Modeling Workgroup Quarterly Review

April 6, 2021

Event webpage:
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9:00 Announcements and Amendments to the Agenda – Mark Bennett, USGS and Dave Montali, Tetra Tech

- **Dave Montali says we should plan for getting feedback about the new longer break format for quarterly meetings. He says we have taken day 1 for the watershed and day 2 for the estuary. Longer break format designated discussion periods. We also want feedback on future meetings assuming covid eases up.**
    - **Lew Linker says May 5th is when abstracts are due for CERF (virtual meeting. The Chesapeake region is hosting CERF.**
    - **Dave Montali says there is also a planned one day meeting in May to discuss any topics from this meeting. Today we will start with Gary on a timeline for phase 7 model development.**

9:05 Overall Development Plan for Phase 7 WSM – Gary Shenk, USGS A plan outlining the tasks, sequence, timing, critical paths for the various tasks of Phase 7 CAST, CalCAST, and Dynamic Model for a fully operational model by December 2023 will be presented.

- Gary Shenk talks about getting to the end 2023 with an operational phase 7 model
    - Gary Shenk mentions the goal is to DELIVER Partial crediting of BMPS with a finer scale phase 7 model.
- Olivia Devereux says for CAST 7 they will create an interface to see loads and make selections with maps down to the NHD scale. This will be on a web interface but you can

make it interactive at that scale.
    - Gary Shenk says we are fortunate inputs are in at NHD scale ALREADY so they don't have to disaggregate them.
    - Olivia Devereux says they are working with NAS to make the interface usable on the web.
- *CHAT*
- *from Norm Goulet to everyone: 9:23 AM*
    - *Conservancy is generating high resolution hydrography flow paths, how will that product compare to the NHD100?*
- Norm Says this will be talked about later this afternoon he will wait.
- *from Kristin Saunders to everyone: 9:27 AM*
    - *Do you plan to ask the other goal teams what priorities they have for Phase 7?*
- Gary Shenk says this isn't on their radar. They have teams working on those science priorities and we are talking with them at meetings. It would be worthwhile to reach out and tell them.
- *CHAT*
    - *from Kristin Saunders to everyone: 9:32 AM*
    - *It's really important - they have been asking to be included and consulted in the model, and this is the next opportunity to really make good on that request.*
    - *from Kristin Saunders to everyone: 9:32 AM*
    - *I am happy to help you*
- Gary Shenk will get on the schedule and talk to them.
    - Kristin Saunders will help get started.
- Gary Shenk says new phase 7 model will have 3 levels (smallest to biggest)
    - Fine scale
    - Management scale
    - Seasonal and flow scale
- James Martin asks what will the calibration window be? Is there value in making this more modern from a climate change perspective?
    - Gary Shenk says 1985-2014 was the window last time and he will extend this to 2020 now that the calibration is to have long term data available .There are issues with hydrologic and critical periods relevant to climate change.
    - James Martin says these should be in play so we should consider making this part of the update. If using a calibration window 85-20 how much is the effect of climate change confounding calibration or to what extent is climate change affecting the model? should we narrow the calibration period to a more MODERN period?
    - Gary Shenk says he needs to think about that more closely. His initial reaction is that a longer calibration time allows them to use Isabella's analysis and more time to compute trends making them better off. It brings up important climate change questions, most relevant is the critical period. The hydrological averaging period might modernize inputs without modifying TMDL actions but that's a bigger conversation.
    - Lew Linker says that's something to think about. Right now, they use the 1993-1995 critical period to compare to previous work done. If we change hydrology this will shove loads around, such as carrying capacity which is impacted by the 1993-1995 hydrology. THATS BEYOND MODELING WG decisions. Wet and dry years sway things MUCH more than long term climate change influence.

Weather is a bigger determinant than climate change when calibrating.

- Mark Bennet agrees with Lew's comment and says climate over time isn't a long-term linear trend. It's an increasing sine wave. By shortening the period, you can artificially reduce multi decadal cycles.
- James Martin is fine keeping 1985-2020 for the hydrologic period. We NEED to understand how much of climate change is baked into that calibration process and how much needs accounted for with separate processes. It will have to be accounted for in some way. He says modelers are more sensitive to critical period and TMDL then he is. As we approach 2025 it will be a critical time to update this to better reflect a newly accepted critical period.
    - Gary Shenk says the CRITICAL period is defined at 1993-1995 3 yr. period of a wetness cycle. The average condition is over 10 years. It's not necessarily choosing something more modern but something WETTER to account for climate change. The QUESTION IS TO EITHER KEEP CLIMATE change separate or put it INTO THE CRITICAL period?
    - Lew Linker says this is a BIG PROGRAM decision to adjust fundamental TMDL elements.
    - James Martin says he agrees this is an up-chain decision BUT doesn't know many people who understand the issue or how to discuss the question, so the partnership needs the Modeling WG's advice to introduce the issue for partnership decision.
        - Lew Linker hears an invitation for Gary Shenk to the WQGIT.
        - James Martin says he might just go to PSC and skip others.
            - George Onyullo agrees with James Martin's comment.
            - Lew Linker agrees but wants others to be on the same page before going to the PSC, whatever we agree to we can do.
- Lew Linker says they will eventually have hydrology set up for downstream estuarine tributary teams. They will use phase 6 loads initially but moving into late 2022 it might be wise to use updated hydrology, nutrients, sediments as available to increase the ability to work with FINE SCALE embayment's. He wonders if splitting inputs of Phase 6 and 7 inputs together would be useful?
    - Gary Shenk says they would benefit from getting things sooner but can't mix flows and sediment from two different models.
    - Lew Linker agrees and wants to look at this to see how we might move forward regarding concentrations and loads to see how different they might be.

9:45 Phase 7 WSM Development – Gopal Bhatt (Penn State), Gary Shenk (USGS CBPO),

The presentation will provide progress updates on last Quarter's development of Phase 7 fine-scale distributed hydrology and water quality model of the Chesapeake Bay watershed at NHD100k catchment scale. Plans for further development over the next several quarters will be discussed.

- *CHAT*
- *from Olivia Devereux to everyone: 9:53 AM*
    - *What are your thoughts for eventually converting to NHD-HR? I know some within USGS are going that direction. It is possible that it would too strongly covary with the land use given the county scale of much of the data.*
- Gopal Bhatt says his opinion is that the finer the better but NHD 100 scale appeared to

be a medium resolution keeping the computation of the dynamic model down. Putting together the Dynamic model will give him a better sense of the scale they can go too.

- *from pclagget to everyone: 9:54 AM*
    - *For Phase 7 land use, it would be useful to intersect the NHD catchments with county boundaries and extend the domain to all intersecting/adjacent counties to ensure accurate allocation of county-level data to NHD catchments.*
- *from pclagget to everyone: 9:56 AM*
    - *How will smaller streams (1:2000 scale) be treated in Phase 7?*
- *from Greg Noe to everyone: 10:00 AM*
    - *Streams smaller than NHD 100K are very important for sediment source modeling*
- Gopal Bhatt answers Peter and Greg saying NHD 100k reach is just a skeleton for the model but does not preclude us from inducing finer scale information. Stream density allows to incorporate stream density which can be used even with NHD 100 scale.
- *from pclagget to everyone: 10:04 AM*
    - *How are you accounting for the portion of NHD streams flowing through tidal wetlands? Should they be excluded from the watershed model domain?*
- *from Bhanu.Paudel to everyone: 10:04 AM*
    - *@ Gopal: Are you continuing to model hydrology and edge of the stream load (nut and sediment) for the entire counties that intersect the Bay?*
- Gopal Bhatt answers that it is true, they have land uses for entire counties so they simulate for the entire county, portions outside watershed are not part of the watershed.
- Bhanu Paudel says thanks.
- Olivia Devereux asks if this is change she says she thought we had this already?
- Gopal Bhatt clarifies if we have EOS loads for counties touching the bay they will have EOT. For counties outside the watershed, they won't have an EOT load.
- Olivia Devereux asks if they will still have an EOS load?
- Gopal Bhatt says yes but won't have anything to calibrate to.
- *from Joseph Zhang to everyone: 10:04 AM*
    - *Do the hydrologic models include groundwater effects?*
- *from Lew Linker to everyone: 10:18 AM*
    - *Yes Joseph, there will be an estimate of groundwater and surface inputs from Phase 7. We'll need some decision rules where Phase 7 interflow and groundwater are introduced into the sigma layers of the tidal Bay model.*
- *from Joseph Zhang to everyone: 10:23 AM*
    - *Fantastic, thanks Lew!*
- Gopal Bhatt says YES the dynamic model has both surface and groundwater. CalCAST with a time averaged model separating these further would be the plan to draw upon the data to inform the dynamic model partition of surface and groundwater.
    - Lew Linker expands that in the 2017 midpoint assessment surface and groundwater interflow for Phase 6 was used but top layer estuarine model all this water was added to the surface area. WITH A NEW unstructured grid, they cannot distribute this water differently to the estuary and will need decisions to be made on.
- *from Joseph Zhang to everyone: 10:06 AM*
    - *@Peter C.: estuarine model can handle tidal wetlands also.*
- *from pclagget to everyone: 10:07 AM*
    - *Is the stream execution sequence equivalent to stream "magnitude", and not*

"stream "order"?

- *Gopal Bhatt says that's exactly the case they avoid stream order as they have established meetings.*
- *from DAVE.MONTALI to everyone: 10:11 AM*
    - *What is the smallest stream order for which there is a USGS gage and how many of those do you have?*
- Gopal Bhatt says he doesn't have an answer for this but there are several stations that are finer scale then stream reaches, they are in a catchment off a reach. For now, they are trying to use all the available information, even smaller scale monitoring data for calibration. He can get this information but this will take a little time.
    - Dave Montali thinks when fine tuning the calibration, half of segments being first order you might be able to compare this to observational data with gauges on these small segments. It sounds like they do have these right?
        - Goal Bhatt says yes it will be good to investigate further as density will change as they understand increased resolution of streams by 80-fold but calibration stations increase by only 2-fold. This will have sparse monitoring stations at small scale but there will be some.
- *from BillK to everyone: 10:23 AM*
    - *Will manures and fertilizer still be handled at the county scale?*
- Gopal Bhatt defers to Gary and Olivia
- *from Olivia Devereux to everyone: 10:37 AM*
    - *@BIll K. Fertilizer data comes in for the entire Ches. Bay Watershed and is apportioned to states/counties. That is not expected to change substantially.*
- *from Olivia Devereux to everyone: 10:38 AM*
    - *BMP data still comes in at scales between state, HUC8, county and sometimes lat/long. Most BMPs are at county scale.*
- Gary Shenk says they won't have dramatic improvement that's based on decisions from the WQGIT and Ag Workgroups.
- Bill Keeling says he doesn't understand how valid loads will be at finer scale then current data.
    - Gary Shenk says it's reasonable to think this but load from any point on the watershed is a product of mgmt. and ability to deliver that load. It won't make progress on what happens with that field. If they make progress on the landscape ability to deliver loads then this can inform tools to say that areas are leaky or retentive. This is a first step to get Landscape delivery right to incentivize landscape information at these locations.
    - Bill Keeling says manure and fertilizer are NOT managed at county scale.
    - Gary Shenk would love better info but we have what we have.
    - Gopal Bhatt says its double edged with high resolution info having uses but there will be some issues that aren't fully addressed. He reminds us that we will have ability to upscale and hopefully downscale based on external information. That option will be there.
    - Bill Keeling asks if anyone asked for consolidating land uses? If you use census at county scale you artificially create bias for land uses.
    - Gary Shenk says he shares that question when creating phase 6 simplified watershed delivery and agricultural modeling the subcommittee went the other way with inputs and land uses. With complex model increased uncertainty in output the WQGIT build complex farmer behavior and land use models. Many

issues we have approaching CAST 2021 have to do with unintended consequences from those models. IT'S NOT UNDER the Modeling WG to decide land uses. He would love to simplify the model for farmer behavior.
    - Dave Montali asks if we have time to do that? If those groups would consider simplification? When would we need it?
    - Gary Shenk says it would simplify things for the Modeling WG but doesn't know if they'd have time.
    - Olivia Devereux says it would simplify inputs since most aggregate agriculture uses. Doesn't know why we need all of them and no issue with simplification. Just a question of if AG WG wants to do this.
    - Lew Linker says with the need to respect deadlines hydrology will be done by the end of 2021. He thinks with a fine scale resolution difference between fertilizer county to county would make a difference. Knowing where those areas of difference are is a BIG deal even if it is more uncertain.
- *CHAT*
- *from thtesler to everyone: 10:45 AM*
    - *Crop aggregation addresses full season soybean concerns...*
- *from Norm Goulet to everyone: 10:36 AM*
    - *How will the nutrient calibration be handled with this fine segmentation with BMPs for the most part held to county level*
- *from Lew Linker to everyone: 10:37 AM*
    - *If we use a more detailed PET estimate like Penman-Monteith and we make it a function of land use will we need to have growing seasons for crops and deciduous-evergreen splits for wooded areas? Do we already have this info from CAST or other sources?*
- Gopal Bhatt says seasonality will be an essential issue for assembling dynamic models that needs to be examined. They might do a base adjustment for seasonality. A second point is the importance of land use in driving hydrology. This exercise shows this is critical. They need to separate deciduous and evergreen forests.
    - Lew Linker says we have an estimate for HSPF for interception storage; it's only at the county land segment basis that's good going forward.
    - Peter Claggett can do that but needs a list of stuff to do. They can be more specific to capture these differences but NEED TO KNOW WHEN AND THE SCALE.
    - Lew Linker says evapotranspiration storage, interception storage, dry deposition storage for Jesse and Sarah
- *from Guido Yactayo to everyone: 10:38 AM*
    - *baseflow partition or portion is usually derived from observed streamflow time series, how is baseflow partition handled in rivers without monitoring?*
- Gopal Bhatt says they are targeting land use related inputs and watershed (WS) characteristics to get better calibration for base load only at monitoring stations. This is all driven by high resolution information. That will bridge between areas monitored vs those that aren't. It will use common data across the WS and gauged regions will inform the ungauged regions.
- Lew Linker asks how we will take out drainage areas that drain into impoundments and stormwater management and place them as BMPs? With impoundments - stormwater would have affected the area. For Flow and S N P they might establish decision rules to determine how much is discharged from small ponds. Does that make sense?

    - Goal Bhatt says yes. They need to ensure no double counting of natural or management influences for the same features. He's excited that they can capture the influence of these features within the watershed with GIS information, Peter Claggett will talk about these later. This can determine how hydrology is modified from there.
    - Lew Linker likes this and asks if they will need to add evapotranspiration from HSPF for these features for phase 7?
    - Goal Bhatt says yes they will add these averages to the time averaged model and disaggregate for the dynamic model. They will need NEW calibration routines for disaggregation effects on features.
- Peter Claggett asks what portion of streams not accounted for are within tidal wetlands?
    - Gopal Bhatt says this is a flaw in the tidal calculations since the domain used does not include wetland area in it. So, they should combine tidal water and tidal wetlands to get tidal estimations. They might do this by redoing the exercise with better information with a hybrid of tidal water with the addition of land use and cover information targeting tidal wetland areas as well.
    - Peter Claggett agrees and will follow up with this offline.
    - Lew Linker says we need a clear boundary for tidal and watershed domains.
    - Gopal Bhatt says to put this together the model structure allows to add revised information quickly as the changes are anticipated.

11:00 Comparison of Modeled and Monitored Nutrient Trends – Isabella Bertani, UMCES and Gary Shenk, USGS-CBPO

An appropriate comparison between the output of the Phase 6 Dynamic Watershed Model including lag times and flow normalized loads from WRTDS including the accounting for droughts will be presented.

- Isabella Bertani uses regression trees which group data based on responses to response variables. (machine learning)
- *CHAT*
- *from Denice Wardrop to everyone: 11:24 AM*
    - *Why are trends selected as the response variable, and not load at a specific place and time?*
- *from Denice Wardrop to everyone: 11:25 AM*
    - *Trends are a management question, while load is an ecosystem question*
- *from Gary Shenk to everyone: 11:26 AM*
    - *@Denice. That's right. Anthropogenic trend in load is the prediction of interest for the TMDL. Gopal's work will optimize on spatial loads.*
- *from Denice Wardrop to everyone: 11:27 AM*
    - *thanks*
- Lew Linker wants to expand on Denise's question about trends vs load as the response variable. He asks could this particular analysis be used for loads not within WRTDS with loads added as a concentration flow at an area vs a continuous time series? Would these look different and is there merit to investigating this?
    - Isabella Bertani says they might look different. Her current focus on

trends is the management question. She would like to NOT use trends. They will stick with a measure of trends, change over time, but are open to different ways to estimate differences between two trends. All response variables looked at so far have shortcomings and it's difficult to compare vs absolute trend values which would be easier.
    - Lew Linker asks would it be worthwhile to examine trends and then loads from observations? One answer is no since you would have 1 to 1 relationship for trends. Lew Linker opens this up to the group but we will continue the current path.
    - Gary Shenk has talked about Isabella's work and its job to inform predictions about management. This is a big event but we can use the techniques to help with spatial calibration for CalCAST. Lew is bringing up temporal aspects. Gary says they can probably do this if they have the time.
    - Lew Linker defers to Denise Wardrup.
    - Denise Wardrup says CART is a wonderful exploratory tool and she likes the idea to analyze trends with it. If you found effects and went to the specific time period and used CART you could see what the model assumes important processes are. Would allow us to see if the model misses an important variable at a specific time. She thinks using a 1 2 approach is good.
    - Isabella Bertani mentions they want to use this tool as an exploratory tool and then dig deeper. Then they might dig into loads vs trends and processes that are simulated. There will be a second step with results to determining why results give what they give in terms of results.
- *CHAT*
- *from Greg Noe to everyone: 11:32 AM*
    - *I may have missed it, but will you also try to predict WRTDS trends, and not just the discrepancy of WRTDS vs. CAST? That could generate interesting insight into observed system behavior.*
- Isabella Bertani says she doesn't think this will be a part of this project but Qian Zhang is working on a similar project using these techniques on WRTDS trends to try and cluster similar stations and relate these clusters to explanatory variables to describe watershed properties. They might cross paths but her current work is not going to tackle this issue.
    - Greg Noe says this makes sense and says following on Denise looking at loads might not be as productive. Denise's point in shortcomings of existing model approaches with nested domain driver influence is VERY important. He agrees this 1 2 approach is useful.
    - Lew Linker says the direction taken is a comprehensive decision not just Gary and Lew. Lew adds that this was a good presentation which will be added to the July Quarterly.

12:00 BREAK

1:00 Optimization Update: Development of A Memetic Algorithm for Large-Scale

Watershed Optimization – Gregorio Toscano, Kalyan Deb, and Pouyan Nejadhashemi, MSU

In large-scale optimization problems it's challenging for evolutionary algorithms to converge quickly to promissory regions. However, local search with gradient information is a powerful tool that enables fast convergence. The presentation will present the considerations and building blocks of a memetic algorithm that uses a genetic algorithm for coarse search and an interior-point-based method for local search to solve large-scale non-convex watershed optimization problems.

- Gergorio Toscano, Sebastian Hernandez, Kalynmoy Deb all co present
- *CHAT*
- *from James Martin to everyone: 1:14 PM*
    - *I would not say never...inefficient BMPs may be preferred in some cases, high co-benefits for example*
- Kalyan Deb says they've done work now SPECIFICALLY based on N loading.
    - Gregorio says N was it yes. He says they will add an additional dimension which will make co benefits present.
    - Kalyan Deb says all benefits are considered in the future so they won't be discarded.
- *from Gary Shenk to everyone: 1:16 PM*
    - *Is dominance determined at run time? I'm thinking of an instance where efficient BMPs cannot be implemented for policy reasons. In a future application, could a user provide constraints?*
- *from Pouyan Nejadhashemi to everyone: 1:19 PM*
    - *@gary: Yes, we can define constraints*
- Kalyan Deb says this will be done online or once at the beginning. He wants to fix the problem, solve it then create a dynamic version of the problem.
- *from BillK to everyone: 1:17 PM*
    - *What about using load source groups to reduce the variables? Like all the various cropland load sources lumped into cropland.*
- Bill Keeling says no one used load source groups as they were but lumped them together.
- Kalyan deb says will consent group to make sure they don't eliminate without consensus.
- *from Pouyan Nejadhashemi to everyone: 1:21 PM*
    - *@BillK: Are you asking this as one approach to reducing the number of variables?*
- *from J. Sebastian Hernandez to everyone: 1:22 PM*
    - *@James Martin: Yes, in the filtering approach we can also consider co-benefits to keep those BMPs. In this presentation we showed an example considering removal efficiencies and cost, but additional criteria can be included.*
- *from James Martin to everyone: 1:22 PM*
    - *Would there be any value in having individuals with local knowledge review the initial optimization runs in the counties you listed to see if the BMPs selected are appropriate?*
- Kalyan Deb mentions Gregorio is in the US and will he in MD maybe by the end of the month
- Lew Linker says this summer we expect to have face to face meetings so the timing is

good.

- *from Pouyan Nejadhashemi to everyone: 1:25 PM*
    - *@Martin: Would there be any value in having individuals with local knowledge review the initial optimization runs in the counties you listed to see if the BMPs selected are appropriate? Yes, this is going to be a part of the process*
- *from James Martin to everyone: 1:27 PM*
    - *There will also need to be constraints to limit the amount of land conversion BMPs on agriculture*
- Lew Linker asks if when running the first optimization work they had some success involving the community looking at different results under different scenarios? There were insights provided then optimization costs were calculated. He thinks it would be illustrative.
    - Bill Keeling says they went public and planned at a non-county scale. If they make an optimization different then the public puts forward. He asks how do we reconcile that with the public?
    - Pouyan Nejadhashemi says the optimization is based on seeing if it can increase resolution, NOT specific questions for groups. They can go all the way to parcel level. Results can be generated at parcel level and can aggregate from there.
    - Kalyan Deb says they just give cost values and loading values, then based on these they see what's efficient. If the public wants things they can be added as hard constraints into the system even if inefficient. The question of doing optimization without users then the public wants something different they must be defined as to why the public might want them. They are not fixed on something they are flexible and develop algorithms based on feedback. It's possible for the algorithm to incorporate the community.
    - Pouyan Nejadhashemi says public input can make the issue easier since it places limits on what the model can do to optimize.
    - Gregorio Toscano says they are considering adding user preferences so they can map these opinions and tweak the optimization with preferences to give them the best the BMPS
- *CHAT*
- *from James Martin to everyone: 1:34 PM*
    - *We should also think about the transferability of the algorithm to the P7 model*
- *from Kalyanmoy Deb to everyone: 1:34 PM*
    - *Local knowledge would be absolutely vital for creating our initial solutions for optimization. In fact, we shall try to understand the essence of local solutions and create our initial solutions.*
- *from Norm Goulet to everyone: 1:34 PM*
    - *There will always be constraints that you will not be able to model such as the political decision-making process.*
- *from Pouyan Nejadhashemi to everyone: 1:38 PM*
    - *@Norm Goulet: Yes, this is correct and they will be considered.*

1:30 High-resolution Landscape Characterization to inform Phase 7 CAST, CalCAST and Dynamic 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 talks about products for land use information to inform the CBP Phase 7 model.
- Peter Claggett says his GIS data maps acreage of farming might be better than current agricultural acreage data census maps.
- *CHAT*
- *from DAVE.MONTALI to everyone: 1:46 PM*
    - *Is pond count also influenced by incorrect water (i.e., shadows classed as water?)*
- Dave Montali asks if misclassifications with water are counted?
    - Peter Claggett says if an area with large error or systematic error or a general error is found in the county review they'll be fixed by December.
    - Dave Montali says these ponds must be inflating pound counts.
    - Peter Claggett says that's true in some cases, in others not so much. In Baltimore Co. there are a lot of ponds but they are stormwater ponds built from the 1990s to today. They generally are finding a lot of ponds not detected in other datasets and result from stormwater laws in developed counties. These are again not seen in NHD or NWI datasets.
- James Martin says in Loudin county there are low pond counts but high development. What's driving this? Are other products dated?
    - Peter Claggett has no answer. They are still investigating that.
    - Norm Goulet says might be seeing the disappearance of Farm ponds in the Western side of Loudin county, as it's developed they are getting away from ponds for SW development so that could explain some of it.
    - James Martin is concerned about the plan for use of these products in Phase 6. Maybe he'll leave it to Dave and Lew for a different meeting or asks if he can touch in it today?
    - Dave Montali says James can make his point.
    - James Martin says they are making edits vs methodological changes for updating what will go into CAST 2021 with detailed edits for later products.
        - Peter Claggett says edits for VA will be done in May, he can't guarantee major edits will be done in those counties, they are having fewer systematic errors. For the most part the differences between June and December work will be locally reported areas which will be fixed. That takes a lot to manually correct and will be done over the fall. They will alter tidal wetlands mapping by updating those. U university of Vermont will map potential wetlands in forested areas for VA, WV so potential wetlands won't be in until December, but this makes no difference to loading. It might also be different in hyper-resolution hydrography, which he wouldn't recommend using immediately. Streams are mapped differently in Phase 7 rather than Phase 6 so using these new streams for

Phase 6 doesn't make sense. It will matter for Phase 7 when they are accounted for.
        - James Martin says he didn't see 60 land classes and wonders how they translate into older land classes?
        - Peter Claggett says they translate into the original 13. These will be mapped differently so the partnership can choose how to alter how change is portrayed from 2013-2014.
        - Gary Shenk says it's not explicit in Phase 7 plan how all this new information will be used. He says they haven't seen data on these extra streams yet. They want to understand how these affect nutrient transport and build that into the models. In the 10 m static model he is thinking about the new attributes Peter is mapping but is doing so without knowing how to connect them yet.
- *CHAT*
- *from Lew Linker to everyone: 2:00 PM*
    - *Q for Gary & Gopal & Peter. The floodplain can be an important feature to attenuate or in very high flows increase loads. Will we use the floodplain data to adjust the P7 F-tables? What is the timing of the product?*
- *from pclagget to everyone: 2:06 PM*
    - *Floodplain mapping will be worked on in 2021 and 2022, and hopefully done by 2023.*
- *from Gopal Bhatt to everyone: 2:06 PM*
    - *Lew, the last slide that Peter showed for the floodplain appears to be very promising and a great opportunity for a high-quality F-tables.*
- *from Lew Linker to everyone: 2:07 PM*
    - *@ Gopal and Peter: Sounds good, thanks.*
- James Martin says the principal concern is the idea of using a change product for 2013-2017 going into CAST vs updates using the best science available for land use data aggregated to the same land use groups. He's heard they will use the best land use data and now hears land use change 2013-2017 being used to update existing land use for base conditions for CAST. He's uncomfortable with this and wants the modelers to discuss the topic.
    - Gary Shenk jumps in asking if the question is what's the most accurate land use? The answer to this is the new product. For the question of using information for this with TMDL. turns to what is most accurate measure change for land use since 1995. NEED trend in land use represented in order to work with TMDL. since phase 6 have used 2013 land use and back calculate from 2013-1995. Have data from 1995 to create change to 2013. Want to use the anchor point of 2013 to measure CHANGE in land use from 1995.
    - James Martin asks why they don't treat ag census data points the same way?
        - Gary Shenk says they don't use industry data directly, they use change products from census data.
- *CHAT*
- *from Lisa Beatty, PA DEP to everyone: 2:08 PM*
    - *Can CBP create a graphic to visibly show the timeline that includes:*
    - *• When deadlines for each product was approved by the partnership*
    - *• Definitions of products and their data sources*
    - *• Timelines for raw data collection and finished products for CAST 21 or*

CAST23
    - *• Include what geographical areas will be in included for these products CAST 21 and CAST23*
- Bill Ball says to James Martin that he didn't see a difference between best available data and change products. If they use a change product and want to correct to 2017 to map corrections used then putting in corrections doesn't that give you 2017 data? What's the difference?
    - James Martin says the change product is new 2017 land cover and a 2012-2013 rerun with the same method as 2017. The change product isn't based on the original 2013 land cover in the model.
    - Peter Claggett says it's all part of the adaptive management attempt for using the best available data. The change right now is very precise and is about 1%. They are not seeing swings that census reports so change will be taken from high resolution data. They might get different crops but have the same footprint. This will allow us to refine data to land use over time.
    - James Martin appreciates Gary's point to keep a smooth transition from 1995-2025 but in terms of the application of the model aren't we best served by representing today through 2025 being as accurate as possible?
        - Gary Shenk says that changes question, change vs absolute value is different. Different versions of CAST have components added as change products. IF they did not they would need to go back and change the 1995 loads and alter the whole model. It is approved to add new features but if they used absolute values and changed these you can't use the model.
- *CHAT*
- *from Norm Goulet to everyone: 2:14 PM*
    - *Current schedule still does not include a local jurisdiction review of the final Land Use. Land cover is only being reviewed.*
- *from Lew Linker to everyone: 2:16 PM*
    - *Q for Peter, Joseph, Nicole, Richard and other estuarine modelers: Peter will provide MLW or some other absolute delineation of the separation between the watershed and tidal Bay model. Tidal wetlands will note be simulated in the watershed model but their area will be estimated in the NHD100 segments for the tidal model to simulate. Is everyone ok w/ that?*
- *from James Martin to everyone: 2:16 PM*
    - *And no review of the revised 2013 or the resulting change product*
- *from karl Berger to everyone: 2:17 PM*
    - *Even if Gary is right in how we apply the new land use numbers, it will still help for public acceptance to see what the totals actually are under various ways of incorporating the data.*
- *from pclagget to everyone: 2:18 PM*
    - *Norm- that's true. We can't have a county-level review of the land use for all counties because it's a classification based on decision rules and if one county's concerns result in a rule change we'd have to make the change and reissue the data for a second round of review. This could result in an endless round of local reviews.*
- *from Norm Goulet to everyone: 2:18 PM*
    - *@Peter, I understand but I can't sell it*
- James Martin struggles with this as well since when people look at the model since they

want to see it represents actual land use not a continued representation of land use. This has been hit by locals who don't think the model is an accurate representation of on the ground land use. This is hard to sell.

- Gary Shenk says this has been a hard rule for 2 decades. If it breaks now then it will open the floodgates on what the model is useful for and how crediting is assigned.
- James Martin says they can add 2017 data and leave out 2013, change from 2013 to 2017 would represent a change in land use based on incorrect land use assumptions but give 2017 data point that's as good as information that is available.
- Gary Shenk says they can't see a way back out of that principle of change products. He suggests they continue to talk later.
- Dave Montali says we won't solve this problem. We can live through until phase 7 and deal with later it's a WQGIT issue anyway.
- James Martin remembers Peter went to MB to talk about continued discussion for finding land uses and they agreed. He wonders if they realized future data points won't be in phase 6 or 7 model but change products will be used?
- Peter Claggett says we need to discuss this for a later model, his understanding was they will be used in Phase 7. HE can go through the entire history from 1995 with complete coverage of 1 meter resolution data and will be a problem for a short period. This will be solved after 2021.
    - James Martin says 2021 products need to be waiting for phase 8
    - Peter Claggett says can be designed then tack on 21 through 25 when it comes.
    - James Martin doesn't understand but this would be good.
- *CHAT*
- *from Joseph Zhang to everyone: 2:21 PM*
    - *@Lew: overlapping between models for tidal wetlands is fine, as long as CBPO knows where to look for results. We had the same discussion with National Water Model folks as our model overlaps with NWM.*
- *from Norm Goulet to everyone: 2:22 PM*
    - *At what point do we catch up to reality?*
- *from Lew Linker to everyone: 2:24 PM*
    - *@ Joseph: Yes, that sounds good. Just as long as everyone understands this is how we'll be doing the watershed and Bay model hand-off of the simulation of loads.*
- Lisa Beatty says her post at 02:08pm wasn't answered.
- Peter Claggett says this is something that needs collective work but thinks this comment is prompted by confusion over new lidar data for PA being released but not being able to use for CAST 21. He responded to comments on this with different spreadsheets. Thinks would be helpful to work on but would take several weeks to develop.
- Lisa Beatty says defining products with data sources can help them provide data. It's just ambiguous when it is named at different times in different ways. Would be helpful to everyone if things were clarified. She wants a clear picture of overall products of this with data sources timeline etc.
- Peter Claggett says he will work on this.
- Dave Montali checks in with Lew on the topic.
- Lew Linker says it's been addressed and Peter will decide where delineation occurs between WSM and Estuarine, Tidal wetlands will be simulated by tidal bay model, they now have an empirical approach for this.
- Dave Montali asks for more comments.

- James Martin says to Peter Claggett that VIMS has a tidal wetlands data layer for VA which can be added to his data as well.
- Peter Claggett has seen this and he understands it is in the national wetlands data set and still has some gaps that he can talk about later, some of those gaps can be valid. If he used NWI but compliments this with 1 ft of SLR emergent vegetation it seems to be a better more consistent product.
- Lew Linker says this sounds good.
- *CHAT*
- *from pclagget to everyone: 2:32 PM*
    - *@Karl, we should be able to produce a comparison between the CAST-21 land use based on incorporating just the change vs the mapped 2017 land use data.*

2:15 Plans for CMAC Refinements, Tracer Runs, and Phase 7 Scenario Support – Sarah Benish and Jesse Bash, EPA-ORD

A "scenario library" of Chesapeake Airshed Model Scenarios will be developed over the next three years for Phase 7 Watershed and Bay Model development. The Airshed Scenarios will include 2010, 2017, 2025, 2035, 2050, and perhaps a future low carbon/NOx emission scenario. In addition, new work on an updated and improved estimate of the transport and fate of atmospheric emissions of oxidized nitrogen (NOx) and ammonium (NH_4^+) will be presented. The analysis centers on the question, "For a nitrogen emission source from different regions in the Chesapeake watershed, what is the fraction that is deposited to a particular region or point?"

- Lew Linker says it's great to see this progress and asks if the CMAQ domain for the Bay runs includes coastal ocean atmospheric deposition?
- Jesse Bash says yes the domain will be the same size as before but will use an updated model version and have greater detail for nutrient deposition, including tall vs short vegetation vs open water.
- Dave Montali asks what is the background vs other condition?
- Sarah Benish says the background is from running up the model vs the other category which does not track emissions.
- Dave Montali asks if others are in the airshed and the background is influenced outside that?
- Sara Benish says this depends how regions are defined the airshed would be its own region and anything outside of this would be in OTHER category.
- Dave Montali says if you select regions to trace within an area then you can trace sources. He asks if the gray areas outside specific regions but within the regions of the airshed are other?
    - Sarah Benish says no. The airshed will be tracked as the airshed region. It will look like WV but everything outside the main regions and airshed will be considered other.
    - Lew Linker says emissions from the Chesapeake Bay Watershed end up with 50% of what comes up comes back down. The airshed excluding the watershed accounts for 25% of atmospheric deposition. Everything from CMAQ in the USA minus the watershed and airshed another 25% comes from that. By expanding to be airshed open to a larger area they get another large source of deposition with different deposition modes. Does this help?
    - Dave says maybe he needs to hear over and over.

- Lew Linker says for post processing of 12x12km grid cells they may want to parse tidal bay into different regions (8 main bay segs) or regions. It might be of interest to see if deposition from mobile sources is greater in closer regions of the bay that are closer to mobile sources.
    - Sara Benish says it can be done.
- Dave Montali opens to other questions hearing none he concludes the day's discussions.

3:15 ADJOURN

- Dave Montali said Lew did a good job with discussion times. Overall good job on discussion periods.

DAY 1 Participants:

Lew Linker, Olivia Devereux, Breck Sullivan, Richard Tian, Bill Ball, Peter Claggett, Kalyanmoy Deb, Ashley Toy, Julian Blank, Guido Yactayo, Pouyan Nejadhashemi, Tyler Shenk, J. Sebastian Hernandez, George Onyullo, Marjy Friedrichs, Luke Frankel, Gregorio Toscano, Carl.Friedrichs, Sophia Grossweiler,Cassandra Davis,Jeff Sweeney,Sam Merrill, Mark Bennet, Annabelle Harvey,Jeremy Hanson, Tish Robertson, Hassan Mirsajadi, Clint Gill, Lisa Beatty, Christopher Thompson, Kyle Hinson, James Martin, Gopal Bhatt, Ruth Cassilly, Loretta Collins, Denice Wardrop, Jeremy Trombley ,Jesse Bash,Neil Ganju, Theodore Tesler, Rebecca Murphy, Karl Berger, Steve Schreiner, Arianna Johns, Joseph Zhang,Mukhtar Ibrahim, Richard Tian, Carlington Wallace, Peter Tango, Nicole Cai, Isabella Bertani, Kevin Wayne, Kristin Saunders, Bhanu Paudel, Norm Goulet, Bill Keeling, John Clune, Dave Montali, Greg Noe, Sarah Benish, Gary Shenk,

Chesapeake Bay Program
Science, Restoration, Partnership.

Modeling Workgroup Quarterly Review

April 7, 2020

Event webpage:
https://www.chesapeakebay.net/what/event/april_2021_modeling_workgroup_meeting_quarterly_review_day_2
For Remote Access - WebExLink:
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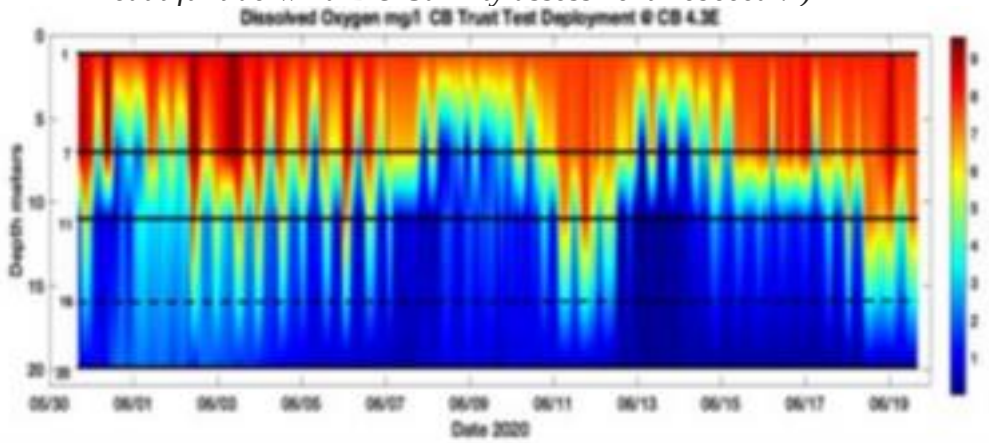
Meeting number: 120 872 5106 **Password:** GnHAY2rR

Phone number: +1-408-418-9388 **Access code**: 120 872 5106
To enter the webinar, please open the webinar link first

9:00 Announcements and Amendments to the Agenda – Mark Bennett, USGS and Dave Montali, Tetra Tech

9:05 Initial Analysis of Prototype Deployment – Rebecca Murphy, UMCES A small group composed of Rebecca Murphy, Peter Tango, Gary Shenk, Jeremy Testa, Peter Tango, Gary Shenk, Larry Sanford, and Isabella Bertani will report out initial analysis findings of what the of prototype deployment is telling us regarding hypoxia processes.

- Rebecca Murphy talks about preliminary analysis of 2020 vertical continuous monitoring data.
- Lew Linker says Rebecca's graphic on vertical plots is great. He can see DO values at different percentiles and can compare this with open water quality standards and sees for a specific station they have 50% attainment rates of shallow water. Is this correct?
    - Rebecca Murphy says when assessing for criteria they determine the pycnocline and open water at 4.3 E would end at roughly 2m deep, often when O2 is at a value of 3mg/L that's well within the deep-water zone.
    - Lew Linker likes this graphic a lot.
- *CHAT*
- *from pjtango to everyone: 9:27 AM*
    - *Beautiful tide-wind-DO-Salinity assessment Rebecca :-)*



- Lew Linker talks about this being a small analysis. He says it is a very good snippet. He wants to help move this work forward with the analysis. He hopes she can come back in the July quarterly, he wants to deploy more stations with these analyses being justification
- Dave Montali says we should deploy more closely to places where we are close to attainment?
    - Rebecca Murphy says she hasn't thought much about where to sample but this is a good point. She thinks where we're close in the VA deep channel is very useful.
    - Gary Shenk says if they are using this info to create a 4D WQ estimator we need temporal and spatial variability to be understood. They had talked about having 2

or 3 closes together so they can do spatial analysis of variability. He thinks they need several close together to know how a big roll out would work.
    - Marjy Friedrichs says this is great bringing this back to Aaron Beavers 2018 paper there are sites recommended for these monitors. She says this addresses areas where criteria are sometimes met and sometimes not. This work could be a great contributor to ideal deployment locations. Models get diurnal and tidal variability modeled very well. She likes sampling with the model and determining which model processes create this variability. This can validate the model and allow you to see various sites and compare them.
- *CHAT*
- *from Bill Ball to everyone: 9:39 AM*
    - *Excellent analysis of important new data. Clearly, more of this kind of sampling is in the future as probes and transponders become more robust and cruises become more expensive.*
- Larry Sanford thinks of a few things, first the statistics analysis is a good way to attack this problem. He thinks that comparing with models the sources of variability is critical. A lot of semi diurnal variability is due to the vertical motion of the pycnocline. Internal slosh with up and down on either side but not in the middle. This has been shown with papers at this location. The model vertical resolution determines if it can match high frequency fluctuations. Knowing the physical source of advective variability is important to model interpretation. After this is done then the model can determine where to site properly.
    - Lew Linker says 30 years ago internal slosh findings of estuary were big and at least for some deployments close vertical sensors in pycnocline would best pick this up?
    - Peter Tango thanks all involved and says this is informative. They are talking about sampling designs and spatial distribution. More insight is very critical to determine deployments, this discussion is very timely.
- Dave Montali opens to Bill Ball in the chat
- *CHAT*
- *from Bill Ball to everyone: 9:42 AM*
    - *I have a comment/question that is less related to the monitoring data but more to the criteria. In particular: given the fact that the definition of "OW" depth is allowed to vary, what aspect of current criteria actually protect against the infamous spatial "squeeze" on rockfish and other OW species?*
- Bill Ball wonders what aspects of criteria cover shallow depth of open water for species squeeze, such as rockfish, and says this can be a concern. It's off topic but wonders if this is covered by other criteria? If you don't protect from squeeze in the upper bay that's an issue. He asks Lew if has a comment?
    - Lew Linker doesn't know to what extent WQ standards protect against that. He thinks rockfish are squeezed from high temperatures and do so need optimal temperatures with enough DO. This leads to a deep-water squeeze. As improvements to hypoxia occur this can take care of rockfish habitat with existing criteria
    - Bill Ball says he will rephrase, he has a concern with decreased volume of open water DO.
    - Lew Linker says Jeremy will talk about this today, so more is to come.

9:40 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.

- Carl Cerco says the big concern is the path of N from SAV roots to its addition to the water column which makes sediments a sink of nutrients. SAV makes sediment less of a sink.
- *CHAT*
- *from Bill Ball to everyone: 9:59 AM*
    - *@carl: I'm surprised to hear that SAV does not enhance denitrification. Thanks, would think that the root surface area adjacent to organic matter would be very important for maintaining healthy ecological niches for bacteria. And perhaps especially an anammox process.*
- Bill Ball brings up his chat question about deterministic effects on denitrification, he feels microbes are increasingly important to surface area provided by roots. He says this must influence denitrification. He feels our understanding of science is weak. Is Carl sure?
    - Carl Cerco can only speak about the model, microbes are out of his current model
    - Bill Ball reminds people that the model is different from reality.
    - Carl Cerco will qualify that when presenting later. He feels from others inputs the idea is that the science isn't all there yet
- Lew Linker asks for slide 16, cb1 fluxes of Vallisneria. He sees in the early part of the year nutrients are retained in sediment then after May they are released. Wonders if DIN from spring freshet is key for this period? Further into the year without SAV a large flux out in October. Is this from ORG N released at that time? He wonders what DIN and ORG N look like with these plots and asks if they think they would be good?
    - Carl Cero says last time he showed all fluxes which overwhelmed the audience, he can add these. Diminished retention with Vallisneria in months 9 and 10 is above ground die offs.
    - Lew Linker asks for slide 15 to see die offs of surface biomass. We see a decrease in DO with excessive SAV might be a carryover of nitrogen. This is good stuff.

10:20 Analysis of Chesapeake Bay Marine Discharges – Richard Tian, UMCES and Lew Linker, EPA-CBPO

An initial analysis of the movement of marine discharges in the lower Bay will be described. The analysis is aimed at gaining insight into where marine discharges are adjective and their residence times based on conservative dissolved and particulate tracers in the 2017 Bay Model will be presented.

- Lew Linker opens with some background information on the project. Richard Tian will share work the modeling team is doing to examine NDZs in the Chesapeake. VA- DEQ and Anne Arundel County are putting in NDZ's. We see some NDZ in the Chesapeake Bay to cover discharge of marine waste related to MSDs and discharge of waste which can have human health concerns and nutrient pollution. Richard and Carl are working to

retool the WQ model to allow for bacterial decay and settling and are putting in a tracer study.

- Bill Ball has question for end of presentation
- Richard Tian starts with him being at the starting point of this project. His concern of fecal coliforms and using a tracer analysis to track these
- *CHAT*
- *from Norm Goulet to everyone: 10:25 AM*
    - *Many pleasure vessels do have AIS these days, especially transient cruisers.*
- *from Bill Ball to everyone: 10:27 AM*
    - *I'm flabbergasted. In 1976 (45 years ago!!) I wrote my undergraduate thesis (in engineering) on marine discharge systems in general, but especially focusing on recreational vessels, which often collocate near shellfish beds. It was clear then that holding tanks and pump outs were the best solution (practically, economically, and otherwise) for the Chesapeake, and I thought this was already law —hence the ubiquitous (required!!) availability of Pumpout stations at marinas. I have always assumed (and though I'd been TOLD) that overboard discharge was against the law. I guess I've been wrong. This is very sad.*
- *from Bill Ball to everyone: 10:30 AM*
    - *(Clearly I should have continued to stay abreast of the regulatory situation! I'm embarrassed that I did not!!)*
- *from Norm Goulet to everyone: 10:32 AM*
    - *Type 3 (holding tanks) are standard on pleasure vessels that have a head. Any discharge from that would be illegal inside of the three mile boundary. The legal discharges are from Type 1 & 2 and for the most part are from larger vessels. Type 1 up about 60 ft and type 2 for larger.*
- *from Bill Ball to everyone: 10:38 AM*
    - *Thanks Norm — that was my understanding and I know that everyone Zi know (including myself!) NEVER discharged overboard. So pleasure vessel discharge at mouth of Rappahannock would not be expected*
- *from Bill Ball to everyone: 10:43 AM*
    - *Thanks for clarifying Norm and Lew. Am very discouraged to hear the 50% violation estimate. Also discouraged that commercial vessel requirements have not become more stringent in these 45 years! Excellent treatment is quite feasible... certainly enough to eliminate fecal coliforms.*
- Lew Linker starts by saying that type 3 MSDs are holding tanks that should be used, discharge of type 3 is prohibited but estimates are that ½ MSD holding is captured in pump out stations. Some discharge occurs. Type 1 and 2 discharges occur after treatment with no floatable waste. The question is more about capturing type 3s with a NDZ. It would also capture types 1 and 2 to a limited extent. These analyses with sinking and decay rates can be developed anywhere. On slide 7 with northern neck 8 tracers, we would be doing tracer in the middle of the bay for 1 and 2 discharge tracers along recreational boats, then either side of the gate. The question is where material goes and from where it starts for types 1 2 commercial or 3 recreational.
- Dave Montali asks for the disconnect with boat passage, such as big commercial boats with types 1 and 2 MSDs. Those locations are specified, does this exclude recreational boats?
- Lew Linker says will see what VA DEQ wants.
    - James Martin says the initial illustration of traffic patterns includes large

commercial vessels, foreign flag marpol vessels which precludes them from being discharged. They are working to isolate vessel types and potentially exclude commercial vessels. There are recreational vessels in smaller embayment's at protected marinas. A lot of big traffic in rivers is likely smaller commercial or recreational vessels.

- Dave Montali assumed tracer locations would be at marinas, which seems like a distinction of travel for large and small vessels traffic.
- James Martin says smaller boats are tucked into smaller tributaries which are not well represented by model grids.
- Larry Sanford asks if the same framework might work for oil spill risk?
  - Lew Linker says he would imagine so but defers to Carl and wonders if the coast guard has things for this already?
  - Carl Cerco says he doesn't know current oil spill data. Buoyant transport was driven by wind primarily, you could configure the model to do but it wouldn't be a great estimator.
  - Lew Linker says 10 years ago they had no NDZ now several are in place and we have an analysis tool regarding these that jurisdictions can use.

10:40 Chesapeake Bay Marine Vessel Nutrient Discharges – Tom Butler, CRC, and Richard Tian, UMCES

A small but real nutrient input load yet unaccounted in Chesapeake tidal waters is from Marine Sanitation Devices (MSDs). Estimates of the TN, TP, and TOC load made by an Expert Panel and parsed into monthly inputs with location and nutrient species will be made ready for input into the new unstructured grid model to be applied in 2025.

- Lew Linker says adding these loads into phase 7 is likely but could also be phase 8.
- Dave Montali asks if he said phase 8? He assumed we were trying to do this for phase 7
- Lew Linker says we can incorporate into any model phases. We are incorporating into phase 7 for 2025 use and beyond.
- Dave Montali discusses the methodology for MD and VA for the effects of the pump out that isn't true. The N:P ratio is different but that should not be the case. They should both have the same ratio.
- Bill Ball was thinking about that and if people are measuring N:P ratios the lack of P removal could be due to people not excreting solid wastes on boats as much. If someone is measuring that's big.
- Norm Goulet says Bill is kind of right but solid wastes are created. A lot of waste pumped out ends up going to the septic system and not the wastewater treatment facility. This subject is important to him and he gets excited talking about the aspect of SSOs being outside of modeling work and that is a much greater load then recreational boats from this report. The tetra tech report from a few years ago was reviewed and they saw many issues with this report. It did not differentiate the number of vessels using the bay vs what was registered further inland. He suggests if using this report then you need to go through it in detail. Regarding SSOs if this is incorporated into phase 7 they need to go into phase 7 to.
- Lew Linker will quote Norm on that. Number 2 happens. To the point yes this is a decision of incorporating or not. Maybe this issue is not important for nutrient capture but more important for public beaches and shellfish. If that's the case then we are ok. It is a decision point, and relatively small at that. If areas of NDZ want to take advantage of

nutrient removal there must be some way to do this. It is a decision we need to address without too much trouble but it should be addressed.

- Norm Goulet says he doesn't think most recreational boaters will have an issue with the NDZ once they understand what it really is. His concern is that if we add a BMP for crediting nutrients he has an issue.
- Lew Linker says the program might go forward as NDZ based on shellfish and human health concerns. That would be fine, we would develop technical tools for tracer analyses but wouldn't add a nutrient load.
- Dave Montali says it seems like this effort might not be within the scope of what the Modeling WG is charged with. He asks if we need to get something from the WQGIT to direct us?
- Lew Linker says for nutrient incorporation we certainly do. He would like James' thoughts on this. They have a request for the tracer analysis from a bay partner and have agreed to this. We are on good ground there but we need to check in with WQGIT if this is something we do or do not do.
- James Martin agrees that loads from this subsector are small and unnecessary to be chasing. There is justification for NDZs from a human health perspective. He reiterates there are bigger fish to fry such as SSOs. He agrees those should be a priority. He had the CSO SSO topic raised in the VA legislature as an argument against requiring livestock exclusion. Why should cows be excluded from stream access when cities downriver have discharges that are far larger?
- Lew Linker says they have designed sewer overflows in the model now, with an influence from climate change. The sanitary discharges are not in. they are generally repaired quickly and he welcomes the opportunity to get these into the model. He hears James say that the NDZ doesn't need to be raised to the WQGIT. This would shut it down and leave the tracer analysis going.
- James Martin says the WQGIT does not regularly decline BMPs but this one was declined already.
- Lew Linker says this is useful, he says we can take this as guidance to continue with the tracer analysis but not continue with the co benefits of nutrient reduction.
- *CHAT*
- *from Bill Ball to everyone: 11:00 AM*
    - *How is crediting for removal of illegal boat discharge any different than crediting the city of Baltimore for addressing illegal sewer system overflows? (My understanding of the latter (Baltimore) issue is that has been viewed as being "outside the system" of the TMDL modeling and regulatory process —is that ?incorrect*
- *from Norm Goulet to everyone: 11:01 AM*
    - *Bill you stole my thunder!!!!*
- *from Bill Ball to everyone: 11:05 AM*
    - *I guess that sewer overflows will also be specifically modeled and somehow addressed in Phase 7?*
- *from Norm Goulet to everyone: 11:05 AM*
    - *The Tetra Tech report had lots of issues when it came to the statistical work. For instance the state surveys of #of vessels did not account for what vessels were registered inland vs vessels that actually used the bay.*
- *from Bill Ball to everyone: 11:20 AM*
    - *If nothing else, putting SSOs in the model should help it's calibrations to be better*

at creating predictive accuracy

- *from Ashley Toy to everyone: 11:20 AM*
    - *TMDLs can not assign WLA/LAs to unauthorized discharges. However, from a modeling perspective, they could be considered as an existing load to be reduced to zero.*
- Gary Shenk thinks in the SSO issue no one has been against putting these loads into the model. Getting the SSOs in model is a good idea.
- Dave Montali says to put this on the list for phase 7 for water quality. We haven't got much WQGIT input for improvements, he throws out that not all SSOs are the same and they aren't all quantified across the watershed. Issues exist with quantifying SSOs across the watershed and they need to accurately characterize these.
- Lew Linker says this is a good direction for this part of the project which we will not move forward with.

11:15 BREAK

11:30 Extent and Causes of Chesapeake Bay Warming – Kyle Hinson, Marjorie Friedrichs, Pierre St-Laurent, and Fei Da, VIMS and Ray Najjar, Penn State
Recent Chesapeake Bay warming trends and their proximate causes were analyzed using a combination of observations and the ChesROMS modeling framework. Results demonstrate that temperatures in warmer months are increasing 3-4 times faster than cooler months. Although these trends are primarily driven by atmospheric warming for much of the year, oceanic warming also contributes substantially to southern Bay summer warming patterns.

- Kyle Hinson talks about the extent and causes of Chesapeake Bay warming.
    - Increased river temp = almost no effect on the bay
    - SLR = cools the bay in summer warms in the winter
    - Warming ocean temp = leads to a much warmer bay in summer months
    - Atmospheric = dominant cause of warming in the bay, changes are the least in the summer where ocean warming has a greater impact
- Lew Linker says this was nicely done and is a good contribution.
- Rebecca Murphy says she has an analysis of monitoring data, she would like to see how these results compare to the model? Does Kyle see the same patterns?
    - Kyle Hinson says he's grouped monitoring stations by region and compared observations vs model outputs at the same time. They seem to align well and Kyle highlights how sampling biases from after a storm can affect overall trends over a 30-year time period.
    - Rebecca Murphy likes subsampling the model and that it provided the same seasonal pattern.
    - Carl Cerco asks, to what do we attribute the temperature decrease in November?
    - Kyle Hinson says overall November air temp over the bay has been decreasing and he does not know what's driving it.
    - Carl asks if in the future we expect a colder November.
    - Kyle Hinson says it's hard to predict.
- *CHAT*
- *from julie.reichert-nguyen to everyone: 11:52 AM*
        - *This work is timely for the STAC discussions that are planned around*

management options to deal with rising water temperatures

- James Martin says November isn't warming as fast as December and potentially its cooling?
    - Kyle has no answer but it's a good question.
- *CHAT*
- *from pjtango to everyone: 11:56 AM*
    - *Excellent Kyle! Thanks. Question - if temperature rise is a pretty consistent baywide feature, do you have any other direction for locating one or more sensor packages?*
- Peter Tango clarifies his question on locating where to add sensors he asked if he had thoughts on change consistent for baywide scale. Does this give more flexibility to place sensors access the bay or should they filter again to find places?
- Kyle Hinson says focusing on where the extent of sea level warming would be would show if warming goes up bay. He would suggest going to the tongue of SLR within the bay.
- *CHAT*
- *from Tom Parham to everyone: 12:03 PM*
    - *Kyle - Good presentation. Is the ocean warming impacting bay waters near the mouth of the Bay in the surface and bottom waters equally?*
- *from Kyle Hinson to everyone: 12:08 PM*
    - *Hey Tom, good question. There is a greater impact on bottom waters than surface due to the effects of ocean warming. During warmer months in the polyhaline region, surface warming is ~0.2 deg C while bottom warming is closer to 0.7 deg C*
- *from Tom Parham to everyone: 12:14 PM*
    - *Thanks! It will be interesting over time to see how these changing water temperatures will impact Bay circulation.*
- *from Kyle Hinson to everyone: 12:14 PM*
    - *I agree!*

12:00 Effects of Reduced Shoreline Erosion on Chesapeake Bay Water Clarity – Jessie Turner, Pierre St-Laurent, Marjorie Friedrichs, and Carl Friedrichs, VIMS

The difference between two scenarios of shoreline erosion vs. highly armored shorelines with reduced erosion was investigated using ChesROMS-ECB. Results show that armoring improves water clarity, especially where and when river influence is low; however, armoring creates an *Organic Fog Zone* in the mid-Bay in spring as Secchi depth and light attenuation depth change in opposite directions due to enhanced organic matter production.

- Lew Linker understands one feature of an armored shoreline is more wave reflection and reduced scouring of intertidal sediment is that incorporated into the simulations?
- Jessie Turner says this was not incorporated into this study but spatial scales can be impacted differently, at small scale it's very important to account for this armoring. She adds that different types of shoreline hardening can have different impacts but do not exhibit the scour effect.
    - Lew Linker comments that with SLR some land will retreat and some will have some protection so we will see changes where the shoreline will now be less

stable.
    - Mark Bennet says Jessie might want to mention this is not about armored shorelines. Some will see armor as a method of reducing sediment which will detract from offset of sediment compared to organic growth. This changes the focus to organic growth and away from armoring
        - Jessie Turner thanks Mark and will adjust.
- Carl Cerco wants to see the equation to convert secchi to light attenuation and asks where it came from?
    - Jessie Turner says this came from Carl Friederichs and her using years of CBP data to create a linear trend analysis to match the CBP data.
    - Carl Cerco asks if a high weighting of organic solids reduced secchi?
        - Jessie says yes relatively more than light attenuation does.
- Carl Cerco mentions a paper about secchi depth science and asks if Jessie is familiar?
    - Jessie Turner says yes. It's interesting since someone converted light attenuation and went into great depth. If she hadn't seen it though it would have been good to see.
    - Jessie Turner says in the estuary secchi depth is not a linear relationship with KD. Different types of particles cause these differences so response is not linear, there are several papers on that as well.
    - Lew Linker says this is consistent with Chuck Gallegos' findings and is relatable to WQ standards. We have a water clarity standard for SAV and measure clarity often with secchi. It is good to note that as Jessie points out SAV responds to KD not secchi. Water quality standard for SAV resources is paired with an imperfect metric, secchi. This is something the program needs to address. He also adds that he likes the naming of an organic fog region.
- Jeremy Testa asks how algal carbon interacts with the OSS pool in the model? It seems like chla had its own light attenuation coefficient. He asks how any detritus from the model plays into the light parameter in the model?
    - Jessie Turner says the KD equation for TSS adds phytoplankton, zooplankton, and detritus all together. These are then tuned based on observations. The best fit from these was between TSS and salinity. (plankton and detritus) and salinity. They found the chla coefficient did not help KD in model. TSS and salinity are best predictors.
    - Jeremy Testa says the attenuation effects of chla pigments are relatively small vs other factors, for secchi depth. He asks if OSS is part of this?
    - Jessie Turner says yes plankton and detritus as well.
    - Jeremy Testa asks if looking at feedback on phytoplankton growth contributes to these parameters?
        - Jessie Turner didn't specifically look for this sensitivity but that organic matter self-shading happened all the time. If she decreased organic matter then still ended up with a large amount of organic matter. Whenever light hit she got more organic matter production.

12:30 BREAK

1:30 Climate Change and Tidal Shallow Water Oxygen Dynamics STAC Technical Synthesis – Jeremy Testa and Richard Tian, UMCES

The STAC Science Technical Synthesis led by Jeremy Testa on oxygen dynamics in tidal shallow water will apply observations, research, and modeling to develop a diagnostic and predictive understanding of what controls the attainment of dissolved oxygen criteria in Chesapeake shallow waters allowing the CBP Bay Model to better represent tidal shallow waters. Progress on this work will be presented.

- Dave Montali makes the comment that this new meeting format seems to be working well. He says he will wait until the end of the meeting today to get everyone's feedback. He then introduces Jeremy,
- Jeremy Testa discusses his updates on the shallow water oxygen work
- *CHAT*
- *from pjtango to everyone: 1:39 PM*
    - *Jeremy - has SAV prevalence, density been factored into the analysis at any time? It would seem we have decades of imagery to overlay with stations and time distribution of these locations.*
- *from Nicole Cai to everyone: 1:58 PM*
    - *Jeremy - is there any carbon data in this river for validation, since the DO simulation has a correlation with the DOC?*
- Lew Linker is happy to have Jeremy and his team work on this. The fact that wind ends up having a negative effect on DO is interesting. In open waters wind would create higher DO but in the shallow it does the opposite. There are many things from this that are good to know, this is great to have so they can get ready for shallow water processes. Lew is curious if others with unstructured grid models in shallow water have these same issues?
- Jeremy Testa says there are minimally concentrated measures he is not sure about DOC since it has been removed from the monitoring program over time.
    - Jeremy Testa clarifies with wind that high wind pushes DO to atmospheric equilibrium so it mutes the variability. With high wind that stirs up water and might encourage a net respiratory balance. If wind is low you see chla emerges with positive saturation that allows DO to accumulate.
    - Lew Linker says it is interesting that they can have a saturation point that wind helps reach. He asks if high chla with low wind can cause supersaturation?
    - Jeremy Testa says yes.
- Lew Linker asks if Nicole Cai has these problems in her shallow water unstructured grid?
    - Nicole Cai says that her model always overestimates DO so this is interesting. She hasn't looked at a fine time scale DO. She usually outputs DO over several hour increments a day. She would like to know how they fractionate different nutrient groups. This will be a good way to do simulations.
    - Jeremy Testa sees phosphate in the model is low, this could be because algae have taken it up. Phase 5.3 model loads may be underestimating phosphate as it uses baseflow when stormflow provides most of the phosphorus.
    - Gary Shenk says P isn't based on base flow but he doesn't know if the CBP have the correct dynamics for P
- Carl Cerco says Dominic says never get more than 3mg.day DO, due to diffusion into sediment. He doesn't know what causes 6mg/day as that's very high. He suggests that they might want to focus on a more representative area.
    - Jeremy Testa says you may be right since Walter Boynton made those measurements. These are some of the highest PO4 measurements he’s ever seen.

He is concerned this might be too extreme a case and so not representative. Jeremy thinks focusing on lower parts of systems is potentially better.

- Dave Montali brings up Peter Tango's chat question about if SAV was factored into the analysis?
    - Jeremy Testa says not yet. He talks about the benthic algal model saying he has a strong sense it's a big part of the system. There are some cases where people living in watershed have seen SAV around the water but generally he decided SAV was sparse.
    - Peter Tango was thinking of 180 stations and SAV in Mattawoman creek vs the Severn vs the Magothy river where they have a diversity of situations with variety species and densities which would impact lower end variability. In pelagic production beyond benthic production, it might be less useful so he might be thinking narrowly.
    - Jeremy Testa says a couple of known conditions at different stations can be clustered together. They didn't get to it in time with his post doc. O2 concentrations are super variable in SAV beds. SAV is productive in the day but not as much at night. In the Susquehanna flats this same trend is not seen. He doesn't know if O2 is produced so much that it isn't drawn down at night. To examine this, it might be useful to look in Mattawoman creek.
    - Peter Tango says it's good to look at other stations and look outside regions as this could go well with teasing apart small-scale areas.
- *CHAT*
- *from Larry Sanford to everyone: 2:07 PM*
    - *What about microphytobenthos?*
- Lew responds that ICM can handle Larry's comment for including microphytobenthos.
- Carl Cero says this component is present in ICM but not sure if it is in SCHISM.
- Richard Tian says it is included but not activated yet. It's a part of the plan to get a reasonable calibration then do sensitivity analysis with the module on and off to see how it impacts results.
- Jeremy Testa wants to look at KD values from the model and see if they match to observations. KD is the dominant control in models that isn't constrained yet.
    - Richard Tian thinks they need to do that, Nicole made a good point that DOC and POC are drivers of O2 consumption and need to be looked at. He comments that may be an issue for nutrient loading being incorrect. At this point the phase 5 output is not giving enough P to drive productivity. The ratio of P vs N in loading is one order magnitude lower than the Redfield ratio. He would like to switch to phase 6 loading.

2:10 Tributary Summaries – Jeni Keisman, USGS

Progress with the Rappahannock Tributary Study and other future tributary studies like the Potomac Tributary Report completed last quarter will be described.

- Jeni Keisman says Lew Linker has indicated that her chosen tributary summary reports might serve as the basis for different modeling teams.
    - Lew Linker says he wants 5 tributary teams working on separate unstructured grid models to provide tributary bios providing information on each tributary. This will be a common starting point for a lot of tidal work for the bay.
    - Jeni Keisman pulls up the Potomac river summary to provide some information

on the basin and other facts relevant to the basin, and river itself.
    - Lew Linker asks if Jeni can let modelers know when these reports hit the street? They will be immediately used once released.

2:30 A Tidal Water Model for the Assessment of 2035 Climate Change Risk to the Chesapeake TMDL – Lew Linker, EPA-CBPO

Progress on the Chesapeake Bay Program Request for Assistance (RFA) for the next generation state-of-the-science model of the Chesapeake using an unstructured grid will be discussed. 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. The approach will be 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.

- Dave Montali asks about 2024 being used as the year of review for the WSM. What's the status of the estuarine model January 1 2025? Will it be sufficient to have people review WSM to understand what's going on? WSM load changes need to be related to the Estuarine model.
- Lew Linker says the way to do this is document the 2024 model so documentation for the estuarine model is ready at same time as the fully operational model. It's what needs to be done to allow for model development. He will ask for a good or better review of the unstructured grid tidal model. We will rely on the tributary teams to review the models. The estuarine and WSMs must be released at the same time.
- Dave Montali says with respect to modeling quarterlies will day 2 of this meeting be dominated by work going on? Should they have semiannual PI meetings coordinated with the modeling WG? Is this a separate meeting which reports out at quarterly meetings?
    - Lew Linker says yes, Marjy Friederichs is working in the Chester river as a prototype. He would like a clear response to the modeling quarterly. May has meetings scheduled close together with semiannual meetings just before quarterly review. The modeling wg will see what seems right.
- Mark Bennet says with multi tributary teams we will see different results due to different methods, is that organically allowed to happen with teams then being told how to model ? Those little differences will behave differently. How can we handle these?
    - Lew Linker says that it's important to clarify, will use the same model, which as this point is still undetermined, fvcom schism etc. Each group will use the same model and have semi-annual reviews to determine the best approaches from each team. Each smaller team's results will be utilized to improve the main team through applications with the overall model. The overall main model is constrained and will be a coarser gridded whole bay model that incorporates all findings. This combines all modeling efforts together. It will likely have regional calibration for specific tributaries but that's a decision point that needs to be controlled.
    - Richard Tian mentions that for this issue in the Bay the functionality for each tributary is different. Having tributary model teams acting differently should

be allowed to gain tributary specific insights. The only issue is they might end up with different parameter values.
    - Lew Linker says we have 2 checks:
        - Check of the tributary teams with meetings between teams
        - Check of the regional approach which was decided by modeling WG.
            - PIs will defer to modeling WG on any necessary decisions.
- Dave Montali says the big picture needs to add an equity bullet for the differences between separate regions. He asks if this favors or disfavors areas and jurisdictions? If something is different and something is changing they need to think about the big picture.
    - Lew Linker says this is so true and the modeling WG has the responsibility to get this right so it will be a topic for some time to keep everyone on track.

3:00 ADJOURN

- Dave Montali likes the new format as it allowed for good discussions he asks if anyone else has comments?
- *CHAT*
- *from Larry Sanford to everyone: 2:55 PM*
    - *I thought it went really well also!*
- Lew Linker says adding discussion time made it work more smoothly
- Dave Montali says it limits during presentation questions which tend to throw things off track and commends Lew on the agenda timing.
- Lew Linker says the problem with virtual meetings is discussions. It's not as good as face to face but this format worked well and we will keep going forward.
- Dave Montali says we will be meeting again on May 6th.
    - Lew Linker says this is still an as needed meeting and is open to new ideas.

DAY 2 Participants:

Lew Linker, Breck Sullivan, Gregorio Toscano, Raleigh Hood, Elizabeth Hoffman, Kristin Saunders, Larry Sanford, Denice Wardrop, Karl Blankenship, George Onyullo, Cassandra Davis, Isabella Bertani, Hassan Mirsajadi, Karl Berger, John Clune, Ron Vogel, Sophia Grossweiler, Carl Friedrichs, Luke Frankel, Julie Reichert-Nguyen, Jeremy Testa, Jeff Sweeney, Ashley Toy, Sarah Benish, Jesse Bash, Anne Schegel, Mukhtar Ibrahim, Bhanu Paudel, Sam Merrill, James Martin, Lisa Beatty, Jeni Keisman, Diana Domotor, Theodore Tesler, Jessie Turner, Carl.Friedrichs, Guido Yactayo, Gregorio Toscano, Mark Trice, Carl Cerco, Peter Tango, Qian Zhang, Tom Parham, Gopal Bhatt, Marjy Friedrichs, Bill Keeling, Richard Tian, Arianna Johns, Joseph Zhang, Mark Bennet, Norm Goulet, Kyle Hinson, Carlington Wallace, Kevin Wayne, Nicole Cai, Gary Shenk, Rebecca Murphy, Bill

Ball, Dave Montali, Joseph Vince