- Explore factors influencing spatial and temporal trends, especially for the effects of climate change
- Adopt freely available data streams from satellite imagery
- Model measurements where data are sparse or absent
- Pursue technical analysis of additional water quality criteria and consider policy implications







- *From our Strategic Review System*

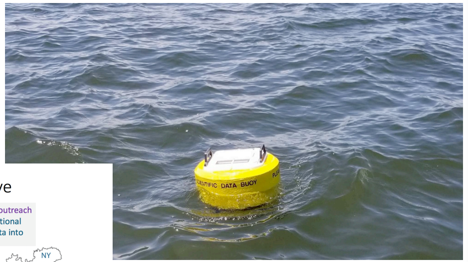
July 2020 Management Board Meeting presentation

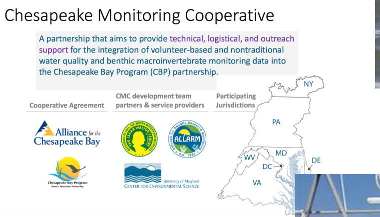
Help Needed

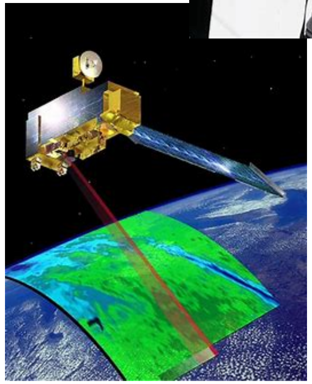
Monitoring Support:

- Maintain funding support (**** Tidal and Nontidal Monitoring and Analysis Programming****)
- Commit to assessing how your state, agency or institution uses matching funds to improve capacity in the monitoring program.
- Request WQGIT and STAR to formally incorporate quality assured Citizen Science and nontraditional partner data into WQS attainment assessments
- Request STAC and STAR to work with the Bay science and management community to extend monitoring capacity through the commitment to:
  - * adopting data from nontraditional monitoring sources into assessments,
  - * incorporating data from new technologies into assessments
  - * updating analysis approaches to accommodate new data sources and
  - * update decision protocols for evaluating analysis results

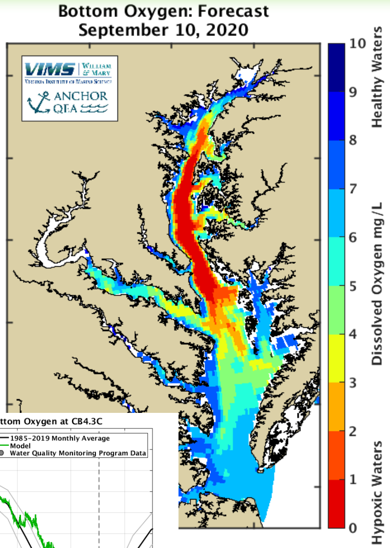
What has changed since the 2007-2009 Chesapeake Bay Monitoring Program evaluation that we might recommend adopting for adapting and updating our assessments?

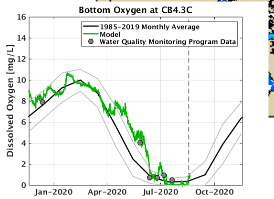


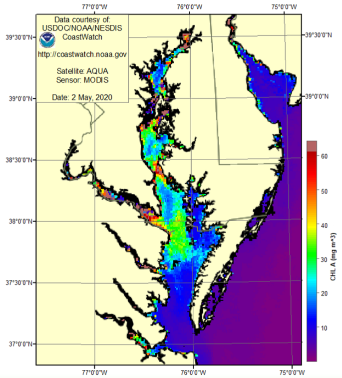




Update integrated monitoring approach







Update analytical and assessment approaches

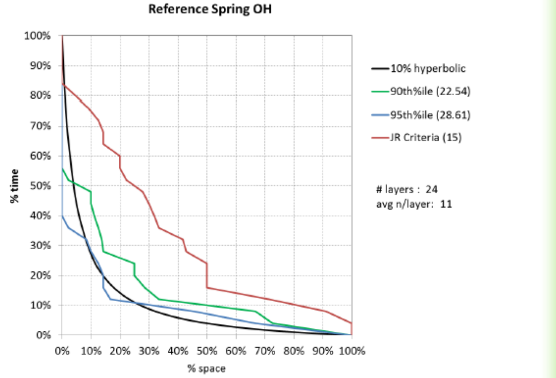


Figure 4b. Spring oligohaline CFD curves for chlorophyll *a* from reference water quality conditions.

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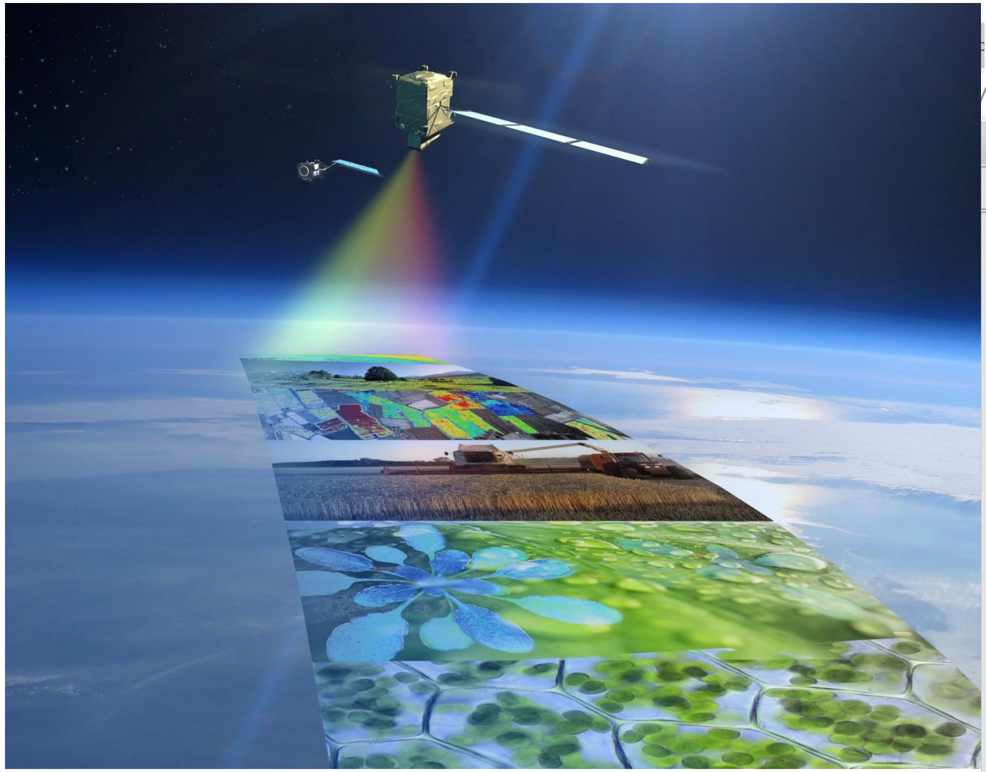
Dissolved Oxygen Criteria

Measured

Unmeasured

Improved capacity
fill habitat assessment gaps

Chlorophyll: Florida has been EPA approved for assessing coastal chlorophyll *a* water quality standards with satellite image interpretation since 2012



/www.nasa.gov/vision/earth/lookingatearth/coastal_waters.html

Feature

Text Size

NASA Satellites Eye Coastal Water Quality **08.29.07**

Armed with data from two NASA satellites, researchers have invented a way to map the fleeting changes in coastal water quality from space - something that has long evaded researchers and coastal managers relying only on ground-based measurements.

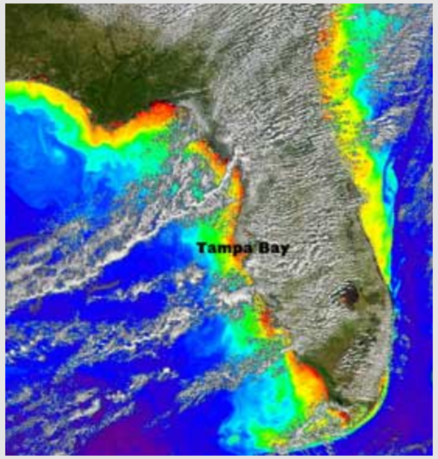
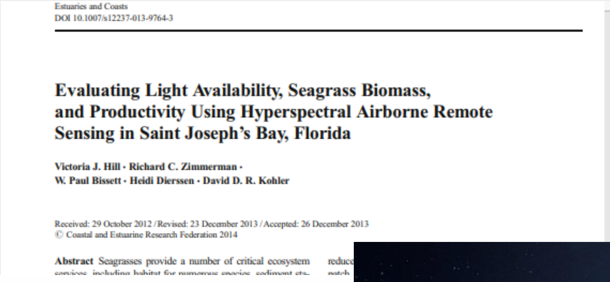


Image right: High concentrations of microscopic plants called phytoplankton (red regions) along the Florida coast and in Tampa Bay are an indicator of ocean health and change as seen in this SeaWiFS image from October 2004. Researchers have successfully used data from similar images to monitor almost daily changes in coastal water quality. + High resolution Credit: SeaWiFS Project

Using data from instruments aboard NASA satellites, Zhiqiang Chen and colleagues at the University of South Florida in St. Petersburg, found that they can monitor water quality almost daily, rather than monthly. Such information has direct application for resource managers devising restoration plans for coastal water ecosystems and federal and state regulators in charge of defining water quality standards.

The team's findings will aid in the effort to tease out factors that drive changes in coastal water quality. For example, sediments entering the water as a result of coastal development or pollution can cause changes in water turbidity – a measure of the amount of particles suspended in the water. Sediments suspended from the bottom by strong winds or tides may also cause such changes. Knowing where the sediments come from is critical to managers because turbidity cuts off light to the bottom, thwarting the natural growth of plants.

E.g. Financing the SAV program: Satellite assessment of SAV in high resolution in estuaries over large areas is already being done, AI/ML interpretation make high thru-put assessment feasible

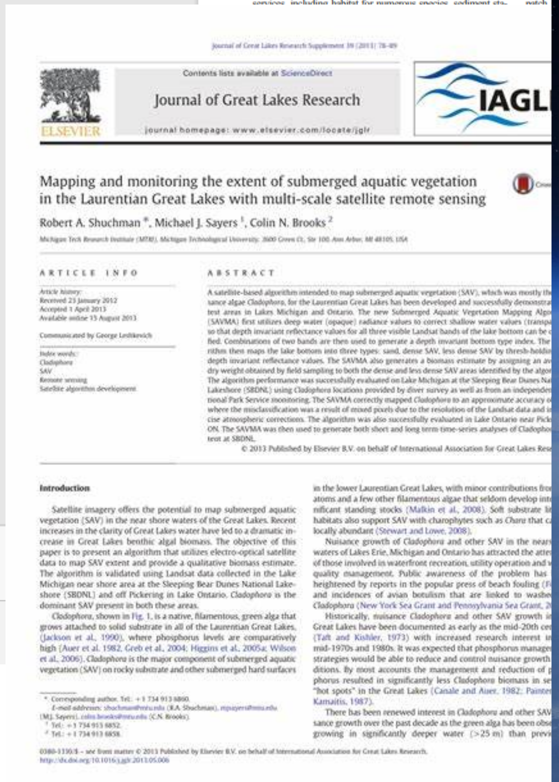

Estuaries and Coasts
DOI 10.1007/s12237-013-9764-3

Evaluating Light Availability, Seagrass Biomass, and Productivity Using Hyperspectral Airborne Remote Sensing in Saint Joseph's Bay, Florida

Victoria J. Hill · Richard C. Zimmerman · W. Paul Bissett · Heidi Dierssen · David D. R. Kohler

Received: 29 October 2012 / Revised: 23 December 2013 / Accepted: 26 December 2013
© Coastal and Estuarine Research Federation 2014

Abstract Seagrasses provide a number of critical ecosystem


Contents lists available at ScienceDirect
Journal of Great Lakes Research
journal homepage: www.elsevier.com/locate/jglr

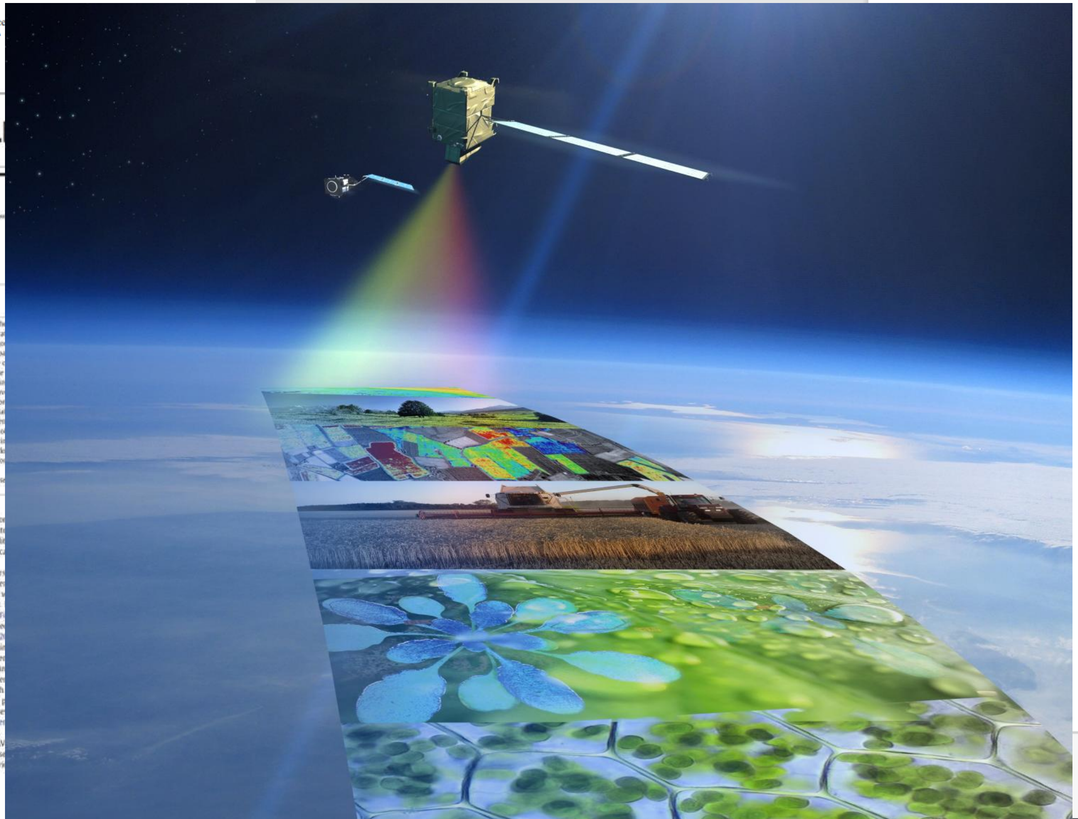
Mapping and monitoring the extent of submerged aquatic vegetation in the Laurentian Great Lakes with multi-scale satellite remote sensing

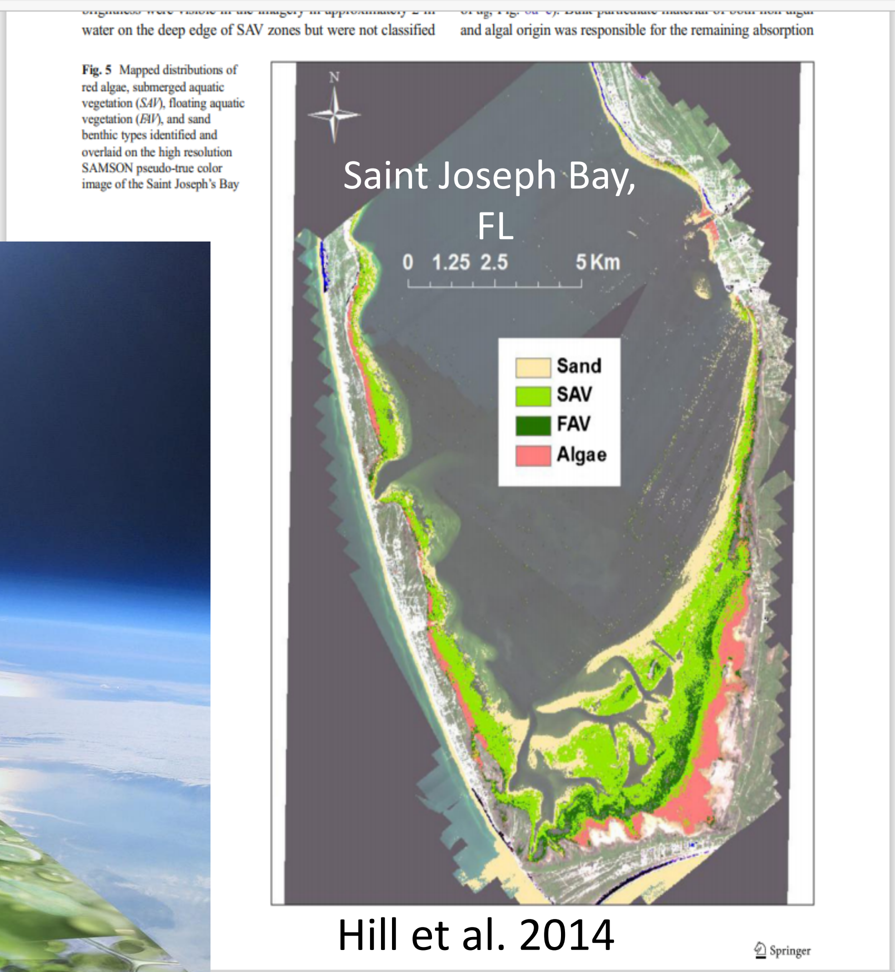
Robert A. Shuchman, Michael J. Sayers, Colin N. Brooks

ARTICLE INFO

ABSTRACT

Introduction



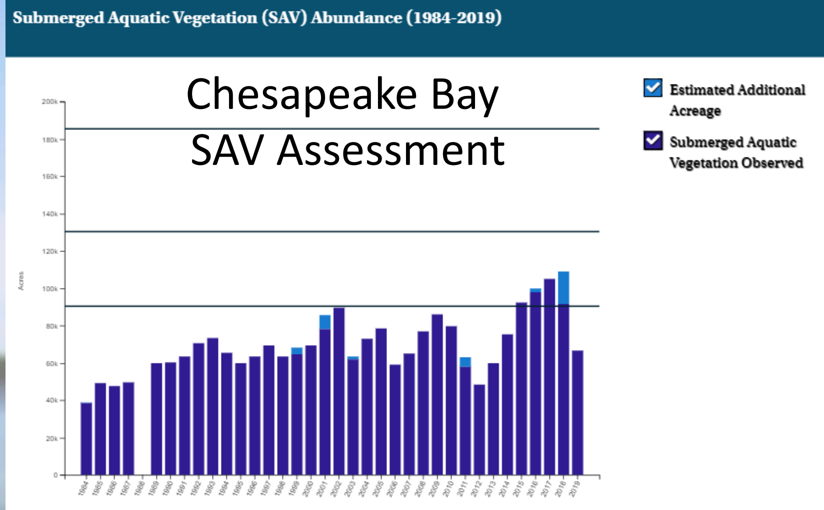

water on the deep edge of SAV zones but were not classified

and algal origin was responsible for the remaining absorption

Fig. 5 Mapped distributions of red algae, submerged aquatic vegetation (*SAV*), floating aquatic vegetation (*FAV*), and sand benthic types identified and overlaid on the high resolution SAMSON pseudo-true color image of the Saint Joseph's Bay

Springer

Hill et al. 2014



Exploring Satellite Image Integration for the Chesapeake Bay SAV Monitoring Program

~a Responsive STAC Workshop~

Co-Chairs 2019-2020:
Brooke Landry and Peter Tango

Recent success:

* VIMS – recent gap filling data
Needs with satellite imagery
For the SAV annual survey

* Zimmerman Lab at ODU

* Workshop focused on the protocol
steps needed from planning
data collection through phases
of interpretation

***FREE DATA* ($300K worth of FREE)**

We will be back for Spring 2021 report out to STAC on workshop findings!

Exploring Satellite Image Integration for the Chesapeake Bay SAV Monitoring Program

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Co-Chairs 2019-2020:
Brooke Landry and Peter Tango

Dissolved Oxygen: 2018 Chesapeake Bay Program Partnership Memorandum of Understanding: ***Using Citizen and Non-traditional Partner monitoring data to assess progress toward restoration.***

Partners

ALLIANCE for the Chesapeake Bay

University of Maryland Center for Environmental Science

CMC Chesapeake Monitoring Cooperative

ALLARM

Chesapeake Bay Program

CMC

Chesapeakemonitoringcoop.org

Chesapeake Bay Program
A Watershed Partnership

OCTOBER 12, 2018

MEMORANDUM OF UNDERSTANDING

AMONG

The State of Delaware, the District of Columbia, the State of Maryland, the State of New York, the Commonwealth of Pennsylvania, the Commonwealth of Virginia, the State of West Virginia, the Interstate Commission on the Potomac River Basin, the Susquehanna River Basin Commission, the Metropolitan Washington Council of Governments, the United States Environmental Protection Agency, the Chesapeake Bay Commission, and the Chesapeake Monitoring Cooperative.

REGARDING

Using Citizen and Non-traditional Partner Monitoring Data to Assess Water Quality and Living Resource Status and Our Progress Toward Restoration of a Healthy Chesapeake Bay and Watershed

WHEREAS, the health of the Chesapeake Bay and its watershed depends on individual and community-based stewardship by the more than 18 million people who call this watershed home;

WHEREAS, the Clean Water Act states that all existing and readily available information must be evaluated for assessment of our nations waterways and the Chesapeake Bay Program is a leader in leveraging resources through a partnership approach;

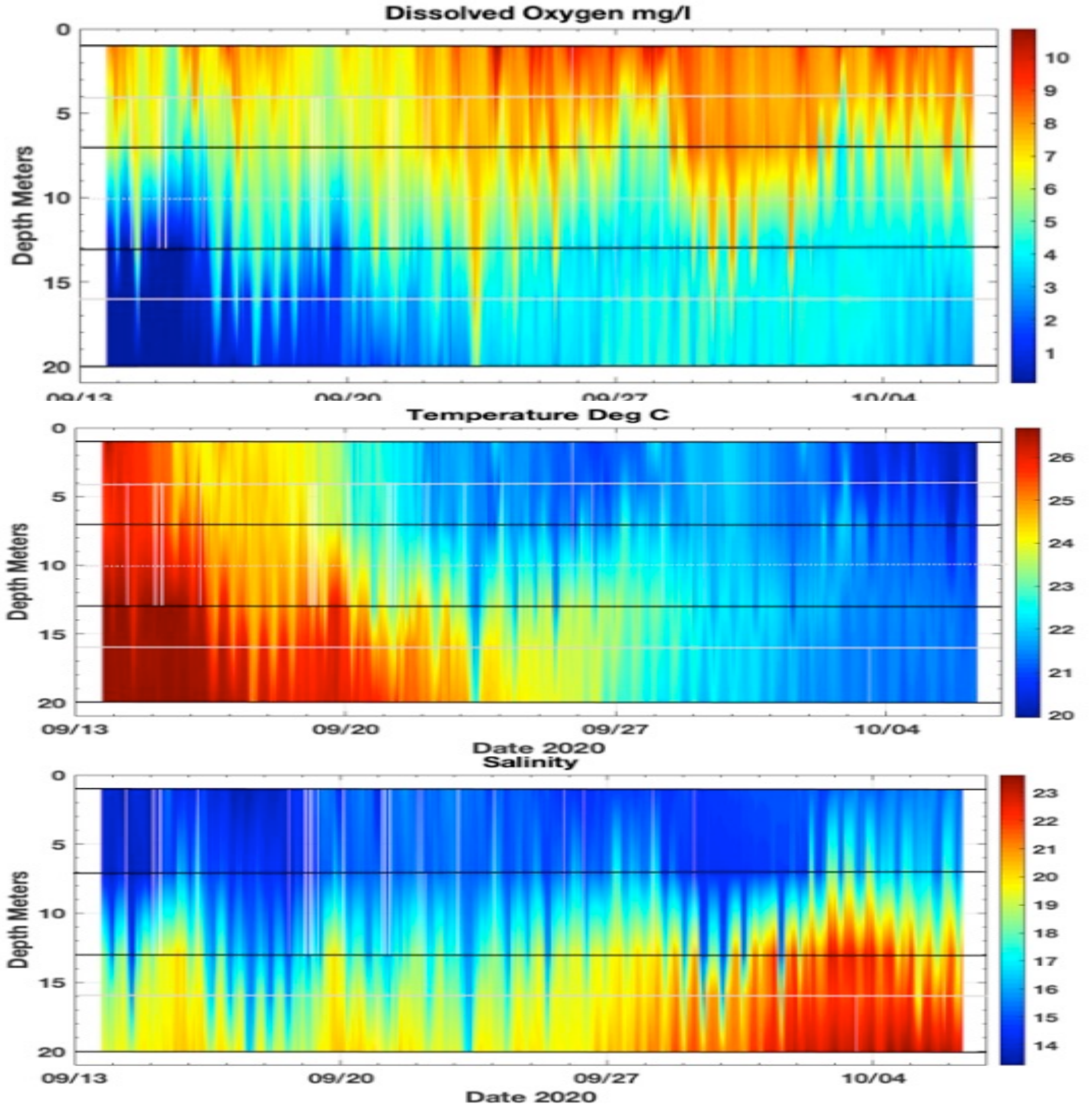
NOW, THEREFORE, we, the undersigned representatives of the District, state, interstate, and federal entities with responsibility for monitoring the waters and resources of the Chesapeake Bay and its watershed agree that we will:

- Work cooperatively with the CMC and the Chesapeake Bay Program partnership to support and sustain a network of citizen science and non-traditional monitoring partners.
- Endorse an open-access clearinghouse of quality-assured environmental data generated by citizen

$470K per year investment in data collection by citizen scientists and nontraditional partners

Dissolved oxygen: We have had success with profilers in the open bay habitats. Station CB4.3

- **Dissolved oxygen** – water at this station becomes oxygenated
- **Temperature** stratification is lost and becomes isothermal
- **Salinity** stratification declines before oxygen rich high salinity water moves into the bottom waters



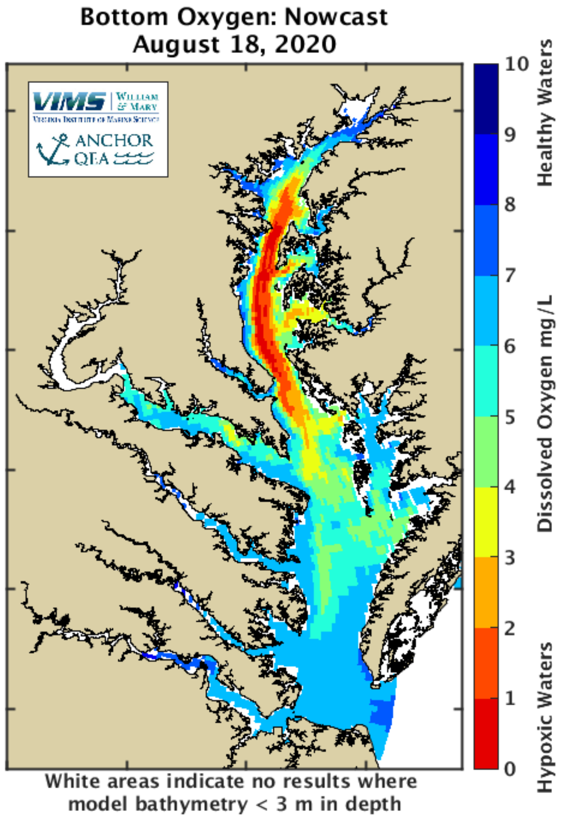
~ $50K Instrument with high data return on investment

September 2020

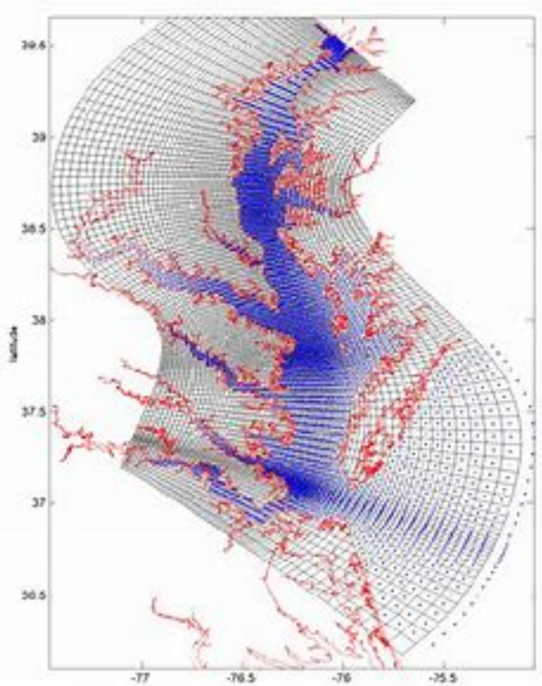
D. Wilson 2020. 2019-2020 CBT GIT-funded pilot project results

Data Interpolation – Presently, we are not nimble for data integration using 1980s methods in our 2020s world. We can do much better.

- Is ChesROMS our next generation interpolator?



- Are we ready to create the 4-D interpolator?



Help Needed

Monitoring Support:

Workshop proposal: Do advances in the fields of monitoring and assessment provide readily adoptable support for addressing information gaps, improving analyses, and offer cost-effective, sustainable solutions to support water quality standards attainment assessments related to the TMDL.

update decision protocols for evaluating analysis results

Outline: Draft workshop themes evaluating options for how we can improve assessments and capacity

- Theme 1. NO NEW DATA
  1. Use existing data with new rules of interpretation.
  2. Update the standards for dissolved oxygen to be reported based on the Multimetric Water Quality Standards Indicator results
  3. Fully implement Conditional Probability approach ("Umbrella Criterion Assessment").
- Theme 2. INTEGRATE NEW DATA and NEW TOOLS
  1. Apply existing analyses to data with improved resolution in space and time
  2. Apply new data interpretation approaches
  3. Develop next generation interpolation with low and high frequency monitoring feeds

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Proposed STAC Workshop Structure

Opening Workshop event

- 6 (or more) options to address our monitoring and assessment challenges, enhance capacity in monitoring and assessment

- Address each option or theme –
  - pros, cons,

Second workshop event

- Review examples of how it works or doesn't work and produce a recommendation for what is needed to adopt and implement in a timely manner (not 17 years) actions to meet assessment needs of our water quality standards.
- Establish steps to adoption and implementation of capacity building targets for improved assessment of TMDL criteria in the water quality standards by 2025

Comments and Suggestions Welcome!

- Concept ok?
- Structure of Workshop?
- Draft Themes and Options are open for editing, additions/deletions
- Workshop Team volunteers?
- Candidate for STAC support?

Chesapeake Bay Program Strategic Science & Research Framework:

Clean Water

Breck Sullivan, STAR Co-Staffer

Emily Majcher (USGS), Scott Phillips (USGS) Sally Claggett (USDA), Lucinda Power (EPA), Peter Tango (USGS)

STAC Quarterly Meeting

12/14/2020

Reminder: CBP Strategy Review System (SRS)

Chesapeake Bay Program
Science. Restoration. Partnership.

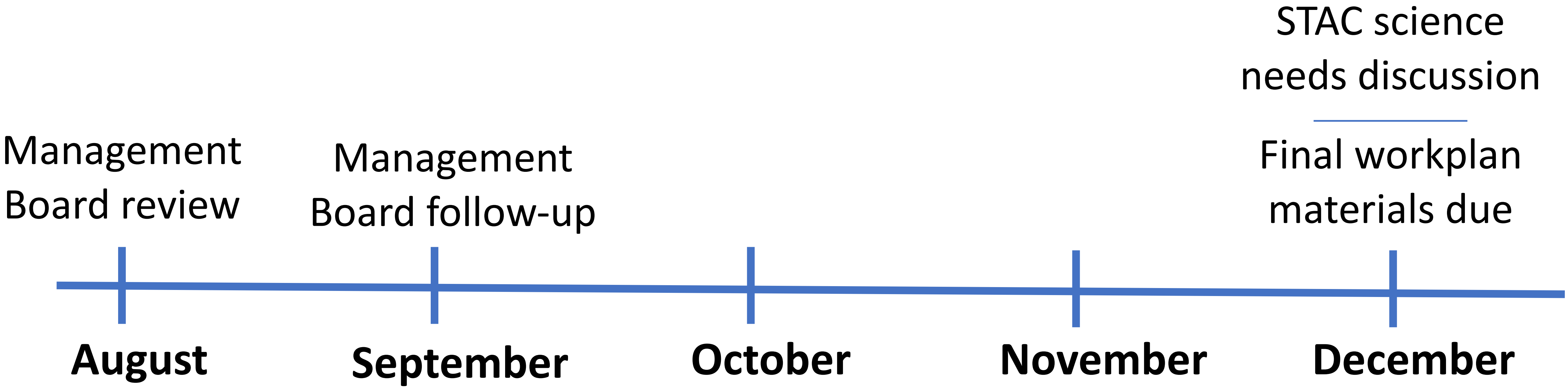
- Cohorts of workgroups for each outcome report progress to Management Board
- Workgroups develop and update short-term action plans for achievement of long-term goals
- New 2019: incorporated Strategic Science & Research Framework into SRS

Clean Water Cohort

Chesapeake Bay Program
Science. Restoration. Partnership.

- Toxics Contaminants Policy and Prevention
- Toxics Contaminants Research
- Forest Buffers
- 2025 Watershed Implementation Plans
- Water Quality Standards Attainment and Monitoring

Clean Water cohort SRS schedule



Clean Water Cohort

Feedback requested from STAC:

- Do you or any of your colleagues have interest in contributing to addressing one of these needs?
- Do you want more information to come back to STAC from any groups on specific needs/projects?
- Are these needs appropriate? Do you see something missing?
- Do you have recommendations on ways to improve our engagement with you through this process?

Toxic Contaminants Policy and Prevention

Chesapeake Bay Program
Science. Restoration. Partnership.

Outcome: *Continually improve practices and controls that reduce and prevent the effects of toxic contaminants below levels that harm aquatic systems and humans. Build on existing programs to reduce the amount and effects of PCBs in the Bay and watershed. Use research findings to evaluate the implementation of additional policies, programs and practices for other contaminants that need to be further reduced or eliminated.*

Toxic Contaminants – Policy and Prevention

Chesapeake Bay Program
Science. Restoration. Partnership.

PCB Science needs (have been migrated to Research)

- Refining PCB sources and methods of source identification (monitoring and analytical)
  - Stormwater
  - WWTP/biosolids
  - Atmospheric deposition
- Advances in regional PCB models (coordination for TMDLs)
- Effectiveness of BMPs
- Innovative remediation approaches

Toxic Contaminants Research

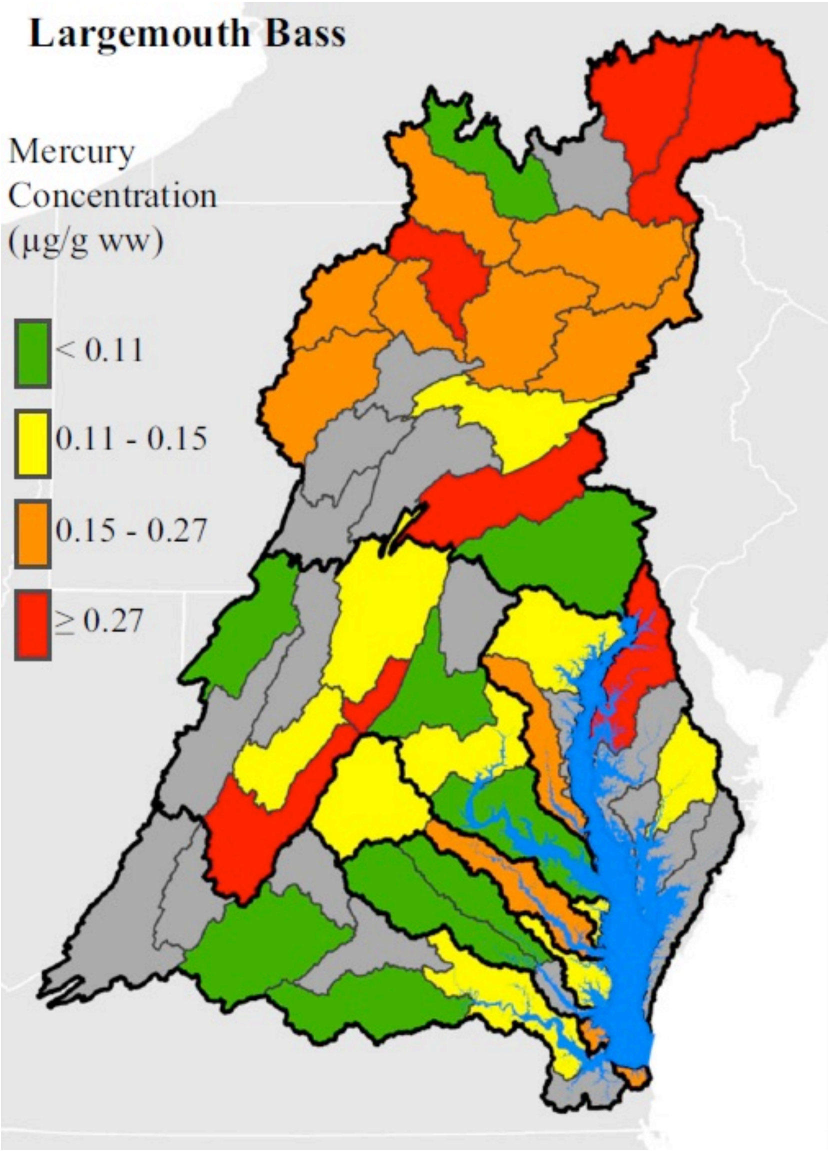
Outcome: *Continually increase our understanding of the impacts and mitigation options for toxic contaminants. Develop a research agenda and further characterize the occurrence, concentrations, sources and effects of mercury, PCBs and other contaminants of emerging and widespread concern. In addition, identify which best management practices might provide multiple benefits of reducing nutrient and sediment pollution as well as toxic contaminants in waterways.*

Toxic Contaminants Research – Mercury

- Willacker and others (2020) found mercury widespread in freshwater fish and concentrations pose risk to fish, birds, humans

Science needs:

- Explore coordinated monitoring network for mercury
  - Better assess if air reductions are working
  - Assess needs for other management actions
  - Compare risk of mercury to fisheries and humans



Toxic Contaminants Research – PFAS

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- Fish in urban areas reported abnormal tissue growth and reduced reproductive success. In ag areas reported fish kills and a variety of fish-health issues.

Science needs:

- Continue understand occurrence and ecosystem effects of toxic contaminants in different landscape settings
- Coordinated science approach for PFAS
  - Focus on occurrence and ecosystem effects (fish/shellfish impacts)
  - Leverage existing and planned studies

Toxic Contaminants Research – BMPs

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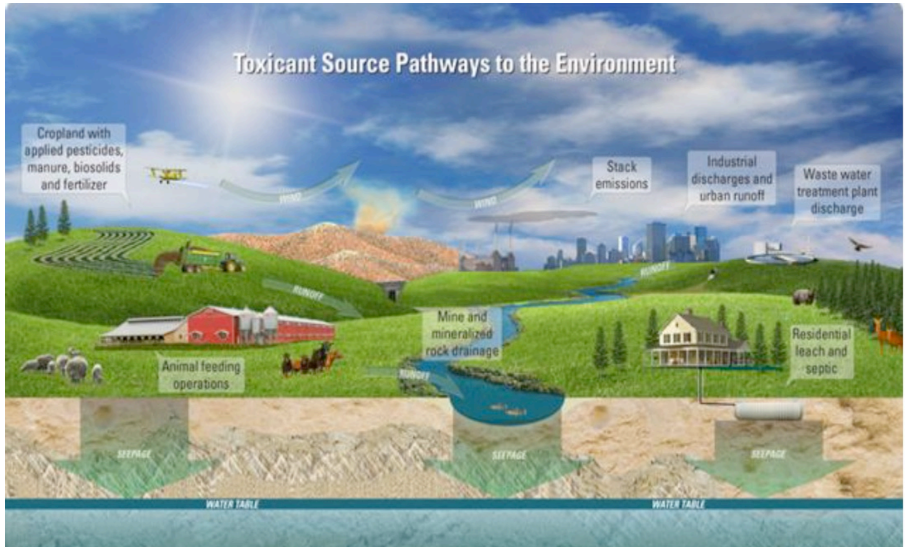
- STAC workshop and report detailed progress on BMPs in urban and ag areas

Science needs:

- GIT funded project to develop road map to adapt science advances into CBP decision tools (e.g., CAST)
- Promote science and knowledge transfer of priority contaminant fate in BMPs (CBP response to STAC)



Toxic Contaminants Research – Emerging Issues

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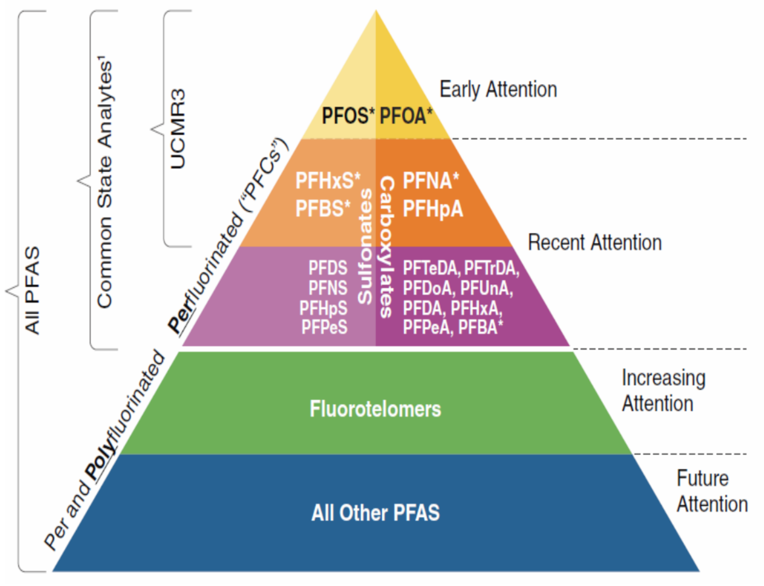
- Knowledge transfer focus to prioritize the numerous emerging issues

Science needs:

- State of science updates from researchers on:
  - PFAS
  - Microplastics (toxicity) action team
  - Road salt/chloride



Microplastics sample from the Rhode River. (Photo Credit: Will Parson, courtesy of the Chesapeake Bay Program)

Forest Buffers Outcomes

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Paraphrased Outcome: *Continually increase buffers on landscape by 900 mi/year.*

- monitor forest buffer cover change using hi-rez data and assess drivers of buffer gain and loss
- Develop low-cost methods for verifying buffer acres
- Identify better methods for quantifying, communicating co-benefits
- Develop and adopt methods to reduce the costs associated with planting and maintaining buffers
- Explore restoration systems, establishment effectiveness, species planted, etc.
- Tailor buffer outreach materials to reflect different motivations and benefits
- Monitor older forest buffer plantings for lessons learned
- Identify agricultural landowners who have the greatest amount of bufferable acreage to target for buffer outreach

2025 WIP Outcome

Outcome: *By 2025, have all practices and controls installed to achieve the Bay's dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll-a standards as articulated in the Chesapeake Bay TMDL document*

2025 WIP Outcome

Science needs:

- Exploration of alternative verification methodologies, including numerical values for credit duration
- Greater understanding and application of social science to address implementation barriers and advance implementation
- Updated science and data for CAST 2021
- Incorporation of monitoring and trends data into assessing progress towards outcome
- Quantification and integration of co-benefits into decision support tools to assist with planning and implementation
- Understanding climate resilient BMPs in Ag and Urban sectors

Water Quality Standards Attainment & Monitoring

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Outcome: *Continually improve the capacity to monitor and assess the effects of management actions being undertaken to implement the Bay TMDL and improve water quality. Use the monitoring results to report annually to the public on progress made in attaining established Bay water-quality standards and trends in reducing nutrients and sediment in the watershed.*

- *From our Strategic Review System*

July 2020 Management Board Meeting presentation

Help Needed from the Management Board

Monitoring Support:

- **Maintain** funding support (*** *Tidal and Nontidal Monitoring and Analysis Programming****)
- **Commit** to assessing how your state, agency or institution uses matching funds to improve capacity in the monitoring program.
- **Request** WQGIT and STAR to formally incorporate quality assured Citizen Science and nontraditional partner data into WQS attainment assessments
- **Request** STAC and STAR to work with the Bay science and management community to extend monitoring capacity through the commitment to:
  - * adopting data from nontraditional monitoring sources into assessments,
  - * incorporating data from new technologies into assessments
  - * updating analysis approaches to accommodate new data sources and
  - * update decision protocols for evaluating analysis results

Water Quality Standards Attainment & Monitoring

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Science needs:

- Further involve jurisdictional technical staff in explaining water quality trends
- Explore factors influencing spatial and temporal trends, especially for the effects of climate change
- Adopt freely available data streams from satellite imagery
- Model measurements where data are sparse or absent
- Pursue technical analysis of additional water quality criteria and consider policy implications

Climate Change and Resiliency Cohort SRS schedule

STAR science needs discussion: Dec. 17th

STAC members encouraged to participate

Management Board review

November

Management Board follow-up

December

January

Final workplan materials due

March

STAC science needs discussion

April

Climate Change and Resiliency Cohort SRS schedule

- **Climate Monitoring and Assessment:** Continually monitor and assess the trends and likely impacts of changing climatic and sea level conditions on the Chesapeake Bay ecosystem, including the effectiveness of restoration and protection policies, programs and projects.

- **Climate Adaptation:** Continually pursue, design, and construct restoration and protection projects to enhance the resiliency of Bay and aquatic ecosystems from the impacts of coastal erosion, coastal flooding, more intense and more frequent storms and sea-level rise.

Climate Change and Resiliency Cohort SRS schedule

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- **Black Duck:** By 2025, restore, enhance and preserve wetland habitats that support a wintering population of 100,000 black ducks, a species representative of the health of tidal marshes across the watershed. Refine population targets through 2025 based on best available science.

- **Wetland:** Continually increase the capacity of wetlands to provide water quality and habitat benefits throughout the watershed. Create or reestablish 85,000 acres of tidal and non-tidal wetlands and enhance function of an additional 150,000 acres of degraded wetlands by 2025. These activities may occur in any land use (including urban), but primarily occur in agricultural or natural landscapes.

Chesapeake Bay Program Strategic Science & Research Framework:

Clean Water

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