Modeling Workgroup Quarterly Review
July 7, 2020

Event webpage:
https://www.chesapeakebay.net/what/event/july_2020_modeling_workgroup_quarterly_review

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

10:10 Fine-Scale Chesapeake Regional Hydrology Model (CRHM) Development – Gary Shenk (USGS-CBPO), Gopal Bhatt (Penn State), Jeffrey Chanat (USGS), and Joseph Zhang (VIMS)

The presentation provided progress updates on the aspects of (a) the development of fine-scale distributed hydrology model of the Chesapeake Bay watershed at NHDplus catchment scale, (b) the hydro-ecological analysis of daily observed and simulated streamflow for hydrologic indicator and aquatic habitat and living resource modeling and prediction, and (c) the linkage of fine-scale distributed hydrology simulation with SCHISM (Semi-implicit Cross-scale Hydroscience Integrated System Model) estuarine model and initial findings.

Discussion:

- Lew raised concerned with the sparse blocks in the Shenandoah region on the NHD catchment and asked if there is any plan to correct it.
    - Gopal responded that he emailed Scott Ator and Andrew and they told him that this is not an artifact. He added that Peter and Gary were pulling together a statement regarding that watershed.
    - Scott added that this artifact was there when NHD was orginially created from the USGS quadrangle maps and those happened to be quadrangle maps that were just mapped it.
- Lew pointed out that with phase 6 version of the models that we were able to map finer scale outside the watershed with MD, VA and DE. He added with NHD plus version it would be strictly within the Chesapeake Bay Watershed.
    - Gopal responded that we were able to take advantage of gating stations that co-located in the county, but he was not sure if that is feasible this time.
    - Gary added that he would need to investigate to be sure of this.
- Dave asked if there are any generic reasons why inherent high bias when simulating smaller watershed.
    - Gopal responded that he noticed that biases is positively biased that we get higher flow most of the smaller scale basis. This will include looking through some of the codes that were put together for this analysis.
- Guido asked if the same calibration methodology used in Phase 6 was applied to the NHD model.

- Gopal responded that this would be the default method but Jeff will talk more about eco flow method later which may provide new insight on model calibration.
- Guido asked if this model has not been calibrated and just passed the parameter from phase six to the NHD plus model. Gopal confirmed.
- He added that this is the reason that you are not having a good calibration in smaller rivers is that calibrations have not performed yet.

11:10 **High-resolution Landscape Characterization to inform the Next Generation of Hydrologic Models – Peter Claggett, USGS**

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

Discussion:

- Norm pointed out that we may have multiple high resolution hydrography here and he asked if there is any concern with this.
  - Gary commented that this is an exciting database and he thinks we are the first to incorporate that amount of data into hydrologic model. He added that it is still unknown how to perform simulations. He commented that the model will incorporate important information as soon as we can but the full meaning of this new type of data for hydrology and nutrient transport in Chesapeake will take several versions of the models to understand.
  - Gopal added that there will be opportunity to apply finest resolution to the model just as the way with the land cover data for the hydrography as well.
- Karl pointed out that more precise hydrology and precise geology is available but some inputs at the same level of resolution like BMP locations will not be available.
  - George added that the reason DC developed the NHD at the 1 to 2400 scale is to use the outcome to inform the BMP implementation.
  - Gary added that the difficulties is to have a TMDL model where implementation of BMPs can be accounted in a fair way and also provides information at a very fine scale.
- James Davis Martin asked if Peter is drawing watershed around those streams or just stream network being produced.
  - Peter responded that FACET tool will generate high resolution and streams network at 2k catchment scale.

    - George added that at that scale a lot of ground trooping work will be needed to verify that information.
- James asked if the need for directionality of flow is relatively easy with LiDAR.
    - Peter responded that this is a derivative of FACET.

11:40 **Development of NHDplus Inputs for the Fine-Scale Chesapeake Regional Hydrology Model (CRHM) – Isabella Bertani, UMCES**

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

12:00 **IDF Curve Development for the Chesapeake Watershed– Arthur DeGaetano, Cornell U.**

Art will presented the recommended approach to IDF development for current and future time periods to help Modeling Workgroup understand the similarities and differences in the methods that the Cornell-RAND team is using for the future precipitation estimates for IDFs, and the methods CBP uses for future precipitation estimates for climate risks to the Chesapeake TMDL.

Discussion:

- Dave mentioned that a question was asked during the joint Workgroup meeting before and after period. He asked the WG thinking about the future climate work, if there is any emphasis that need to be placed on the periods that we dealt with the 30 year periods and the past work. He added that if there is value in keeping those periods like from 1995 to 2025 or 2025 to 2055 when we perform a refined climate assessment in 2025.
    - Art added that knowing this information at this stage of his research will be very helpful.
    - Lew added that the Bay Program has the different perspective and would want information by county so that it can be implemented at the appropriate local scales and near field information. He added that currently we are on 2025, 2035, 2045 and 2055 periods.
    - Art responded that information by county is doable but specific points from the model because the uncertainty will be added and precision and accuracy will be compromised.
    - Norm added that based on the comments he received, it was almost unanimous that people looking for county level information.
    - Art added that with this work he will look more specifically at sub daily rainfall intensities. Shortern duration will influence the Bay Program need.
- Art added that regarding the period, he will be looking into longer period of time in order to look at the extreme so 10 years are too short.
- Mark commented that increment can be 20 or 30 years but you can still work with a wider period of data. To Norman's group, the intent was to provide information that would be useful to the people that are implementing BMP and I would think that that's looking at information that is 80 years away which may not be useful for people implementing BMPs.

- Gary pointed out that he thinks of it as new ideas about how we should probably create our data sets, it wouldn't be exactly the same endpoints .

12:30 **Comparison of Modeled and Monitored Nutrient Trends – Gary Shenk, USGS-CBPO; Isabella Bertani, UMCES; and Gopal Bhatt, Penn State**

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

Discussion:

- Dave asked about the reason why AST lines goes down kind of reflecting instant credit but then going back up.
- Olivia responded that it is that a number of locations where there was a decrease in BMP implementation reported by the states and included in this scenario in 2019 compared to 2018.
- James commented that implementation could be at a constant level, but because you're losing previous years implementation due to credit duration. The implementation could be steady, but appearance is would be a reduction.
- Olivia responded that it is one possible explanation.
- Norm mentioned a question for the watershed technical WG to think about is what kind of percentage of BMP so we actually losing a year.
- Oliva responded that that information was shared with the watershed technical work group at the end of the 2019 progress and they were shown which BMPs, they would have gotten credit for if they had inspection dates compared to those that they did not get credit for that reason. This information has been shared with them before but they didn't have much discussion about this. She added that reporting differences that changes in state tracking systems can result in some anomalies that are probably not there on the ground but show up in the data that are recorded, which is particularly true with VA.
- James commented that the idea of lag times. A lag time is what was measured in 1985 is really representative of what was done in say 1905. He added the concept of calibrating to monitor. Within the calibration period, whatever else was going on the landscape was baked into that calibration we tuning the model to match what's measured. He asked shouldn't lag time be baked in as a result of the calibration.
- Gary responded that what is that calibration is really concentrating on the spatial distribution of loads based on physical factors. When we were doing the calibration, it was a calibration of the dynamic model. So there was a lag in there was calibrated. Essentially we are calibrating to those lag data, but primarily the calibration. We don't have much that will tune the trend. The thing that creates the trend in CAST is our land uses and BNP is inputs and none of those are tunable parameters.

- Jeff asked how to model deviations from the CAST model. Gary responded that they are all assembled in cast. We need to make sure that there are pulled out by station and that we've got like the right stuff that we want and that you have the same stuff that we have.

1:00 Future Directions and the Importance of Scale in Estimating Atmospheric Nitrogen Loading to the next generation Chesapeake Bay Model – Jesse Bash, EPA-ORD

To provide relevant inputs to the next generation of watershed/water quality models, the U.S. EPA's Community Multiscale Air Quality (CMAQ) model has a new land use specific deposition option. Additionally, the land use specific dry deposition results will be mapped to higher resolution versions of the CMAQ land use data, 30-meter NLCD data, to parameterize finer scale atmospheric deposition rates for inputs in the next generation of high-resolution water quality models.

Meeting Participants:
Cuiyin Wu
Patrick Thompson
Lewis Linker
Mukhtar Ibrahim
Bill Keeling
Gopal Bhatt
Norm Goulet
Olivia Devereux
Joseph Zhang
Gary Shenk
John Brakebill
Kyle Hinson
George Onyullo
Bruce Michael
Dave Montali
Ted Tesler
Clint Gill
Isabella Bertani
Arianna Johns
Mark Bennet
Guido Yactayo
Lisa Beatty
Rebecca Murphy
Jeff Chanat
Kristin Saunders
Richard Tian
Jeni Keisman
KC Filippino
Isaac

Scott Ator
Emily Trentacoste
James Martin
Breck Sullivan
Greg Bush
Peter Claggett
Cassandra Davis
Sam Merrill
Arthur Degaetano
Karl Blankenship
Julie Reichert-Nguyen
Lee McDonnell
Luke Frankel
Marjy Friedrichs
Qian Zhang
Jeff Sweeney
Monet Kim 3rd
Carl Friedrichs

Modeling Workgroup Quarterly Review

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

10:10 Application of the Refined Hypoxia Forecast and Exploration of Future Directions – Isabella Bertani, UMCES

In 2020, the hypoxia forecast model was updated and refined through a collaborative effort by scientists at the University of Michigan, UMCES, VIMS, and CBP. The enhanced model now provides hypoxia projections for an average July, average summer, and total annual hypoxia volume, and is based on nitrogen inputs from the entire watershed and tidally discharged point sources. Approaches to further refine the Hypoxia Forecast for next year will be explored.

Discussion:

- Lew asked if ongoing communication about hypoxia forecast and look back is possible.
- Isabella responded that Bruce Michael and a few other people to try and coordinate how to provide communication but wont be like updates of forecast here but MDNR always provide update at the end of the summer assessment.
- Bruce responded that MDNR reported to the public on a cruise by cruise hypoxia which is based on the Bay interpolate model and compared to hypoxia level with the historic month. There is also an end of year summer hypoxia assessment.
- Marjy also recommended to have a consistent report all along the summer to keep interests on the bay. It would be confusing for the public to receive two hypoxia forecast on the bay.
- Bruce added that MDNR is willing to work with others to have a consistent methodology.
- Mark Trice added that they can also provide hypoxia for the VA portion which is not very difficult to do.
- James hypoxia product should be a communication piece and be able to support implementation and educate the public on what is driving the hypoxia which should be leveraged to promote implementation.
- Gary added that this effort should coordinated with STAR as well.

10:25 STAC Climate Change Technical Synthesis Shallow Tidal Water DO Dynamics – Jeremy Testa, UMCES

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

Discussion:

- Gary asked how this detailed formal analysis were in the time dimension, how to group different estuaries based on physical characteristics of the estuary and if he has thought about that same kind of question for the average do and not just the variation.
- Jeremy responded with Mark Trice's help, he is able to come up with a number of variables that represent each station. More investigation is needed on how to group the stations. He is also looking at the oxygen concentration and percent saturation to remove the tide.
- Raleigh asked about the wind effect being so regional like in the Patapsco Annapolis region. He asked if that is a particularly windy area or is there a lot of variability in the wind in that area. Jeremy was not sure but he speculated this is related to the wind direction.
- Bruce mentioned MDNR is staring the phase 2 of the shallow water monitoring program. He asked if there are any areas that additional data or more information is needed and how you would like to strategically place are shallow water monitoring.
- Jeremy responded several criteria. If the stations are meeting the criteria most of the time and what are the features of those stations. He added maintenance of time series should also be considered.

11:00 **Refined Analysis of Tidal Bay Nutrient Limitation and Potential Applications to the 2017 Bay Model – Qian Zhang and Richard Tian, UMCES and Lew Linker, EPA-CBPO**

The importance of nutrient limitation to Bay Model calibration and as applied to broad CBP policy such as the Watershed Implementation Plans (WIPs) will be discussed and the basis of a refined nutrient limitation analysis will be presented. An application of examining estimated nutrient limitation of key scenarios such as the WIP3, No Action, and Progress Scenarios was described.

Discussion:

- Gary commented that Mike Kemp's map inform the N to P ratio in the model and this work can look through time to make sure that the next generation model is able to meet those different time periods of limitation, because this is kind of an extremely important.
- Dave commented that this work will help with generation model and there will be no changes made to phase 6 model. Lew agreed.
- Dave asked if N would have more importance on the model than phase six. Qian said this work does not make any inconsistency with the phase six.

- Raleigh was concerned with overfitting the data with CART model if you have too many degree of freedom. Qian said he was aware of this when trying different models and he performed cross validation.
- James commented the CAST 2019 will be approved this week but he commented that in the cast 2017 model, particularly for Virginia a lot of BMP data was missing.

11:30 **SAV Nutrient Dynamics and DO Impacts – Carl Cerco, Attain and Richard Tian, UMCES**

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

11:45 **Co-Benefits Module for WMOST (Watershed Management Optimization Support Tool – Naomi Detenbeck, EPA Atlantic Coastal Environmental Sciences Division and Emily Trentacoste, EPA-CBPO**

A co-benefits module for WMOST is under development and will provide a considerable head start for the CBP development of CAST co-benefit estimates. Naomi will give a broad overview of the new WMOST co-benefits module and Emily will describe the initial work in the CAST co-benefit effort.

Discussion:

- George pointed out the limitation of the tool with respect to the HUC size and he recommended to have utility with DC they should consider downscale the information.
    - Naomi responded the calculation can be scaled up or down and WMOST can be applied to finer scale.
- James commented that local government advisory committee is interested in cobenefits at the finer scale, such as flood mitigation.
    - Naomi responded that flood risks and costs are already quantified or can be quantified in the WMOST.
- James asked which BMPS is the same suite of practices that we have in our models that are in WMOST.
    - Naomi responded that most urban BMPs is covered but limited ag BMPs.
    - Gary added that cross walk between CAST and WMOST should be detailly investigated.
- Dave asked about about land conservation and in WMOST is it forest conservation that's explored and or farmland conservation. This is my first question.
- Naomi responded that in terms of the benefits quantification, WMOST focused more on green space aspects.
- Dave asked if the benefit from green space weighted higher in areas where there are there's already less green space versus those where there's an abundance.

- Naomi responded for this is correct for the benefits that are related to population density or building density. Property values is also factored in the equation.
- James asked why there is less Ag BMPs in the WMOST.
- Naomi responded that when WMOST first started, it was focused on green infrastructure stormwater BMPs so the calculation is to link SWIM model.

12:10 ADJOURN

Meeting Participants:
Cuiyin Wu
Carlington Wallace
Richard Tian
Dave Montali
Mukhtar Ibrahim
Clint Gill
Norm Goulet
Gary Shenk
Kyle Hinson
Rebecca Murphy
Arianna Johns
Lewis Linker
Mark Trice
Raleigh Hood
James Martin
Isabella Bertani
Marjy Friedrichs
Richard Tian
Guido Yactayo
Breck Sullivan
Greg Bush
Bruce Michael
George Onyullo
Qian Zhang
Luke Frankel
Karl Blankenship
KC Filippino
Ted Tesler
Jeremy Testa
Jeni Keisman (USGS)
Jim George
Emily Trentacoste
Kristin Saunders
Olivia Devereux

Larry Sanford
Naomi Detenbeck
Sam Merrill
Yeonjeong Park
Mark Bennet
Gopal Bhatt