



## **Modeling Workgroup Quarterly Review**

January 6, 2021 (Day 1)

### **Event webpage:**

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### **10:00 Announcements and Amendments to the Agenda – Mark Bennett, USGS and Dave Montali, Tetra Tech**

- **Dave Montali asks for roll call for anyone who is calling in via phone**
  - call in user 3 is identified at Bill Keeling
  - Call in user 4 is identified as Joseph Vince
- **Dave Montali runs over the order of presentations and asks if anyone has any announcements.**
- **Karl Berger directs a comment towards Lew Linker and says that the scheduling of meetings is an issue. He wants to plead for a meeting at a different time. He says this two day meeting is at a time where it hits three different meetings and would like to in the future avoid conflicts.**
- **Lew Linker says it's his fault due to setting up these meetings a year in advance. There was a prior meeting which conflicted with this current meeting and he did not look to check if this conflicting meeting was still scheduled. Lew says he should have looked but set the meeting calendar to the first week of each quarter, January, July, April, and October. Point being we respect your time and try to make it as easy as we can. He apologizes for not recognizing that the meeting was not blocked.**
- **Karl Berger asks if this schedule holds for meetings in the first week of each quarter then that first week will conflict for the entire year of 2021. He thinks we will need to figure out conflicts.**
- **Lew Linker wants to meet offline to talk but says the modeling WG meetings have been in place since the 1980s. He first wants to see what everyone's needs are but will work on it.**
- **Dave Montali says he is in the same boat but hasn't seen this conflict in a while. He suggests that if we can avoid this conflict by doing meetings in the 2nd week then that**

would be good.

- **Lew Linker wants to take this conversation up offline. He then asks Tom Butler to make sure 2021 is already scheduled and to schedule for 2022 in advance.**
- **Lew Linker then brings up change in subject from modeling WG staffers from Cuyin to Breck filling in, and now Tom Butler is the new modeling staffer.**
- **Lew Linker announces that CERF was set for Richmond in Nov but is now completely virtual. The modeling WG is not putting in a specific session but encourages others to look for abstract requests at CERF to try to get a strong virtual presence this year.**
- **Dave Montali asks for any other announcements and then gives the floor to Gary.**

**10:05` Fine-Scale Chesapeake Regional Hydrology Model (CRHM) Development – Gary Shenk (USGS-CBPO), Gopal Bhatt (Penn State)**

The presentation will provide progress updates and 2021 plans on the development of a fine-scale distributed hydrology and water quality model of the Chesapeake Bay watershed at NHDplus catchment scale.

- Gary Shenk says the PSC approved his work on climate change from 2019 in the model WG and this morning a long report about technical modeling has been placed in the CAST documentation.
  - Lew Linker says congratulations to Gary and the Modeling WG which makes it possible to begin the implementation process.
- Bill Keeling says the problem he has is if we currently have decoupled phosphorus (P) and sediment then how can we get to the legacy issue at the scale recommended when we have limited soil P data to use in phase 6? How can we carry this down to something at a finer scale than we can currently support? We are data limited, especially at a county scale. How do you manage things with county level data when in reality it should be managed at a farm scale?
  - Gary Shenk says sediment and P are decoupled at some point but sediment is its own thing not dependent on P although P is dependent on sediment however, bad soil P data is a good point. The management board has resolved that the ag wg should provide soil P data, they recently got some from W VA. Gary agrees that we need more soil P data. He envisions dealing with the modeling WG having the idea that if nitrogen (N), P and sediment delivery can be modeled on a small scale then the modeling workgroup can move towards differential credit for BMP placement. Bill's point is correct but Gary wants to push physical delivery to the finest scale possible. Then management can apply this based on the scale of other data which is available to sufficiently manage.
  - Dave Montali says this same problem is present with BMP info as well. If we have county scale information would a self calibration correct for BMP locations and change delivery factors? This is a large issue given the scale of BMP information present.
  - Gary Shenk says BMPs are generally county level and most monitoring stations calibrated to are county level or greater. BMP placement is probably not a huge issue unless within a county they are placed in particularly efficient or inefficient areas. Gary wont be able to deal with that much but will be able to identify critical source areas better then we can now.
  - Bill Keeling says he has more data from a larger extent with HUC 12 information and the minority of his data are at a county scale.

- Gary Shenk asks if BMP scale is what he's referring to?
- Bill Keeling says yes.
- Gary Shenk says this is good, at whatever level they have information they will use it.
- Olivia Devereux says most urban data is submitted via Lat Long but most states submit agricultural data by county. Some states do but provide BMP information in a variety of scales, such as county or HUC 12. This varies for each year for each state, the current model can work with any of these scales. It is most useful for planning to know where BMP is but to protect the identification of farmers we can't look at this small scale.
- Bill Keeling says he can't get P data from labs, since some won't divulge information for the same reasons.
- Olivia Devereux says this is an issue in VA since legal issues can stop data sharing as they have had past legal actions taken against them for using individual farm data. She then says that Gary is working with the ag wg to get better data.
- Lew Linker says calcast and relationships with other elements described are BRILLIANT. This is a clever approach for modeling WG. We are always data limited but describing data limitations and finding where this can be improved is where we should be. What Gary has described offers more checks on calibration and leads to a potential gained in understanding of costs of management actions. The goal here is to help managers with BMP sighting and keeping costs reasonable to protect the environment and deal with climate change.
- Norm Goulet says what Lew just said has stumped him. If this management model won't ever be used for sighting BMPS since too many site specific factors are present he has concerns about setting up unrealistic expectations for the use of this model. By getting finer scale people think we are more accurate, which is NOT true. He has concerns about water supply planning. Since this is not encompassed in this model why are we going there with this?
  - Lew Linker says with respect to BMP placement in the urban areas is very specific. This will just be a better tool to help advise sightings for BMPs. With respect to water supply management reservoirs have a big impact on water quality. Working with reservoir managers will give better information on releases, withdrawals etc. Water supply folks will benefit from the additional information provided. This will end up benefiting everyone involved.
- Chat:
- From James Martin to everyone: 10:49 AM
  - Gary - Does any of this help with representation of stream bed and bank loads?
- From Gary Shenk to everyone: 10:52 AM
  - @James, the calibration method will help, but we have other data sets coming in from Greg Noe and others that will do a much better job with stream bed and bank loads.

- from James Martin to everyone: 10:53 AM
  - Good. Thanks Gary
- - Bill Angstadt would like to see examples of requests for finer scale modeling. He assumed urban stormwater and sighting of BMPs? With Agriculture, which already does Geospatial mgmt, which farmers also do as well, they do not need a model since they have real data of yields, soil, types, etc. Bill wants to see examples of utility of finer scale modeling and for what sectors would it be applicable.
  - Gary Shenk doesn't want to use a model for sighting BMPs since many considerations go into management. He has heard that partnerships want TMDL differential crediting in a spatially efficient manner. No models today that are consistent with TMDL models are doing this but this will allow the CBP to give consistent TMDL models with different sightings.
  - Bill Angstadt wants this to come into the Ag WG since expert panels and AG WG wouldn't want to deal with such fine scale due to the complexity of differentiating BMPs placement into small areas.
  - Olivia Devereux adds users want to know where BMPs will be impactful. Making delivery factors at a smaller scale shows where BMPs have a better impact. This is one small example from CAST users.
  - Bill Angstadt says this is what wetland restoration focused users are looking at, i.e. surface water runoff, which doesn't need the rest of this. There is a downside, when talking with the farming community at 10 m resolution. This is a dangerous direction to go as it leads many to question the legal authority to allow for such an invasion of privacy
  - Gary Shenk says this is not his intention.
  - Bill Angstadt reiterates that based on Olivia's comments this is a dangerous direction to go.
  - Zack Easton says differential crediting is supposed to encourage managers to seek out high load critical sources for treatment. There is no incentive to do this without differential crediting in the framework.
- Chat
- from Zach Easton to everyone: 10:58 AM
  - Gary any thought to using some sort of HRU or similarity index to capture relevant info, this avoids the 10m issue
- from Gary Shenk to everyone: 11:03 AM
  - @Zach - I expect that the upscaling will involve something like that, but the indices or HRUs will be calculated based on fine scale data that can theoretically be downscaled. We will definitely be coming to you for advice throughout the process.
    - Gary says the scale at 10m pixel takes data at this level and expands it to NHD catchment scale. The underlying data at the 10m level would be used to inform the model at an NHD catchment level. If the partnership chooses then the model can go down to the 10 m scale in a method consistent with the TMDL to incentivise people to put

things in specific places with differential credits. This doesn't make people have to do that.

- Lew asks for muted speakers
- Dave Montalo wants the water quality GIT to weigh in on what the priorities are for the next phase model. We don;t know what water quality GIT wants yet. He suggests to talk with James Martin directly to get formal input into what WQGIT wants from phase 7. In terms of management we need to move on to the next presentation and ask if Gopal will talk?
- Gary Shenk says no.
- Chat from James Martin to everyone: 11:04 AM
  - @Dave.Montali - Yes. I will raise this recommendation with the WQ GIT leadership and seek to get it on an agenda soonest.

**10:40 Comparison of Modeled and Monitored Nutrient Trends – Isabella Bertani, UMCES and Gary Shenk, USGS-CBPO**

Maturation of the CBP's non-tidal monitoring network and the inclusion of lag time components in the CBP's Phase 6 Dynamic Watershed Model have created the opportunity to better compare modeled and monitored trends. The presentation will focus on obtaining an appropriate comparison between the output of the Phase 6 Dynamic Watershed Model and flow normalized loads from WRTDS. Future work will involve statistical methods for a comparison of trends.

- Isabella Bertani gives updates on a project talked about in the last quarterly about modeling products and loads.
- Chat
- from Bhanu Paudel to everyone: 11:26 AM
  - @ Isabella: Does this mean dry condition high TP (TP hump) could be due to the release of P from sediments to compensate the decrease in conc. otherwise provided by flow?
- Scott Phillips likes the presentation and asks for perspective on when during this process would CAST and trend results be compared in the workload?
  - Isabella Bertani says they are doing that already, but aren't convinced the drought is the only factor and so they are looking for other factors such as nonstationarity. These results will help create a flow normalized record to compare to CAST.
  - Scott Phillips asks if Isabella has done an oranges to apples comparison over the last 10 years for stations to see how much agreement is there vs not? Has this initial assessment been done?
  - Isabella Bertani says yes this is on the way but the results are not ready to be shown yet. We are not at a stage where there is something presentable due to lack of clarity and agreement, this will take a little while.
  - Scott Phillips wants to see a framework on how big of a problem this is before digging into it.
  - Isabella Bertani says she can come up with another presentation, and says it's important to agree on how we define agreement. She also cites disagreement over longer time spans and how agreement changes with different time periods. Spin up issues with WS model can show disagreement with the first 10 years of the dataset. We know the last few years of a record in WRTDS flow normalized estimates are very uncertain (last 5 years) and that many

- considerations must be accounted for making this a large issue for the big picture. If this is a priority then an overview can be shown.
  - Lew Linker says this would be good. Model WG has CAST but when compared to WRTDS management we see humps and questions why these humps don't line up with CAST? This is something we can use to make better apples to apples comparison from CAST to WRTDS trends analysis. He then asks if this is a fair summary?
  - Isabella Bertani says yes.
  - Scott Philips reiterates that bigger picture: he wants a summary on how big of an issue this is before spending resources on the “issue” and that he wants quantitative accounting.
  - Isabella says yes this is a good idea and she can do that since CAST and WRTDS measure different things.
- Dave Montali brings up chat Question from Bhanu Paudel
  - @ Isabella: Does this mean dry condition high TP (TP hump) could be due to the release of P from sediments to compensate the decrease in conc. otherwise provided by flow?
  - [Isabella Bertani](#) does not have an answer but states we have different hypotheses where during dry conditions there is no flush of total Phosphorus (TP) from the landscape causing accumulation. She also says TP is made available due to movement during low flow events. This also builds up TP in soil, and water which during high flow events create large TP flushing. This was affected by vegetation, and other factors (not necessarily only drought).
- Dave Montali moves us on

#### 11:10 Optimization Update: Development of A Memetic Algorithm for Large-Scale Watershed Optimization – Gregorio Toscano, Kalyan Deb, and Pouyan Nejadhashemi, MSU

In order to find a true global optimum and avoid local optimums as final solutions the presentation will introduce a memetic algorithm for large-scale non-convex optimization problems such as with the CAST optimization of “minimize cost\maximize nutrient reduction (and co benefits)”. The proposed approach successfully combines a genetic algorithm for coarse search and an interior-point-based method for local search.

- Kalyan Deb and Gregorio Toscano will start.
- Lew Linker asks a question about Ipopt cost reductions for combined counties. Is this cost reduction for combined counties for previous optimization which was a year old at WIP level? What was the basis for cost reduction?
  - Gregorio Toscano is comparing this to the previous optimization algorithm (CRC) work.
  - Lew Linker asks if this cost is a cost reduction and post treatment load reduction is to the old optimization? Are we achieving lower loads in relation to both or are we trading off?
  - Gregorio Toscano says yes with the newest approach we achieve a way better cost reduction and lower post treatment loads.
    - Lew Linker says this is important for improvements. Reminds that the CRC optimization ended with LP (linear programming) approach only on certain BMPS that had factors. The points are important and show real improvement.

- Kalyan Deb says he is looking for keeping the program fixed and uses a standard optimization (Ipopt) which they modified with results showing better results to optimize CAST. He is trying to find a better algorithm than the existing one.
  - Lew Linker says less cost, higher post treatment load reduction and faster optimization speeds are all great..
  - James Martin asks which pollutant this is for?
  - Kalyan Deb responds this is for Nitrogen
- Lew Linker asks if the 90% reduction from original loads is based on original county load from baseline run?
- Kalyan Deb says yes, multicounty analysis has more flexibility since BMPs can be placed differently allowing for counties to vary BMPs. The sum is always better than individuals and so far when we consider multiple counties loads are reduced more but costs reductions are not as great.
- Lew Linker says this is important for decision makers since collections of counties will do better, there might have to be restrictions formed between counties, such as state basins.
- Kalya Deb agrees.
- Dave Montali says this is useful since in many states (W VA) they use collections of counties.
- Lew Linker says yes for DE, NY, etc this would be useful.
- James Martin thinks this would be good to look at disregarding state lines to see how much better of a solution we might find. (not that this will happen)
- George Onyullo says implementation happens due to governments within political boundaries.
- James Martin says absolutely and as is keeping in mind that solutions are focused on main stem deep water deep channel DO from Chesapeake Bay and tends to ignore local water quality issues which need to be addressed.
- George Onyullo agrees.
- Lew Linker adds that this will be a task to organize counties by different groups, i.e. state, basin, etc.
- Kalyan Deb says getting numbers gives us a better understanding.
- Chat
- from Joseph Zhang to everyone: 12:17 PM
  - @Grogorio: if u use GPU, does that mean CAST needs to be ported to GPU as well?
- Dave Montali says if anyone has questions, reach out to Kalyan Deb and Gergorio Toscano since we are short on time.

#### 11:50 [High-resolution Landscape Characterization to inform the Next Generation of Hydrologic Models](#) – Peter Claggett, USGS

A key aspect of support for the CRHM is provided by a one-meter-resolution land-cover and land-use datasets and complementary 1-meter resolution hydrography data now being developed. The land-cover datasets will be translated into three, 58-class, land-use datasets using a variety of local (e.g., tax parcels) and regional (e.g., soils and roads) ancillary datasets. To complement these data, the development of hydrography data consisting of 1-meter resolution (1:2400-scale) fluvial features such as channels, gullies, and ditches are also being developed. Channels will be attributed with estimates of flow permanence and channel dimensions (width, depth, and bank angle) and the mapping of

floodplains and other hydrologically active areas on the landscape will be refined.

- Peter Claggett lost no information when working with 10m resolution due to the extensive knowledge and aggregation of 1m resolution data. (1219)
- Peter Claggett opens floor to questions
- Lew Linker says we always see a great meeting but Peter and his team work magic.
- Dave Montali asks if when the network of streams is expanded from phase 6 to 100k etc... you make more water. During phase 7 this will have less land and more water. Can you speak to that from the upland perspective where there is a higher resolution network of streams. What's the magnitude of change from land to new water?
  - Peter Claggett says he has not got an estimate, stream width in phase 6 has 10m resolution ( 10m pixel) estimation of stream width. This was incorporated into phase 6 data and increased the water class by 25%. This class was small to start with and so he doesn't think this will be consequential. New data will also show more ponds, streams, wetlands, retention ponds, and in the new hydrology model this will have more impact, as more areas will be there to retain sediments and nutrients.
  - Dave Montali asks how new identification of land cover and identification of water will impact phase 6? Will there be a difference in CAST 2021?
    - Peter Claggett says the decision was made to keep 2013 baseline acres fixed, with no change from the 13 land uses for phase 6. This baseline acreage will stay the same but as 2017 and 2021 are developed to the 2013 to make comparable only the change from 2013 -2017 will be applied to the 2013 original to update the 2013 land use. This will make differences in stream definition much less consequential than they look visually.
    - Dave Montali asks if this means water will stay the same in phase 6?
    - Peter Claggett says yes.
    - Dave Montali asks if bare shore is a component of upland streams?
      - Peter says probably not, bare shore is a non wetland barren area adjacent to water. If a reservoir is drawn down and you get a mud perimeter this is a bare shore. This would show up on 1m data, and you don't want to attribute this to another land category. Bare shore also represents sand bars adjacent to the Bay. These are not high loading areas anyway, they will be rolled up to water.
      - Dave Montali looks at land cover and sees several areas along the banks of small rivers and asks if on a big river will likely be rolled into water?
        - Peter says yes, don't want to count ephemeral changes for management.
- Dave Montali opens the floor to other questions
- Chat
- from Lew Linker to everyone: 12:42 PM
  - Peter, can we get your presentation or a link to your presentation that we can use for the Quarterly record? Thanks!
  - Peter will send to Tom for Distribution.

**12:30 BREAK**



**12:45 Climate Change and BMP Performance – Zack Easton, VA tech** Zack will provide an update on the STAC Technical Synthesis *A systematic review of Chesapeake Bay climate change impacts and uncertainty: watershed processes, pollutant delivery, and BMP performance.*

- Dave Montali says we are 15 min late and apologizes before introducing Zach Easton.
- Lew Linker asks how factors like temp affect the potential for some BMPs like cover crops to become more efficient in changing climate conditions?
  - Zach Easton says he will cover this soon
- Dave Montali asks how Zach is handling forest buffers on pasture and that BMP has a buffer and livestock exclusion component.
  - Zach Easton says in CAST buffers can have fences included or not, Jerney can jump in if wanted?
    - Jeremy Hanson says we will see what literature has depending on studies. Studies may consider pasture in scenarios but will see what is in literature to parse out into BMPs as described by the CBP.
    - Dave Montali says livestock exclusion fencing being damaging due to high water is not a component what Zach looks at?
    - Olivia Devereux says CBP is the only place that combines the two. Most others have both as two separate BMPs.
    - Zach Easton says he isn't trying to modify the efficiency of BMP performance but wants to know how climate change affects BMP efficiency metrics.
  - Dave Montali brings up this is important to W VA and headwater states, and thinks the biggest risk is the loss of the exclusion part.
    - Zach Easton agrees.
- Lew Linker has 2 questions: first if looking at all the inputs and outputs of a crop system the biggest output is harvest. This would increase with inc CO2 is that in analysis. Is this considered in this analysis?
  - Zach Easton says harvest isn't a BMP, although he could see increased plant growth.
- Lew Linker's second question is whether RCP 4.5, and 8.5 are probably less influential in terms of change in BMP under climate change but the tension between evapotranspiration and volume increase and intensity increase. Do any changes in spatial variability factor into the report at all?
  - Zach Easton says yes. Spatial variability is expected to be a very important component.
- Robert Sabo mentions a point on crop uptake, and how the hard freeze date will shift by weeks over the next decades. In literature reviews are they evaluating further south if cover crops are as effective? We can actually use this info for future effectiveness. Has this been done?
  - Zach Easton says one of the systematic review changes was to include the ability to incorporate a space for time comparison.
  - Robert Sabo says if cover crops grow longer this may be incorporated into nutrient management plans.
  - Lew Linker says this report is VITAL to the CBP.
- George Onyullo asks if the primary emphasis is on crop cover; we don't see anything speaking to the urban environment where crop cover is not a sign part of processes.? Crop cover is important but doesn't speak to urban issues.
  - Zach Easton clarifies that he has just used this cover crop BMP as an example of what his conceptual model can do. He clarifies that they intend to push all BMPS through

the conceptual model, including urban BMPs.

- Lew Linker asks Zach Easton how often should this type of report be updated? Once a decade, every five years, etc? This might have to do with the rate of article generation or topics of publications?
  - Zach Easton says he thinks this should maybe be a once a decade process, but this is dependent on the literature availability.
- [Gary Shenk](#) asks for climate change TMDL issue leaders, this work is a bridge to get the workgroup to accomplish what the management board wants to see. This question is how many more or different BMPs do we need to implement to counteract the effects of climate change? For this we need a number, Zach and his team have shown that the literature doesn't support this idea. He says that Zach has proposed asking a different question to ask with robust decision making. It is unclear to Gary how we can get from concept models with no numbers, to either numbers or if the CBP would be ok going in a different direction with this question?
  - Zach Easton says this is a great question; he doesn't think anything precludes his model from including quantitative information into the conceptual model but that if they do they should perhaps be adding ranges to exogenous forces which impact specific BMPs. Given the uncertainty in climate change it's hard to put a deterministic number on how BMP x will change unless you say it will change by Y amount under climate future one. Without knowing what climate futures will look like he is hesitant to do this.
- Olivia Devereux is having trouble understanding the numerical part of this and says for urban BMPs we know the efficiency and that it's constant until it fails. She asks how will this be incorporated and used to inform the meeting of the TMDL?
  - Zach Easton reiterates his intent is not to tell the CBP what BMP efficiency should be changed to under climate change. What they can do is provide estimates of risk for BMPs. If there is a BMP sensitive to climate change, then he might bump this BMPs implementation priority down. This can create a base list of BMP implementation priorities to the risk and sensitivity of BMP implementation. There is much work to be done to determine what final output looks like. Any suggestions will be great.
- Julie Reichert-Nguyen asks if from these results we could rank BMPs based on the certainty of performance based on this analysis?
  - Zach Easton says yes and thinks we can quantitatively rank BMPs under different climate futures based on the robustness of BMP performance. This is possible with a proper description of the climate future.
    - Julie Reichert-Nguyen is familiar with the robust decision making process and thinks this would work. The CRWG is looking to figure out what is identified as research gaps to help modify efficiency values of BMPs. This is likely the next phase of work after Zach's research is done.
- Mark Bennet says to Gary this request came from the PSC and this is the first step looking at the state of knowledge. This will need to be reported back to the PSC. They will decide if the program wants to pursue this or not.
- Dave Montali says we need to move forward but will look for updates later on.

### 1:15 [Introducing FieldDoc](#) – John Dawes, Chesapeake Commons

Field doc is an online application that allows users to document BMP implementation while in the field using spatial data to assist with fine-scale targeting and integration with

state BMP databases. Critical elements include management practices that were utilized, where the practices are located, and their current condition. FieldDoc seeks to address the data management challenges by providing a reporting framework that cleanly integrates with investment programs targeted at restoration and land protection projects.

- John will talk about field docs
- Chat
- from Olivia Devereux to everyone: 1:58 PM
  - Great new feature to enter the same BMP for several different grantors.
- Robert Sabo thinks the app is a great idea; he asks if there are spatial polygons where nutrient mgmt plans are being implemented and where there might be nutrient use efficiency measures in polygons?
  - John Dawes says data collected in the system follows practices related to CAST and CBP. He would be able to see geography encompassed by a nutrient management plan. This info is structured and can be shown in the system. He hasn't prioritized but focused on tracking information. There are currently no tools yet to prioritize where plans should go based on soil nutrient levels. He could accommodate that with a newly released module letting individuals add layers to project maps where the reference layer could visualize where prioritized. This would be a hacky workaround and would need to discuss what components would be most relevant and need updated..
  - Robert Sabo asks if he needs a login to access data layers ?
  - John Dawes says this is done on a program by program basis, this is due to restrictions with the farm bill that inhibits open access. Easiest way to start by reaching out to:
    - For general users, they can signup and start tracking practices here: <https://fielddoc.org/register>. It's important to note that for those requesting data behind the system programs we can grant access on a case by case basis. Simply send an email to [support@fielddoc.org](mailto:support@fielddoc.org)
    - Will eventually bypass paycall support for export. For now contact link
- Dave Montali moves us on

**1:30 CB County Fact Sheets – Robert Sabo, EPA and Breck Sullivan, CRC** Robert and Breck will provide an update on the status of the county level fact sheets and efforts to develop bay-wide nutrient inventories across the Chesapeake Bay and efforts to relate shifts in the inventory to observed changes in water quality. Overview of major trends for likely sources of point and non-point source pollution will be presented at the county level as well as preliminary statistical results on state level effects on these trends. This inventory and associated County Fact Sheets demonstrate the power of maps and pictures in communicating largely positive progress in the Chesapeake watershed and Bay clean up and satisfy stakeholder and decision makers' desire to see where they stand, by county in this case, relative to other counties and regions.

- Breck Sullivan shares the presentation
- Robert Sabo wants feedback on the rough draft figures which are going in a manuscript.
- Lew Linker says the insight into increased N and P use efficiencies is a great benefit.
- [Robert Sabo](#) asks if a 2000-2019 analysis would be more useful for seeing the newest efficiencies and subtleties?

- Lew Linker asks about nitrogen (N) use efficiency, isn't W VA higher in terms of Nitrogen Use efficiency than MD, and VA?
  - Robert Sabo says the mean value is higher for W VA. he needs to better communicate the results of a post hoc tucci test to better illustrate all these changes. One issue with W VA is there are fewer counties. you are observing correctly. This is different from P which is worse, broiler production around Moorefield.
- Olivia Devereux asks what years data are being used for this?
  - Robert Sabo says this is the Mann kendall slope estimates of the trend using data from 1985-2019.
    - This data includes crop and pasture removal
  - Robert Sabo asks if he should show the mean response and the summed declines side by side of would one be better in the supplemental?
    - Lew Linker says we can talk at model ad hoc but these should both be shown since context is everything.
    - Robert Sabo says he appreciates this and wants to avoid making this a competition between states. He wants to emphasize this is good news across the board.
- Chat
- from Jeremy Hanson to everyone: 2:42 PM
  - There's a LOT of great info here. beyond the fact sheets may need to have a repository or publication to house more of the details that can't fit into fact sheets.
- Dave Montali says there may be something wrong as W VA has had large N decreases since 1985 but the graph doesn't seem to show this.
  - Robert Sabo will check but might be seeing a peaking of point source loads but several other towns might have updated their wastewater treatment facilities. This might create a slump with a linear trend slope and this short term trend might have overcome a long term N decrease since from 2000 on W VA has had large N declines.
  - Lew Linker adds that W VA might have overall lower loads since the point source loads are overall much smaller compared to MD or VA. If we saw percent reduction this might look different.
  - Robert Sabo says this is uncorrected data with no normalized area and might be misleading.
    - Dave Montali says the fact that he can see a P decrease but not N decrease it makes this look wrong.
    - Robert Sabo agrees and would love to have states review graphics and data. He asks people to email hm to review work [sabo.robert@epa.gov](mailto:sabo.robert@epa.gov)
- Robert Sabo asks what is driving these statewide differences? Changes in industry? He wants a potential conference call later.
- Robert Sabo saw a 7-8 year lag in predicted N decline near conestoga after management actions were put in place, this is in Lancaster county.
- Lew Linker comments WOW on the lag.
- Chat
- from Clint Gill to everyone: 2:50 PM
  - Is there somewhere to find a copy of this presentation?
  - Robert Sabo responds verbally that he has to get the presentation through clearance first but if you email him he can send you a private personal copy [sabo.robert@epa.gov](mailto:sabo.robert@epa.gov).
- Chat
- from Breck Sullivan to everyone: 2:52 PM

- @Jeremy We are working on a manuscript to include more of the details.
- from Jeremy Hanson to everyone: 2:53 PM
  - Thanks Breck!
- from Jeremy Hanson to everyone: 2:53 PM
  - And thanks Isabella I also wanted to see your pres today and I'll miss it tomorrow :(
- from Robert D. Sabo to everyone: 2:53 PM
  - Thanks everyone, I enjoyed the conversation and please reach out if you have further questions or comments. My email is [sabo.robert@epa.gov](mailto:sabo.robert@epa.gov)
- Dave Montali wants to push ahead and get Bo Williams in.
- Lew Linker wants to have both Bo Williams and Isabella today.
- [Isabella Bertani](#) offers to switch places with anyone.
- Dave Montali wants to hear Bo Williams today and [Isabella Bertani](#) tomorrow.

## 2:00 Development of NHDplus Inputs for the Fine-Scale Chesapeake Regional Hydrology Model (CRHM) – Isabella Bertani, UMCES

Inputs needed for the CRHM at the NHDplus scale of more than 80,000 model cells will be a big job in 2020. Isabella will describe the initial development of input data and provide a look forward at the overall task at hand.

- Put in Bo Williams today and pushed Isabella Bertani to tomorrow
- ***Notes from this presentation are listed below:***
- Dave Montali has some big picture points about BMP information and how point source information may be required to report monthly but they will likely have continuous monitoring. He asks if the department of energy has continuous monitoring information?
  - Isabella Bertani says some are and some are not, the big question for her is if they need to invest time gathering reported continuous data, this might outweigh the gains they could get from these data.
  - Dave Montali says there are resources at the jurisdiction level to get what you want. If the department of energy information isn't continuous there might be NPDS permitting data which might be recorded that you could ask for. info available.
  - Isabella Bertani agrees and thanks Dave Montali.
  - Lew Linker asks about Mt Storm and Lake Anna, where the temp difference between intake and discharge is between 10F. He says there are implications with reaction rates and he is making the point that climate change and temperature are issues which we might want to mention. It begs the question if we want to track other heating sources such as power plants and that we need to assess if this is worthwhile.
  - Chat from James Martin to everyone: 11:43 AM
    - What about other point sources like paper mills
  - Dave Montali adds to the chat topic by James Martin in asking Isabella if we have all the appropriate types of significant heat point sources.
    - Isabella Bertani says paper mills are amongst these sources but do not report to the department of energy but that information is available for facilities that do report temperature data.
    - Lew Linker says he is leaning into this to test this and see if it makes a difference.

## **2:15 Analysis of Cobenefits of CBP BMPs – James (Bo) Williams, EPA-CBPO**

Bo will report out on the progress being made in in several projects on estimating co benefits of BMPs and other CBP management actions including the quantification of the hazard mitigation benefits of nutrient and sediment BMPs.

- Bo Williams has a hard stop so he will run through his presentation quickly; he also adds that he is a pass through for much of the information.
- Lew Linker thanks Bo Williams for the overview. He wants to include co benefits in modeling efforts for 2025. The way to include these in optimization is to have them monetized so that there is ecologic and fiscal value for benefits. Does W Lewis have co benefits monetized?
  - Bo Williams says there is a cost aspect to the model to identify trade offs between management practices. Which also includes eval competent with unit costs evaluation.
  - Lew Linker asks for clarification if W Lewis does monetize?
  - Bo Williams says there is a cost effect and monetization in the W Lewis model. This is a unit cost evaluation for N retention.
- Dave Montali does not hear any other questions, thanks Bo Williams and everyone for participation and will see everyone tomorrow.

## **2:30 Adjourn**

### **Day 1 attendees**

**Hassan Mirsajadi, Clifton Bell, Rebecca Murphy, Pouyan Nejadhashemi, Isabella Bertani, Scott Phillips, Alex Kua, Gopal Bhatt, J. Sebastian Hernandez, KC Filippino, Jeremy Hanson, Xia Xie, Jordan Baker, Richard Tian, John Clune, Mukhtar Ibrahim, Jeni Keisma, Sophia Grossweiler, Sam Merrill, Theodore Telser, Norm Goulet, Lisa Beatty, Joseph Zhang, Tish Robertson, Marjorie Zeff, Jordan Baker, Mukhtar Ibrahim, Gary Shenk, Guido Yactayo, Qian Zhang, Peter Clagget, Lee McDonnell, Kyle Hinson, Bhanu Paudel, George Onyullo, Robert D. Sabo, cassandra davis, Bill Angstadt, Dave Montali, Clint Gill, Marjy Friedrichs, Jhih-Shyang Shih, Julie Reichert-nguyen, Arianna Johns, Denice Wardrop, Bill Keeling, Mark Bennet, Niel Ganju, James Martin, Carl Friedrichs, Anna Jalowska, Beth Boyer, John Dawes, Zach Easton, Karl Berger, Gregorio Toscano, Kalyanmoy Deb, Carlington Wallace, Olivia Devereux , Lew Linker, Breck Sullivan, Bo Williams, Joseph vince**





## **Modeling Workgroup Quarterly Review**

January 7, 2021 (Day 2)

**Event webpage:**

[https://www.chesapeakebay.net/what/event/january\\_2021\\_modeling\\_workgroup\\_meeting\\_early\\_review\\_day\\_2](https://www.chesapeakebay.net/what/event/january_2021_modeling_workgroup_meeting_early_review_day_2)

**For Remote Access:**

**WebEx**

**Link:**

<https://umces.webex.com/umces/j.php?MTID=mf44faf1ad1ec16798be0c2e694e6f0fc>

**Meeting ID:** 120 672 0171

**Password:** jWBbqguG

**Phone number:** +1-408-418-9388 United States Toll

**Access code:** 120 672 0171

To enter the webinar, please open the webinar link first

### **10:00 Announcements and Amendments to the Agenda – Mark Bennett, USGS and Dave Montali, Tetra Tech**

- Dave Montali requests that [Isabella Bertani](#) presents her talk, which did not happen yesterday, before lunch today.
- Isabella Bertani is ok with that and she will be on the call all day.
- Chat
- from Norm Goulet to everyone: 10:01 AM
  - A number of people may be over at WTWG
- There are no new announcements at the start of today's meeting.

### **10:05 Open Bay Vertical Water Quality Assessments in High Temporal Resolution – Peter Tango, USGS**

An update will be provided on tradeoffs on 2-3 or more sensor arrays, telemetry or download sensors, number of sensors on string and overall cost.

- Lew Linker says with respect to mimicking long term monitoring depth profile we don't need a sensor every meter. Looking at the profiles/timeseries of

vertical DO profiles we'd be lucky to get close with current models and we can test this to see how the model does relative to these sensors. If we have 4 sensors on the current stream, 2 deployments would be a good start from the modeling side. This is testable.

- Peter Tango says this is a great starting point. What has been done in the pilot test being useful from a modeling perspective is a good sign .
- Neil Ganju asks what's the plan for QA and publication of these data so that they can be accessed easily? Is there a plan for that?
- Peter Tango asks if Neil means for existing data or future data?
- Niel Ganju says both.
- Peter Tango says existing data is out, and for the future data it would be something consistent with current EPA quality assurance protocols. He would need to talk with the database folks for how to make new data available.
- Chat
- from Rebecca Murphy to everyone: 10:27 AM
  - <https://sensors.ioos.us/?#metadata/103543/station>
- Bruce Michael says both DNR in MD, ODU and VIMS in VA have people on the water and would be happy to work and service instruments to ensure QA QC is done to ensure good quality data. He has people available to calibrate sensors if it is needed.
- Peter Tango says this would be helpful for calibrating shallow water sensors to get fine scale measurements and this is critical to ensure the quality of the data set.
- Carl Fredricks seconds Bruce and wants to get VIMS involved. He asks about internal tides moving the pycnocline, and says this emphasises the importance of continuous monitoring and shows that that fact that since internal tides move O<sub>2</sub> up and down this gradient means it means the resolution is effectively much higher than 4 depths would suggest. This means that you can interpolate since the sensor passes the gradient over repeatedly. This could encourage the use of interpolation to reduce the need for more sensors. He agrees that 4 sensors would be great and that you can infer more detail with data analysis methods.
  - Rebecca Murphy added a link to the chat to give access to the June data shown. She comments on the data and sees how you can get more information from this data. The 1m data had breakdowns but the 7, 11, 20m depths are good. The interpolations between 1 and 7m depths are really based on the 7 depth. She states that 4 sensors is good but that they may want duplication at critical depths in case there is a sensor issue. She agrees that 4 is good if you have constant data but wants redundancy.
  - Gary Shenk says if we are going to have multiple vertical profilers then it would be great to have one every meter. That way we could better understand the mechanics of the surface mixed layer and the bottom mixed layer, which are so important to criteria assessment. Carl's statement about inferring from fewer is interesting but this would require some dense vertical data to understand this. Maybe Carl could convince him otherwise?
    - Carl Fredricks says Gary's point for surface and bottom mixed layers is true, since in shallow layers the internal wave



amplitude is constrained not to be big. He says you can't get all the information in the surface and bottom water but can have less information in the middle water column.

- [Larry Sanford](#) says this is great. He thinks questions abound but other expertise is out there. He thinks this question would be a GREAT STAC workshop. Many considerations, such as if a line crawler is better than individual sensors in sequence? Perhaps piggybacking on permanent mooring sites? He thinks STAC would be a great platform for this topic.
- Chat
- from Tish Robertson-VADEQ to everyone: 10:30 AM
  - Peter, will this work help to inform us on what is an appropriate allowable space-time frequency for the short duration criteria? Or is the plan to stick with the 10% CFD?
- from Gary Shenk to everyone: 10:36 AM
  - @Tish - my understanding is that the 10% CFD is used when we don't have the biological information to separate out designated uses and assessment periods into 'pass' and 'fail' based on ecosystem response. We had BIBI for deep water, but nothing for open water and no 'passes' for deep channel
- from Tish Robertson-VADEQ to everyone: 10:41 AM
  - That jibes with my understanding too. I'm wondering if the allowable space-time frequency that should be used to inform the monitoring effort both vertically and horizontally.
- [Peter Tango](#) says they are moving towards a STAC proposal on monitoring advances and wonders if this could be an element of this or a stand alone workshop. He would like to have Larry's questions accounted for. They are currently focused on DO criteria but research applications are broader. Earlier experiences with crawler systems have shown issues with the mainstem of the Bay but the DNR has had success in shallower waters like Harris Creek. Still looking for an open water system for the Bay. must be cost effective.
- Larry Sanford says there are tradeoffs to both, variations and calibrations can be headache, failures can happen, crawlers have issues. This is a far bigger issue than several modeling workgroup meetings can solve. He thinks this would be better to have a smaller focused workshop on just the time series issue which is separate from other monitoring talks.
- Lew Linker says the STAC monitoring workshop is proposed and underway but they could carve out time to discuss this. He also would like to discover the best way to test various ideas and that a STAC workshop has the weight to make this happen.
- Jeremy Testa says to Larry's point, it's good to think broadly. He thinks it is necessary to think about what the relative priority is in terms of getting the deep channel versus other parts of the system. The aninstem is highly emphasized. But it has a wide diversity of relatively deep waters that makes him wonder if moving sensors around can capture variability over the entire system. Jeremy comments on Carl's point on missing information of hitting profiles at different times within several hours. It seems like there could be a subsampling of the time series with artificial visits, like a traditional profile sampling. He asks how likely you would be to get picture wrong sampling? He doesn't know who would do this but it is interesting.

- Peter Tango says this lends itself nicely to several new deployments which have happened since June which are useful for this analysis.
- Lew Linker says this is important to coast and estuarine restoration science and model calibration. The modeling team will step up and be useful, they will use existing models to gain insights. The modeling team would like to join in this analysis to move on effectively.
- Peter Tango says it is helpful to use in house experience to move the 4d interpolator into use, and see what other help might be needed. He thanks everyone for help working with these new data which can feed the next generation interpolator.

### **10:30 STAC Climate Change Technical Synthesis Shallow Tidal Water DO Dynamics – Jeremy Testa, UMCES**

A comprehensive synthesis that includes a statistical analysis of the shallow water data in concert with numerical model simulations and linkages to local physical conditions and watershed features will explore the DO dynamics of shallow tidal waters. The synthesis will generate an improved understanding of how local eutrophication and the effects of future climate will impact oxygen criteria and dynamics in shallow waters, provide estimates of uncertainty for how sensitive oxygen will be to future climatic change, and lead to improved numerical tools to CBP assessment of future shallow habitat change in response to the Chesapeake restoration.

- Jerney Testa emphasizes that this is a collaborative project with Wei Liu doing the dominant share of the work which has been going on for a year.
- Chat
- from Tish Robertson-VADEQ to everyone: 10:56 AM
  - Jeremy, I'm dying to know what you found for TF5.6 with the CART analysis, but it isn't on the map. TF5.6 is in the James.
- from Dave Parrish, CBNERR-VA/VIMS to everyone: 11:01 AM
  - Hi Tish, I believe it is missing from the CART analysis because it is conducted on the shallow water/high frequency monitoring stations
- from Tish Robertson-VADEQ to everyone: 11:02 AM
  - Doh! That makes sense, Dave! Thanks!
- Peter Tango asks what do you do for daylength? Where does this factor into the expectation that chlorophyll can have the largest positive or negative impacts?
  - Jeremy Testa says day length isn't built in directly to analysis, PAR at surface is based on an hourly record, so they integrate over a day to get a number which implicitly considers day length. They haven't looked at seasonal changes in day length. Are you experiencing the biggest blooms with the longest day length or is there a shift with day length?
  - Peter Tango says when you run out of sufficient daylight to sustain populations producing excessive oxygen the phytoplankton die off when there is not enough daylight. Looking for those swings Jeremy pointed to and linking this to daylight's ability to sustain itself is important.
  - Jeremy says there is a seasonal element referred to and in some ways there is a limitation to analysis based on good reliable data to analyze. This tends to be from April to October where daylight change exists. Both a positive and negative effect to chlorophyll could occur within a week where high light

causes a bloom then low light leads to a crash. If we're looking at how frequently o2 levels are at a good limit length for organisms might be good then bad after. Is there potentially a hidden consequence in reducing eutrophication if it helps cause high o2 concentrations. There is likely a consequence down the road when dealing with light induced blooms.

- Peter Tango loves what is done and looks forward to the publication.
- [Larry Sanford](#) asks if this is all based on a surface sensor or are the sensor depths all the same?
  - Jeremy Testa asks if he means the sensor depth at a particular station?
  - Larry Sanford says yes.
  - Jeremy Testa says yes and no. He has focused on stations with deeper water that may not quite represent a well mixed water column. Some deployments are different with some sensors at fixed places, some are also suspended on floats just below the surface. There are some moving with the tide and others in the same place. He hasn't analyzed if this matters.
  - Larry Sanford says these data are representative of shallow water and asks what is shallow?
  - Jeremy Testa says most stations are less than 5 meters, some he has restricted to the surface layers, Jeremy doesn't know a specific number. Has used small creeks to monitor o2 levels and saw that almost the entire water column was anoxic for 3 days. The vertical structure was measured at inch depths and found stratification within a meter of water. This occurred over a 3 day period. Jeremy thinks these happen everywhere but don't last as long and are more episodic.

- Chat

- from Jeremy Testa to everyone: 11:16 AM

- Hi Tish, we did not examine the seasonal station data, as Dave pointed out.

### 11:15 [James Chlorophyll Model Findings](#) – Tish Robertson, DEQ and Jian Shen, VIMS

Tish and Jian will review a series of scenarios developed with various point source discharge loads from different point source locations in the tidal James helped to provide a decision framework that allowed for the possibility of an outcome that was both environmentally protective and cost efficient overall. The findings of the work that the Modeling Workgroup has contributed will be presented.

- Chat from pjtango to everyone: 11:23 AM

- Tish - on the insights of allowable space time frequency question, I believe long term the ability to understand habitat condition distribution coupled with living resource behavior offers future insights into how organisms survive relative to condition distributions around them. A lot of historical work is based on looking at fish in a lab setting, we don't often get to see fish behavior in respect to habitat variability that we can effectively quantify. In that way, advances in effective 4D habitat characterization coupled with fish distribution, fish health info, will eventually better inform "allowable exceedance", or, help us develop next generation criteria that are aligned with

our understanding of habitat-fish behavior interactions.

- Due to a technical difficulty with one of the presenters Dave Montali recommends that we have [Isabella Bertani](#) present and that we will come back to Tish Robertson and Jian Shen in roughly 15 minutes.
- **Development of NHDplus Inputs for the Fine-Scale Chesapeake Regional Hydrology Model (CRHM) – Isabella Bertani, UMCES (corresponding notes are found under the presentation noted above)**
- After 15 minutes we return to Jian Shen's presentation.
- Lew Linker adds the modeling workgroup to the list of responsible parties for this work being accomplished. He then thanks other groups involved, DEQ, VIMS, CBP. Lew Linker suggests that the outcome of the work provided the least cost most efficient solution and thinks this was great collaboration.
- Chat
- from CBell to everyone: 12:21 PM
  - I have a question for Jian.
- Clifton Bell repeats the version of a question he asked sent to DEQ. He appreciated the high level of detail given to this topic. He has a question on slide 17, about future forecasting. Regarding the 2 green climate curves, he asks if they give similar calibration results?
- Jian Shen says yes because the current calibration is right. You can only increase, like curve 1, curve 2 is an eppley curve and neither result affects the calibration.
- Clifton Bell says that as things get warmer we are speculating at the responses to high future temperatures due to low amounts of data. Short term results can be driven by relatively little data increasing sensitivity to this. You are assuming perfect biochemical adaptation where you have increased temperature causing an exponential increase with growth. Short term results could be sensitive to the right side of these curves due to this result being driven by a short period of higher temp. The resulting wasteload allocations could be very sensitive to what we assume on the right side of these curves. The recommendation he had was to look at that for example if curves calibrate similarly would you still be in attainment? He is concerned that as we move into the future we continue to speculate with no optimum temperature and in doing so we may overstate the impact of climate change. Do you have more recent thoughts on that?
- Jian Shen agrees with him that the curve is sensitive especially with short term change. The short term sensitivity tells them the low and high bounds are a difference of about 5% change with nutrient reduction, so we have a 5% uncertainty. Jian says this is a challenge and he doesn't know how to translate that to the management.
- Clifton Bell says curve 2 is conservative vs curve 1 so why aren't people making noise that we didn't use curve 1? What is the reason not to use curve 1?
- Jian Shen says when comparing the impact of dynamic changes, including sea level rise and salinity change, compared to temperature. The dynamic impact is 6% avg change. Temperature has a change of 2% so dynamic change could be a larger factor. He says that there are more factors than just this curve.
- Clifton Bell says if you continue to use curve 2 for future climate scenarios again you will get push back on whether this resulted in bigger changes due to its speculative curve and wants to search for concrete information.
- Jian Shen agrees and says he will likely do a sensitivity analysis for both curves 1 and 2 and see if they agree or disagree. If they disagree then he will look to see if this

disagreement is within margin of error.

- Dave Montali says we are 30 minutes behind and asks if anyone has time constraints?
  - Carl Cerco has no problem.
- Dave Montali offers a 15 min break.
  - Lew Linker has a hard stop at 3 pm.
  - Dave Montali offers juggling presentations.
  - Lew Linker and Jeni Kiesman say they can switch spots if needed.
  - Dave Montali says we will take a short break and come back at 1245.

## **12:00 BREAK**

- **DaveMontali asks what is the best time to get phase 7 Input? Can we wait for an in person meeting this fall or do we need to get that sooner?**
- **Gary Shenk says in person seems to be more effective and we have a lot of background tasks to build to phase 7. He is interested in a face to face but could be swayed.**
- **Dave Montali says it sounds like we have the time to wait for a face to face since this is the best way and that waiting for the fall would work?**
- **Lew Linker says yes, we have enough foundational steps to keep us busy until he needs the management input. We can wait until the fall for this.**
  - **Sidebar occurs with Gary, Dave, Lew about getting face to face interactions built up. All want face to face but we likely have the time to wait and see if things open in the fall.**

## **12:30 SAV Nutrient Dynamics and DO Impacts – Carl Cerco, Attain and Richard Tian, UMCES**

An update on the 2017 WQSTM estimated nutrient flux by submerged aquatic vegetation will be presented. Examination of net nutrient flux is anticipated to simulate net import to SAV in the growing season, augmented by simulated enhanced settling of particles in SAV beds. However, after the SAV growing season a nutrient flux out of the SAV beds, mostly as organics, is anticipated.

- Due to an excel issue Carl Cero has placed a key for his figures within the presentation which is posted on the [website](#).
- Lew Linker asks to clarify whether in tangier if SAV is an organic N exporter to the water column. He asks if the net is the mass balance around the tangier region itself. So SAV could be exported to the water column but could also be focusing organic matter to other areas of the bay like the deep trench right?
- Carl Cerco says yes this is possible but the primary release to the water column is in shallow water since that is where the SAV is. He is considering the segment as a whole and isn't concerned where organic matter goes after that. Down the road they will be able to see how SAV influences WIP 3 conditions and see how SAV influences DO or chl<sub>a</sub>. At the moment this is just a summary of flows averaged over CBP data.
- Lew Linker says it is good to work with small careful steps.
- Carl Cerco thanks Richard Tian and asks the group what they want to see from what Carl Cerco is doing?
- Lew Linker says we need confidence in SAV simulation for the next generation tidal bay model. On another level it's very interesting that SAV is a nutrient pump from the sediments. This indicates that SAV beds might have supported pre columbian primary

- productivity.
- Richard Tian says that we have a challenge in that we would like to assess the SAV criteria with model results or scenarios. But the criteria assessment of SAV is based on acreage, or area. He asks how are we confident that the model can simulate the area of SAV?
    - [Carl Cerco \(CarlCerco@outlook.com\)](mailto:CarlCerco@outlook.com) is not confident with that at all, this is a problem with the SAV simulations. For the calibration he inputs the area based on observations, he does not try to reproduce SAV area. He has an annual area of SAV. For the WIP he uses the expected SAV area under WIP conditions. With the WIP 3 run he uses the projected SAV area. WIP3 run vs calibration will have different areas of SAV but this is not predicted as it is input.
  - Niel Ganju asks how the model handles incomplete coverage of SAV over a grid cell. If one cell is de-vegetated are roots occupying all of the bare sediment?
    - Carl Cerco cannot deal with coverage that is patchy within a cell. It is an all or nothing approach for SAV coverage.
  - Dave Montali says W VA has a local algae problem and says someone proposed that rooted aquatic vegetation in a freshwater environment was acting as a sediment pump of dissolved P. This was potentially fostering filamentous algae growth. This seems to align with Carl's saltwater environment and asks if this is similar with freshwater?
    - Carl Cerco says he doesn't know why it would be different in freshwater but that he doesn't know for sure. This sounds like a reasonable hypothesis.
    - Dave Montali asks what mechanisms cause the SAV to pump N into water?
    - Carl Cerco says species and environment make a difference. At CB1 there is a big dieoff of *valisineria* every fall. He doesn't consider time in what he has shown today but would expect at CB1 there would be a large seasonality with a large release of organic N to the water column in fall due to mortality vs respiration. At CB7 he has *zostera*, year round, and would expect less seasonality which would cause changes to be due to respiration with mortality playing a smaller role.
  - With no other questions Dave Montali moves us on to the next presentation.

## 1:20 Analysis of Tidal Bay Nutrient Limitation based on the 2017 Bay Model – Qian Zhang and Richard Tian, UMCES

The importance of nutrient limitation to Bay Model calibration as applied to broad CBP policy such as the Watershed Implementation Plans (WIPs) will be discussed. A comparison between model estimates and bioassay observations and an examination of estimated nutrient limitation of key scenarios (e.g., No Action, WIP3, E3) will be described.

- Dave Montali brings up a point about Tish Robertson's presentation on increased reduction on nitrogen making the problem worse he thought of nutrient limitation.
- Qian Zhang says to Dave that he will not talk about tributaries, but instead will focus on the mainstem.
- Lew Linker references the four scenario matrix and, thinking out loud asks if with no action we have plenty of P and not much P limitation. Is that what this index is saying?
  - [Qian Zhang](#) is only considering the potential for each of the three categories. The scale is always from 0-1 and from aggregation you get a N, P, of a Light index which always sums to 1. The N index is close to 1 in the summer

- in the mesohaline region but the P index is .2-.4 most places in the bay and is very small.
  - Lew Linker tries to relate this to mgmt N index of 1 would be indicative of limitation and low index would be little limitation?
  - Qian Zhang says yes, his maps use 0.4 as a cutoff.
  - Lew Linker says that maybe under no action a low P index is because there is plenty of P around and little nutrient limitation, mostly light limitation from self shading. As we go to WIP3 we push down N and P and see the limitation of N and P correct?
    - Qian Zhang says especially P yes.
  - Lew Linker then asks with the forest scenario, what are we seeing with this white space? Limitation must be intense. How do we interpret that?
    - Qian Zhang was puzzled as well. P becomes less important but that N makes sense.
    - Lew Linker says it does make sense as things are more hungry for N as you move from no action to forest.
    - Lew Linker asks if in the forest scenario they are so hungry for N that there isn't enough algal demand generating the white space? He doesn't know and is spitballing.
    - Qian Zhang welcomes all experts' opinions but says this is what the Bay model results tell us.
    - Richard Tian says for N or P limitation it is relative when comparing which is lower so it may be tricky where we put the interpretation.
- Chat
- from Tish Robertson-VADEQ to everyone: 1:45 PM
  - Hi Qian, do your modeling results assume climate change?
- Lew Linker says generally this tells a story that as we push more down on a eutrophic estuary we see more nutrient limitation as we go to a WIP3 scenario we see more with N but also with P.
  - Qian Zhang says this is the strongest with the N moving left to right, the light index also shrinks more clearly with more nutrient controls.
  - Lew Linker says we should go to a modeling ad hoc meeting to interpret the last graphic's P index in forest white space. Most others make sense but the last window needs further analysis.
  - Richard Tian says we don't have anything for N P colimitation.
  - Qian Zhang says single N and P are merged to create the index.
  - Richard Tian says there may be change in N P co limitations between different scenarios.
  - Qian Zhang says we can easily do it in 4 rows not 3 rows without merging N and P indices.
  - Richard Tian says these are pretty maps but relatively harder to wrap your head around. The map would be better with an index if things were displayed differently.
  - Qian Zhang said he did contours based on category and how co limitation is defined, by a cutoff, so contours aren't giving the full description.
- Harry Wang says on the 2. WQSTM scenarios slide, why has the most left diagram got so much light limitation when the previous slide says something different?
  - Qian Zhang says the 1 monitoring data vs WQTSm is based on the calibration period the 2 WQSTM runs a no action scenario.



- Lew Linker clarified no action scenario run 1999-2000 and no action is taken in point sources other than primarily settling, no action taken in BMPs. Growth occurs with no management for nutrients.
- Richard Tian says nutrient loading for no action would be much higher than for the calibration data.
- Lew Linker says Harry's comment would be a base 1991-2000 scenario between no action, an intermediate nutrient step before WIP3.
  - Qian Zhang thanks everyone for their comments.
- Richard Tian thinks the next steps are to compare wet and dry years, this would be interesting.
  - Qian Zhang agrees and says this is straightforward to implement given the code they have created. It becomes a question of what is the most useful.
  - Richard Tian thinks for the middle one only 10 years isn't far enough apart. He has done scenarios for longer time periods which might be interesting to compare the longer term and short term data.
  - Qian Zhang agrees.
- James Martin comments on the differences between the E3 to forest steps. He says that moving from one step to another the natural assumption is that you are moving forward with a linear relationship regarding nutrients and that is not necessarily the case. He says looking at the loads associated with these scenarios it may allow you to explain the scenarios. This isn't the case but looking at loads for scenarios would be beneficial.
  - Richard Tian, Lew Linker, and Qian Zhang all agree.
- James Martin suggests finding a progress scenario where loading is approximately equal to what the loading was at time of monitoring and comparing model loading vs monitoring data at that loading rate. This would likely be between no action and WIP3 and provide a good comparison
  - Richard Tian says this is a good idea but observation is from 1992-2002 and calibration is from 1991-2000. The time period is similar but the calibration is a good approximation for this proposed result.
  - James Martin agrees this is good. He says the management area of interest is the area between no action and WIP3, particularly the WIP3 side of that continuum. If you do additional runs, find loads higher than WIP3 but lower than no action that is more representative of the bay we have today.
  - Qian Zhang agrees.
- Lew Linker says throwing in the base case, like the calibration then doing a 2020 progress to make up to date. Would those be chosen?
  - James Martin would choose 2010 and 2017 since those are significant dates. He would also include the calibration as well.
  - Richard Tian says a progress run for 2017 or 2019 would be between the calibration and WIP3 so this could do it.
  - Lew Linker says this is where we need to be, we have a pattern reflecting the changing ecology of the bay. This will allow management to move to a finer scale with perhaps a base case and 2017 run to go through nutrient reduction history.
  - Qian Zhang will talk with Richard offline.
- Dave Montali brings up a chat from Tish Roberston about if the modeling results account for climate change?
  - Richard Tian says no. He may do further analysis with climate change



scenarios but this data set does not include any climate change forcings. There may be different nutrient changes between scenarios but there is no accounting for climate change although there should be.

- Chat
- from Tish Robertson-VADEQ to everyone: 2:00 PM
  - Thanks, Richard
- Dave Montali moves us to the next presentation.

### 1:50 Potomac Tributary Report – Jeni Keisman, USGS

Jeni will present the *Potomac Tributary Report: A summary of trends in tidal water quality and associated factors, 1985-2018* which is the first in a series of important assessments on Chesapeake's tidal tributaries.

- Lew Linker adds Jeni's presentation will be related to his presentation on the next generation model. The tributary summaries will contribute to the multiple team approach for the tidal tributaries.
- Chat
- from Olivia Devereux to everyone: 2:06 PM
  - Trib Summary Reports are located here:  
<https://cast.chesapeakebay.net/Home/TMDLTracking#tributaryRptsSection>
- Lew Linker comments we want to launch tributary teams based on this format of what Jeni has done. This is a good start and reference point.
- Carl Freiderichs notices WRTDS isn't the reference for input to the Potomac tributary, why didn't you use this?
  - Jeni said we do, she only showed one figure of the RIM plus WSM loads. The factor section starts out with watershed synthesis from the USGS showing RIMS and WRTDS for each basin. This is in but was excluded for today's presentation to save time.
  - Carl Freiderichs says thanks

### 2:10 A Tidal Water Model for the Assessment of 2035 Climate Change Risk to the Chesapeake TMDL – Lew Linker, EPA-CBPO

The Chesapeake Bay Program requires a next generation model of the Chesapeake Bay tidal waters that is a state-of-the-science model of the Chesapeake using an unstructured grid. The new tidal Bay model, to be fully operational in 2025, is needed for the assessment of water quality standards under 2035 climate change conditions. An approach consistent with the STAC Next Generation Model Workshop Report using multiple tributary model teams, all using the same model structure and code, in conjunction with an overall integrating model of the main stem Bay and all tributaries will be discussed.

- Lew Linker says that he has a budget line for this year's budget but needs to fill it in with numbers.
- Carl Freidrichs asks Lew, when you say multiple models and whole bay models what do you mean? In a quote from Raleigh's paper it says individual models would be aggregated into a whole bay model. Is there one whole model? There must be tributaries? Am I misunderstanding something?

- Lew Linker thanks Carl and says tributary teams would work at a finer scale resolution but the whole bay model would include this info in coarser resolution too. If there was a need to keep the finer grid then could make a common boundary for tributary teams to feed the mainstem..
  - Carl Cerco says thanks, this sounds like the best of both worlds.
- Dave Montali opens to other comments.
- Lew Linker brings up the CBP which has big decisions which will be driven by the managers and asks where should the emphasis on tributary teams be placed? There will be a back and forth between practitioners and managers.
- Dave Montali brings up doing a water quality GIT call for what they might want or need for future models. He says the requests should be for both estuary and watershed models.
  - Lew Linker says yes and says we should also include the airshed model which Jesse Bash and his team work on. He says it would be good if we can direct these requests at all three.
- James Martin says thanks for the airshed model that's important. The WQGIT presented on using air reductions beyond the clean air act requirements as additional nutrient reduction credits towards WIP implementation credits. Having input from the air model is a good idea but will require good background or training for the team.
- Lew Linker says yes can put that together.
- Marjy Freidrichs who has been online with Carl asks if the whole Bay model would be schism with higher resolution along the coast line and lower resolution in mainstem. Would tributary teams use multiple different models like FVCOM, ROMS, schism?
- Lew Linker says this can't be the case since differences could be attributed to model differences not tributary differences. All of the tributaries must be done with a standard model. This same model would use the same state variables.
- Marjy Freidrichs says this makes sense. The terminology of multiple models was confusing, this would be one model, i.e. schesim (unstructured grid ) which would benefit from multiple teams working at different locations. This would allow for a much higher level of focus for each tributary team to work and compare results with the whole bay team and potentially help solve issues found in other tributaries.
- Lew Linker says this is a great point, in james river chla would be broadly applicable to other tidal teams.
- Marjy Freidrichs says this could help improve the entire bay model. They could have more info then would need for the whole bay model.
- Lew Linker says this should look familiar as the structure was presented by Marjy and her team to practitioners for the shared results for chester river simulation.
- James Martin asks Marjy how she feels about a timeline for having a new model ready by the end of 2024.
- Lew Linker says there isn't enough time. We won't get the model we want but will have what we can get done by deadline.
- Marjy Freidrichs says this is ambitious but is a reasonable goal. There are several good unstructured grid models employed for the whole bay now. Choosing which model we will use will be a big decision but thinks this is a reasonable timeline.
- Harry Wang thanks Lew for the plan moving forward. He thinks putting the water and airshed models together is a challenge. Does Lew have enough computational resources?

- Lew Linker does not know, he deals in tradeoffs. They will need to run the model in less than 24 hrs. There will be trade offs but they have to constrain these. RTP has a supercomputer but they are currently using cloud computing resources (amazon cloud). They would likely use the cloud to get resources needed to run the model.
  - [Harry Wang](#) agrees this is one way to do it.
- [Marij Friedrichs](#) envisions individual teams using their own computational resources since most teams have access to significant computing resources.
- Lew Linker agrees but wants practitioners to run on a platform which is the most comfortable to them. If resources aren't available then they need to think about what they can do to support these teams?
- Jeremy Testa thinks doing scenario runs with teams using their own resources would be a challenge to run finer simulation models. Where the tradeoffs are made and what the resolution of the tributaries are will be a big factor. He thinks it will be easier for tributary groups to examine finer scale trends with their own resources. If they are all using one model leveraging the community expertise will be much easier. He sees a small logistical challenge in getting teams up to speed on running the model on their own system, and there is a need for resources for tech transfer.
- Lew Linker thinks that is the most beneficial way to get everyone in agreement. Regarding scenarios this would always be on the integrated model, with lower resolution. This is because they are dealing with huge datasets. Tributary teams will provide insight and improve the overall modeling efforts for a good foundation to open the stage for decision makers to run scenarios which they feel are appropriate for the partnership.
- Jian Shen asks about the timeline and how they might want to engage the community to make a standard case to test the entire model..
- Lew Linker says once the RFA goes out and tributary teams are selected then it would be good to get together and collect ideas to act on together.
- Lew Linker comments that we need a meeting soundtrack.
- Dave Montali appreciated everyone's flexibility, and said that we need to find a way to talk more without rushing presentations. It might be beneficial to extend meetings for an hour. He again appreciates flexibility and opens up for final comments.
- Lew Linker says this was a great meeting and looks forward to the April meeting.
- Dave Montali ends the meeting.

### **3:00 ADJOURN**

#### **Day 2 Attendees:**

**Carlington Wallace, Scott Phillips, Robert Burgholzer, Andy Stoddard, Lisa Beatty, Gregorio Toscano, Lee McDonnell, Jeremy Testa, Karl Berger, Rebecca Murphy, Dave Parrish, Jian Shen, Nicole Cai, Harry Wang, Bruce Michael, Qian Zhang, Guido Yactayo, George Onyullo, Peter Tango, Gary Shenk, Bill Ball, Richard Tian, Carl Friedrichs, Neil Ganju, Xia Xie, Jeni Keisman, Hassan Mirsajadi, Larry Sanford, Mark Bennet, Kyle Hinson, Carl Cerco, Gopal Bhatt, Dave Montali, Isabella Bertani, Tish Robertson, Arianna Johns, Norm Goulet, James Martin, Bill Keeling, Jesse Bash, Cassandra Davis, Mukhtar Ibrahim, Jim George**

**Alex Kua, Clifton Bell, KC Filippino, Olivia Devereux, Lew Linker, Breck Sullivan**