Modeling Workgroup Quarterly Review
April 7, 2020

Event webpage:
https://www.chesapeakebay.net/what/event/april_2020_modeling_workgroup_quarterly_review1

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

10:10 **Initial Assessment of Allocation Methods to Address Climate Risk in the Chesapeake Watershed and Tidal Waters – Gary Shenk, USGS-CBPO**
Gary will present, for Modeling Workgroup technical review, the progress on the Water Quality Goal Implementation Team's (WQGIT) requested modeling analyses on options for allocating climate targets.

Discussion:
- James Martin mentioned that the dots on the relative effectiveness chart can move along the lines. Gary confirmed and he added that even though you move along the dots you are still responsible for the same amount of effort. James asked if it is the same amount of effort or the same amount of effort of increase so it would be good to move at the same amount of effort. Gary mentioned it would involve rearranging the 2017 planning target.
- Bill Ball commented that the relative effectiveness chart is a policy decision, but he recommended STAC to revisiting the scientific evidence behind it.
- On the slide of open water thoughts, Dave mentioned that there are different number with regards to deep water and deep channel he asked why there is no number to cover CB4 deep water 5.49% to 2025. Gary responded that CB4 didn't have the variance problem till 2025.
- Bill Ball recommended that revisiting decisions on the segmentations in the lower bay especially defining "open water" as from top to bottom. Gary responded that Lew is setting up a plan to work with Peter Tango's team on this.
- James commented that the percent violation does not provide information on how severe the DO level is or what the potential impact on the living resources. Gary commented that when the segment is in compliance it does not mean the DO level is great.
- James mentioned that most of the violations are in the deeper water portion of the Bay and more influenced by the ocean and he questioned if the statement of "open water may be more affected by temp due to concentrations closer to saturations" is still valid. Gary responded that open water is more affected by temp but it is not causing the violations at the mainstem of the Bay above pycnoclinenocline, which is also supported by Rebecca's findings.
- Jeni added that if pycnocline is detected, there is a Deep-Water designated use, if not the segment is open water from top to bottom. Richard added that in the

code, it first to see if pycnocline was detected. If no pycnocline was detected and the total depth is greater than 12 meters, then long term average pycnocline will be used. In this case, the long-term average pycnocline will be applied in the most part of south Bay.

- Dave summarized that the findings of the assessment are ready to move to WQGIT and Climate Resiliency WG. For 2025, deep water and deep channel is 5 verses 9.
- Bill Ball commented that it is anticipated to have pushback from the wastewater treatment plant because of additional loads. He recommended considering septic tank to relive the pressure on the WWTP. James added that the WWTP is just a matter of allocation formula and how jurisdiction is allocating the loads if the WWTP is not mandatory.
- James recommended for Modeling WG to provide recommendation to the WQGIT on including CB6 and CB7 open water. Lew added that the recommendation will be at this point, there is not sufficient confidence to apply the model in CB6 and CB7 open water since we are still actively researching this issue. More results on this issue will be released in July Modeling Meeting.
- Dave recommended that Modeling WG to draft a few statements of recommendation within next week on where to apply the models to the Water Quality GIT.
- The spreadsheet of the loads reduction can be downloaded here.
  With open water at CB6 and CB7, Modeling WG recommended that we need more evidence due to the open water segmentation issue.
  Recommendation: The Modeling WG recommended that more evidence is needed regarding the proper delineation of CB6MH and CB7MH Open-Water DO before using violations to drive climate allocation policy.

11:00 **Effects of Sea Level Rise on Chesapeake Tidal Water Temperatures – Pierre St-Laurent, VIMS**
A model intercomparison on the effects of SLR in Chesapeake Bay will be presented on the findings of estimated slightly warmer temperatures in winter and slightly cooler temperatures in the summer for Chesapeake bottom waters under climate change conditions. The estimated causes of the phenomenon, based on model outputs from ChesROMS-ECB and UMCES-ROMS, will be discussed.
Discussion:
- Lew summarized that with the additional volume means a change in the thermal inertia of the Bay. The warmer winter will be even more so with the temp increase. Cooler summer will have a lag in response and slower to warm up.
- Julie asked if SLR impact with cooler summer create refuge in temp increase or the temperature increase will overshadow the cooler summer. Pierre responded that the temperature increase will overshadow the cooler summer.
- Bill asked if the model takes into account of the insolent radiation. Pierre responded treatment of the heat flux is reasonable but the model doesn't simulate shallow water very well.

- James asked that with regards to the additional volume caused by SLR, if there is a way to differentiate where the additional volumes are by designated use. Pierre said inundation can be captured by the model and to his understanding, it would be one meter in the Bay not at the shallow water. James encouraged more work can be done in this area.

11:30 **Long-term Observations of Temperature, DO, and Salinity in Chesapeake Open Waters – Rebecca Murphy, UMCES; Breck Sullivan, CRC; and Jeni Keisman, USGS**

An update on progress with the ongoing instigation of climate risk in attainment of Open-Water DO standards will be presented. The investigation centers on long-term observations of temperature, salinity, and DO in shallow Open-Water (generally less than 2 meters depth) and deeper Open-Water DO in main-Bay segments extending in depth from the surface to the pycnocline). Ultimately the goal is to assess observed Open-Water DO trends by CB-segment in order to understand the risk of increased temperatures on Open-Water DO criteria.

Discussion:
- Lew asked if the temp increase along CB7 and CB8 is related to the coastal water increase in the coastal shell. Richard mentioned that he reviewed salinity flux and heat flux and this is a typical function with estuary circulation.
- Richard mentioned that with watershed model temp simulation change, groundwater contributes a significant portion of the total discharge. He asked Gopal if he noticed that this contribution differs spatially. Gopal responded that temperature change is very uniform, but he doesn't have the quantification of the change from north to south.
- Kyle mentioned that the temp change at the boundary is similar to what he has found.
- Larry recommended using temp as a tracer which could be indicative of change that we have not think about and he also pointed out that the data could be biased to a particular time.

12:30 **Fine-Scale Hydrology Model Development – Gary Shenk, USGS-CBPO and Gopal Bhatt, Penn State**

Progress on developing a fine-scale distributed hydrology model of the Chesapeake watershed using a catchment segmentation on the order of about one square mile will be presented. The fine-scale model is designed to support more efficient BMP applications, living resource needs, and water supply decision-making.

Discussion:
- Dave asked if there is any anomaly in VA with NHD plus streamflow monitoring station map. Gopal pointed out this is a known issue with NHD plus catchment.
- Dave asked about the alignment of the streamflow on slide 9 and the unresolved issue on the far right one. Gopal responded that he would need to contact USGS colleague on this station.

1:00   **Maintaining Resiliency of Stormwater and Restoration Practices – Tom Schueler and David Wood, Chesapeake Stormwater Network (CSN)**
Progress will be presented on the design and encouragement of accelerated adoption of stormwater management practices appropriately designed for rainfall volumes and intensities expected in the future for all counties in the Chesapeake watershed.
Discussion:
- Lew asked if this work can lead to future IDF projection criteria change. David commented that situation is fairly different by locality and some are already far ahead such as some localities in VA. They are open to the idea of future IDF curve. Tom added he is planning to present the future IDF curve idea during a future meeting with the states and counties.

1:30   **USWG IDF Progress – Normand Goulet (USWG Chair), Northern Virginia Regional Commission**
An update on the Urban Stormwater Workgroup's work to deliver updated and future climate hydrology probabilistic Intensity Duration Frequency (IDF) curves for all Chesapeake watershed counties.
Discussion:
- Dave suggested having a group meeting with Climate Resiliency Wg and Stormwater Wg and Urban Stormwater WG in June or July.

2:00   **Developing County Level Time Series of Nutrient Inventories and Trend Maps – Robert Sabo and Emily Trentacoste, EPA, Qian Zhang, UMCES with Cuiyin Wu and Breck Sullivan, CRC**
A project to develop county level time series of nutrient inventories for all counties of the Chesapeake watershed was presented at the 2019 October Modeling WG Quarterly Meeting. An update on the progress will be presented including (1) an intro chapter covering data sources and underlaying assumption for this work, (2) estimated trends for each individual nutrient source using the Mann-Kendall Test, which were converted into county-level, watershed-wide maps, and (3) an update on feedback received from partners.
Discussion:
- Bill commented that with Loudoun County input maps, it looks like the graph is showing that the urban fertilizer has gone up more than the ag fertilizer has dropped. He asked what the exact estimation technique for urban fertilizer technique. Robert responded that it is most likely based on the extent of detected lawns and golf courses and fertilizer sale data. Norm added that we don't have a lot of confidence in CBP fertilizer data. Robert added that the trend should be on the right direction but the magnitude may not be accurate.
- Karl pointed out that the fertilizer application rate per acre is the same for all the counties in VA which is not right. He added that USGS data is also based on the sales data.
- Bill added that blue sky flooding should be considered in measuring the amount of nitrogen and phosphorous.

- Dave commented that the reason that Loudon County urban fertilizer is going up is because of more lawns in the Loudon County. Robert agreed and added that similar response is missing with Washington County.
- Lew mentioned that Peter Claggett team has data on sewer-shed.
- Emily summarized that the group's next step would be to brief Water Quality GIT on this issue.
- James recommended the team to update database using CAST2019 data.

Meeting Participants:
Scott Philips
Carlington Wallace
Richard Tian
Dave Montali
Gary Shenk
Mukhtar Ibrahim
Lew Linker
William (Bill) Ball
Mark Bennett
Bill Keeling
Gopal Bhatt
Kristin Saunders
Clifton Bell
Isabella Bertani
Breck Sullivan
Lee McDonnell
Marjorie Friedrichs
Arianna Johns
Rebecca Murphy
Ted Tesler
Pierre St-Laurent
Dinorah Dalmasy
Cassandra Davis
Yeonjeong Park
Daniel Kaufman
George Onyullo
Karl Berger
Larry Sanford
James Davis-Martin
Norm Goulet
Jeremy Hanson
Julie Reichert-Nguyen
Bruce Michael
Jesse Bash
Kyle Hinson
Jeffrey Sweeney
Cherie Schultz
Bhanu Paudel

Clint Gill
Ken Hyer
John Clune
KC Filippino
Greg Bush
Jeni Keisman
Gavin Yang
Carl Cerco
Fei Da
Qian Zhang
Xia Xie
Emily Trentacoste
David Wood
Jimmy Webber
Andy Stoddard
Tammy Zimmerman
Robert Sabo

Modeling Workgroup Quarterly Review

April 8, 2020

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

10:10 **NSF Aeration Workshop – Lora Harris and Jeremy Testa, UMCES**

A recent NSF workshop will be reviewed that considered a long-range strategy of engineered aeration to deep waters of the mainstem Bay as an "on demand/as needed" support and augmentation to the Partnership's watershed based nutrient reduction strategies.

Discussion:

- Dave asked potential area for demonstration. Lora responded that some locations have been mentioned, such as Severn River and Patuxent River and mainstem of the Bay.
- Lew asked Lora what are some potential next steps for this experiment. Lora mentioned that she needed support from this group on the design of the pilot project. There are a lot of questions can be answered through this project. Larry added that small scale oxygenation is needed to understand the oxygenated process.
- George asked the criteria to select location for pilot project. Lora responded the right type bathymetry to mimic the pycnocline in the mainstem of the Bay. Some other criteria includes practicality and science based questions, and other criteria such as persistent load of oxygen at the bottom, strong pycnocline, sites on land to install.

10:30 **Accuracy of SLAMM Estimated Increases In 2025 Tidal Wetland Area – Peter Claggett and Sarah McDonald, USGS-CBPO**

A comparison of SLAMM and NLCD estimated 2025 tidal wetland area will be presented focusing on specific areas such as the Pocomoke Tidal Fresh (TF), Appomattox TF, Anacostia TF and others. The work is aimed at assessing a known limitation of SLAMM that it "likely overestimates the area of new marsh created by sea level rise as it fails to account for future development of currently undeveloped land that the model assumes will be available to accommodate marsh migration." The 2025 increase in tidal wetland area has implications for the CBP climate change risk analysis.

Discussion:

- Peter concluded that no photographic evidence for undeveloped upland converting to "transitional salt marsh" and no photographic evidence for woody swamp transitioning to herbaceous brackish marsh but transitions may be not be visible for decades (woody vegetation has to decay and transition to herbaceous to be visible). He noticed apparent photographic evidence for marsh loss to open water in

Blackwater Wildlife Refuge. And existing available photography is challenging to interpret for land to water transitions in shallow tidal areas due to the unknown tidal stage and limited spectral bands (black and white) in pre-2000 imagery.

- Lora commented that this version of SLAMM does not include any dynamic of marsh equilibrium process-based mechanism that could lead to your results here.
- Dave commented that wetland is an important improved component for Phase 7.

11:00 SAV Nutrient Dynamics and DO Impacts – Carl Cerco, Attain and Richard Tian, UMCES (No presentation link, this was a verbal update to the Modeling WG.)
An update on the 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 and net nutrient flux out of the SAV beds, mostly as organics, in the winter season.
Discussion:
- Guido asked if the magnitude of the fluxes is aligned with what we know. Guido added that Kemp et al. 2005 has estimate of sedimentation simulation of denitrification sink and he is not sure if the paper applied to the current time.

12:20 Bay-Wide Nitrogen and Phosphorus Trends – Rebecca Murphy, UMCES
An update will be presented on work linking station-level Bay-wide nitrogen and phosphorus trends to changes in monitored watershed and below-fall line point source inputs.
Discussion:
- Lew asked if it would be worthwhile to include the nonpoint source since we have below the fall line estimate.
- Larry asked with regards to open Bay (mid and lower Bay), if it is possible to attribute the trends to a single dominant source or combine different potential source. Rebecca responded that it is not possible to attribute the trend to a single source. It is difficult to attribute point source and river loads down at lower mainstem Bay. Larry asked if is possible to optimize which point source is dominant at certain point. Rebecca responded that she used the model fit determine.

12:35 Watershed Phenological Response Analysis – Lisa Wainger, UMCES; Ciaran Harman, JHU; Amy Collick, UMES and Jeremy Testa, UMCES
Initial work on a phenology study looking at a broad picture of potential climate change policies needed in the Chesapeake watershed will be presented. The work is based on SWAT modeling of estimated farmer behavior in a small Chesterville watershed and looks at future climate risk outcomes.
Discussion:
- Julie asked about some example of weather driven BMPs. Lisa responded that state contingent scenarios and the farmers will be compensated for not able to drain.

- James mentioned that he is interested in applying different BMPs to control the loads and how to differentiate the source of the loads. He asked which suite of BMPs that were tested against of the loads. Lisa mentioned that the timing of seedling of cover crop. Ciaran added that in this model there was no change in the amount of fertilizer that were applied by farmers and no change in amount of deposition, and the only change is the timing of farming activities and rainfall. The increase in loads is from fertilizer but not from deposition.
- Gary mentioned the results of eastern shore estuary is heavily influenced by the rest of estuary not just the local watershed. Susquehanna is more influential in Chester and Choptank. This is also demonstrated by Rebecca's earlier presentation.

1:00 **Refinements to the CBP Summer Hypoxia Forecast Model – Isabella Bertani, UMCES**
Improvements to the CBP Summer Hypoxia Forecast Model will be presented. The refined CBP Summer Hypoxia Forecast Model will be applied to this summer's forecast. Discussion:
- Dave asked if Isabella used all RIM stations or subtracted some of the RIM stations. Isabella showed the total annual loads by river graph and she suggested that considering the amount from James it should not matter but she did not exclude the James loads.
- Lew recommended to reach out to communication team to receive help in communicating the message.
- Larry recommended incorporating forecast of wind direction. Isabella responded that it is worth considering for a longer-term project.
- James commented that if publishing the hypoxia prediction in June each year, then the timing to implement management actions to influence the hypoxia has passed.

Meeting Participants:
Cassandra Davis
Dave Montali
Isabella Bertani
Mukhtar Ibrahim
Lew Linker
Richard Tian
Gopal Bhatt
James Davis Martin
Arianna Johns
Norm Goulet
Raleigh Hood
Carlington Wallace
Lora Harris
Carl Cerco
George Onyullo

Gary Shenk
Rebecca Murphy
Danny Kaufman
Bruce Michael
Clint Gill
Mark Bennet
Ted Tesler
Luke Frankel
Lee McDonnell
Larry Sanford
Breck Sullivan
Greg Bush
Annabelle Harvey
Yeonjeong Park
Jesse Bash
Julie Reichert-Nguyen
Jeremy Testa
Peter Claggett
Sarah McDonald
Karl Berger
Kyle Hinson
Tammy Zimmerman
Jeni Keisman
Amy Collick
Xia Xie
Ciaran Harman
Lisa Wainger
Jim George
Qian Zhang
Marjorie Friedrichs