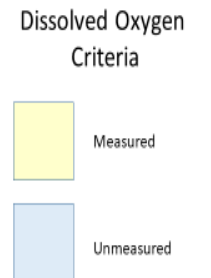


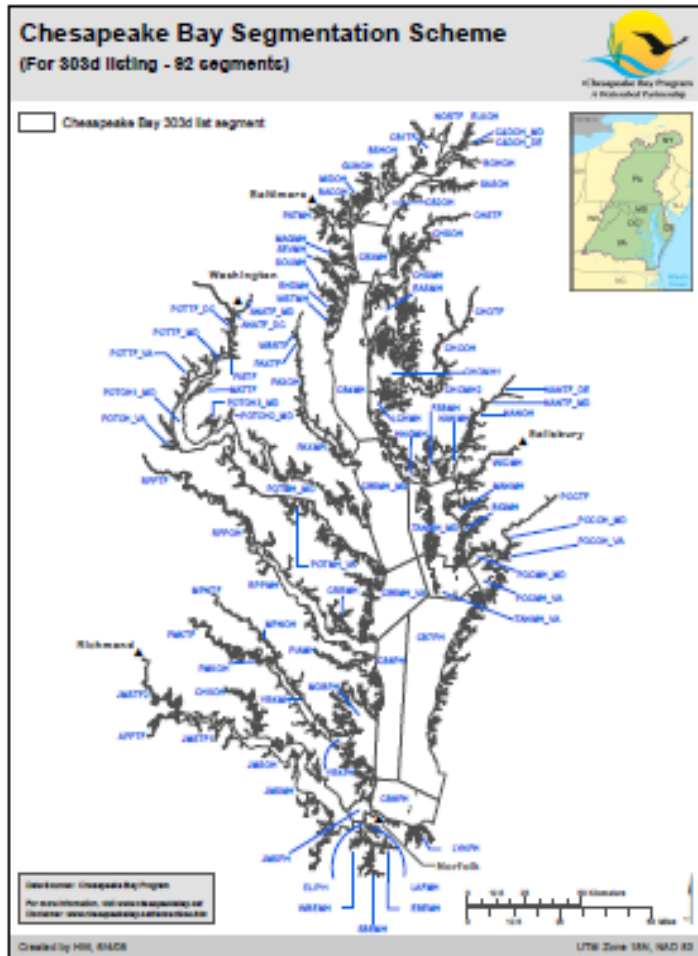
Assessment of all Bay dissolved oxygen water quality criteria for 2025

Peter Tango
 Water Quality GIT
 April 27, 2022

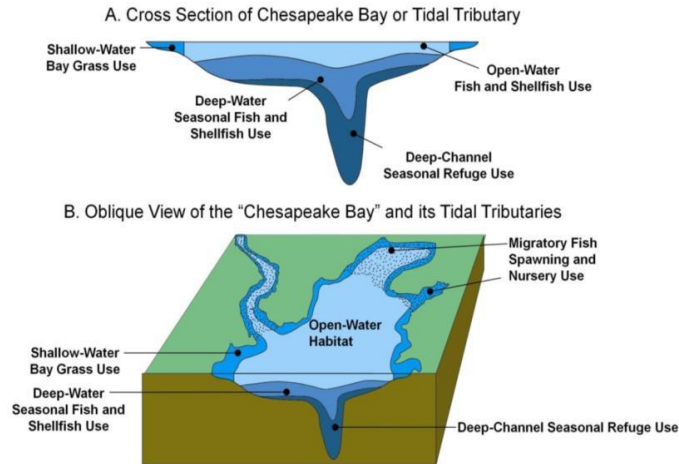
Designated Use	Dissolved oxygen Criteria Concentration/Duration	Temporal Application
Migratory fish spawning and nursery use	7-day mean \geq 6 mg/L tidal habitats with 0-0.5ppt salinity	February 1 – May 31
	Instantaneous min \geq 5 mg/L	June 1 – January 31
Open water fish & shellfish designated use criteria apply		
Shallow water Bay grass use	Open water fish & shellfish designated use criteria apply	Year-round
Open water fish and shellfish use	30-day mean \geq 5.5 mg/L Salinity: (0-0.5ppt)	Year-round
	\geq 5 mg/L Salinity: >0.5ppt	
	7-day mean \geq 4 mg/L	
	Instantaneous min \geq 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 \geq 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



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



Refined Designated Uses for the Bay and Tidal Tributary Waters



No assessment available for approximately 61% (512 of 838) Individual decisions needed to make a full assessment of the bay criteria (PT)

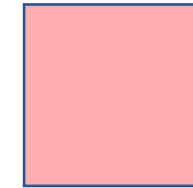
0

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



Challenges

- **Unassessed criteria** remain a hurdle for delisting decisions of State-adopted water quality standards with our existing framework
- **Contraction** of traditional long-term monitoring programming
- **Limited** use of new interpretation and interpolation options



= Inability to report on standard attainment

Designated Use	Dissolved oxygen Criteria Concentration/Duration	Temporal Application
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Historical interest in 4-dimensional (4D) water quality interpolation: 2008 STAC Workshop

Assessing the feasibility of developing a four-dimensional (4-D) interpolator for use in impaired waters listing assessment December 2008 STAC Publication 08-008

Recommendations from the STAC Expert Panel

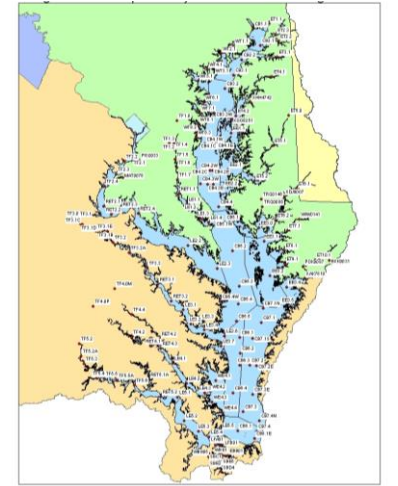
- Frank Curriero (Johns Hopkins University)
- Eileen Hofmann (Old Dominion University)
- Ragu Murtugudde (University of Maryland)
- Jian Shen (Virginia Institute of Marine Science)
- J. Andrew Royle (U.S. Geological Survey)

2008 Findings

- Insufficient information to evaluate the feasibility of a 4-D interpolator
- The panel recommended a study to evaluate the different approaches available for developing a 4-D interpolator
- Data analysis studies should be initiated to develop the statistical basis for a 4-D interpolator.

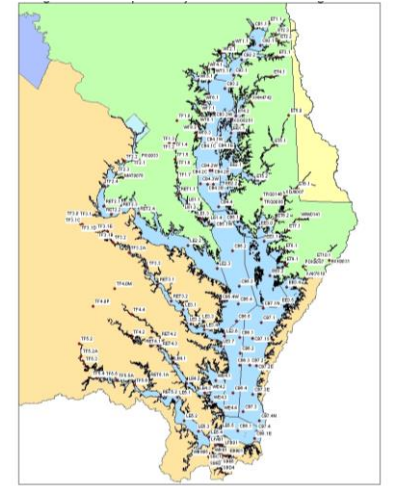
2008 STAC Workshop findings:

- A consensus opinion from the expert panel was that **the sampling frequency and spatial resolution of the existing Chesapeake Bay datasets are insufficient for successful extrapolation to four dimensions.**
-



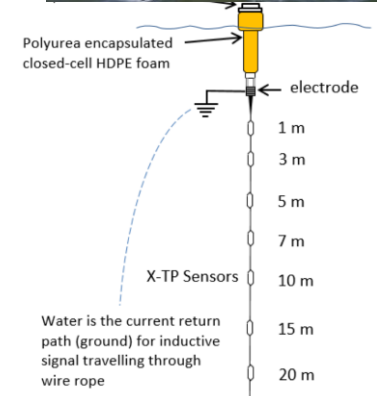
2008 STAC Workshop findings:

- A consensus opinion from the expert panel was that **the sampling frequency and spatial resolution of the existing Chesapeake Bay datasets are insufficient for successful extrapolation to four dimensions.**



- However, there is an on-going effort among Chesapeake Bay partners to acquire funding to deploy continuous monitoring buoys, which are equipped with vertical profilers in deep water areas of the Chesapeake Bay and tidal tributaries.

“If these efforts succeed, then the shortcomings of existing datasets will be greatly alleviated.”



Where are we a decade or so later
addressing the 4-D workshop
recommendations towards
supporting assessment of unassessed
criteria?

Organizationally: 2 new workgroups formed under STAR to address infrastructure and analysis developments needed to support habitat assessment and 4-D interpolator development

The screenshot shows the website for the Hypoxia Collaborative Team. At the top is the Chesapeake Bay Program logo with the tagline "Science. Restoration. Partnership." Below the logo is a navigation bar with links: "Discover the Chesapeake", "Learn the Issues", "State of the Chesapeake", and "Take Action". A breadcrumb trail reads "WHO WE ARE > HOW WE'RE ORGANIZED > HYPOXIA COLLABORATIVE TEAM". The main heading is "Hypoxia Collaborative Team" with social media icons for Facebook, Twitter, and Email. Below this is a section for "Upcoming Meetings" which states "No upcoming meetings." with links for "<< View Past Meetings" and "View Meeting Calendar >>". A "Scope and Purpose" section follows, describing hypoxic conditions and the team's role in monitoring and implementation.

- Hypoxia monitoring network design, operation, and maintenance

Co-Leads: Peter Tango, Bruce Vogt, Jay Lazar, Kevin Shabow
CRC Staff: Justin Shapiro

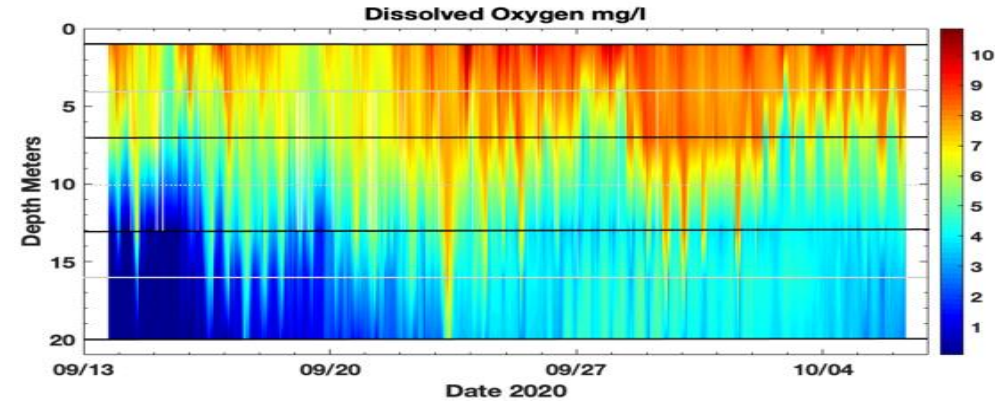
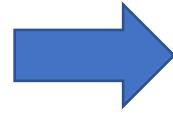
The screenshot shows the website for the Bay Oxygen Research Group. It features the same Chesapeake Bay Program logo and navigation bar as the first screenshot. The breadcrumb trail is "WHO WE ARE > HOW WE'RE ORGANIZED > BAY OXYGEN RESEARCH GROUP". The main heading is "Bay Oxygen Research Group" with social media icons for Facebook, Twitter, and Email. Below this is a section for "Upcoming Meetings" which states "No upcoming meetings." with links for "<< View Past Meetings" and "View Meeting Calendar >>". A "Scope and Purpose" section follows, discussing the need for sufficient dissolved oxygen (DO) and the current methods for assessing and improving it.

- 4-dimensional interpolator development, data needs, data ingestion and interpretation

Co-chairs: Rebecca Murphy and Peter Tango
CRC Staff: Amy Goldfisher

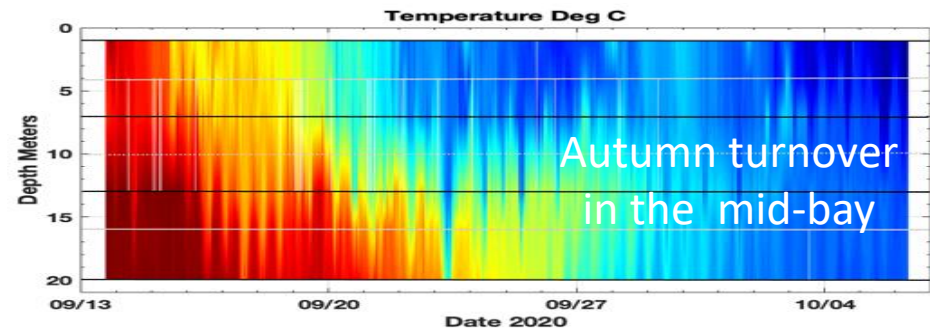
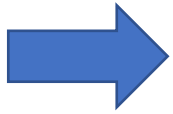
Addressing the data issues: 2019-2020 GIT Funded Pilot Project on robust, cost-effective high frequency water quality profiling data collection

- Dissolved oxygen

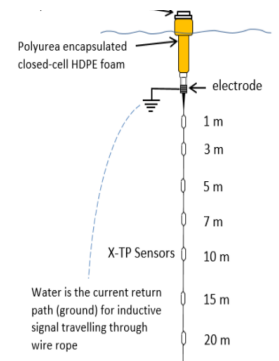
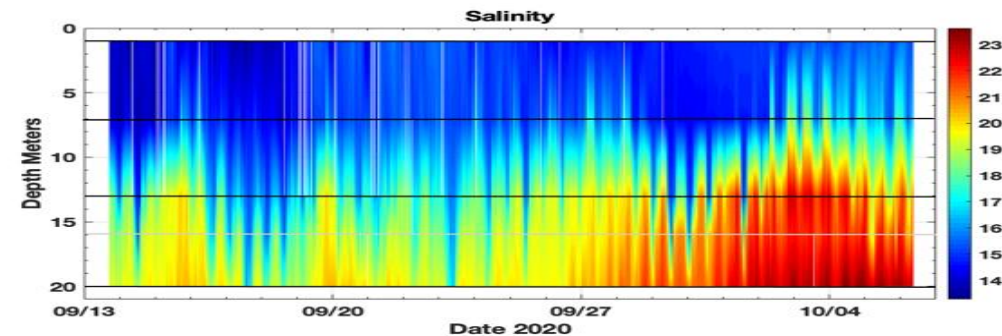
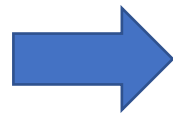


~ \$50K
instrument
with high
data return
on investment

- Temperature

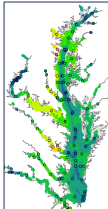


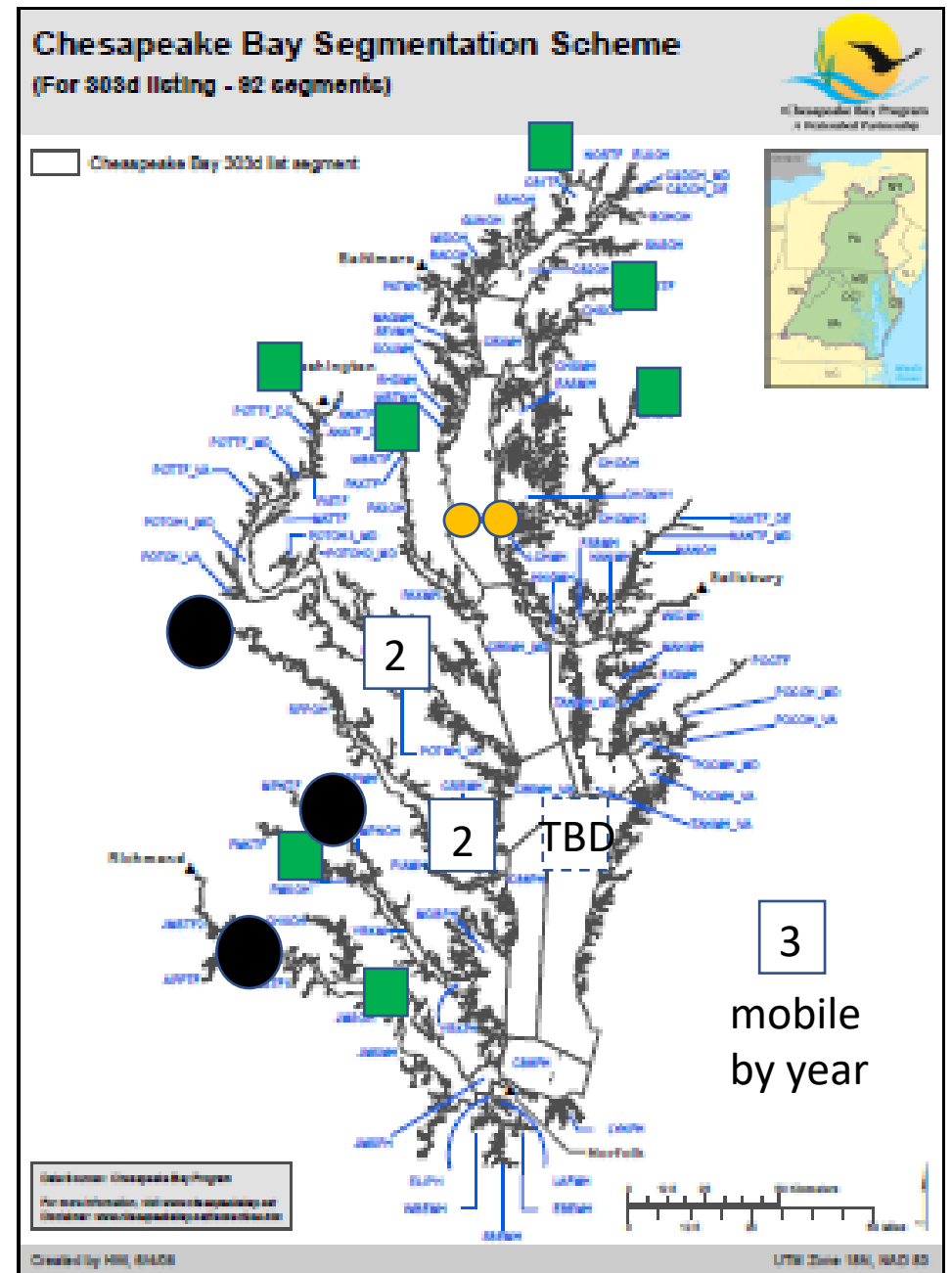
- Salinity



Sept-Oct 2020 mid-Bay CB4.3

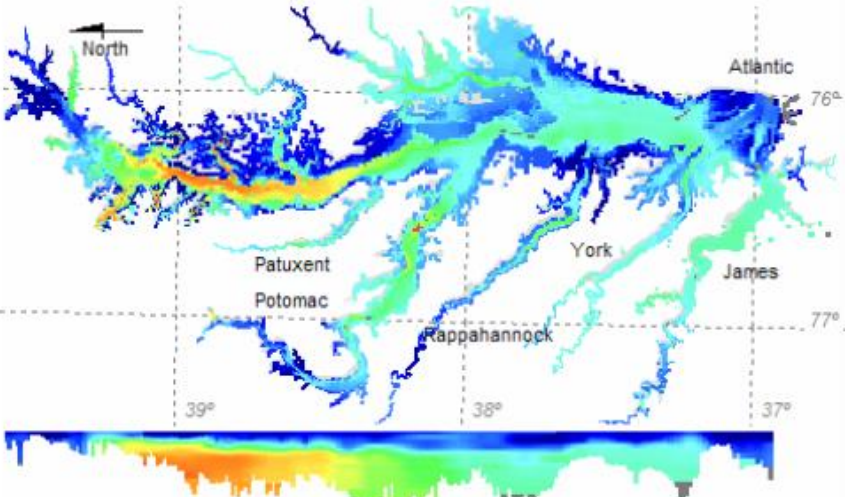
Addressing high temporal frequency data needs issues by expanding monitoring and assessment capacity 2021+

- NOAA supports 2 vertical sensor arrays ●
- Virginia DEQ/USGS coordinate on 3 river input continuous monitors ●
- 2021-22 PSC Monitoring Review proposal for capacity to support **unassessed criteria assessment, improved fish habitat assessment, modeling calibration and verification:**
 - 8 new tidal water vertical array sites
 - 7 new river input con-mons at tidal/nontidal boundary
 - New 4-D water quality interpolator tool development 

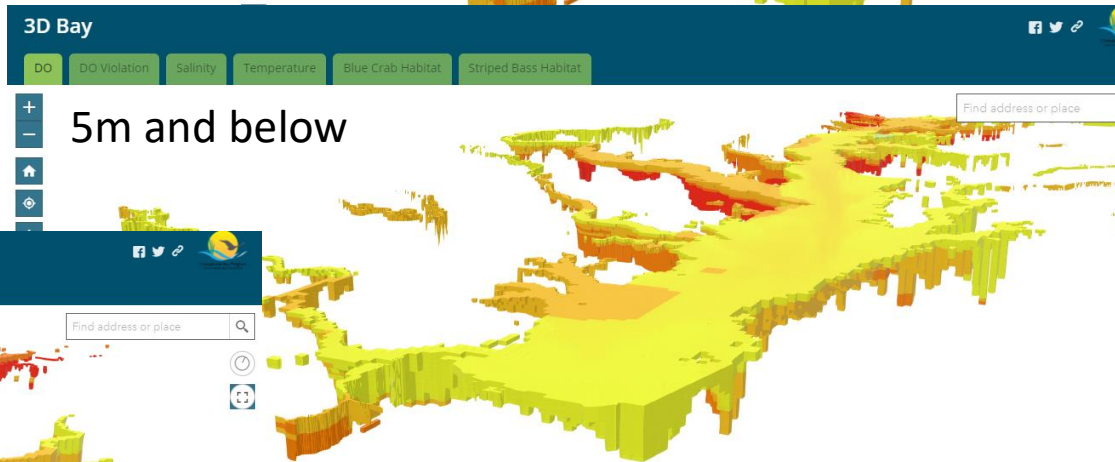
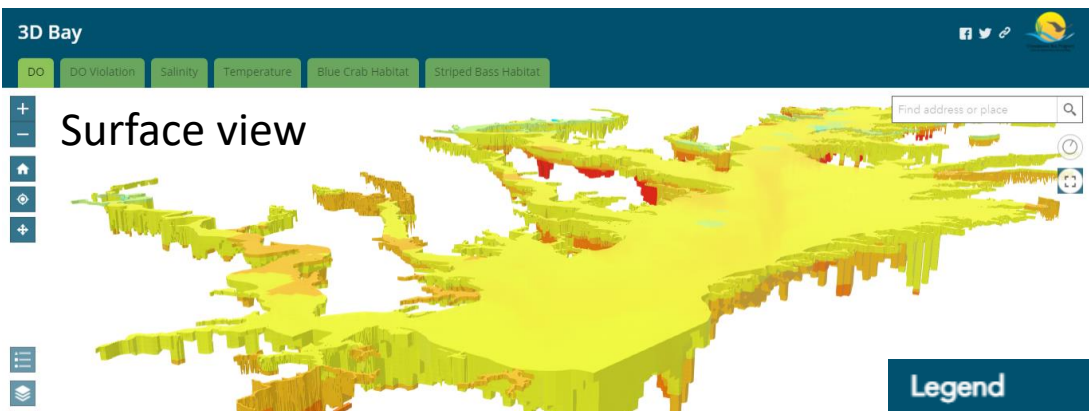


Interpolation tools: Currently, we are still in 2008 interpolation world getting water quality snapshots in time (inverse distance weighting algorithm)

July 2017 interpolation of DO



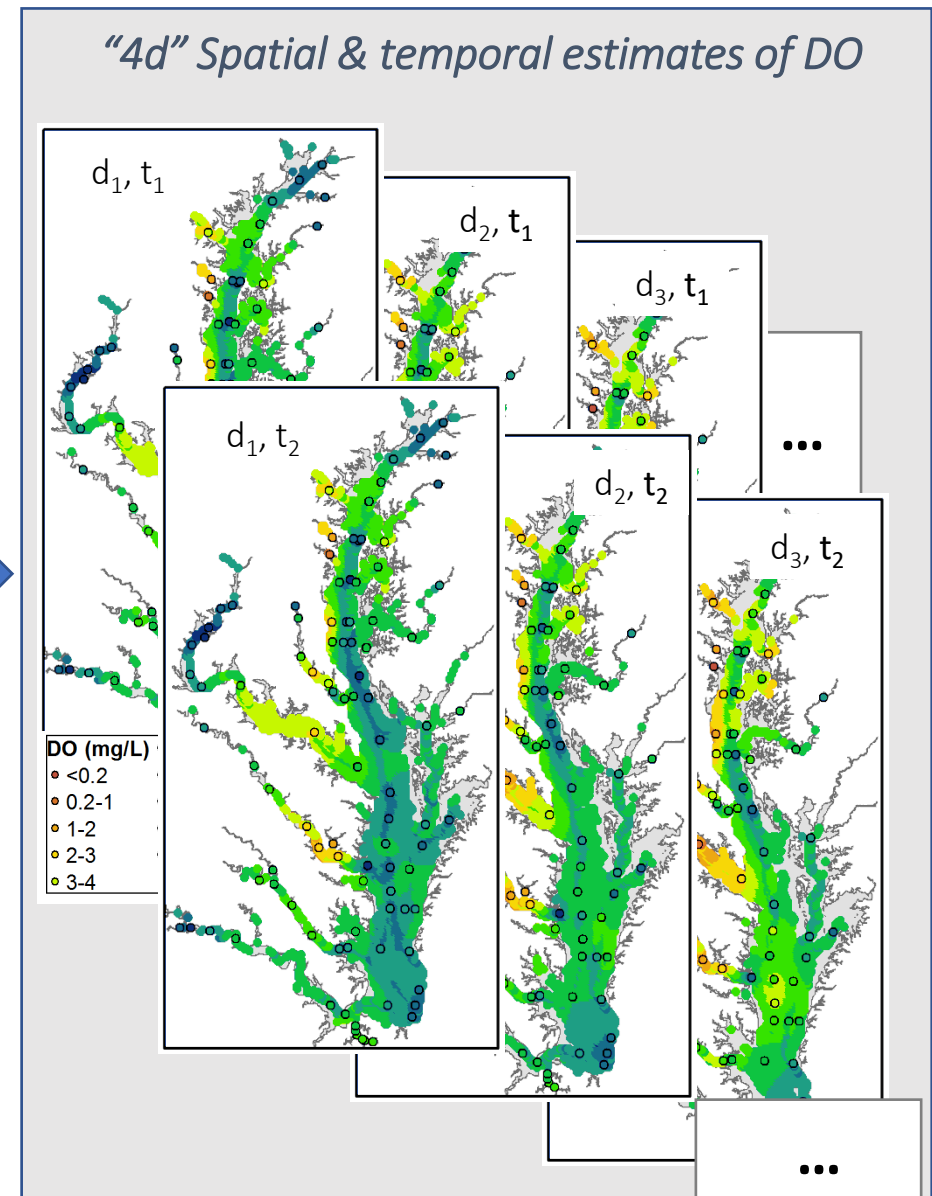
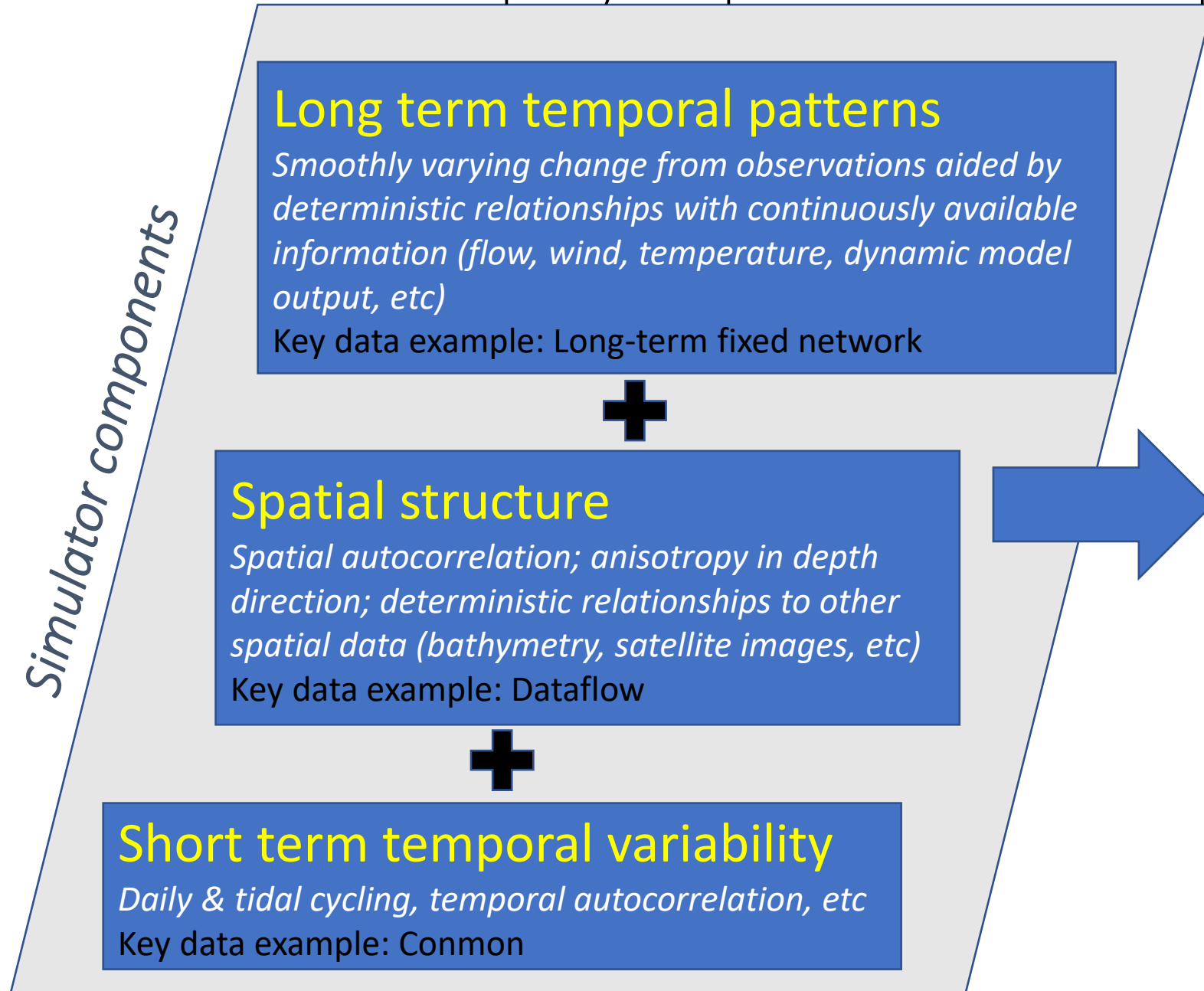
VOL3d program output



Zhaoying (Angie) Wei: beta tool
<https://bit.ly/2loRqbm> and
<https://chesbay.maps.arcgis.com/apps/MapSeries/index.html?appid=9ece32c58926433a99e066c4fe6edd78>

2022: New 4-D water quality interpolation is under development (Bay Oxygen Research Group):

Space-time interpolation with GAMs



Where we are heading: Assessment of all Bay oxygen water quality criteria for 2025

A new analysis system, built on an expanded data collection effort, is envisioned that will allow assessment of all water quality criteria. Figure 1 shows the flow of information in the proposed system.

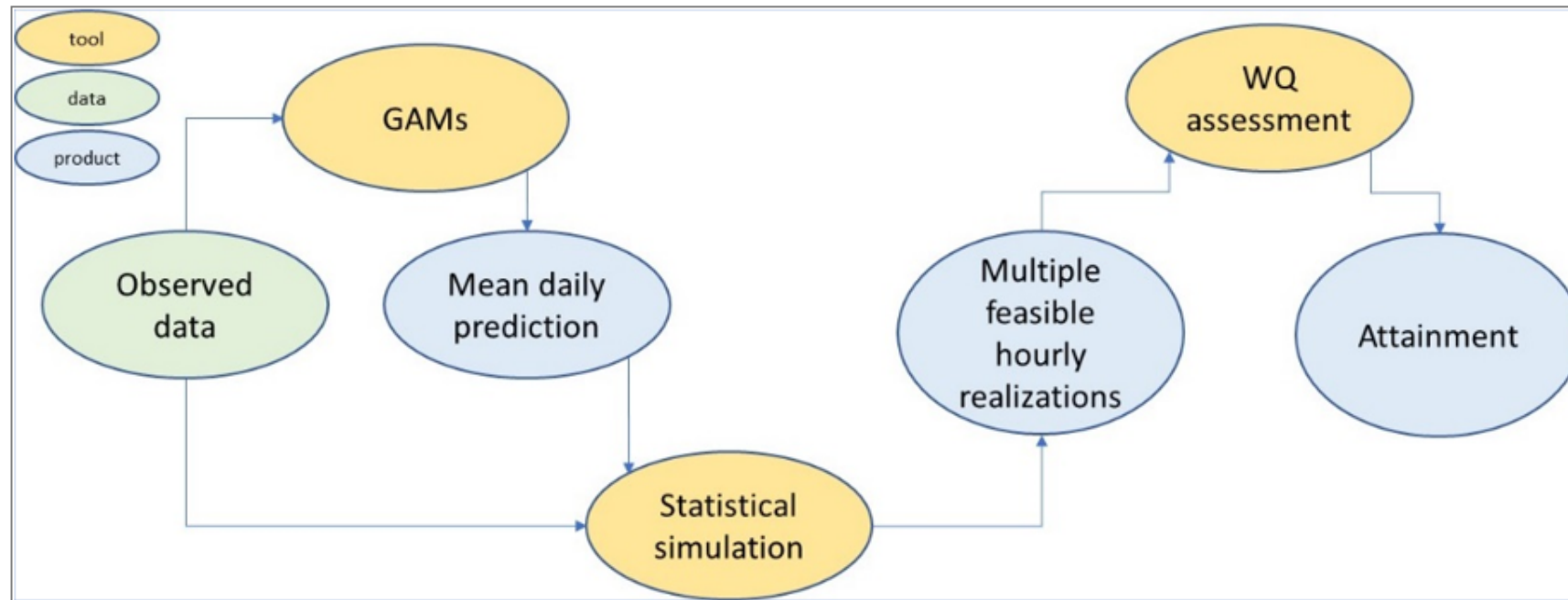


Figure 1: Interpolation and attainment assessment system

We have ripe opportunities to expand use of our toolbox to estimate conditions over much of the Bay and its tribs

Chesapeake Monitoring Cooperative
 A partnership that aims to provide technical, logistical, and outreach support for the integration of volunteer-based and nontraditional water quality and benthic macroinvertebrate monitoring data into the Chesapeake Bay Program (CBP) partnership.

Cooperative Agreement: Alliance for Chesapeake Bay, CMC development team partners & service providers, Participating Jurisdictions (PA, WV, MD, DC, VA, DE).

Update integrated monitoring approach

