Setting the stage for 2023-2025

Topics for discussion, documentation, product development in CAP WG

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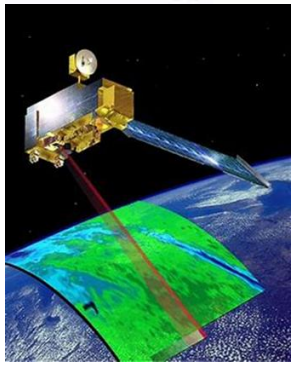
CAP WG

11/16/2022

Items to work on in future agendas and product development



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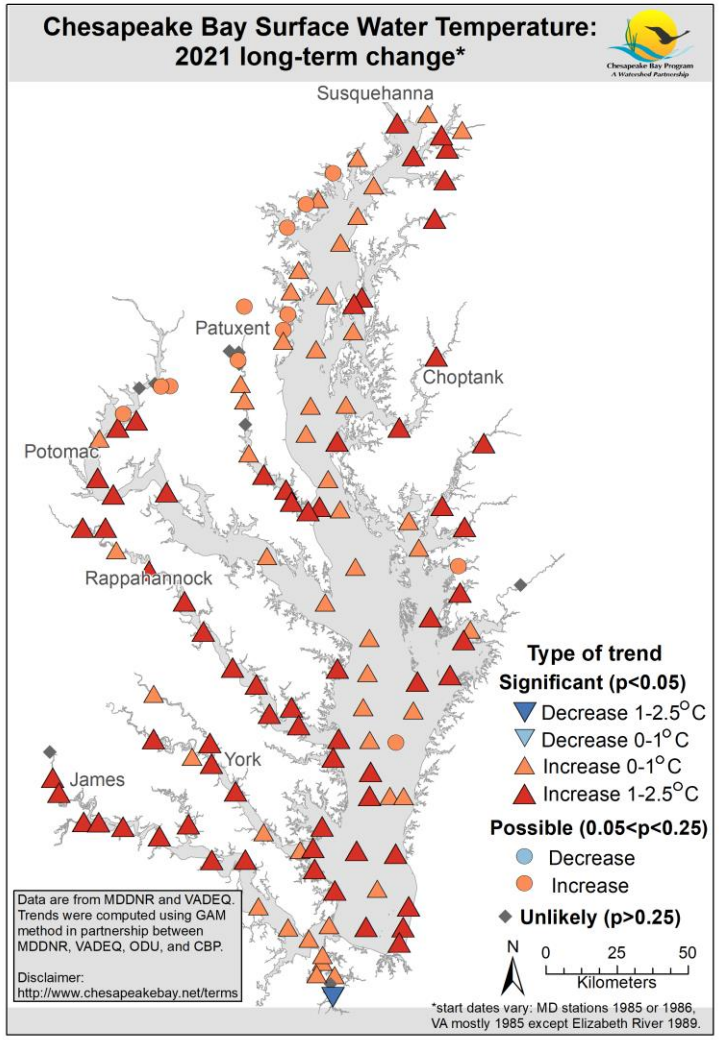
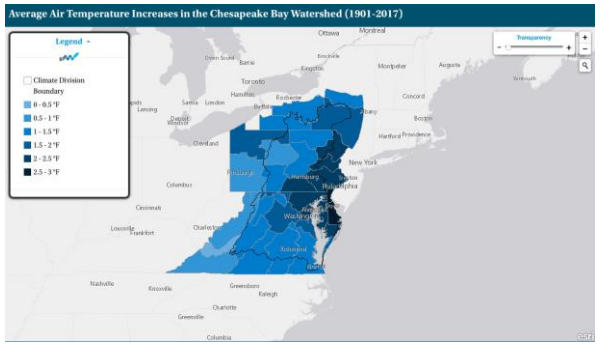
- Water temperatures are rising – do we need “temperature adjusted criteria” going forward? (Is there such a thing?)
- SAV satellite-based assessment – progress, documentation
- Satellite-based assessment of Water Clarity criteria – research yes, operation?
- Satellite-based assessment of CHLA criteria – new research to review for Ches Bay
- Dissolved oxygen criteria assessment – 4D interpolator development, hypoxia network, the need to document our evolving methods
- Significant digits in our assessment – rounding in our criteria attainment assessment?
- CB6/7 boundary layer for designated uses – the power the of the data, updated habitat distributions (Tish today)





Should we be revising criteria to account for climate change effects?

Temperature effects on bay hypoxia biting into progress on restoration

- **"average hypoxic volume in the summer would increase by 9% (410 Mm^3) from 1995 to 2025 as air temperature increases by 1.06°C and water temperature by 0.9°C."**
  - Mechanisms Controlling Climate Warming Impact on the Occurrence of Hypoxia in Chesapeake Bay. 2021. R. Tian, C.F. Cerco, G. Bhatt, L.C. Linker, G.W. Shenk. JAWRA.

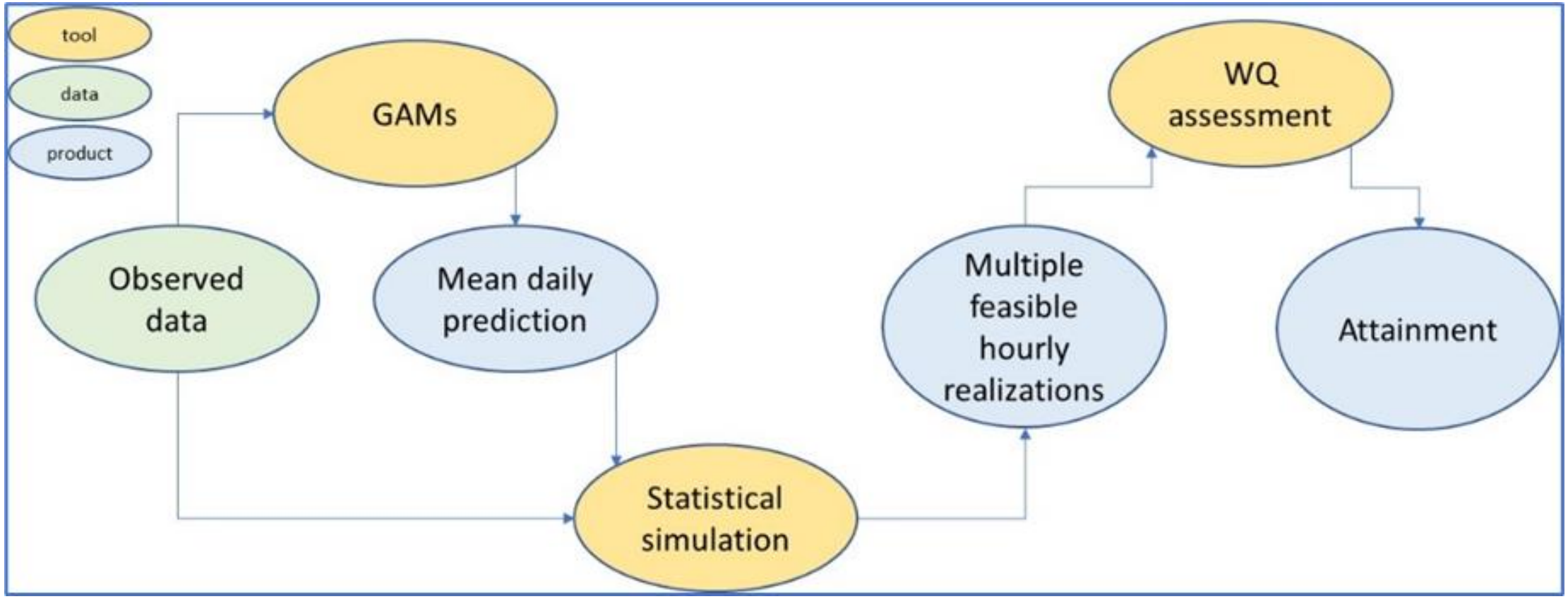
- **"warming in the Bay that has exacerbated hypoxia and offset roughly 6–34% of the improvement (in dissolved oxygen) from nitrogen reductions.**
  - Nitrogen reductions have decreased hypoxia in the Chesapeake Bay: Evidence from empirical and numerical modeling. 2021. Frankel et al. Sci of the Total Env.

We already have some temperature specific protections

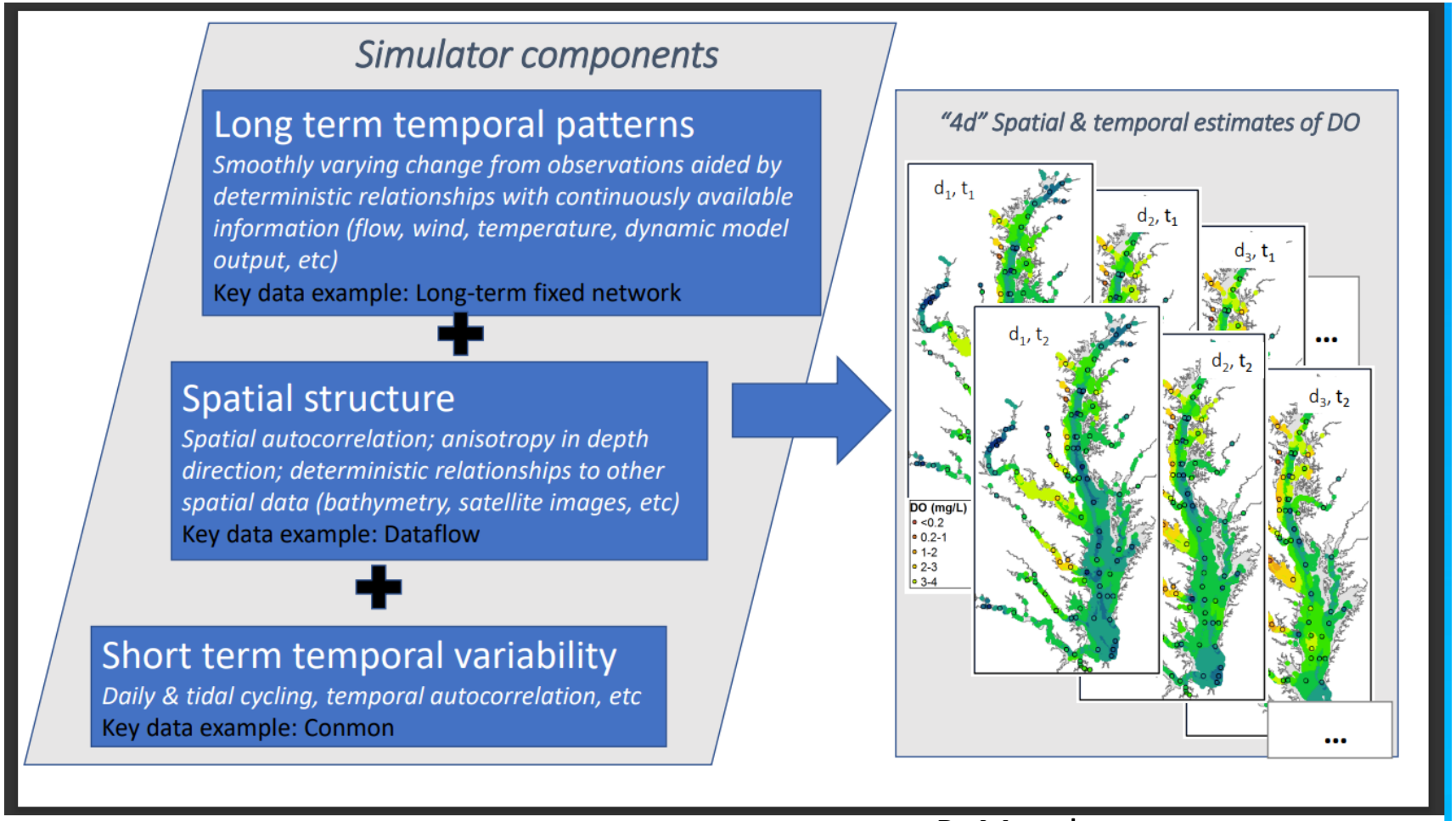
- USEPA (2003) -
- Open water instantaneous minimum criterion is 3.2 mg/L
  - "At temperatures considered stressful to shortnose sturgeon (>29^{o}C) dissolved oxygen above an instantaneous minimum of 4.3 mg/L will protect this listed species."

- Do we need something more?

Update on Assessment of all Bay Oxygen Water Quality Criteria for 2025

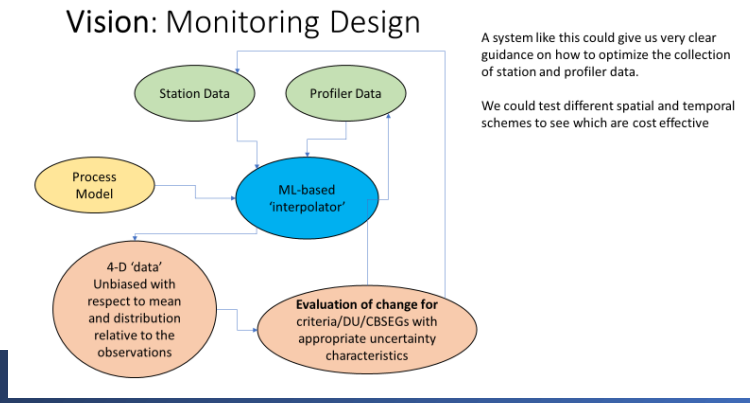


G. Shenk: Conceptual model of new criteria attainment approach

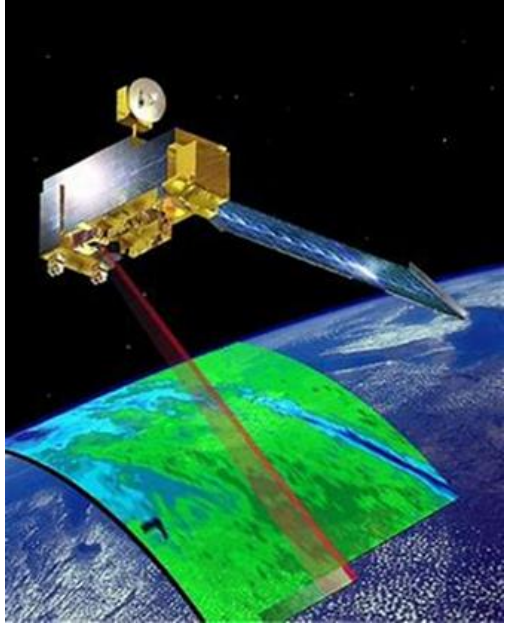


R. Murphy
4D interpolator

- Work of the Bay Oxygen Research Group is developing the interpolator continues.
- Monitoring design is evolving in part in the Hypoxia Collaborative – need to synch shallow water data collection



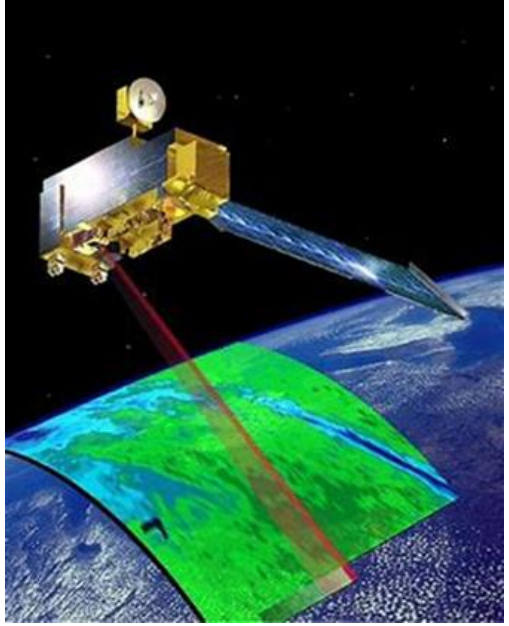
Satellite based SAV, water clarity, CHLA assessment?



- **SAV**: Good images can allow for SAV assessment (e.g., Maxar hi-res), however, protocols are improving toward a monitoring approach
  - Need documentation work and large scale field pilot proof of concept.

- **Water clarity** : In 2022, a small group is exploring further the research work identified in the STAC Advanced Monitoring Workshop.
  - Kd measurement in the bay and tidal tribs needed for calibration, verification

Satellite based SAV, water clarity, CHLA assessment?



- CHLA – NOAA NCCOS 2022 reviewed applicability of algorithms for satellite CHLA assessment in the bay, we need a review and discussion of their results.
  - Wynne, T.T., Tomlinson, M.C., Briggs, T.O., Mishra, S., Meredith, A., Vogel, R.L., and Stumpf, R.P. 2022. **Evaluating the Efficacy of Five Chlorophyll-a Algorithms in Chesapeake Bay (USA) for Operational Monitoring and Assessment.** *Journal of Marine Science and Engineering.* https://doi.org/10.3390/jmse10081104
    - Chesapeake HABs January 2023 is one opportunity for some assessment and discussion of the new work. (Invitation only at this point)

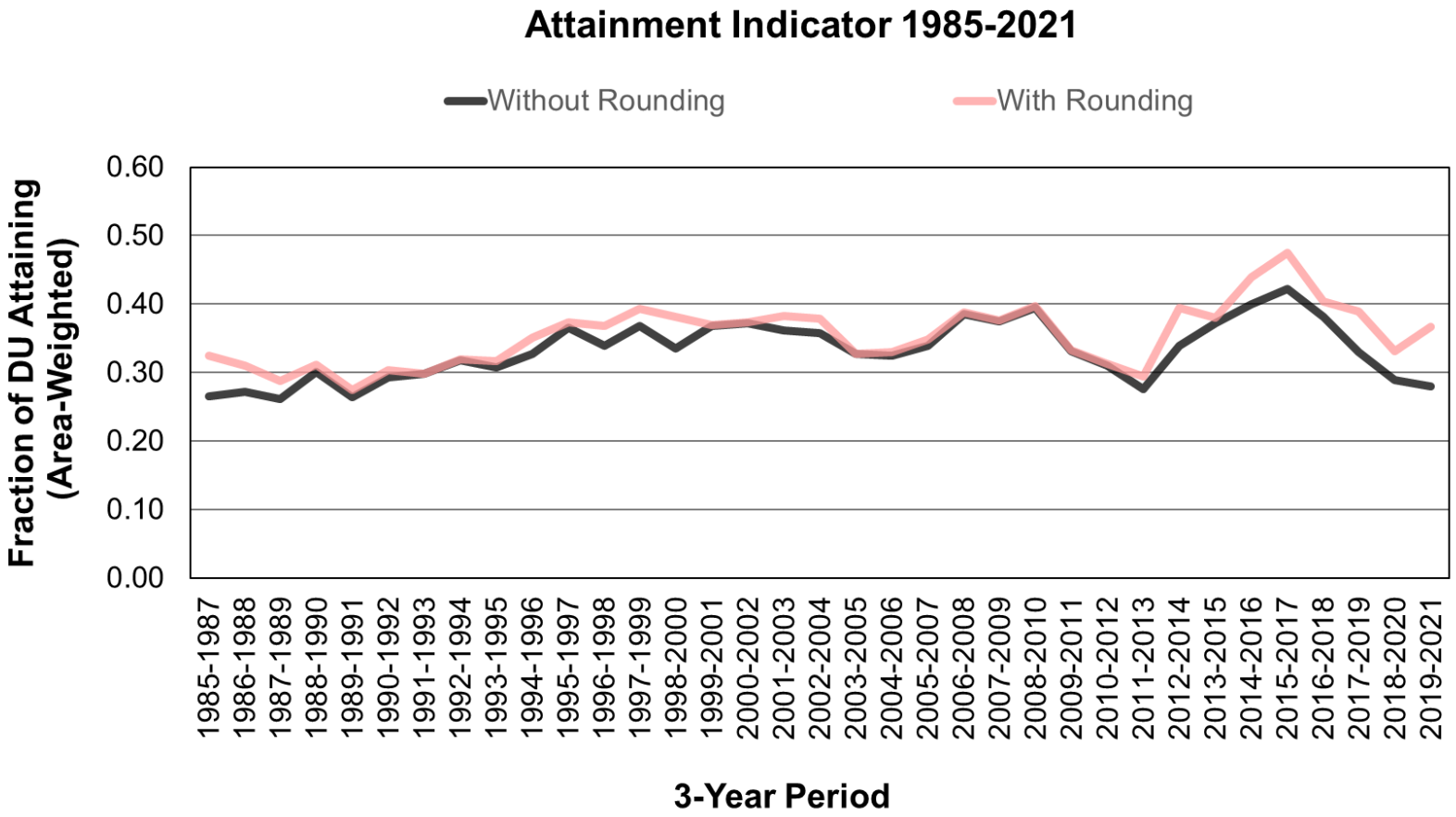
Significant digits in the attainment assessment – Indicator, but also standards

- Existing rule – ANY nonattainment in our analysis means we are out of attainment.
  - E.g., an assessment where we calculate 0.99999999999999999999 as the attainment score is not deemed a “1” for attainment.

- Modeling WG uses some rounding in their assessment of in or out of attainment

- Do we establish a rounding rule in line with 2 to 3 significant digits in our calculations of attainment? Qian has done some testing of the impacts of that sort of decision on our indicator assessment history…

Test Rule:
Any values > 0.999 are rounded to 1



With the rounding, we no longer see a continued decline in the 2019-2021 period.

Instead, there is a reversal in 2019-2021 from 2018-2020.

Also, our record high (2015-2017) changes from 42.2% (without rounding) to 47.5% (with rounding).

3-year Period	2018-2020	2019-2021
Total	28.9% (33.1%)	28.0% (36.7%)
MSN	49.3% (49.9%)	78.5% (78.5%)
OW	45.2% (59.5%)	47.3% (59.3%)
CHLA	2.7% (2.7%)	2.7% (2.7%)
DW	33.9% (33.9%)	10.7% (40.7%)
DC	0.0% (0.0%)	0.0% (0.0%)
SW Bay Grasses	13.6% (13.6%)	10.4% (10.4%)

Without rounding, we see a big decline in DW-DO from 33.9% to 10.7%.

With rounding, we see a big improvement in DW-DO from 33.9% to 40.7%.

It is almost entirely determined by the attainment status of the large-area segment CB7PH DW.

Any immediate input on significant digits considerations?

- Any State rules on rounding with water quality criteria assessments as precedence?

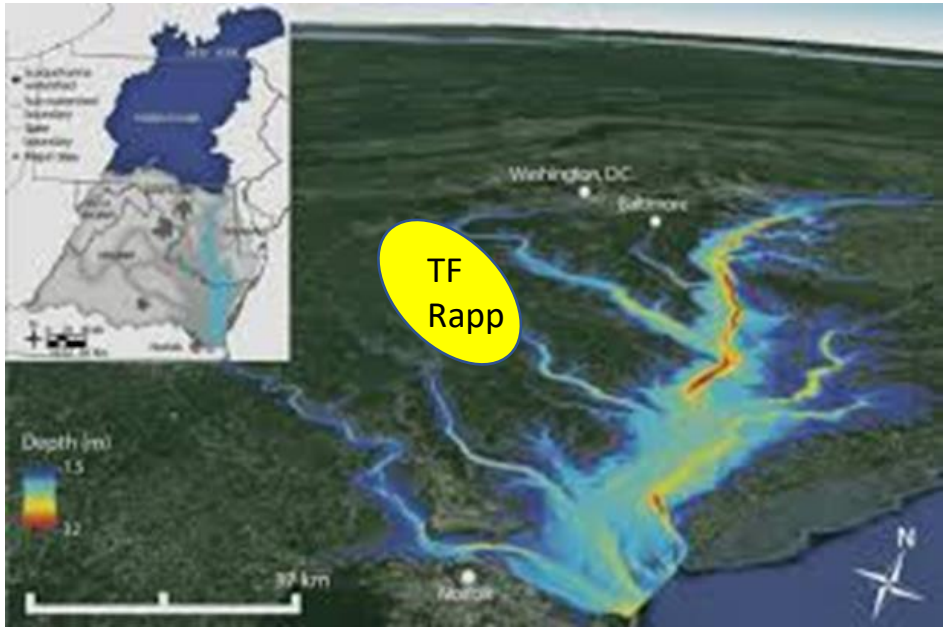
- Lew Linker communication as part of this discussion:
- We have pretty clear decision rules for percent DO nonattainment. They are simple.
- 1) we round nonattainment to the nearest whole number (of percent nonattainment)
- 2) We assume uncertainty and allow a one percent nonattainment exceedance.

- If asked, the CBP would likely extend the same decision rules to all CBP WQ standards but it hasn't come up yet.

- Therefore, if producing nonattainment assessments of CBP WQ standards for CB decision makers we need to, at the very least, round to the nearest whole number percent, i.e., only two significant figures should be used.

End Topics intro, see below for Rapp stations

Issue – End a station time series and start new stations, or retain long-term continuity at 2 sites on the Tidal Fresh Rappannock River while their bathymetry is changing?



In Virginia, the monitoring team has noted stations 3-RPP091.55 (TF3.1B) and 3-RPP098.81 (TF3.1E) on the Rappahannock River are getting increasingly shallower.

- 3-RPP091.55 (TF3.1B)

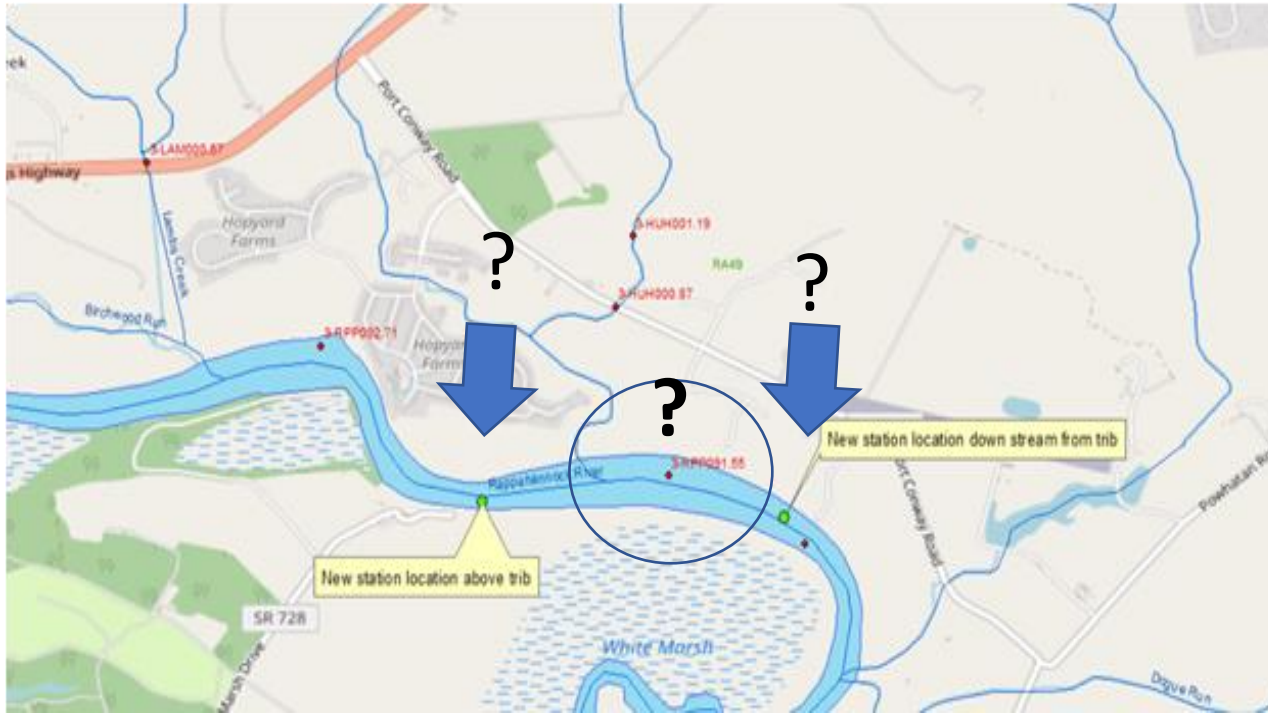
- 3-RPP091.55 historically was at **10-11ft** depth and is currently located on a bar (on the chart from the new Parker).

- The proposed downstream station marked was at **19-20ft** depth (0.35 downstream from current station)

- The potential new upstream station marked was at **28ft** depth (0.52 upstream from the current station)

- The drainage area of the nearby tributary is only 2.7 square miles. A very small drainage area. mostly from the nearby new community of Hop Yard.

- Due to this small drainage the station could be moved up or down stream.



TF3.1E

- 3-RPP098.81 was at **10-11ft** depth and is again currently located on a bar (on the chart from the new Parker).

- The entire stretch of river is shallow ... above and below. The station would have to be moved a greater distance and not sure the best idea at this time**.**
- Drainage area of the upstream tributary (Muddy Creek) is 15.4 square miles.

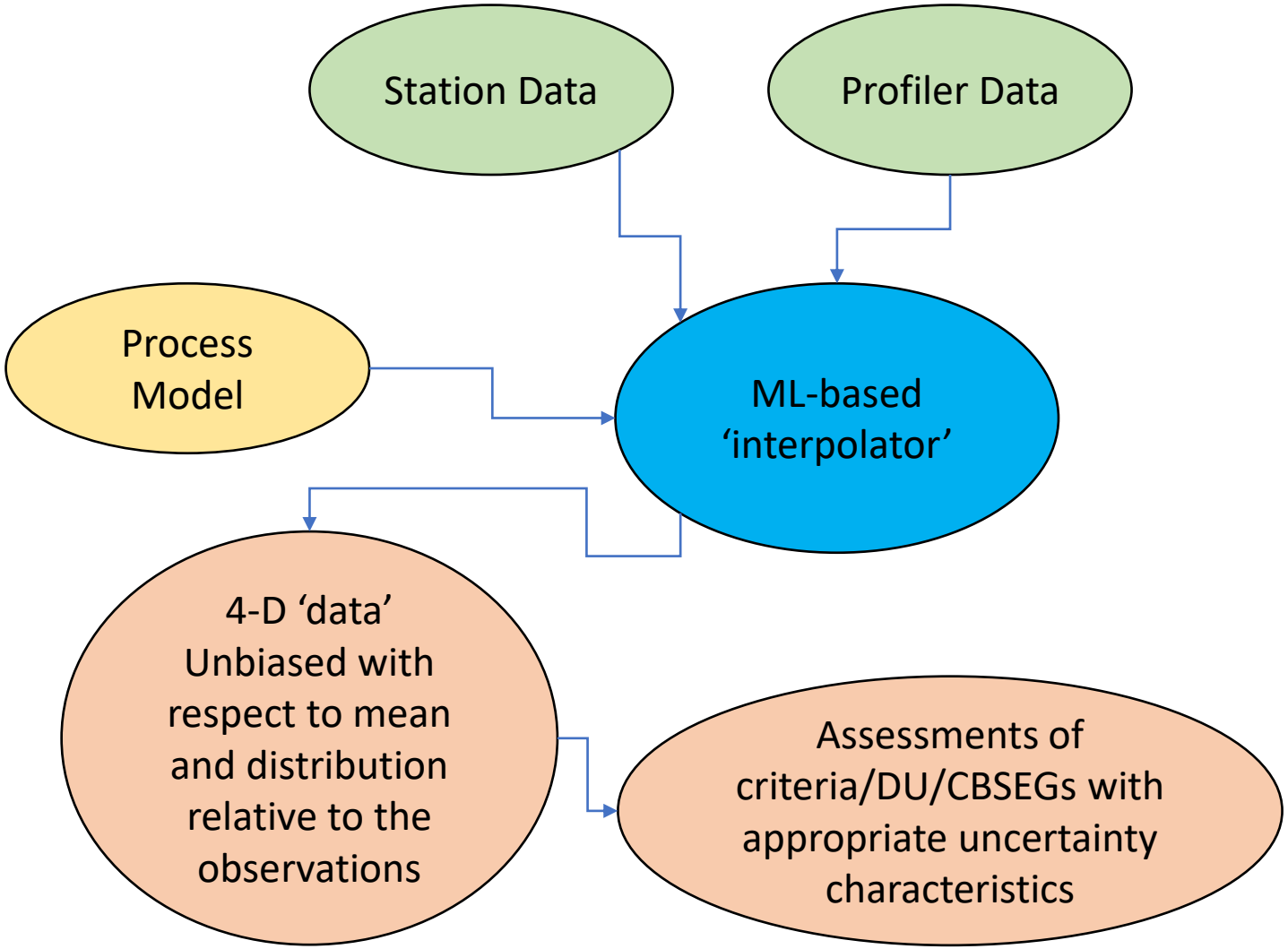
Would it be better to remain at the current sites and continue to obtain surface and bottom samples 1 meter apart

or

Would you prefer a deeper site that would provide additional DO data at depths that were historically available to sample but are no longer there?

Suggestions so far – 1 year co-located assessment to evaluate impact of possible change, similar to Nontidal network protocols.

Vision: Criteria Assessment

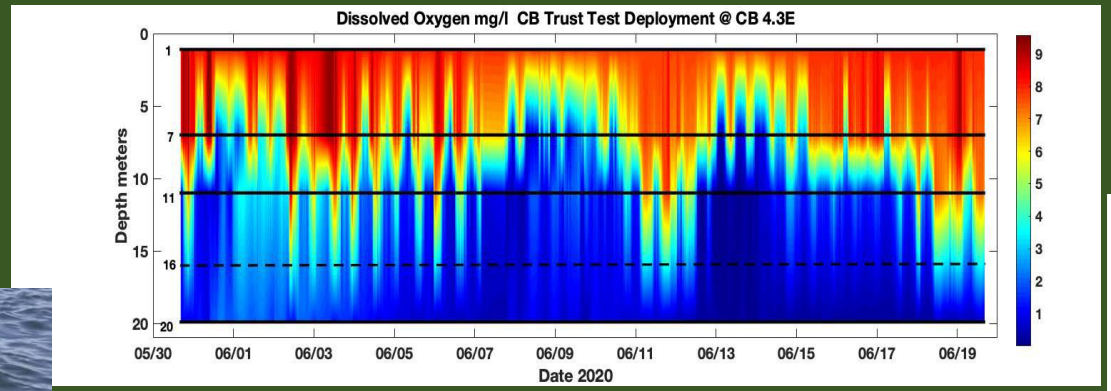


An 'interpolator', perhaps based on machine learning, would take inputs from station data, profiler data, and process models to produce a complete historical hourly record of DO on perhaps a 200x200x1 meter cell.

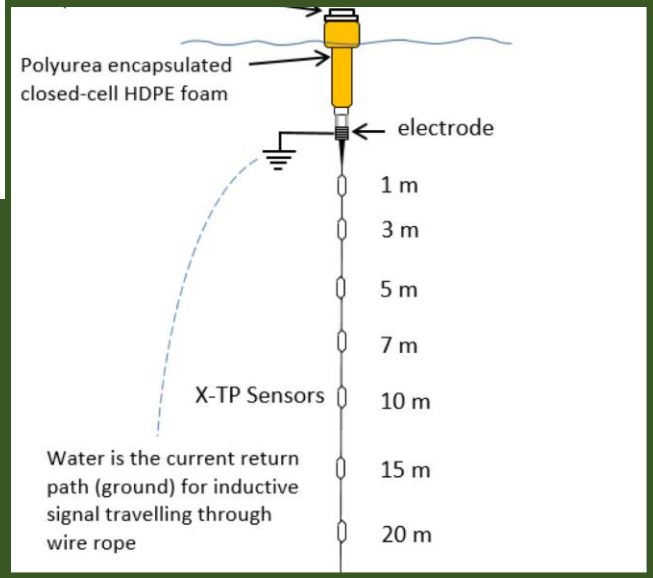
We would want to specify that the resulting history was unbiased relative to several different distribution metrics

Assessments would be carried out in those areas and times-scales when uncertainty estimates are within acceptable ranges.

"New": 2022 Open Bay Vertical Water Quality Assessments in High Temporal Resolution



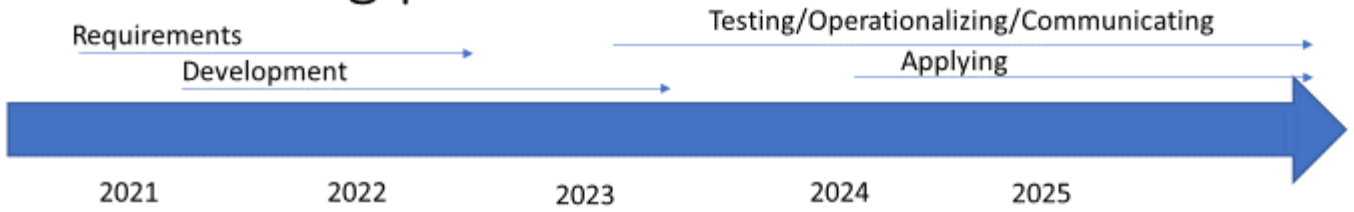
Hypoxia Collaborative is organizing new monitoring with new investments



Hypoxia network buildout 2022-24.
Interpolator buildout and testing through 2025

Action: Documentation development is needed now to support updated data collections and assessment methodologies

Timeline: Big picture



- **PSC request: 9 months (December 2021)** for understanding data requirements – what more do we need from our monitoring program to feed the 4D WQE? Manage expectations (spatially, temporally).
- **2 Year (2023)** – target development timeline for a working WQE.
- **4 Years (2025)** – operational, implemented in decision-support for the CBP
- **Beyond 2025** - applications

Chesapeake Bay Program's
Scientific and Technical Advisory Committee

Exploring Satellite Image Integration for the Chesapeake Bay SAV Monitoring Program

A STAC Workshop: Session 3

Virginia Institute of Marine Science

February 25-26, 2020

Co-chairs Brooke Landry (MD DNR) and Peter Tango (USGS)

VIMS | William & Mary
Virginia Institute of Marine Science

Old Dominion University

United States Environmental Protection Agency

USGS
science for a changing world

Maryland Department of Natural Resources

Results

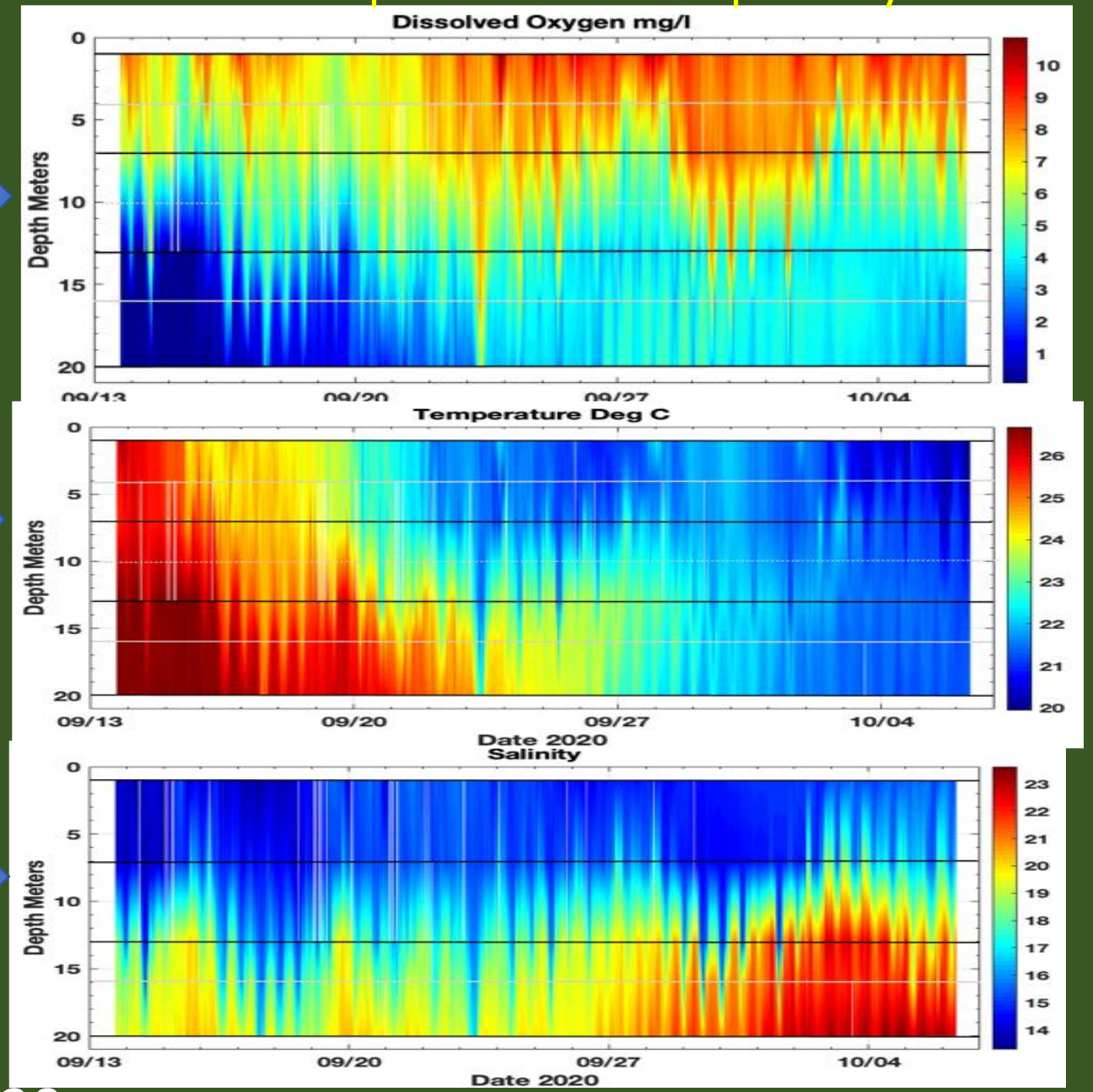
- Good images allow for SAV assessment (e.g., Maxar hi-res)
- Acquiring images – tasking satellites for when and where you need a pic is not yet in synch with monitoring needs to use the approach independent of other data sources.
- Hybrid approach (aerial and satellite) is being used now.
- A full satellite-based monitoring approach is still being developed with new progress every day.

2020. DO, Temp, Sal: We have had success with profilers in the open bay habitats (CB4.3E)

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

4-5K per sensor

September 2020

D. Wilson 2020. CBT GIT-funded pilot project data

However, criteria are based on living resources and not just temperature.

Revisit criteria derivation:

- San Francisco Bay is undergoing a criteria setting effort – we might get a presentation from J. Diamond (Tetra Tech) on their review of the latest on methods informing end points for d.o. criteria derivation as a starting point.