Bay Oxygen Research Group (BORG) Meeting

Thursday, May 20, 2021
01:00 PM – 02:00 PM

Join by Webinar:

https://umces.webex.com/umces/j.php?MTID=mafa4cd533da8132cf65b2b024b85e274 Meeting Number: 120 154 5311
Password: BORG

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Conference Line: +1-408-418-9388 Access code: **120 154 5311**

Meeting Materials:
https://www.chesapeakebay.net/what/event/bay_oxygen_research_group_may_2021_meeting

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

Action Items

- ★ BORG meeting time is standardized to the third thursday of each month from 1-2.
- ★ Maintain current interpolator usability while adding the ability to determine shorter term variability and uncertainty around projections
- ★ Incorporate new information and techniques into the new interpolator including:
  - Satellite imagery
  - 3-D numerical model data
  - Kriging
  - New flow data
- ★ Workgroup members will continue to discuss methods to inform interpolator data sets using dynamic models with data assimilation.

AGENDA

01:00 Welcome, Introductions & Announcements – Peter Tango (USGS), **Breck Sullivan** (CRC)

Breck Sullivan would like to propose standardizing future meetings for the third Thursday of each month from 1-2.

- Breck Sullivan moves to standardize the meeting time to the third thursday of each month from 1-2.
    - This is agreed upon.
- Peter Tango asks for other announcements and hearing none adds that for tomorrow there is a hypoxia collaborative meeting which people might be interested in. It will act as a dovetail for vertical profiling and the 4D interpolator development.
- *CHAT*
- *from Breck Sullivan to everyone: 1:05 PM*
    - *Hypoxia meeting tomorrow: https://www.chesapeakebay.net/what/event/hypoxia_collaborative_team_may_2021_meeting*

01:05 Current spatial interpolation approach and needed advances - Rebecca Murphy (UMCES)

Rebecca will describe the current IDW technique and outline current interpolator outputs. We will discuss features/output what will be needed beyond current outputs.

- Rebecca Murphy opens up with the current interpolator and its structure/methods whereby we currently use a fixed interpolator grid that is larger in the mainstem than in the tributaries. She then discusses what we should keep and what new features are needed for the new interpolator.
    - Rebecca Murphy says we want to keep the usability for partner analysis, as well as being able to feed output into the criteria assessment process as well as visualize the results
    - Rebecca Murphy says we will WANT to temporally interpolate and see shorter term water quality criteria, aid habitat assessments, and generate uncertainty surrounding predictions at least for diagnostics of where the method can be improved. Additionally she would like to. Incorporate more data types in order to get the best interpolations possible.
- Peter Tango says this is a great overview. He is curious what other items people see as needs for the interpolator? He recognizes that the desire to use outputs for habitat assessment is something fisheries folks are keen to get.
- RIchard Tian comments on the last bullet about the incorporation of more available data types. At this point the strategy has been to include as much data

as was available. Each year Mike Malloney did a great job adding available observational data. But he thinks one piece of data that hasn't been used is data flow. This is a high frequency high resolution data piece we should account for in the new method. He thinks data flow is still limited in space locally but would be good to look into.

- *CHAT*
- *from bruce to everyone: 1:23 PM*
    - *Nice presentation! Great to see fish hab under new needs and concur with temporal representations as well.*
- Peter Tango says this is a good point. He wonders if there are other things to help tune with local information to improve understanding of large scale processes and reduce uncertainty within certain areas. We will have other ideas about this in the next presentation.
    - Richard Tian says the interpolation is at a km scale now. Looking at the differences of a finer scale can be interesting. This is related to data availability but if experiments are done where data flow is available we can get insight into this new information.
    - Peter Tango says if DO can be informed by Chla and satellite information gives better estimates for informing at a smaller scale that's good for new sources of data. He says Rebeccas has done co-kriging before and he is game to consider any method to see what is possible for development.
- *CHAT*
- *from bruce to everyone: 1:25 PM*
    - *Will continuous profile monitoring help with temporal interpolation? We plan to have two new profilers out this summer.*
- Tish Roberston has been exploring the interpolators manual and it has the ability to do a true 3D interpolation but this hasn't been used by her. A true 3D interpolator uses the observations closest to the interpolator cell and is used in all directions to make a uniform image. She is curious if will do TRUE 3D interpolation?
    - Rebecca Murphy says yes the new approach would capture vertical relationships and inform the interpolation.
- C*HAT*
- *from bruce to everyone: 1:27 PM*
    - *Peter and Breck just sent a paper on Linkages Between Phytoplankton and Bottom Oxygen in the Chesapeake Bay for sharing*
- *from Breck Sullivan to everyone: 1:28 PM*
    - *file:///C:/Users/bsullivan/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/GOBVY8SP/Zheng_et_al-2020-Journal_of_Geophysical_Research__Oceans.pdf*
- *from Breck Sullivan to everyone: 1:29 PM*
    - *This link should work better for the paper: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2019JC015650*
- Carl Freidrichs thinks this is great. How the interpolator is set up now is VERY

helpful to inform model and observational outputs. He thinks interpolating more things or data works well if the data is at the same time and averaged at appropriate time scales. There is a NEED to have a time averaging, probably a one day avg to avoid tidal influences. Using the average pycnocline is the best. One BIG challenge for cruises is the location of the pycnocline being off. He is interested in the temporal GAM interpolator and then how they could interpolate in time to get more stable values. He is concerned with data flow and capturing the correct time in the interpolation. Getting around tidal aliasing is a big challenge.

- Mark Trice says the diurnal signal of DO is a problem, they can have VERY different data at different TIMES
    - Car Freidrichs says that's very true in smaller tributaries but less true for deep water hypoxia where tidal issue. Shallow water DO is big issue
        - Mark Trice says many assumptions are broken for spatial interpolation of these types of data that are collected over a week or more. This breaks assumptions with data used so new techniques are good going forward.
        - Gary Shenk brings up the idea of uncertainty in predictions for diagnostics. We will need those for the criteria assessment as they need temporal probability of space at a certain level. They will need the probability of predictions for criteria assessment. He would like to ELEVATE the need UNCERTAINTY
        - Mike Trice says using KRIGING you can create probability maps to account for sample design where there are large species between sites and also shows where variation is greater. He worked with Kriging in the beginnings of data flow to see sample tracks and improve the track to reduce uncertainty in sampling design. Although we can't control the day collected this can help them control the track.
        - Richard Tian comments on temporal variability. Currently Jeremy Testa has a high resolution Corsica river model to compare and reproduce continuous monitoring data. With this model they can see the diurnal variability, which has up to 7mg/L variability. This time the challenge is large. On the other hand he thinks this data with diurnal variability can be used to establish a temporal function. Using this data as opposed to GAM fitting with data which underestimates real variability might be a good thing.
    - Rebeccar Murphy says that's what she wants to get data flow in some locations and apply where we don’t have this information. How far we drill down is a good question, we want to be able to get instantaneous data for instantaneous cruitera and if that's not feasible they need to know. They can add in variability, Elgin and Isablella have good ideas to put forth on this. She asked if this conversation would be good to carry on or if due to time constraints we should move on?

01:25 Discussion of data sources available - Peter Tango (USGS**)**

Peter will show what previous long term vertical DO monitoring looked like in the summer of 2020 in order to get feedback for what type of information BORG is trying to interpolate/estimate). He will also lead a discussion on what other data sets might be available

- Peter Tango says they have talked about data sets so he will withhold his presentation to allow Elgin and others to present. His piece highlights shallow water data sets that exist and can be used. He also highlights a fisheries related TETRA TECH report that looked at data sets that they should recheck for new data. This discussion is more important than that. He wants to continue the discussion about uncertainty and how it reflects issues that should be included in any monitoring design.
    - Peter Tango says Bruce Vogt mentioned vertical profilers which can help bridge the gap between deep water high frequency information that isn't currently utilized for short term criteria assessments. From here will need to know the range of information needed to reduce uncertainty.
    - Peter Tango then moves onto Elgin.

01:40 Preliminary exploration of approaches - Elgin Perry, **Rebecca Murphy** (UMCES)**, Isabella Bertani** (UMCES)

1. Overview of the general approach: deterministic model + simulations to capture space/time uncertainty
2. Options for the deterministic component of the model: a couple of slides on GAMs, a couple of slides on BRTs, other methods?
3. An example of what the results would look like: Elgin`s video

- Rebecca Murphy wants a statistical simulation combining aspects of DO in the Bay. Ultimately she would like to combine these and get 4D spatial and temporal O2 estimates through space and time.
- *CHAT*
- *from Isabella to everyone: 1:41 PM*
    - *Elgin, feel free to take your time with your part of the presentation, my part is very ancillary and can be skipped or moved to the next meeting!*
- Rebecca Murphy wants to capture the anisotropy- the difference in the dynamics of the depth direction versus the horizontal direction.
- *CHAT*
- *from bruce to everyone: 1:43 PM*
    - *Another link to fish interests worth following up on. There is a new*

telemetry array going into the main stem bay to track fish movement. We are also developing habitat suitability models for forage species and summer flounder. I'm wondering if we could connect some of the fish data with the interpolator outputs. Flagging for another day when we can bring in fish scientists.

- *from pjtango to everyone: 1:44 PM*
    - *Good one Bruce. Thanks!*
- Elgin Perry shows some old work he did for VADEQ which made a plausible data set for what might be expected for an actual application.
- Isabella Bertani checks to see if people have questions of Elgins broad overview approach?
    - Rebecca Murphy thanks Elgin Perry and says they wanted to show this since this result gives an image of the pieces of information that could potentially be pulled together. If anyone has more thoughts, that's great.
        - Carl Freidrichs loves sperateating time scales to have a smooth longer term component and a short term higher frequency component. They could measure skill on the long term smooth version by subsampling data then running the model with these excluded portions and seeing if the statistics of the high frequency model results are consistent with the observed data's statistics.
    - Tom Parrham likes the idea of observed vs predicted but in some areas without CONMONS he is unsure how to fill in these holes?. How can high frequency data be substituted into these areas lacking data?
        - Elgin Perry says the only thing used from the CONMON time series was the autoregressive component of the model. He can't remember why didnt use diel component. If they can show deterministic factors to include into shore term components to better predict the average of what's going on they'd do that. If they DON'T have a CONMON data set then have to extrapolate from place they do have one. They would have to assume the autoregressive part is a reasonable representation of how the temporal autocorrelation in DO data behaves.
        - Tom Parrham wants to work with surface to bottom and CONMONS to get fixed data. He is trying to think of how he can use that to help predict what will be seen in other areas without heavy monitoring resources?
            - Elgin Perry says diel cycle mid channel is not the same as what's seen in the shoal area. In shoal areas biology consumes DO while the mid channel lacks this. In the mid channel phytoplankton blooms in the late afternoon can create spikes in DO. Signals can be different and the extent to which Tom can collect data to generalize how these signals differ would be helpful to creating a data simulator for how water quality parameters behave.
            - Tom Parrham says yes, anything he can do is great to advise areas without monitoring because there is no way to have

extensive monitoring information in each area.

- Carl Freidrichs says high res numerical 3-Dmodels can help inform statistical data if they have nothing.
- Richard Tian has an idea of an alternate approach to use dynamic models with data assimilation. The model prediction corrected by data. Differences between time and space interpolation can be done based on dynamics and processes. This is a theoretical possibility.

01:55 Final Thoughts - Peter Tango (USGS)

- Peter Tango calls Richard's word as the last comment and thanks everyone for their work on presentations. He thinks related to Tom Parrham on shallow water relationships the 2017 habitat segmentation is related to CONMON results and the frequency of violation in shallow waters is a good point to come back to. Several papers on those lines about predicting have been written. Walt Boynton and Jeremy Testa are experts on this who can be called on later. He wants to come back to work on other options for different approaches. We're still exploring and he wants to come back to Richard's data assimilation idea. He thanks all for their time.

02:00 Adjourn

Next Meeting Dates: June 17, 2021; 01:00 - 02:00

PARTICIPANTS:

Peter Tango, Carl Firedrichs, Rebecca Murphy, Isabella Bertani, Elgin Perry, Breck Sullivan, Tom Butler, Diana Domotor, Mark Nardi, Richard Tian, Matt Stover, Andrew Keppel, Guiodp Yactayo, Amanda Shaver, Mark Tirce, Lucretia Brown, Anglie Wei, Tom Parham, Gary Shenk, Tish Robertson, Leah Ettema.