

Modeling Subcommittee Quarterly Review Meeting (MSC) April 04-05, 2005

Minutes can be found at:

http://www.chesapeakebay.net/pubs/calendar/MODSC_04-04-05_Minutes_1_5932.pdf

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Gary Shenk (EPA CBPO) updated the subcommittee on the sediment calibration for the CBP model. Rainfall data was updated in order to provide more accurate point estimates of rainfall, rather than area rainfall. A hydrology calibration iteration was run using these data sets and overall model efficiency decreased slightly. An iteration run with the new land use and old rainfall data resulted in an improvement in model efficiency and will be used as the final hydrology calibration.

Edge of field sediment is multiplied first by a best management practice factor, then by land use acreage, and finally by a delivery factor to produce the edge of stream estimates. The delivery factor accounts for attenuation of nutrient loads as it travels over land.

Sediment is modeled as detached sediment or sediment within the soil matrix. Detached sediment is created from the energy of raindrop impact and is then available for wash off by surface flow. Detached sediment is reattached to the soil matrix on days without rainfall.

In order to obtain a realistic simulation, calibration rules were set-up such that sediment accumulates asymptotically so that it reaches 90% of its maximum in 30 days and is reduced to about zero after large storm events with a return frequency of about 4 months. Calibration will be completed in about two weeks once the final hydrology parameters are available.

Phase 5 model segments contain many land uses that are distributed at different lengths from the river. To derive a unique delivery factor for each land use in each segment, the average distance to stream for a given land use in a segment is conceived as the radius of a circle.

In-stream sediment transport simulation includes scour and deposition to the riverbed. Deposition is controlled by a low shear stress and settling velocity while scour is controlled by high shear stress and erodability. Currently, there are 50 data stations available for calibration purposes with approximately 200 more stations to be added soon.

Jeff Sweeney (UMD CBPO) updated the subcommittee on the Phase 5 BMP efficiencies for the CBP model. Currently there are 20 agricultural, 12 urban and mixed open, 1 forest, and 3 septic BMP's applied in Phase 4.3 There are an additional 8 agricultural, 7 urban and mixed open, and 2 forest BMP's needing peer review for application in Phase 5.

Jurisdictions report BMP's at different spatial scales, from statewide to a point location. In Phase 4.3, BMP's were distributed to county segments, whereas they must be redistributed to Phase 5 as land-river segments.

BMP's fall into several broad categories. They can be implemented in the model as adjustments to input data (such as reduction in atmospheric deposition or point source discharges) or after the land simulation for management practices.

BMP's that alter nutrient applications to cropland include diet and feed changes, manure transport, and nutrient management plans. In Phase 5, all nutrient management plans will be assumed to be nitrogen-based. For chemical fertilizer application rates, in Phase 4.3, these were provided by state agricultural agencies and for Phase 5, fertilizer sales will be examined to determine application rates.

BMP's with nutrient or sediment reduction efficiencies include conservation and nutrient management plans, storm water practices, erosion and sediment controls, and stream restoration.

Robert Burghlozer (UMD CBPO) gave a presentation on the simulation of manure for the model. There are several differences in the way manure is modeled between Phase 4.3 and 5. Manure collected in enclosures or barnyards is either applied directly to crops or goes into storage for spring and fall application. Manure in barnyards and cropland is available for runoff or volatilization. Manure in enclosures and uncollected manure in pastures is also available for volatilization.

Livestock population numbers for both Phase 4.3 and 5 are obtained from the Ag Census. In Phase 5, Ag Census data prior to 2002 were adjusted in order to reconcile the 2002 numbers with previous census values. This led to an increase in livestock numbers, with broilers having the largest changes with increases ranging from a 1% in VA to 19% in PA.

Phase 5 animal classes were increased over Phase 4.3 to better represent growth stage and production rates. Phase 4.3 livestock classes included beef, dairy, swine, layers, broilers, and turkeys. All Phase 4.3 animals were assumed to be full grown. Phase 5 livestock classes capture the effects of animal age, sex, and weight on production rate and nutrient content of manure. This will impact overall rates of nutrient application to cropland, as well as distribution from county to county.

Manure nutrient content may vary over time due to rates of adoption of feeding supplements (such as phytase), implementation of precision feeding practices, and regional variation in animal type or feed source.

Livestock stream access areas are a new Phase 5 land use (subset of pasture acres where livestock have access to streams). These areas will receive higher manure loads than other pasture due to high concentration of animals in these areas.

Manure application timing in Phase 5 varies to reflect differences between crop types and regional differences associated with seasonality.

Howard Townsend (Oxford NOAA Lab) gave an overview on the Chesapeake Bay Fisheries Ecosystem Model analysis of base and tributary strategy conditions. The Ecosystem Model (CB FEM) is a fisheries oriented trophic network model for the Bay using the Ecopath with Ecosim software. There are four components to the software:

1. Ecopath is used to organize historical data on trophic interactions and population sizes and is governed by two main mass-balance equations. Production equals the sum of predation, fishing, other mortality, biomass accumulation, and net migration. Consumption equals the sum of production, unassimilated food, and respiration.
2. Ecosim builds on Ecopath by combining this data with foraging arena theory to produce dynamic predictions of changes in fish populations due to changes in fishing or environmental regimes.
3. Ecospace builds on Ecopath and Ecosim to address spatially explicit population modeling questions. Cells are linked through dispersal of organisms and fishing effort movement.
4. Ecotrace is used for exploring ecosystem effects of persistent pollution by tracing the accumulation of pollutants through the food web.

The Ecopath module has been completed for the Bay watershed and contains 45 trophic groups with 218 diet links. The Ecosim module has been calibrated with data from 1950 to the present.

As a first step towards coupling the Water Quality Model (WQM) with the Fisheries Ecosystem Model (FEM), a comparative analysis of variables common to both models, is being completed. These variables include: phytoplankton, zooplankton, SAV, benthic suspension feeding invertebrates, and benthic deposit feeders. For the tributary strategy run, both models showed similar patterns for the effects of N & P reductions on living resources, but differed in magnitude.

Upper level trophic responses to nutrient reductions were also examined with the FEM and the results showed moderate decline in striped bass and menhaden populations and minimal changes in blue crab and oyster populations. These results do not consider changes in food web dynamics or non-trophic interactions, but do show some promise for developing model linkages.

Lewis Linker (EPA CBP Modeling Coordinator) presented air scenarios for the 2007 CBP reevaluation. Funding for 8 scenarios of nitrate and ammonia deposition to be run. [THE PREVIOUS PHRASE IS UNCLEAR] A list of key scenarios should be prepared for the reevaluation. 6 potential scenarios were presented to the MSC and results are available at...

Carl Cerco (US Army Corps of Engineers) presented the Menhaden and Living Resource Modeling, using an individual based Lagrangian approach (IBM). Menhaden are modeled as particles that can move from cell to cell. At each location, the properties

of the fish (size, temperature, respiration) and environmental conditions into a bioenergetics model which calculates mass fluxes. The main advantages to this modeling approach are the quick turnaround time for model development, the dynamic coupling to CBEMP which makes it available for management scenarios, and the potential for interactions with other investigations. **However, K. Sellner (STAC rep) noted that this modeling effort ignores on-going menhaden modeling funded by CBP as well as the menhaden projects soon to be funded through the recent NCBO RFP (total funds might approach \$1.5M); he recommended delay until the CBP modelers had consulted with PIs from these other projects to encourage collaboration in the modeling activity.**

The wetlands module is a dynamic, process-based sub-model that interacts with the water column similar to the sediment diagenesis sub-model. The initial emphasis of this model is on tidal freshwater areas. Location and sizing of wetlands will be critical to this task. Processes that will be included are macrophyte production, burial, and denitrification. Accounting for wetlands will be crucial when data from the Shallow Water Monitoring Program becomes available. **Results (UMCES, VIMS?) from recent wetland/marsh work should be forwarded to Cerco/Linker for consideration.**

Jeff Cornwell & Walter Boynton (UMCES) both gave an overview of their study of phosphorous forms and rates and mechanisms of phosphorous release from tidal fresh Potomac River sediments. This work is the first to provide denitrification data for the upper Potomac River. Field and lab work occurred from April to October 2004. *In situ* sediment flux measurements and pore water profiles were taken over a 45 mile transect of the River. Surface sediment samples and water column profiles were also taken.

Most P in the sediments is adsorbed to iron oxides and clay particles. There are several ways that P can be released from the sediments. Lowering the redox level of iron oxides as well as high pH levels will release the adsorbed P. This pH-driven mechanism of P release can create a positive feedback loop that intensifies algal growth. Algal blooms can cause pH to rise. Wave action and tidal resuspension can bring P-rich sediments into the high pH zone of the algal bloom leading to a release of P into the water column. The available P, in turn, can further enhance growth of the bloom.

Inorganic P makes up to about 50-70% of the total P in the Potomac. This proportion increases in coarser sediments. Literature shows that P flux increases sharply with increasing temperatures. Highest P fluxes occur at moderate depths, between 5-10 meters, and in areas of moderate salinity, between 5-10 ppt.

Measurements made in 2004 show fairly low ambient P flux in the Potomac. Lab experiments measured P flux under ambient conditions, and also at elevated pH levels. Next steps in this research will examine resuspended sediment as a source of P. The effects of ammonium chemistry will also be examined.

Other ongoing work funded through MWCOG and Limno-Tech is aimed at providing P speciation/cycling data support model development. These studies will help develop an

understanding of the influence of particulate inorganic P on water column biogeochemistry and algal growth. **STAC or research community input here?**

Carl Cerco (US Army Corps Engineers) gave an update on the Water Quality Model (WQA) and Oyster Simulation status. The final report is nearly complete and will be examined by a review panel. 7 of the 10 *ariakensis* scenarios were completed in December 2004. Current status of fieldwork supporting the Water Quality Model was reviewed:

- Erosion rates – The first year of fieldwork is complete. Second year surveys have begun and will continue through 2005.
- Light attenuation – The first year of fieldwork is complete. Second year has begun.
- Estuarine phosphorous model – Major efforts in 2005 will be field work and literature review.
- Bank loads – MDE has contracted Jeff Halka to add to existing work to include bank load volume. A simplified approach based on existing information will be adapted for VA.
- Alkalinity pH – Substantial fieldwork was conducted in 2004; however, there is currently no funding for modeling activity.
- Algal speciation – MWCOG is exploring potential funding sources but currently there is no activity in this area.

Carl Cerco (US Army Corps Engineers) gave an overview on the Hydrodynamic Model calibration and Wave Model Development. Preliminary results simulating salinity in the main stem and the Potomac showed problems. This was remedied by revising the model's bathymetry. The hydrodynamic model currently runs from 1993-1999 and the year 2000 is in preparation. Results of initial linkage of the water quality model to the hydrodynamic model will be presented at the July meeting.

Wave Model Development was based on work done by I.R. Young and L.A. Verhagen in which wave energy and period for Lake George were expressed in terms of depth and fetch. Wind data was obtained from NOAA archives. Wave height and period were calculated for the Bay and compared to monitoring data from Thimble Shoal. Model results for wave height were in general agreement with the monitoring data. Model results for wave period were generally much lower than observed wave periods. More data for the upper Bay is needed for calibration. Ultimately this wave model will be incorporated into the benthic boundary layer model.

Urban Stormwater Workgroup (USWG) February 15, 2005 meeting

All powerpoint presentations and handouts can be viewed online at <http://www.chesapeakebay.net/calendar.cfm?EventDetails=5749&DefaultView=2>

Gary Shenk (EPA CBPO) gave an overview presentation of the watershed model, explaining what's new and the results of a recent Penn State study (see below).

Phase 5 changes include: the calibration software developed for the Chesapeake Bay Program is more user-friendly, the simulation timeframe has been extended from 1984-1997 to 1999, and the rainfall data for 2000-2003 will soon be available (obtained from 500 daily and 200 hourly stations); more reservoir data [UNCLEAR] (40) simulated. They have also automated the calibration for hydrology and are beginning to set up the same for sediment.

The intention of the Penn State study was to use data from a field study to predict edge of field loads from urban lands but according to the research, loads decrease with urbanization. The Center for Watershed Protection and the University of Indiana may have information on Phase I loads. Lewis Linker (Chesapeake Bay Program Modeling Subcommittee Coordinator) developed a graph that indicated sediment loads are proportional to imperviousness. **The calibration of sediment in the model is ongoing. The nutrient calibrations will be finished this summer. The phase 5 model is available online at <http://ccmp.Chesapeake.org>**

Tributary Strategy Workgroup BMP Special Session March 7, 2005 meeting

All handouts and powerpoint presentations can be found at <http://www.chesapeakebay.net/calendar.cfm?EventDetails=5734&DefaultView=2>

Jeff Sweeney (UMD) presented the current Best Management Practices (BMPs) in the watershed model. MD and VA are using Phase V for TMDL modeling. There is no historic BMP implementation data from NY, DE, DC, and WV. A calibration issue of the model is that it already underestimates the load without BMP's, so when BMPs added, the load will be reduced even lower levels. Currently the model does not have the capacity to go beyond the county level, but county data and river segments can be overlaid to create land-river segments. The model in the near future will have the capability to simulate these segments. The four types of BMP's were discussed and many other issues addressed during this presentation. Please see the website above or contact Jeff at jsweeney@chesapeakebay.net for additional detail.

Russ Mader (Chesapeake Bay Program Nutrient Coordinator) presented the new BMPs associated with the watershed model. Maryland has concerns with plan implementation, nutrient management, and manure transport adjustments and requested further discussion before any recommendations are made. For the highlights of his presentation, please check out the website listed above.

For the current BMP adjustment recommendations presented by Russ at the May 02 TSWG meeting, please view the presentation at <http://www.chesapeakebay.net/calendar.cfm?EventDetails=5735&DefaultView=2>