STAC review of the Water Clarity and SAV components of the Chesapeake Bay Program Water Quality and Sediment Transport Model

March 9-10, 2010
Final Report

Introduction

Late in 2009, the Chesapeake Bay Program (CBP) requested that the Scientific and Technical Advisory Committee (STAC) formally review the updated water clarity and Submerged Aquatic Vegetation (SAV) components of the estuarine Water Quality Sediment Transport Model (WQSTM). The objective of the review was to determine the suitability of these components for setting tidal sediment and nutrient allocations as part of the Total Maximum Daily Load (TMDL) process.

In early 2010, STAC began to plan for the review, to be performed by a 5-member independent panel which would be informed by CBP modelers and through discussion with the broader Bay scientific community. The review was held on March 9-10, 2010, at the Joe Macknis Memorial Conference Room of the Chesapeake Bay Program Office, 410 Severn Avenue, Annapolis, MD. The panel members were Dr. Lawrence Sanford (chair), Dr. Michael Kemp, Dr. Kenneth Moore, Dr. Christopher Madden, and Dr. Zhongping Lee. Other Bay experts participating in the open discussion during the first day of the review included Dr. Carl Friedrichs, Dr. Jeffery Halka, Dr. Christian Jones, Mr. Lee Karrh, Dr. Evamaria Koch, Dr. Robert Orth, Dr. Nancy Rybicki, Mr. Christopher Spaur, and Mr. Mark Trice.

After the open discussion ended, the panel deliberated in consulation with modelers Dr. Carl Cerco and Dr. Charles Gallegos in the late afternoon of March 9, and in closed session on March 10. Logistical support was provided by Ms. Elizabeth Van Dolah and Ms. Melissa Fagan through the Chesapeake Research Consortium. Preliminary materials, presentations and this report are be posted online at http://www.chesapeake.org/stac/savmodelreview.html.

Background

The CBP must set nutrient and sediment allocations for watershed and tidal waters by the end of 2010. Various modeling components will be used to set these allocations for different parts of the watershed and estuarine waters, and most of these components have undergone independent review to assure that they are sufficient for this purpose. The newly developed CBP WQSTM sediment transport components were reviewed in 2008 and subsequently approved by the CBP Modeling Subcommittee. Application of the WQSTM towards predicting changes in water clarity and SAV coverage in response to management actions was not reviewed at that time.

In early 2009, the CBP expressed the need for STAC-sponsored workshop(s) on tidal sediments, specifically addressing the need to set tidal sediment allocations towards reducing nearshore turbidity and increasing SAV acreage. STAC held a mini-workshop in May 2009 to make initial recommendations towards this end, attended by approximately 25 regional experts on tidal sediments, clarity, and SAV. Presentations and the workshop report are posted online at http://www.chesapeake.org/stac/tidalsediment.html. The present formal review is a direct follow-on to the May 2009 workshop, considering CBP modeling efforts since then as well. The results and recommendations of the May 2009 meeting provided a starting point for this review.

Agenda

Tuesday, March 9

9:30 AM	Call to order, organizational notes, introductions – Larry Sanford, Liz Van Dolah
9:40 AM	Background – Larry Sanford
10:00 AM	CBP needs for the SAV/clarity simulation – Lewis Linker
10:15 AM	Coffee Break
10:30 AM	Developing clarity estimates from first principles – Chuck Gallegos
11:00 AM	Discussion
11:30 AM	Shallow water light attenuation observations and simulation – Carl Cerco
12:00 PM	Discussion
12:30 PM	Lunch
1:00 PM	SAV model structure, calibration, and simulations – Carl Cerco
1:45 PM	Discussion
3:00 PM	Break; open discussion ends
3:30 PM	Review panel meets
6:00 PM	Dinner; panel discussion continues
8:00 PM	Panel adjourns

Wednesday, March 10

9:30 AM	Review panel meets; drafts conclusions and recommendations
12:00 PM	Working lunch
12:30 PM	Review panel completes conclusions and recommendations
2:30 PM	Adjourn

Review and Recommendations

The panel was asked to respond to specific questions posed by Lewis Linker. Because of looming program deadlines and logistical delays in scheduling the review, the panel was also asked to respond as soon as possible. The panel's review and recommendations are presented below as short, direct responses to Dr. Linker's questions in an effort to provide a timely, succinct response.

Question 1

Are the current shallow water SAV and clarity simulations sufficient to evaluate allocations needed to meet the Chesapeake Bay SAV/ water clarity standards?

Response to Question 1

A. While the underlying optical model is robust, its translation into water clarity in the shallows results in an underestimation (approximately 50%) of light attenuation compared to observations. This needs to be addressed before the model is applied for the TMDL process. Corrected clarity simulations may improve the SAV simulations significantly, so should be addressed as the top priority.
B. Based on previous model presentations, we assume the simulations of SAV growth potential (with corrected clarity simulations) are sufficient for evaluating allocations. Growth potential refers to establishment of conditions favorable to SAV growth, which may or may not be reflected in restored SAV area.
C. The SAV area predictions in most cases do not agree with the historical observations of SAV area or trends. The probability based approach used to make the model output better fit the patterns in the observations appears arbitrary; a different approach is needed. The SAV area simulations are not ready for use in the TMDL process.

Question 2

Are there short term tests that can be recommended?

Response to Question 2

A. For water clarity, compare predicted shallow water Chl and TSS with shallow-water observations to isolate sources of error. If the Chl and TSS comparisons are good, then focus efforts on light attenuation calculations. If Chl and TSS comparisons are not good, then focus efforts on Chl and TSS predictions in shallow waters.
B. Test changes in SAV biomass and area simulations in response to varying light attenuation in a sensitivity test, to see how much clarity change is needed for improved SAV simulations.

Question 3

Are there any specific improvements that can be implemented quickly in the existing shallow water clarity simulation or in the existing SAV model?

Response to Question 3

Yes, there are specific suggestions/recommendations for short term improvements in the water clarity simulations, but not for SAV acreage simulations. However, SAV predictions may be improved when water clarity issues are addressed. Specific suggestions include:

A. Adjust the CDOM component within a reasonable range.
B. Adjust sediment erodibility and settling velocity to improve TSS simulations in shallow waters.

C. Adjust shallow-water chlorophyll to account for benthic resuspension and enhanced productivity in the nearshore.

In all of these cases, appropriate adjustments might be made in either the SAV model cells or the WQSTM cells.

Question 4

What improvements can be made in the longer term for the next generation of shallow water simulation to assess SAV/water clarity? What are the research and monitoring needs to support these model refinements?

Response to Question 4

Our answers are presented separately for water clarity, SAV potential, and SAV area.

Water clarity:

A. Improve comparisons of spatial and temporal variation of modeled and measured (both in situ and satellite) light attenuation throughout the bay.
B. Eliminate binning in the look-up table and make more continuous functions.
C. Eliminate sharp boundaries created by bay segments.
D. Investigate effects of estimated particle size distribution and composition on optical and other components used in the model.
E. Improve estimates of local sources of CDOM and their potential effects on optical properties and attenuation in shallow water areas.
F. Expand monitoring to include under-sampled locations.

SAV potential:

A. Improve model relationships between TSS (particle size, organic content, etc.) and epiphyte loads (biofouling, periphyton).
B. Test the ability of the model to duplicate case study areas where there have been observed improvements in habitat conditions and SAV resurgence.
C. Quantify the effects of other stressors (salinity, sediment biogeochemistry) on SAV biomass dynamics.
D. Incorporate multiple species (including non-native) potential with species-specific physiology into each SAV cell rather than generic SAV.
E. Further develop SAV to habitat feedbacks.

SAV area:

A. Refine how bottom sediment properties affect species-specific SAV recruitment and survival.
B. Improve simulations of year-to-year variations in SAV species-specific recruitment potential including colonizer species.
C. Include biological disturbance components of mortality.
D. Refine relationships between SAV canopy height and SAV light requirements.

E. Revisit relationships between model predictions of SAV biomass and acreage, potentially based on spatially-explicit comparisons between observed acreage and predicted biomass.