



Chesapeake Bay Program

*Science. Restoration. Partnership.*

# Next generation monitoring: Applications to Fish Habitat

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Peter Tango

Fish Habitat Action Team

April 26, 2021

# Background:

Derivation of our latest push regarding support for our collective needs supporting monitoring and assessment work



## Responding to the PSC Request to Improve the CBP Monitoring Networks

Peter Tango, Scott Phillips, Lee  
McDonnell, Breck Sullivan

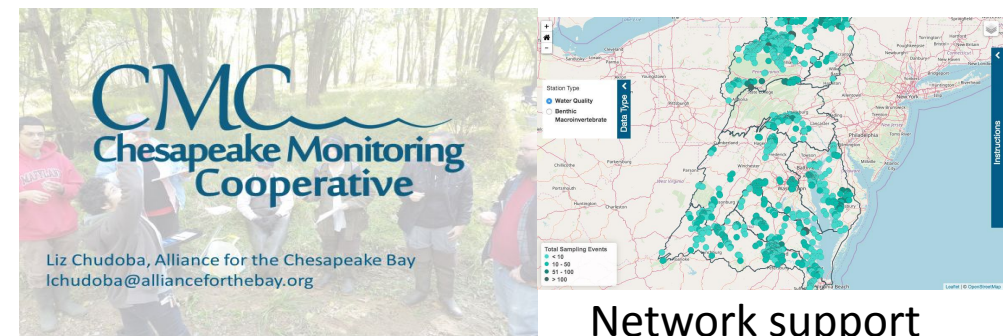
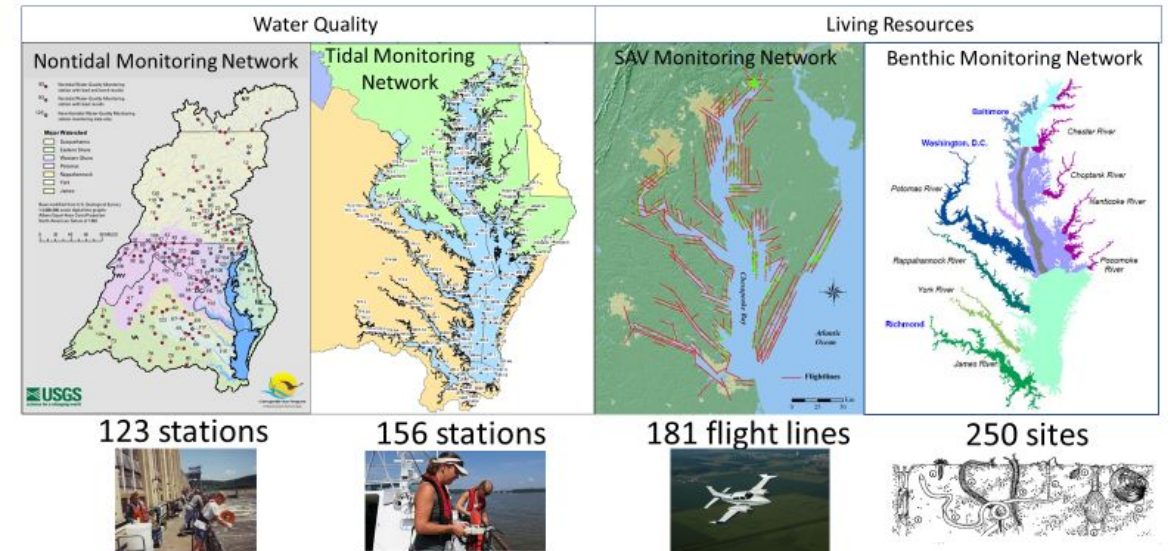
DIWG Presentation 1 of 2

April 13, 2021

# March 2021: Monitoring Presentation to the Principal Staff Committee

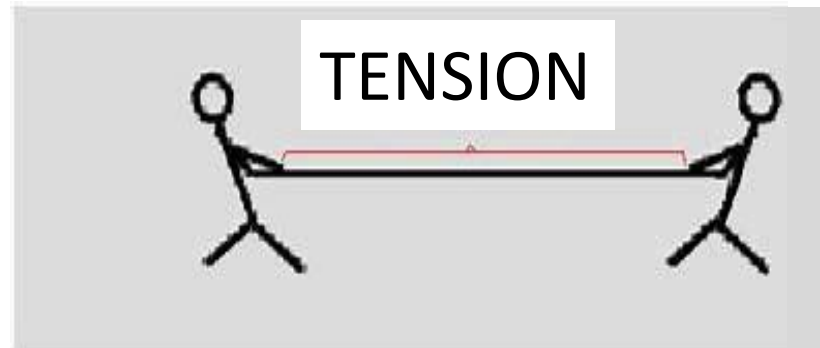
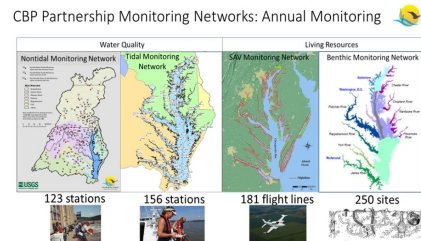
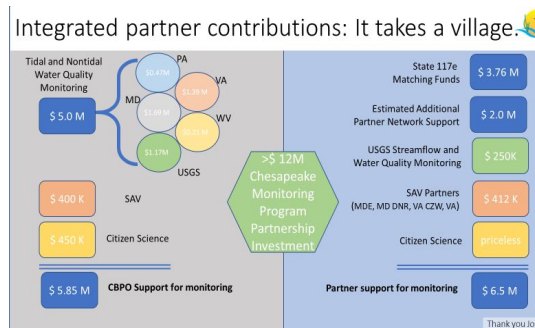
- Lee McDonnell provided monitoring presentation to PSC on March 2
- Help them better understand CBP budget and funding for monitoring
- *CBP World Class Monitoring Networks:*
  - Tidal water quality
  - Nontidal nutrients and sediment
  - SAV
  - Tidal Benthic organisms
  - Citizen Monitoring
- Current Funding:
  - CBP \$5M and partners >\$7M

## CBP Partnership Monitoring Networks: Annual Monitoring



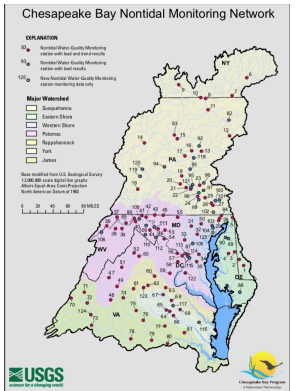
# Overcoming the tension

## Traditional Resources



## Assessment and Reporting Expectations

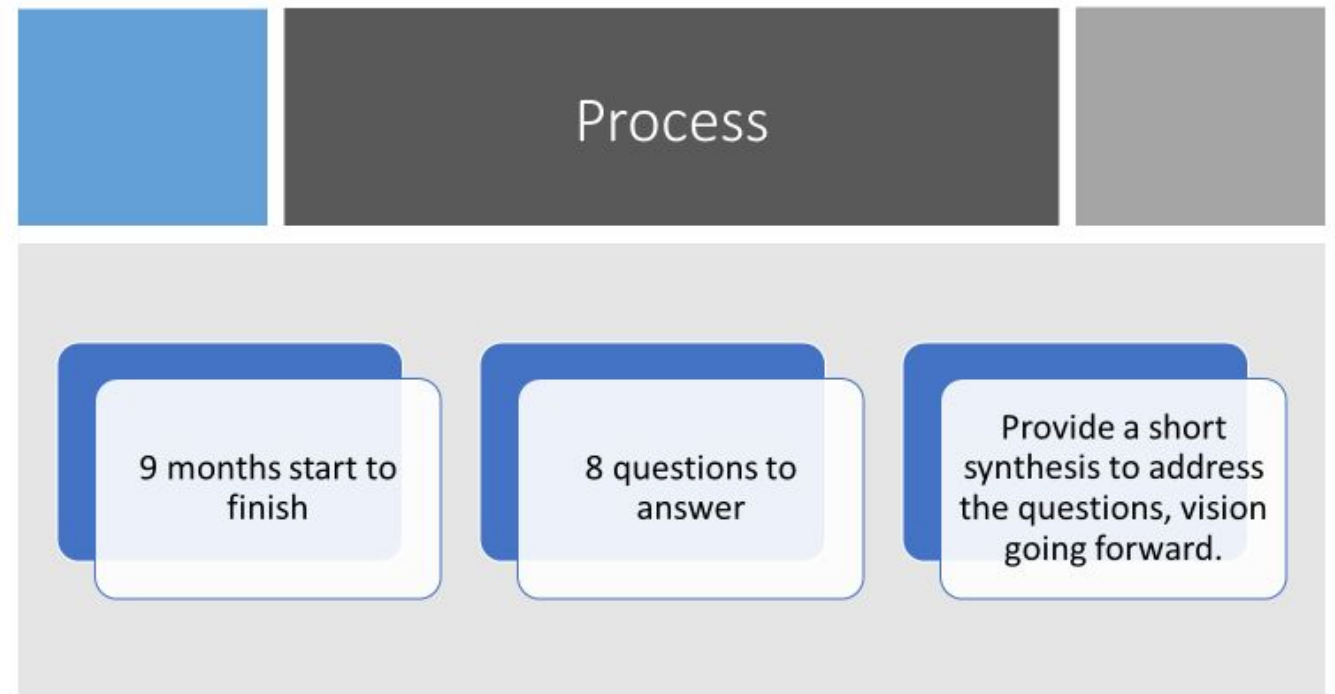
Designated Use	Dissolved oxygen Criteria Concentration Duration	Temporal Application	Criteria Assessment Coverage
Migratory fish spawning and nursery use	7-day mean $\geq 6$ mg/L tidal habitats with 0-6.5ppt salinity Instantaneous min $\geq 5$ mg/L Open water fish & shellfish designated use criteria apply	February 1 – May 31 June 1 – January 31	U.S. EPA 2003 U.S. EPA 2004 and more... Umbrella Criterion – Summer Season assumption
Shallow water Bay grass use	Open water fish & shellfish designated use criteria apply	Year round	Umbrella Criterion or measure it.
Open water fish and shellfish use	30-day mean $\geq 5.5$ mg/L Salinity: (0-6.5ppt) $\geq 5$ mg/L Salinity: >6.5ppt 7-day mean $\geq 4$ mg/L Instantaneous min $\geq 3.2$ mg/L	Year round	Umbrella Criterion - testing (or measure it).
Deep-water seasonal fish and shellfish use	30-day mean $> 3$ mg/L 1-day mean $> 2.3$ mg/L Instantaneous min $\geq 1.7$ mg/L Open water fish and shellfish designated use criteria apply	June 1 – September 30 October 1 – May 31	TMDL basis: Meet summer and protect other seasons.
Deep-channel seasonal refuge use	Instantaneous min $> 1$ mg/L Open water F & S applies	June 1 – September 30 October 1 – May 31	



- We have long standing gaps in assessments
- We recognize a history of resources stressed to sustain and grow the monitoring program
- Research developments and innovations are providing options to address capacity gaps

# PSC request:

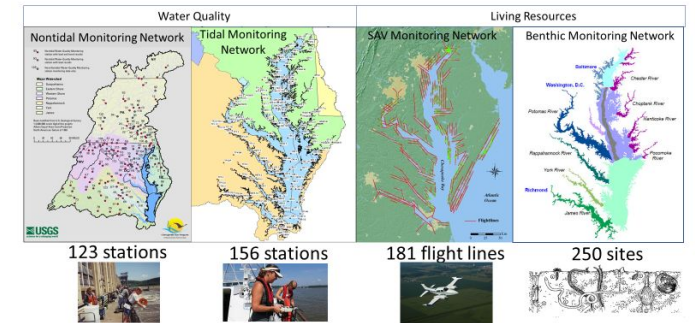
- In response to the status report, they requested information be provided on what is needed to improve the CBP monitoring networks, including:
  - (1) an overview of current status and threats to the networks, and
  - (2) what is needed to address the monitoring networks capacity shortfalls.



# 8 Questions to address in this 9-month review

- NETWORK STATUS?
- VULNERABILITIES?
- PROGRAMMING STRATEGY?
- INFORMATION GAPS TO FILL?
- MONITORING PROGRAM OPTIONS TO FILL GAPS?
- WHAT INNOVATIONS ARE AVAILABLE?
- WHO - PARTNERS FOR ADDRESSING INFORMATION GAP DATA & PROODUCTS?
- DETAIL ON FINANCIALS FOR SUSTAINING AND GROWING NETWORK TO MEET INFORMATION NEEDS?

CBP Partnership Monitoring Networks: Annual Monitoring 



# 8 Questions to address in this 9-month review

CBP Partnership Monitoring Networks: Annual Monitoring 

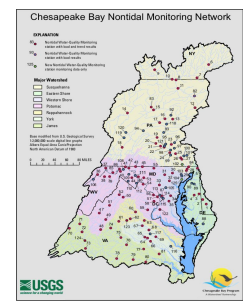


- INFORMATION GAPS TO FILL?
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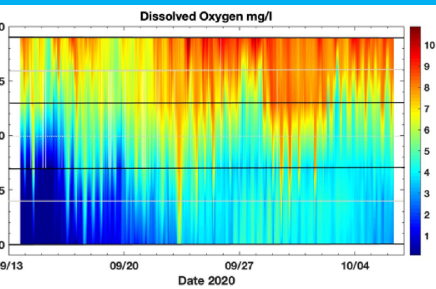
Watershed loads  
Nontidal Network

Lead – NTN WG  
(Coordinator: Peter Tango)  
Support – FHAT, CRWG



Fish Habitat  
Tidal Network

Lead – Hypoxia Collaborative  
(Coordinators: Bruce Vogt, Peter Tango)  
Support - FHAT



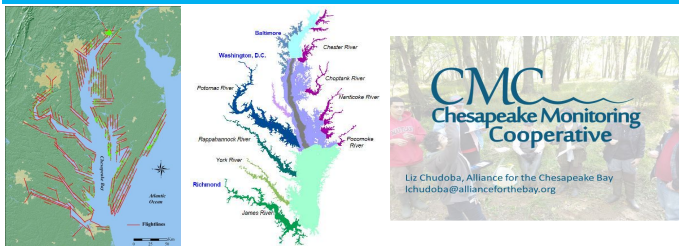
**Network & Workgroup leadership  
developing recommendations to  
the PSC**

Observational strategies

STAR/Integrated Monitoring Network WG  
STAC: 2021-22 Workshop

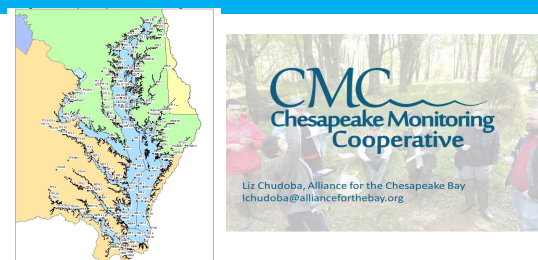
Living Resources - Tidal  
SAV Network

Lead – SAV WG  
(Chair – Brooke Landry)  
Support by Citizen  
Science Network  
Benthic network Lead – CAP WG  
(Chair – Peter Tango)



Water Quality Standards  
Tidal Network

Lead – CAP WG  
(Chair – Peter Tango)  
Support: Citizen  
Science Network



**Tidal Water Quality Standards/Habitat Analysis**  
**4-D Water Quality Estimator Team**  
4D BORG  
(Coordinators – Peter Tango, Rebecca Murphy)

Some recommendations for supporting the Chesapeake Bay fish habitat assessments can be based on feedback that already exists (Leight, Hunt and Mankin 2019)

**Chesapeake Bay Fish Habitat**  
**Summary of Stakeholder Feedback and Identified Needs**

Based on Interviews of Fisheries Managers, Permitting Agencies, and Land Planners

Conducted May 2019 through August 2019

A.K. Leight<sup>1</sup>, Gina Hunt<sup>2</sup> and Erin Markin<sup>3</sup>

<sup>1</sup>NOAA, NOS, NCCOS, Marine Spatial Ecology Division, Oxford, MD 21654.

<sup>2</sup>Maryland Department of Natural Resources and Chesapeake Bay Program Fish Habitat Team  
Coordinator

- Assess habitat at the finest spatial scale reasonably possible.
- Include data and factors that were not available on a national level
- Integrate with other available tools when appropriate and possible

# Some recommendations for the Chesapeake Bay fish habitat assessments need more detail, we will need your specifics: (Leight, Hunt and Mankin 2019)

*? Details in Strategic Science and Research Framework?*

Table 1. Summary of Needs Expressed by State Fisheries Managers

Non-tidal Waters
<ul style="list-style-type: none"><li>• A more accurate layer for cold water systems especially in the areas of brook trout, watershed characteristics, groundwater-surface water interactions, and climate change scenarios</li><li>• A warmwater assessment tool/layer (as opposed to an assessment that does not consider warmwater)</li><li>• A map of populations or habitats at risk or high value to inform permitting decisions</li><li>• A map that shows areas that should be protected or restored, especially for educating local jurisdictions</li><li>• A map that includes or improves the accuracy of Rare, Threatened, Endangered (RTE) species distributions</li><li>• A map of invasive species presence or habitat requirements</li></ul>
Tidal Fresh Waters
<ul style="list-style-type: none"><li>• Areas of shoreline hardening</li><li>• Improve SAV mapping and forecasting and associated fishery management targets/thresholds</li><li>• More information about abundance and distribution of invasive species</li><li>• Species assemblages – habitat condition and stressors</li><li>• RTEs – historical occurrences – predicted occurrence based on habitat condition</li></ul>
Tidal Estuarine Waters
<ul style="list-style-type: none"><li>• Habitat information that could be used for aquaculture and restoration siting</li><li>• Habitat information that could be used in consultations - with other state agencies, with the US Army Corps of Engineers (USACE), NOAA's Office of Habitat Conservation (OHC) and Office of Protected Species (OPR), US Fish and Wildlife Service</li><li>• Habitat information that could help resolve or mitigate user conflict issues</li><li>• An assessment that provides information about fish species distribution, abundance, and migration timing</li><li>• Current habitat conditions, more so than future habitat conditions</li><li>• Rankings of habitat condition (e.g., good/poor quality) would be sufficient in many cases for making decisions</li><li>• Hardened shorelines identification and impacts</li><li>• Development of thresholds beyond impervious surface</li></ul>

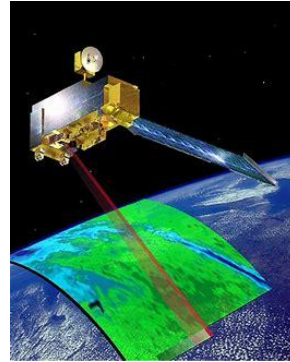
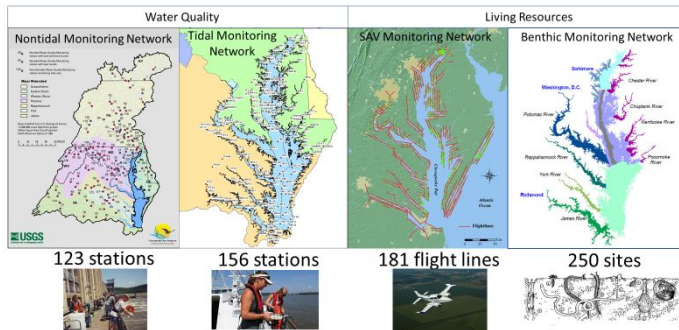
- **Nontidal waters** – Can we have more detail about specifics of needs. Temperature monitoring seems key, where is the balance between modeling and monitoring needs/investments?
- **Tidal fresh** – SAV – actively working on satellite-based assessments/AI interpretations at 1m-x-1m. Other?
- **Tidal estuary** - Define “habitat”. Aquaculture siting = minimizing risks of harmful algal blooms so Chlorophyll measures are a habitat target. Salinity distributions drive species distributions. SAV distribution is structural habitat for living resources. Hypoxia risk distribution in space and time translates to habitat health. What else?

# We need to leverage successful research innovations

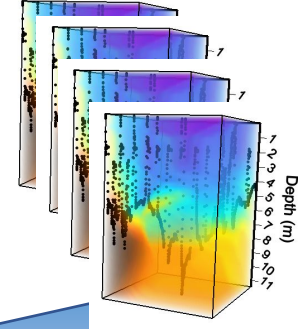
## Adopt, integrate and adapt to address capacity shortfalls.

### Traditional networks

CBP Partnership Monitoring Networks: Annual Monitoring



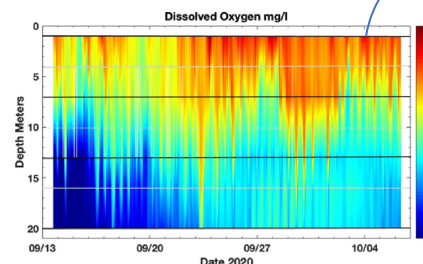
2. Adapt to baywide satellite-based data (SAV, Kd, CHLA)



4. Improve assessment tools (4D water quality estimator)

Monitoring and assessment capacity building beyond traditional monitoring

1. Apply Citizen-based observations (MOU 2018)



3. Innovate and adopt new WQ and living resource monitoring at needed data scales (CBT 2020 work, Bever et al. sampling design insights)

Expanded capacity

Full Water Quality Standards Attainment Assessment for Chesapeake Bay + CrossGIT Benefits


[illegible]

[illegible]

In closing:  
9 Months to a concise issue and  
recommendation summary with financials.  
(December 2021).

- Over a decade since the last CBP monitoring evaluation
- Address CBP Outcome: Standards Attainment and Monitoring Outcome
- Address selected monitoring needs of other CBP outcomes
- Consider new technologies and innovation
- Identify priority improvements and gaps

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

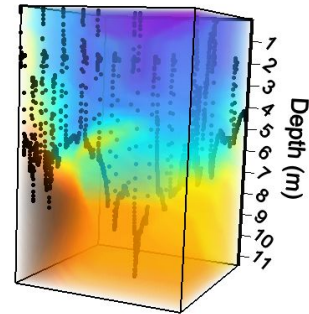
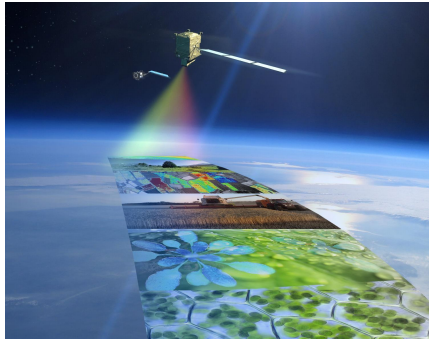
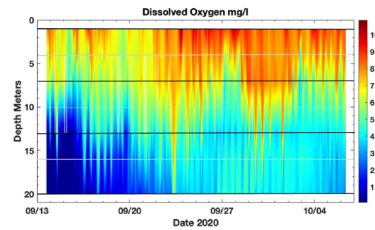


**Goal: Water Quality**  
**Outcome:**  
*Continually improve the capacity to monitor and assess the effects of management actions* being undertaken to implement the Bay TMDL and improve water quality. Use the monitoring results to report annually to the public on progress made in attaining established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

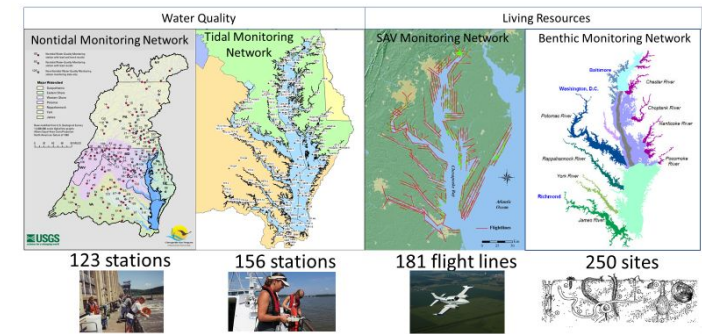


Chesapeake Bay Program

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## CBP Partnership Monitoring Networks: Annual Monitoring



Thank you!

Q&A





# STAC Workshop

## Autumn 2021/Winter 2021-22



# 8 Questions to address in this 9-month review

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- WHO - PARTNERS FOR ADDRESSING INFORMATION GAP DATA & PRODUCTS?
- DETAIL ON FINANCIALS FOR SUSTAINING AND GROWING NETWORK TO MEET INFORMATION NEEDS?

- What is the status of the network (including number of stations, sampling frequency, funding partners for tidal assessment and nontidal stream flow and water-quality monitoring at stations) and current assessment methodologies as it pertains to its stated purpose?
- How have the networks and assessment needs of the CBP partnership changed over time past 5-10 years and what are future threats?
- What needs to be done to sustain the current networks (i.e., stop the loss of stations and number of stations to inflation over the past 5-10 years, address infrastructure challenges, manage the growth of data (databases), and what are the future benefits of doing so?
- What gaps need to be filled to improve the CBP monitoring network to meet current information and decision-support needs?
- How can existing monitoring data and products be used to address these gaps?
- What are some of the approaches that can be considered to improve the networks to address current and future management relevant data analysis products?
- How can other partners can help expand the monitoring capacity through adoption of existing data analyses beyond the traditional Clean Water Act 117e grant funded monitoring programs?
- Assign a financial need if necessary to each recommendation that addresses sustaining and growing the networks

See PSC-request white paper for question details

# Actions: 8 Questions to address in this 9-month review

- **EXISTING NETWORK STATUS?**
- **Action** – Edit available summaries.

Example:

**Chesapeake Bay Benthos Monitoring.** The current Bay-wide benthic monitoring program, initiated in Maryland in 1984 and in Virginia in 1985, now consists of fixed and random site components (Weisberg et al. 1997; Dauer and Llansó 2003; Llansó et al 2003). The fixed site monitoring program has 53 stations traditionally sampled annually **in spring and summer** to monitor changes over time (trends). All fixed sites in Maryland and Virginia are sampled using three replicate bottom grabs. The probability-based, random strata sampling was initiated in Maryland in 1994. Since 1996, the probability-based sampling program has become the standardized approach in Virginia as well, providing for a Bay-wide regulatory assessment estimating impaired habitat conditions. The impairment assessment relies on approximately 200 sites sampled between July 15 and September 30 each year

# Actions: 8 Questions to address in this 9-month review

- **VULNERABILITIES?**
- **Action** - States/USGS – use the already generally identified understanding on near term challenges provided annually in grants/IAGs. Add insights.

Example:

We just spent 3+ years addressing long-term funding needs to continue NTN operations at Conocheague Creek. New EPA support has been developed.

Example:

SAV program risks due to contractor ownership and unusual weather conditions promoted evaluations of alternative image sourcing.

# Actions: 8 Questions to address in this 9-month review

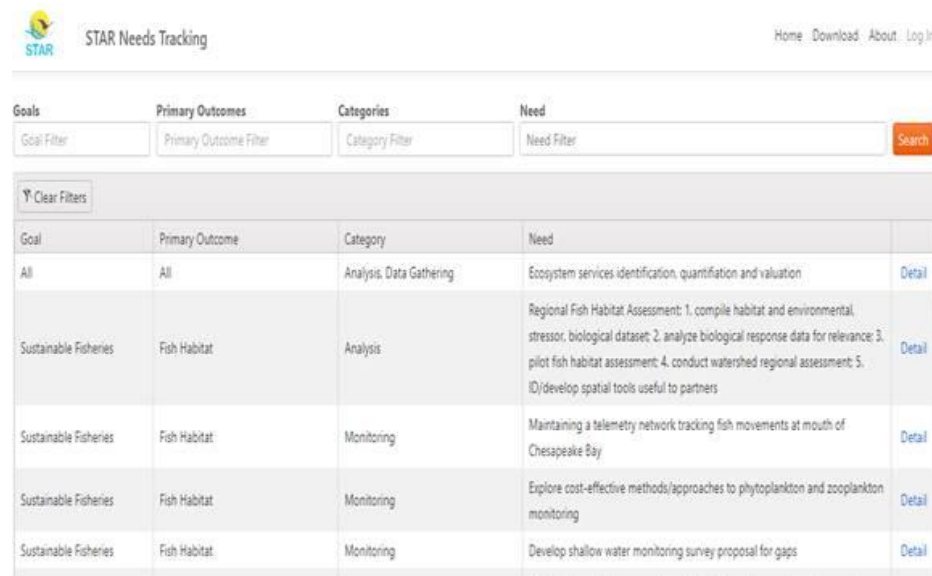
- **PROGRAMMING STRATEGY?**
- **Action** - What is the cost of sustaining existing operations the next 5 years – some insights already available.

Example:

117e grant/IAG 5-year cost projections often provide adaptations/reductions for working with level Federal and State funding as a resource for estimating costs to maintain existing operations.

# Actions: 8 Questions to address in this 9-month review

- **INFORMATION GAPS TO FILL?**
- **Actions** – extract gaps highlighted in the CBP Strategic Science and Research Framework database



The screenshot shows the STAR Needs Tracking website. At the top, there is a logo for STAR and the text "STAR Needs Tracking". To the right are links for "Home", "Download", "About", and "Log In". Below the header, there are four filter boxes: "Goal Filter", "Primary Outcome Filter", "Category Filter", and "Need Filter". A "Search" button is to the right of the "Need Filter" box. Below the filters is a "Clear Filters" button. The main content is a table with four columns: "Goal", "Primary Outcome", "Category", and "Need". The table contains five rows of data. The first row is a header row. The second row shows "All" for Goal, "All" for Primary Outcome, "Analysis, Data Gathering" for Category, and "Ecosystem services identification, quantification and valuation" for Need. The third row shows "Sustainable Fisheries" for Goal, "Fish Habitat" for Primary Outcome, "Analysis" for Category, and a detailed description of the Regional Fish Habitat Assessment for Need. The fourth row shows "Sustainable Fisheries" for Goal, "Fish Habitat" for Primary Outcome, "Monitoring" for Category, and "Maintaining a telemetry network tracking fish movements at mouth of Chesapeake Bay" for Need. The fifth row shows "Sustainable Fisheries" for Goal, "Fish Habitat" for Primary Outcome, "Monitoring" for Category, and "Explore cost-effective methods/approaches to phytoplankton and zooplankton monitoring" for Need. The sixth row shows "Sustainable Fisheries" for Goal, "Fish Habitat" for Primary Outcome, "Monitoring" for Category, and "Develop shallow water monitoring survey proposal for gaps" for Need. Each row has a "Detail" link to its right.

Goal	Primary Outcome	Category	Need	
All	All	Analysis, Data Gathering	Ecosystem services identification, quantification and valuation	<a href="#">Detail</a>
Sustainable Fisheries	Fish Habitat	Analysis	Regional Fish Habitat Assessment: 1. compile habitat and environmental, stressor, biological dataset; 2. analyze biological response data for relevance; 3. pilot fish habitat assessment; 4. conduct watershed regional assessment; 5. ID/develop spatial tools useful to partners	<a href="#">Detail</a>
Sustainable Fisheries	Fish Habitat	Monitoring	Maintaining a telemetry network tracking fish movements at mouth of Chesapeake Bay	<a href="#">Detail</a>
Sustainable Fisheries	Fish Habitat	Monitoring	Explore cost-effective methods/approaches to phytoplankton and zooplankton monitoring	<a href="#">Detail</a>
Sustainable Fisheries	Fish Habitat	Monitoring	Develop shallow water monitoring survey proposal for gaps	<a href="#">Detail</a>

# Actions: 8 Questions to address in this 9-month review

- **MONITORING PROGRAM OPTIONS TO  
FILL GAPS?**
- **Action** - Healthy discussions planned in many forums these next 6 months including STAC Workshop.

Example:

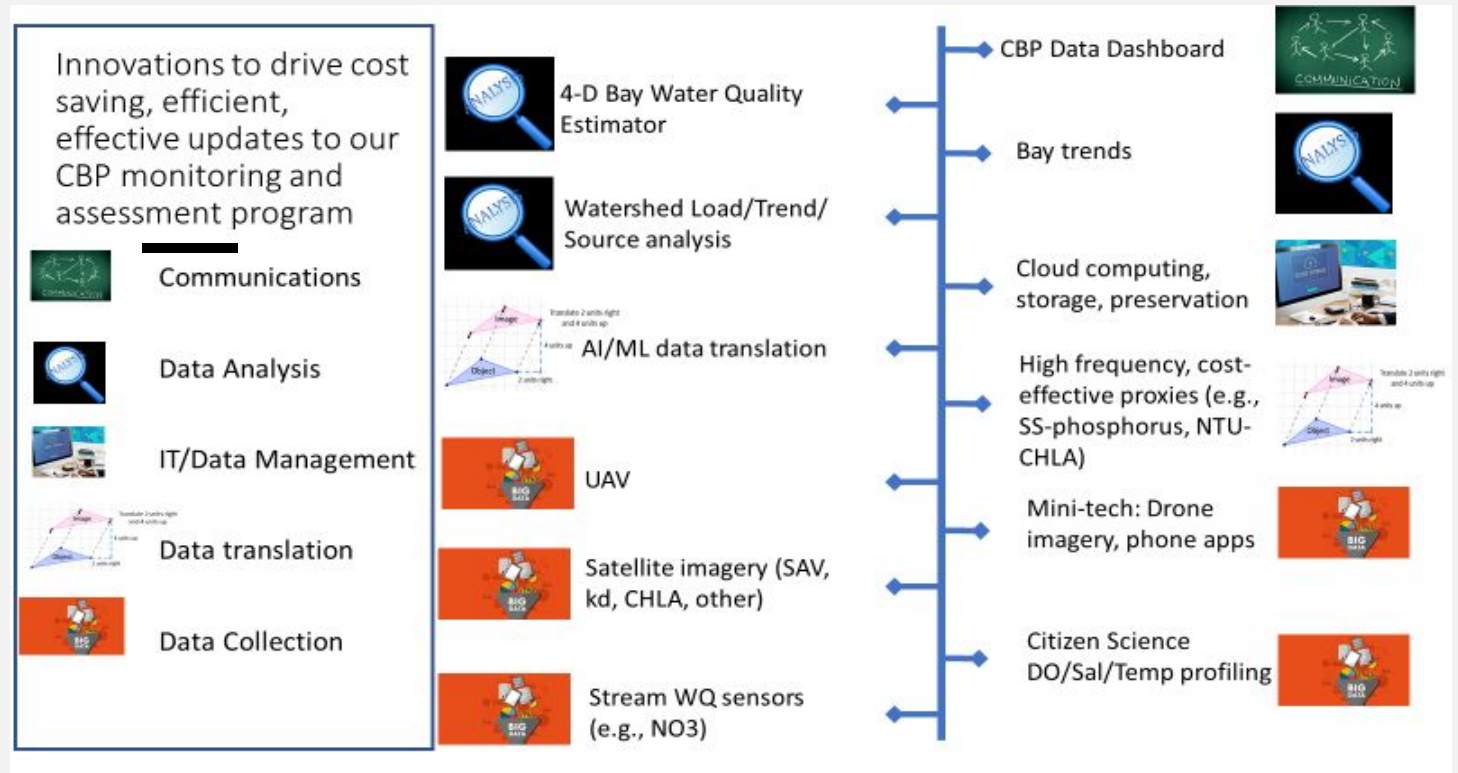
NTN considerations with NRCS-EPA-USGS partnership work

Example:

Strategic collaborations with Citizen Science engagements

# Actions: 8 Questions to address in this 9-month review

- **WHAT INNOVATIONS ARE AVAILABLE?:**
- **Actions:** Discussion in many forums these next 6 months including STAC Workshop to discuss utility and readiness of innovations, their data, and their products.



Actions:  
8 Questions to  
address in this  
9-month  
review

- **WHO - PARTNERS FOR ADDRESSING INFORMATION GAP DATA & PROODUCTS:**
- **Action:** List. That should be obvious from answers from the previous question. Self explanatory.

# Actions: 8 Questions to address in this 9-month review

- **DETAIL ON FINANCIALS FOR SUSTAINING AND GROWING NETWORKS TO MEET INFORMATION NEEDS?**
- **Action:** Reflect costs to address COLAs, new partners with available products, build out and maintenance of new networks, data management, QA, analysis, reporting.



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# Supporting group consultations

Data Integrity WG – All  
Network update  
considerations

Climate Resiliency WG  
– All networks

Fish Habitat Action  
Team – Tidal network,  
Hypoxia Collaborative,  
4D BORG links

Forage Fish Team –  
Benthic Network

Black Duck Team –  
Benthic Network

Healthy Habitats –  
outputs of 4-D analysis

Modeling WG – 4D  
water quality estimator

Water Quality GIT

STAR

STAC

# DIWG guidance during the review process and beyond



- Status on Citizen monitoring and labs collecting citizen samples
- Review and guidance on existing data sources feeding the new 4-dimensional interpolator
  - E.g., Fisheries-based data collections that are already being used in fish habitat-climate interaction analyses
- New innovations and new data sources to bring into the program
  - E.g., Direction on QA, calibration needs (e.g., satellite-based kd evaluation was tuned to mainstem measures, we would need to consider tributary kd calibration needs)
  - E.g., Data integrity for vertical water quality profiler data – support for QA and data management program development of this network

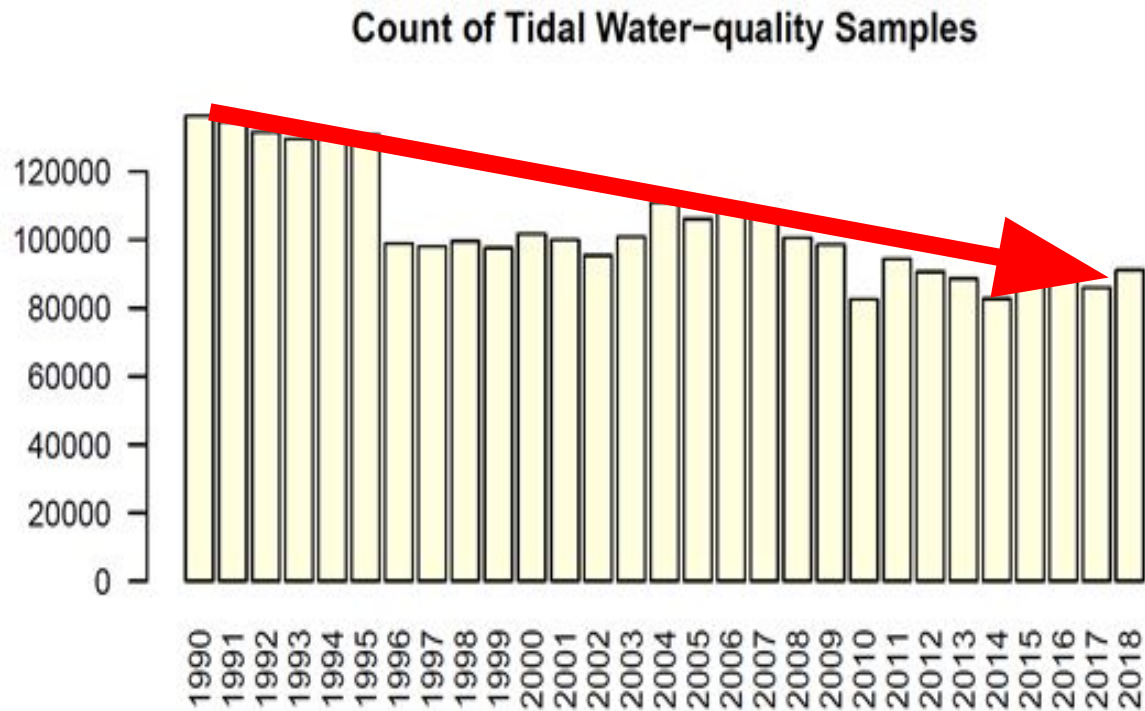
# 2021-22 STAC Workshop on Advanced Monitoring Options and Recommendations

STAC  
ACCEPTED



Peter Tango  
USGS@CBPO  
IMN WG Coordinator  
DIWG Presentation 2 of 2  
April 13, 2021

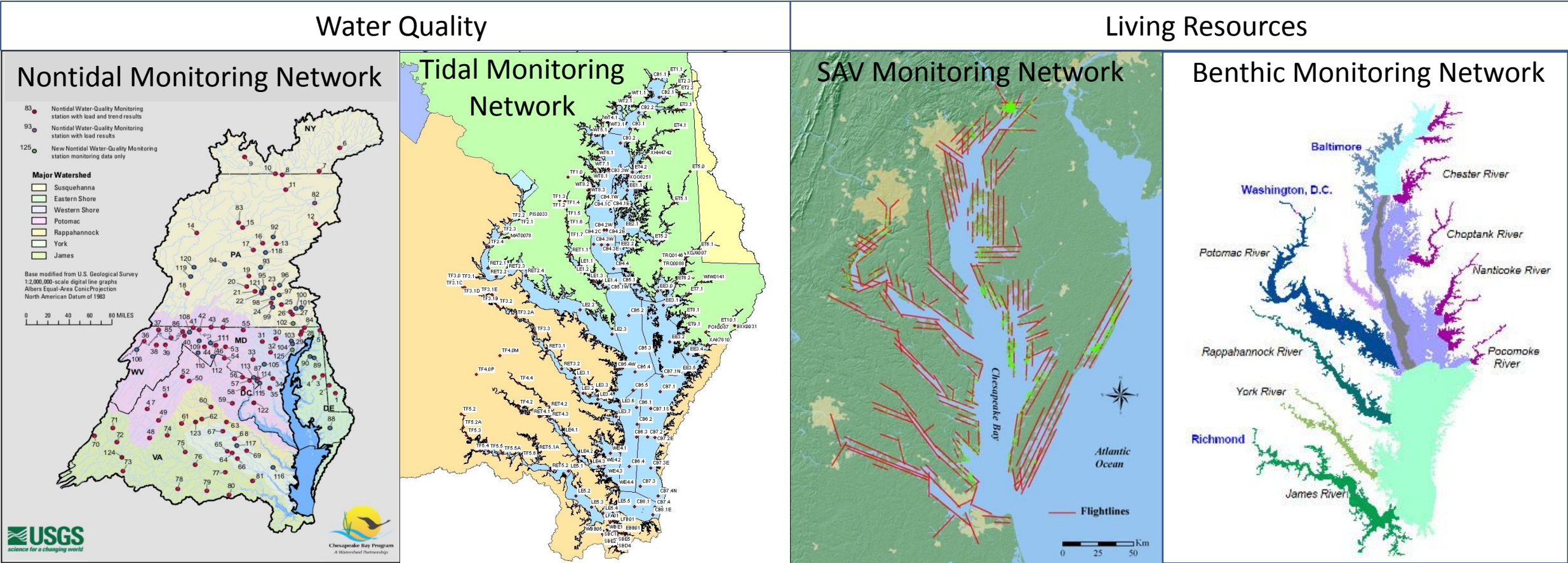
# Chesapeake Bay Monitoring Program Capacity Status?



## Traditional Monitoring Program Capacity: Good/**Fair**/Poor

- Traditional capacity is highly stressed and declining
- ~20 years: Tidal data monitoring remains “marginal” to address management needs
- Nontidal data collection “adequate” for the watershed load estimates, station losses ahead
- Flat funding ignores inflation/COLAs translating to station and data losses.
- Impending SAV program cost increases may challenge program after 2021

# CBP Partnership Monitoring Networks: Annual Monitoring



123 stations



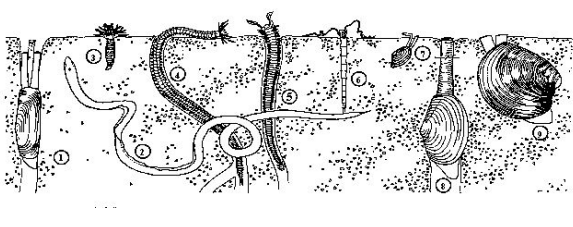
156 stations



181 flight lines

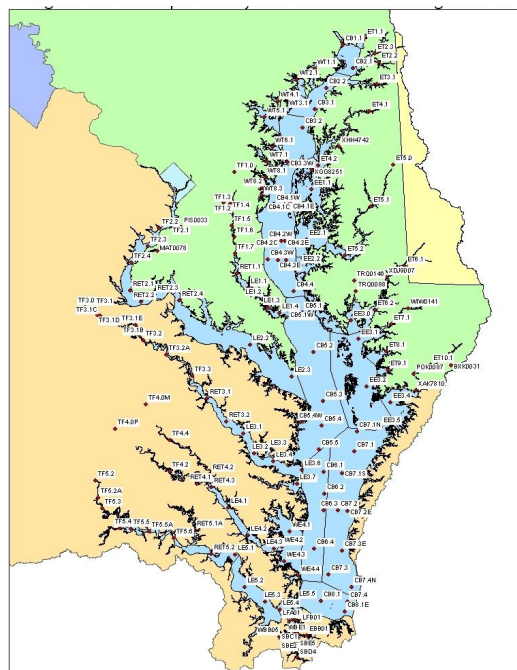


250 sites

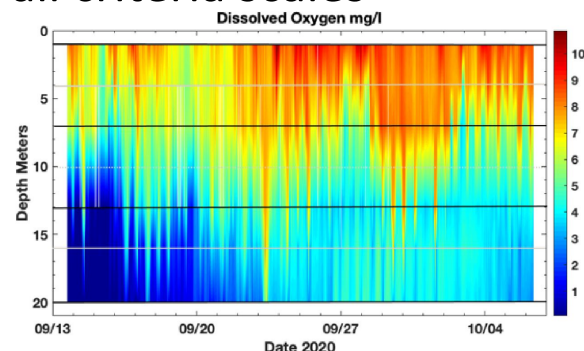


# The future of water quality standards assessment is here

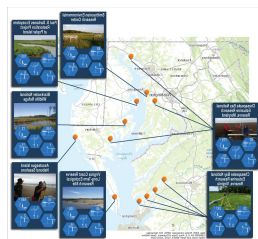
Dissolved oxygen measures  
Supporting assessment at all criteria scales



Fixed station network:  
Dissolved oxygen criteria  
Nutrient/sediment factors



Vertical profiler network  
Short duration DO criteria



Nearshore  
Con-Mon  
Sentinel  
Site  
Network

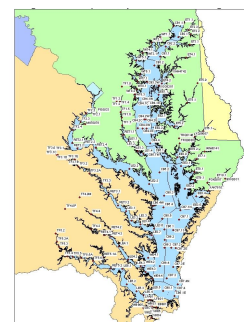
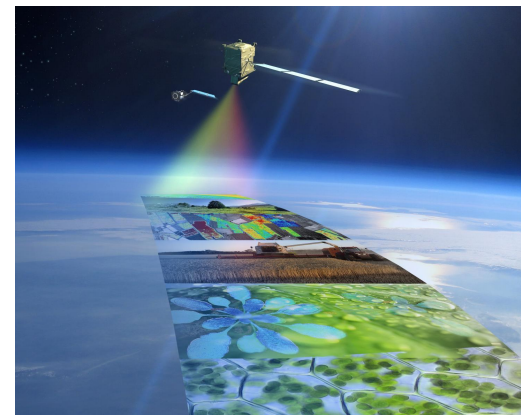


Fisheries-based  
DO profiles



Volunteer network  
Enhanced spatial detail

SAV, kd, Chlorophyll  
Satellite-based assessment  
Intra-annual detail

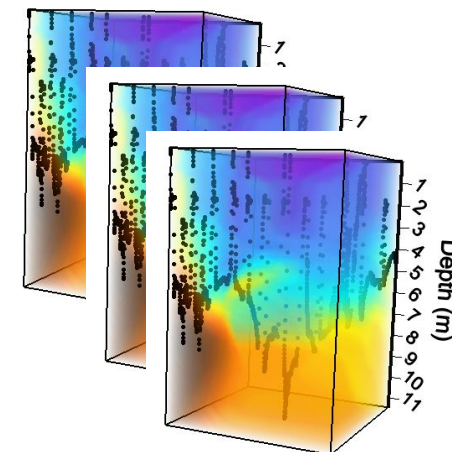


Fixed station  
network:  
CHLA calibration  
CHLA verification



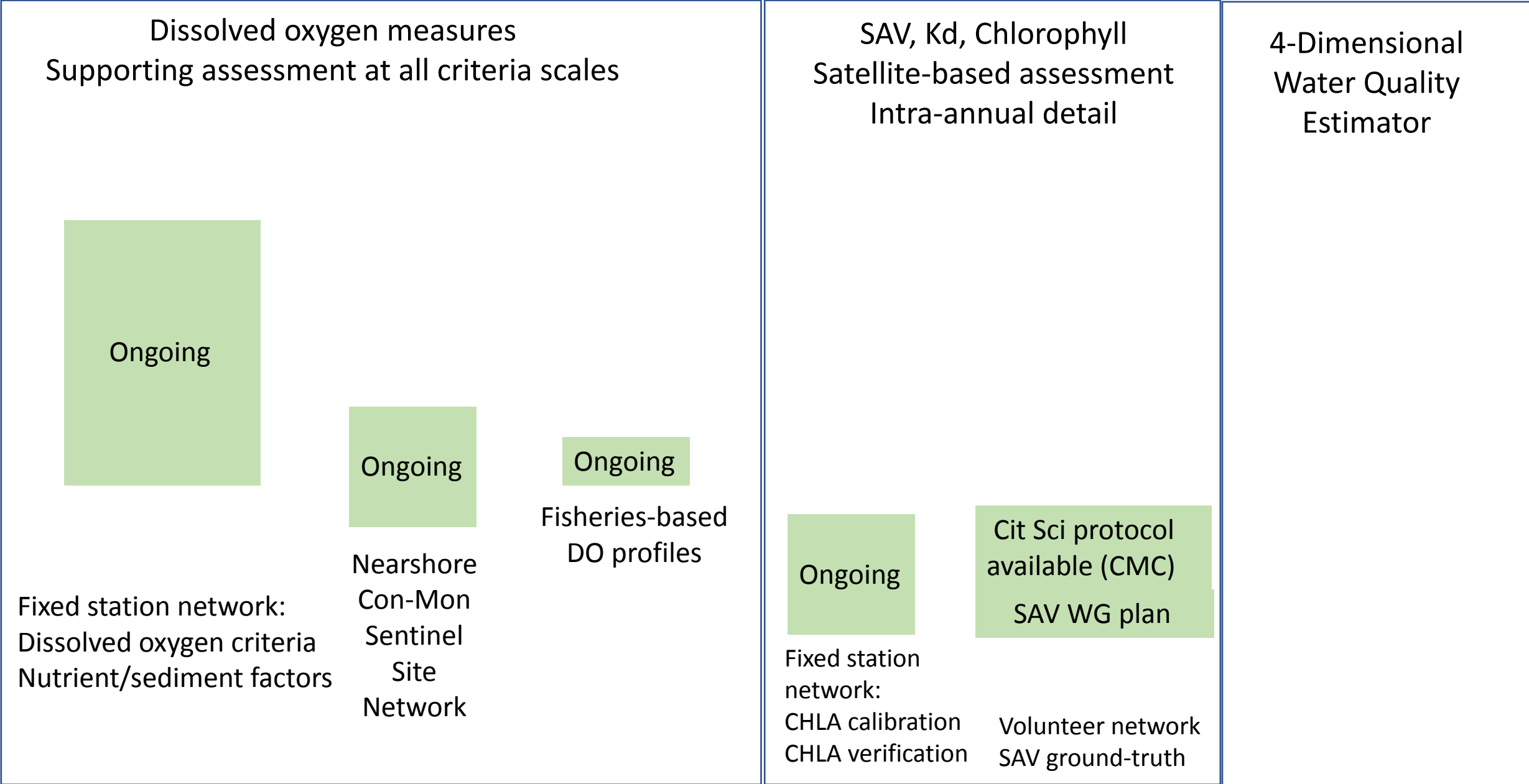
Volunteer network  
SAV ground-truth

4-Dimensional  
Water Quality  
Estimator

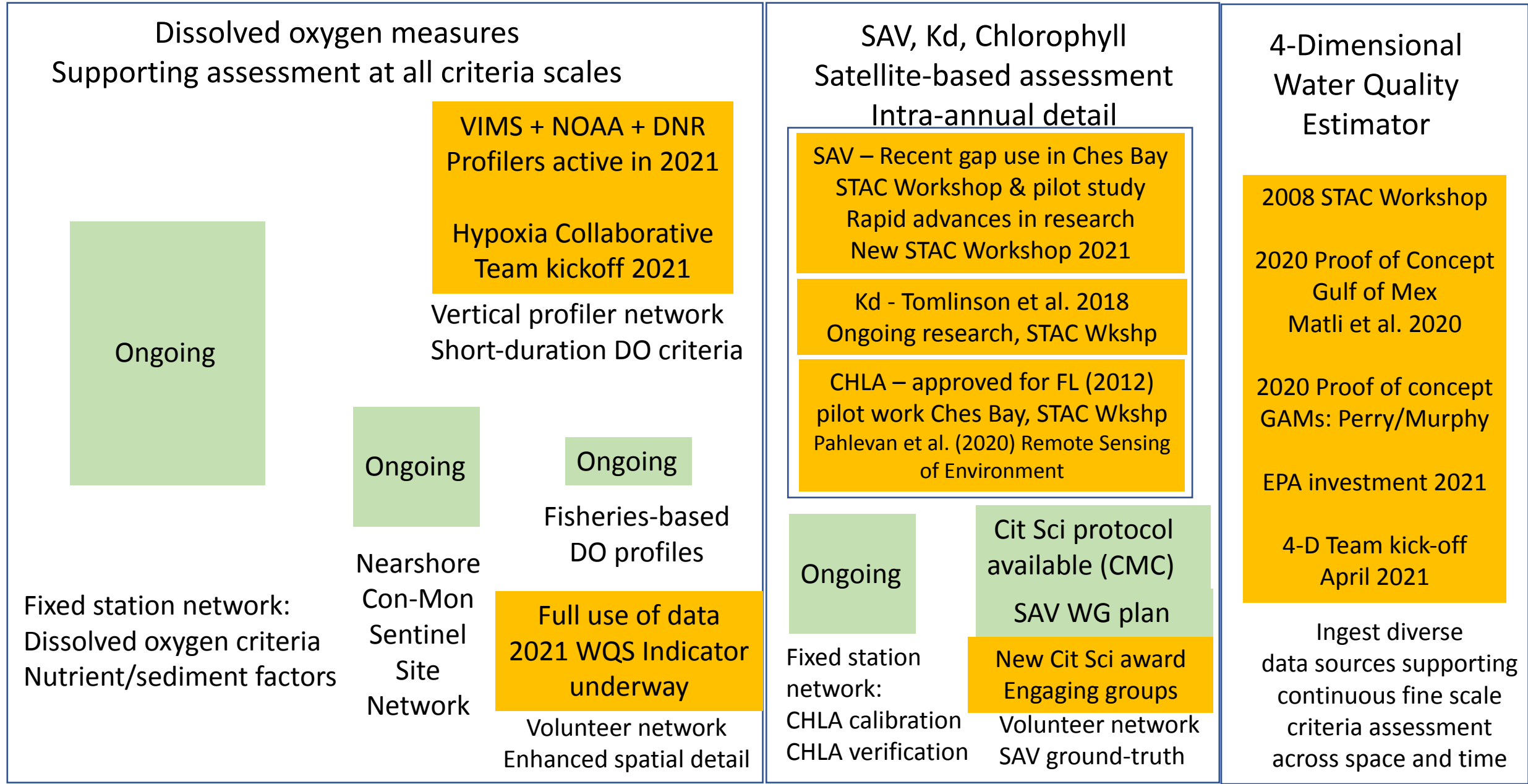


Ingest diverse  
data sources supporting  
continuous fine scale  
criteria assessment  
across space and time

# The water quality standards assessment future is now



# The water quality standards assessment future is now



# STAC Workshop Autumn 2021/Winter 2021-22

- Deeper dive on the assessment of options, their readiness for assessment support, identification of what questions/research needs might be required before adoption
- Tune recommendations on adoption of innovations and alternatives to address long-standing gaps in our assessment efforts
- Mini-meetings targeting topics build from our summer/autumn workgroup meetings:
  - E.g., AI algorithms for SAV assessment
  - E.g., Protocol for acquiring different satellite-based data
  - E.g., status and progress on satellite-based CHLA
  - E.g., 4-D interpolator development support needs
  - E.g., data interpretation options to address assessment



[illegible]