Bay Oxygen Research Group

Monday, February 12th, 2024
12:00 PM – 1:30 PM

Meeting Materials Link

This meeting was recorded for internal use to assure the accuracy of meeting notes.

Participants

Andrew Keppel (MD DNR), Angie Wei (UMCES), August Goldfischer (CRC), Bailey Robertory (CRC), Becky Monahan (MDE), Breck Sullivan (USGS), Bryant Thomas (VA DEQ), Carl Friedrichs (VIMS), Cindy Johnson (VA DEQ), Colin Hawes (VIMS), Efeturi Oghenekaro (DC DOEE), Elgin Perry, Erik Leppo (Tetra Tech), Gary Shenk (USGS), Isabella Bertani (UMCES), Jay Lazar (NOAA), Jim Hagy (EPA), Jon Harcum (Tetra Tech), Kaylyn Gootman (EPA), Leah Ettema (EPA), Lucretia Brown (DC DOEE), Marjy Friedrichs (VIMS), Mark Trice (MD DNR), Matt Stover (MDE), Melinda Cutler (MDE), Peter Tango (USGS), Rebecca Murphy (UMCES), Renee Karrh (MD DNR), Sophia Grossweiler (MDE), Tish Robertson (VA DEQ), Tom Parham (MD DNR), Wes Slaughter (ORISE/UMD), Paul Mayer (EPA), Richard Tian (UMCES)

Action Items

- ✓ Upcoming meetings that may be of interest to the BORG: Hypoxia Collaborative Team on March 4th from 2-3:30pm; Criteria Assessment Protocol Workgroup on March 7th from 1-2:30pm.
- ✓ Email Peter Tango (ptango@chesapeakebay.net), Rebecca Murphy (rmurphy@chesapeakebay.net) and August Goldfischer (agoldfischer@chesapeakebay.net) with topics for future BORG meetings.
- ✓ The next BORG meeting will be in May 2024.
- ✓ NCBO team will consider showing a comparison of raw data vs quality controlled data from the hypoxia monitoring sensors to demonstrate how the data is quality controlled and to show the amount of change from raw to processed data.

Minutes

12:00 PM Introductions/announcements

- 4-D Interpolator development and criteria assessment updates will be presented at the Water Quality GIT Meeting on February 26, 2024.
- Summer 2024 – STAR will update the Principals' Staff Committee on progress from investments made following the 2022 PSC Monitoring Report.
    - Some of the funding for the 4-Dimensional interpolator has come from these investments.
- Future meetings through 2024 and 2025:

- Bay Oxygen Research Group: This group of developers, stakeholders, future users, researchers will meet approximately every 3 months
- Smaller BORG development team: Meets monthly every 3rd Monday (12pm-1pm). Currently CBP staff, contractors, EPA researchers. We'd like to welcome any future users to join these monthly meetings who want to know more details about the technical development.
    - Several meeting participants were interested in joining the smaller technical development team and were added to the email list.

12:15 PM **Update on the 4-Dimensional Interpolator workplan and progress to date –** *Rebecca Murphy (UMCES) and Peter Tango (USGS)*

Presentation summary:

Rebecca Murphy thanked Elgin Perry and Jon Harcum for their work on the development of the tool, and thanked Breck Sullivan for helping to get funding for the project and keep them on track with the timeline (see slide 7 for timeline). Peter Tango explained the interpolator is being developed to allow for combining and integrating measurements from multiple datasets, to generate a more complete interpolation of available data in space and time, and to improve the ability to evaluate water quality for the 303d listing process. In 2007, a STAC workshop assessed the feasibility of developing a 4-Dimensional interpolator. This workshop found that there was insufficient sampling and spatial resolution of data for all criteria assessment, and for successful extrapolation to 4 dimensions. The workshop also suggested that if continuous monitoring buoys with vertical profilers were to be deployed in deep water and tidal tributaries of the Bay, this data gap could be alleviated. Since that time near shore and off shore continuous monitoring has been developed and implemented.

The 4-Dimensional interpolator is under development and will be operational by 2027. There is a detailed timeline of work that has been ongoing. Throughout the process a smaller BORG group has met monthly to focus on technical development work. Rebecca Murphy provided an overview of progress to date. In 2023 Tetra Tech compiled a dataset with 19.5 million Dissolved Oxygen (DO) observations in it from 1984 to 2022. Rebecca thanked the monitoring agencies teams and state agencies for providing data, and Mike Mallonee, Mark Trice, Rebecca Burrell and David Parrish for help with accessing data and answering questions. The data set includes bi-weekly long term sampling, shallow water continuous monitoring, new continuous vertical array data, and more that will be used in the interpolator. Other data like citizen science data will be used for validation and testing of the interpolator in certain regions. The interpolator uses multiple fitted Generalized Additive Models (GAMs) to estimate oxygen daily in tidal waters. In the future additional explanatory variables may be added into the GAM but for now, just smooth functions of time and location are used. Most testing of the tool has been done on the middle of the mainstem of the Bay and in the Patuxent River. Currently work is underway to address challenges using a normal distribution with bounded DO values and a high frequency of low DO. Elgin Perry has been applying a beta-logit approach to address this challenge. Additionally, Jon Harcum is working on scaling the tool to each segment of the Bay. It works, though more testing is needed to refine it.

The hourly prediction part of the project is also being worked on, and evaluation of existing continuous monitoring data is used for this. Patterns are applied in a simulation to make hourly variability predictions Bay-wide. So far, Tetra Tech has scanned through all high frequency data they compiled and

identified any gaps. Elgin has scoped out the method of wavelet analysis for tidal and daily cycles. Tetra Tech has been putting all the high frequency data into the wavelet analysis and tabulating the information that comes out of that to figure out where, when, frequency and period of short cycles of oxygen in the Bay. This information will then fit a mathematical model and use a statistical approach to account for uncertainty in the estimates. However, 4-D interpolator outputs will not be precise hourly DO estimates; they will provide a measure of segment impairment over the appropriate temporal and spatial scale for a criterion.

In addition to the Bay Oxygen Research Group, the Criteria Assessment Protocol Workgroup will be part of the continued tool development, methods and application through input on decision making, with additional input provided by the Modeling Workgroup.

Discussion:

Tish Robertson (VA DEQ) asked if continuous monitoring data collected in VA by VIMS has been incorporated, and Elgin Perry responded that yes, Virginia Estuarine and Coastal Observing System (VECOS) data are being used.

Gary Shenk (USGS) commented that in the water quality assessment step, the 4-D interpolator can give a probability of attainment, or a yes/no assessment. Even if there were multiple feasible realizations, they could go into a cumulative frequency distribution that had several hundred points rather than exactly 12. Gary said either way could be done.

Jim Hagy (EPA) said estimating the probability of attainment seems like a great idea. The alternative of the yes/no assessment – it's not like there is certainty when uncertainty is not stated. He added that if you make a statement like "based on evaluation of the data, a 60% attainment is likely", how does that interact with the regulation? Peter responded that in 2017 they put forward the concept of conditional attainment, thought it was not specified what the conditional probability was. Jim said that there is potential for confusion when you communicate in probabilities of attainment. From year to year the probability of attaining in some places may shift, and if it doesn't, we may be under monitoring, which is useful information.

Another step in the 4-Dimensional interpolator development in the road to application is to create technical documentation to support its use (EPA Technical Document). This would be reviewed by the Science and Technical Advisory Committee (STAC). This document should be started soon since it will likely take a couple of years to complete and undergo review.

12:50 PM **Update on the Real-Time Hypoxia Continuous Monitoring Program – *Jay Lazar (NOAA Chesapeake Bay Program Office)***

Presentation Summary:

Jay Lazar described how the continuous monitoring buoys are built, with a controller with a solar panel, cell modem and GPS. CTDO sensors are placed on an inductive wire. This system allows for flexible location of sensors at desired depth intervals. The system is low profile and low power. In 2023, three stations were deployed at the Lower Choptank River, the Lower Potomac, and in the Mid Bay. For 2024, the target is to increase to 5-7 stations total. They intend to maintain the Lower Potomac and Lower

Choptank sites, but plan to eliminate the Mid Bay site due to operations and maintenance limitations. The Lower Choptank site is currently still active and collecting data.

The 2024 focus will be implementing quality control developments put in place this year. Another focus will be building out the network with limited maintenance capacity. The maintenance effort is being doubled this year, and the sites will be clustered within two geographies so that sites can be maintained via a schedule of two separate maintenance days. A site will be planned to re-occupy CB4. All site location options will be discussed by Hypoxia Collaborative and will be decided by the end of March.

Quality control measures start with daily inspections of data dashboards; bi-weekly to weekly maintenance visits with validation Conductivity-Temperature-Depth (CTD) casts adjacent to stations to have a comparative profile; an annual report and seasonal performance reviews; and seasonal measurements. The 2023 annual report will be available by the end of March 2024. Data can be accessed via Integrated Ocean Observing System (IOOS) pages. Data are updated every hour with 10-minute resolution. From the site you can set up an API to the Environmental Research Division's Data Access Program (ERDDAP) server and download CSV files of everything that's available. Current data status is that the final QC routines are not yet applied but in progress. There will be a slight lag when the 2023 quality controlled (QC'd) data will be available (April 2024). Currently the IOOS page is coming directly from the buoy vendor's server; but ultimately there will be an intermediate server that does the QC routines on the raw data before it goes to the IOOS environmental sensor maps. The ability to download raw data will still be available, as well as to download QC'd data.

The NCBO team working on this project includes Jay Lazar, Kevin Schabow, CJ Pellerin, Max Ruehrmond, Nicholas Coleman, and Anthony Johnson.

Discussion:

Marjy Friedrichs (VIMS) asked how much change is there between the raw data and the quality-controlled data? Jay responded that there is not much change and the raw vs quality controlled data is not that different; the key points are when the team is doing maintenance and the system is out of the water, those measurements are flagged. If it's off station, those times are flagged. Jay said it would be a good idea to have a comparison of what the raw vs QC'd/processed data looks like. Although there is a lag between the availability of QC'd data currently, that is because the team has been developing all the quality control routines, and in 2024 there will not be so much of a lag since the QC will be automated through the intermediary server. There may be manual data flags that are added later. Something that should be noted about the current data flags are that the CTD casts have a small threshold for what is called good vs bad, and there is a lot of movement in the upper water column. Although something not meeting the threshold may be flagged, it may actually be fine, so it's more up to the user of the data to decide which type of flag they want to exclude in their data analysis.

Marjy said that is helpful and often there is hesitancy around putting up data real time without quality control; but even having raw data in real time is helpful (on the research/analysis side).

Jay and Peter mentioned how much work and time went into getting to the point we are now. Jay added that although significant progress has been made, the 2023 deployment was only 3 buoys and 10 sensors, and sometimes sensors were down or a buoy was taken out for 2 weeks at a time. One sensor was down for a majority of the year because it failed after two weeks and there was no backup. The gaps

in this year's data are not going to happen again; for 2024, NCBO has already received a majority of the sensors they contracted for, and they planned for redundancy. Peter said that the team will need to document the approach used (if used) for filling in missing data in time series for a criterion assessment (due to any data gaps).

1:30 PM Adjourn