Chesapeake Bay Program Hypoxia Collaborative Team Meeting

- June 15, 2023 • 10:00 am – 12:00 pm -

Attendance:

- Kaylyn Gootman (EPA)
- August Goldfischer (CRC)
- Piero Mazzini (VIMS)
- Bailey Robertory (CRC)
- Carl Friedrichs (VIMS)
- Rebecca Murphy (UMCES)
- Jay Lazar (NOAA)
- Marjy Friedrichs (VIMS)
- Roxanne Mina (NOAA)
- Peter Tango (USGS)
- Bruce Vogt (NOAA)
- Kevin Schabow (NOAA)
- Emma Venarde (NOAA)
- Matt Robinson (EPA)
- Mark Trice (MD DNR)
- Jeremy Testa (UMCES)
- Cindy Johnson (VADEQ)
- Guangming Zheng (NOAA)
- Pierre St-Laurent (VIMS)
- Dong Liang (UMCES)
- Aaron Bever (AQEA)
- Andrew Keppel (MD DNR)
- Lew Linker (EPA)
- Tom Parham (MD DNR)
- Breck Sullivan (USGS)
- Doug Wilson (Caribbean Wind, LLC)

Action Items:

- Guangming Zheng (NOAA): Share more about work on Artificial Intelligence (AI) model and applications to water quality and fish habitat at future Hypoxia Collaborative Team meetings.
- Include ORISE fellow in future Hypoxia Collaborative Team meetings (Bruce Vogt, NOAA, and Kaylyn Gootman, EPA)
- Jay Lazar (NOAA): Follow up with Guangming and C.J. Pellerin about Guangming's API question when he returns from leave
- Jay Lazar (NOAA): Look into adding horizontal lines to the plots displayed on buoy system sensor website for plots of water temperature, salinity, conductivity, dissolved oxygen, and sea water pressure from the hypoxia vertical array monitoring results.

Meeting Minutes:

10:00 – Introductions and announcements (Peter Tango, USGS & Bruce Vogt, NOAA)

- Member updates/new members:
  - o Bailey Robertory –New Sustainable Fisheries Goal Implementation Team Staffer. Bailey is from Northern Virginia, studied Marine Science at the University of South Carolina, and just finished his master's at Texas Tech. He has an interest in invasive species management.
  - o Matt Robinson – Not a new member, new position at EPA (formerly DC DOEE).
  - o Guangming Zheng – Researcher at NOAA working on an A.I model with VIMS and NASA using data including meteorological data and data from Marjy's hydrodynamic model to predict short term hypoxia and dissolved oxygen (D.O.) prediction at any point in the Bay at any depth. This method is also useful for historical reconstruction of oxygen history in the Bay.
  - o Emma Venarde – Summer intern at NOAA working as a field technician providing weekly maintenance to the hypoxia monitoring station buoys and working on other NOAA field projects.
  - o Roxanne Mina – Hollings scholar at NOAA, working on a project studying the frequency and magnitude of hypoxia and how that has changed over the last couple decades.

10:10 – Shallow Water ROAR proposal announcement (Kaylyn Gootman, EPA)

- Funded for FY23 through internal EPA program Regional-ORD Applied Research program (ROAR).
    - o Analysis work supporting increased understanding of tidal water dissolved oxygen, temperature, and salinity dynamics from high temporal density data (i.e., continuous monitoring at sub-hourly time steps) that will further inform 4-Dimensional (4-D) interpolator development
    - o Hiring an Oak Ridge Institute for Science and Education (ORISE) fellow for a year to dig into the water quality data and work on methods for analysis of continuous oxygen data
- Internal EPA program
- Short term project: Start January 2024
- Questions/comments
    - o <u>Peter Tango</u>: Foundations are using types of analysis of existing continuous water quality analysis. Connectivity between nearshore and offshore.
        - ▪ <u>Kaylyn Gootman</u>: Might become an annual event if successful.
    - o <u>Peter Tango</u>: Are we advertising or do we know who the fellow will be?
        - ▪ <u>Kaylyn Gootman</u>: multiple options including through ORISE, through an interagency agreement, or to work off an existing contract. We've chosen to go through the ORISE method. We have a lead on a PhD student starting at the University of Maryland in August.
    - o <u>Bruce Vogt</u>: We should connect them with this team.
    - o <u>All agree to involve the ORISE Fellow in our meetings</u>

10:20 – Buoy Deployment and Quality Assurance Project Plan (QAPP) updates (Kevin Schabow & Jay Lazar, NOAA)

- <u>Kevin Schabow</u>: Overview
    - o A system of buoys (3-4 on the water now, up to 10 by 2025) that continuously monitor water quality (D.O., temperature, and salinity) every 10 minutes.
    - o Started with STAR and Fish GIT team supported by an approved GIT-funding proposal in 2019.
    - o Pilot program was successful.
    - o Trying to scale it up. More test deployments in order to better understand the instrumentation performance, operations and maintenance required to run the program, and the investment needed to sustain operations and maintenance as we scale up the network for accurate budgeting.
    - o In 2023, the 3 deployed buoy systems are collecting data; quality assurance program plan has been approved by EPA.

- Jay Lazar
  - 3 current locations: Mid bay, lower Potomac, lower Choptank.
  - 5-7 total locations in 2024, 10 total locations in 2025.
  - Not fully sensored – missing some data.
  - Contract signed and approved – remaining sensors in a calibration tank.
  - Lots of barnacle issues occurred in 2022 – needed to swap sensors.
    - Now weekly visits to address the challenges of barnacle colonization to minimize compromised performance of the sensors.
- Shout out to the team servicing buoys.
  - Performed a rescue! First on the scene of a boat that sank, saving the boaters. Outstanding work!
  - Taylor Giordano, Max Ruehrmund and Emma Venarde.

10:25 – Review of Data Dashboard with Hypoxia Continuous Monitoring Data (Kevin Schabow & Jay Lazar, NOAA)

- Data available online –
  - [Mid Bay](#)
  - [Lower Potomac](#)
  - [Lower Choptank](#)
- Quality Assurance Program
  - In current sensor map there are wide measurement ranges (defaults)
    - Not a lot of flagging of questionable data values needing further investigation
  - There will be a manual flag system for bad data.
  - There will be an automated flag system for bad data.
- Vertical array monitoring results for salinity, temperature and dissolved oxygen can be compared for performance check and consistency with Conductivity-Temperature-Dissolved Oxygen-Depth (CTD) profiles collected 1) during each maintenance visit to a station, 2) if a hypoxia station is located at a long term CBP monitoring station, then comparisons with biweekly CTD data collections, and 3) plotted against the vertical profiles at calibration sites from Dataflow data collections of Maryland DNR shallow water monitoring program given initial deployment locations .
  - Peter Tango: what are the dips, temperature spiking? Is the machine out of water? Is it a phenomenon?
    - Jay Lazar: System doesn't delete data, it flags it as bad. Upwelling event: Hour long, 2 degree temperature change within 10 min.
  - Peter Tango: Documentation/ criteria assessment protocol will want to understand details of data management for creating the final data sets that reference this filtering of issue data such as the issue of the sensors running while out of the water with the buoy system undergoing maintenance.

- ▪ Jay Lazar: Visualization and interpolation characteristic (linear interpolation).
- Other information
  - o 9 meter sensor where D.O. portion is failing and needs to be swapped out (Mid Bay).
  - o 10 meter conductivity cell on lower Potomac is bad (sent with poor calibration).
  - o Data for download will have very limited flags – flags will be available in coming weeks.
  - o By the end of deployment everything will be finalized.
- Guangming Zheng: Is there an API that allows the query and download of data in the automated fashion?
  - o Peter Tango: Possibly.
  - o Kevin Schabow: Chesapeake Bay Interpretive Buoy System (CBIBS). This data is integrated into the website.
  - o Jay Lazar: @Guangming- I will follow up with you and CJ when he returns from leave.
- Matt Robinson: Kudos to August for this [nice write-up](#) on the Chesapeake Bay Program (CBP) webpage yesterday on both the buoy and RIM project.
- Peter Tango: Hi Jay, a comment I had on the data - I didn't know each sensor data point was a mean of the previous 10 minutes. Always imagined it was a snapshot every 10 minutes, an instantaneous sample of the conditions. Important distinction for us that will be something we will want clear in any communications about what each sample point represents.
  - o Jay Lazar: Thanks Peter, something that we will clarify. Doug's on the call and may have some insight.
  - o August Goldfischer: @Peter and Jay I also didn't realize that. In the blog Matt linked, I didn't explain it was a mean of the previous 10 minutes. Do you think it would be worth a correction?
  - o Peter Tango: @Jay - regarding the blog, to be most accurate, I would offer the correction. It is different than a snapshot. Analysts will definitely want to know that and we definitely want to explain that in any criteria assessment application. It will be for others to debate and discuss if a 10 minute average = "instantaneous" equivalence. Thanks so much! P.S. - Yes! Forgot to mention the blog story on the deployments in the announcements. Great job! :-)
  - o Jay Lazar: Getting clarification on this Peter, hold off on the correction in case I misspoke.
  - o August Goldfischer: Actually, @Peter and @Jay, may not need a blog correction as we only say "With dissolved oxygen data coming in every 10 minutes" but doesn't specify beyond that. The data is coming in every 10 minutes, so that is still correct.
  - o Peter Tango: Ah, perfect August. Thanks!

- o   <u>Jay Lazar:</u> We intend to use the fixed station data sample variability in an additional QARTOD climatology test, a wonderful use of the historic data. Doug corrected my statement- Note: **Each 10 minute record is an instantaneous measurement at that point in time.**
- o   <u>August Goldfischer:</u> Thanks for clarifying.
- o   <u>Peter Tango:</u> @ Jay. Wonderful. Thanks for clarification!
- <u>Marjyy Friedrichs:</u> Jay - is there any way to flip the color bar on the visualizations? Like Rebecca is showing, the standard format is to have red = bad = low oxygen (rather than having blue = bad oxygen.)
  - o   <u>Jay Lazar:</u> Marjy- I've asked and have been stalled. It will require some additional dev time since inverting the color ramps per parameter has not been part of the software.
  - o   <u>Marjy Friedrichs:</u> Thanks for the update, Jay!
- <u>Peter Tango:</u> Jay, I loved your upwelling insights. I have a favorite example of that same phenomenon from a shore sensor on the lower Potomac, and, that it showed the influence of the upwelling effects water quality for days, not just minutes or hours, complete changes in salinity and temperature structure and extended recovery time to get DO conditions back to above 5 mg/L after going hypoxic from the upwelling. Impressive insights on habitat impacts in the region.
- <u>Aaron Bever</u>: Can horizontal lines be added to the certain plots to mark the depths of the sensors? Then it will be intuitive where the measurements are and where the vertical interpolation is.
  - o   <u>Jay Lazar:</u> We can look into that as well Aaron.

10:45 – Implementation Plan document review and feedback (All – [Jamboard](#) for feedback)

- Bigger picture item of framework for Hypoxia Program (goals, directions, etc.)
- Jamboard available for feedback on Implementation Plan document.
  - o   Edits? Questions? Feedback?
- <u>Bruce Vogt</u>: Other program items on document. We want to have a list of all things as well as partner connections and data available to everyone.
- <u>Kevin Schabow</u>: We want this finalized by next month. It will be open for a month or so.
- Discussion questions:
  - o   Is there anything unclear?
  - o   Is there anything missing from the document, or anything that we should not include?

11:05 – Using the Data from the Hypoxia Continuous Monitors

- Data Analysis Methods (Rebecca Murphy, UMCES)
    - o Some preliminary profiler data analysis: East Gooses 2022
    - o Digging into 2022 data; 4-D project with several people looking at and downloading the data. Happy with data presentation and handling.
    - o 4-D interpolator: interpolate oxygen in space and time throughout the tidal waters.
        - ▪ Goal: to use in the criteria assessment process.
        - ▪ Data will be helpful to learn about patterns of oxygen in deeper waters.
    - o DO profiler provides hourly predictions that can follow tides.
    - o Identify patterns and relationship changes in space.
    - o Considered instantaneous criteria for Open Water, Deep Water, and Deep Channel.
    - o Ideas
        - ▪ Identify designated uses (DU) – open water, deep water, and deep channel.
        - ▪ Distribution of pycnocline.
        - ▪ Compare DO to criteria.
    - o Lew Linker: Can we go back to earlier slide (single-day views)? Tidal and wind influence are clear but are there possible "internal waves" above and below the pycnocline? It is a phenomena we might be seeing. Any thoughts?
        - ▪ Rebecca Murphy: I think we will see episodic events that only last a period of time. When we model we will have an uncertainty variability range in the data.
        - ▪ Lew Linker: Internal waves are shorter duration. Put a marker on this for future studies.
        - ▪ Peter Tango: Related to Lew's thinking, and Jay's flagging discussion, I do wonder if we might see hypoxic lenses in the above pycnocline waters at any time from a lens of plankton bloom that may be sinking, or a migrating dinoflagellate bloom. Interesting opportunities to see such exciting phenomena if they occur in the open waters.
        - ▪ Jay Lazar: How would you validate those occurrences?
        - ▪ Peter Tango: Separate CTD comparison is one way.
        - ▪ Peter Tango: Love that we can track pycnocline boundaries Rebecca. Phew! That was important. YOU ROCK!!! Awesome!!! Love the designated use D.O. patterns!
        - ▪ Jeremy Testa: @Jay, @Peter - there are times when DO is at a minimum in and around (maybe not above) the pycnocline. This happens when the pycnocline is stable and there is a community oxidizing NH4 and H2S diffusing from below. I don't know of any

reports of patches of low-DO water above the pycnocline due to moving communities, maybe because it is shallow enough that particles sink too rapidly.

- ▪ <u>Jeremy Testa</u>: But to answer the "validate the occurrences" as @Jay asked, aside from making sure that temperature and salinity look to be operating normally, with just these sensors it may not be obvious how to do this.
- ▪ <u>Jay Lazar:</u> My question re "validate the occurrence" related to the cause of the hypoxic occurrence being a bloom vs something else. But also, do we have the resolution is another good thought.
- ▪ <u>Peter Tango:</u> Planting a seed here - as we hear from Rebecca and Marjy, please chew on, think about guidance for monitoring designs in the long term - is our vertical resolution of every 2m robust enough for our habitat characterization? Is the 10 minute frequency of data collection good, great? As we grow the operation of the network, is there reason to locate additional sensors close together? Are the insights on duration of deployments you want to share? What can we say about continuity of data at locations across years - for reference, for assessment, for other reasons? THANKS! Love the fishing applications.
- ▪ <u>Rebecca Murphy:</u> Based on the work I showed with the data, 2m did seem fine enough for defining the pycnocline. I was pleased at the comparison with the 1m fixed station density, but we could do more analysis to be sure.
- ▪ <u>Peter Tango:</u> I heard the same sort of need for data in a recent workshop with watermen so this is spot on, wonderful! :-)
- ▪ <u>Peter Tango:</u> Is NOAA still doing Vibrio sampling across the bay each year for calibrating, verifying this forecast?
- o Next steps: examine West Gooses data from 2022 and the East 2020 summer data, aggregate the data to 1-day and 7-day means to think about comparison to those criteria, interpolator development.
- o Additional data over the next two years: examine the idea of empirical assessment compared to interpolated-based assessment and build spatial patterns of all profilers together in interpolator.

- ● <u>Data Applications</u> (<u>Marjy Friedrichs</u>, VIMS)
  - o Application of continuous monitoring oxygen data: the Chesapeake Bay Environmental Forecasting System (CBEFS).
  - o Estuarine model ChesROMS-ECB.
  - o Forecast system: atmospheric, terrestrial, and coastal inputs.
  - o Evaluated and CBP WQ monitoring data: appx 37 years: temperature, salinity, oxygen, pH, nutrients, and chlorophyll.
  - o Surface and bottom forecasts, vibrio forecast, harmful algal bloom forecasts.

- o Annual Dead Zone Report Card
  - ▪ Max daily hypoxia volume near average.
  - ▪ Duration was low.
  - ▪ Total annual hypoxia volume also low.
- o How to use available data
  - ▪ Model improvement in offseason: improve timing of predictions.
  - ▪ Model evaluation.
  - ▪ Enhancing confidence in forecasts.
- o <u>Peter Tango</u>: @Marjy - bummer that the maximum is more stubborn to move than duration. Suggests to me fish/shellfish are still challenged with the DO/Temp squeeze in a big way even if we are chunking down the duration. More rehab work to do. Also good for people to see some metrics of hypoxia (Total, duration) are more responsive than others (annual max).
- o <u>Peter Tango</u>: Very insightful. Looking at higher temperatures and how the warmer winter feeds into spring. I put some questions in the chat to ask the developers and users. Is the 10 minute data frequency still on target for data collection? As we grow, locating sites and considering stratification vs. well mixed sites. Durations and values/ reference sites. Insights on duration and value. Looking at all the segments and meeting the community's needs. Add those questions in the chat. In follow-up discussions we want people to think about what we have in place and how it is operating? Are sensors performing in the way for the outputs we want?
- o <u>Jay Lazar</u>: What was the continuous data being used?
  - ▪ <u>Marjy Friedrichs:</u> Nothing continuous. Ideally show real time data eventually.
- **o** <u>Bruce Vogt</u>: Future ideas: How does this data link to higher trophic levels? Oysters, crabs, and fish? How can we develop a model for these? How are changing environmental conditions related to habitat suitability? Fisherman were really interested in depths of hypoxia. Hope to understand what layer within the water column is suitable for different species. Developing indicators for the bay to tell us how changing environmental conditions are related to habitat suitability. Percent area to see which habitats are suitable. Ability to assess risk and create visualizations for education, outreach, and management.
- o <u>Peter Tango</u>: We have one more question to close out our day today.
- o <u>Guangming Zheng</u>: @Marjy: Great talk! This might be irrelevant to your talk and require a different kind of model, but have you conducted a Lagrangian study by tracking a water parcel in your model and record the temporal changes of oxygen or other water quality parameters?
- o <u>Marjy Friedrichs</u>: Kind of. We've done a little bit of that. Not exactly and not in a while. I worked with a student on a turtle study (high mortality in sea

turtles) and where they came from, water quality conditions on the way influencing rate of decay. So it's not irrelevant and it is a very interesting application we could expand on.

o <u>Tom Parham</u>: We are wrapping up writing the manuscript for the striped bass DO/water temp thresholds and assessment of bay conditions. Hopefully out soon.

o <u>Peter Tango</u>: Thank you to everyone for joining and for your developments. We look forward to your comments. Please follow up with the plan. Please take a look and make sure it is hitting the mark or add something.

---End of Meeting---