Special Sessions for the 2018 Chesapeake Research and Modeling Symposium
Annapolis MD, June 12-14

Biogeochemical and Ecological Forecasting: Challenges and Successes
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Coastal biogeochemical and ecological forecasts are developed using knowledge of the hydrodynamics, biogeochemistry and ecology of a system and are used to predict how ecosystems will change in the future. Forecasts can be made for the short-term (hours to days), seasonally, or for the long-term (interdecadally) taking into consideration future climate change. In the Chesapeake Bay and other coastal ecosystems, multiple short-term modeling forecasts exist. For example, NOAA's Chesapeake Bay Operational Forecasting System (CBOFS) produces nowcasts and two-day forecasts of hydrodynamic variables such as water level height, temperature and salinity in the Bay. Forecasts of sea nettles, vibrio and hypoxia computed using a combination of logistic regressions and process-based models also exist for the Bay. Seasonal hypoxia forecasts are released each spring using empirical models, and mechanistic models are continually being used to predict what the future Chesapeake Bay will look like later this century. Ultimately, these forecasts will result in the availability of improved decision support products for the commercial and recreational use of the Chesapeake Bay. It is critical that such forecasts are generated through a process involving active engagement by stakeholders who are invested in Chesapeake Bay resources.

In this session we encourage researchers who are involved in generating and/or using coastal biogeochemical and ecological forecasts on any of these time scales. We also encourage contributions that explore how stakeholders can play a role in the generation, presentation and visualization of such forecasts and specifically invite presentations that link models with real-time data. Studies focusing on regions other than Chesapeake Bay are also welcome.

Understanding oyster trajectories: wild population dynamics, restoration and the role of aquaculture
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Oyster biomass in the Chesapeake Bay region has decreased dramatically over the last 100 years, driven by intensive harvest, habitat degradation, and disease. The benefits of robust oyster populations include increased benthic diversity, improved water clarity, and nutrient retention and transformation, services which have been compromised by diminished oyster abundance. Increasing oyster abundance has been an objective of resource managers, yet the means by which this may best be affected, and the scope of potential impacts and benefits, for example increased N removal, is not fully understood. The purpose of this session is to identify current data sets and understanding and to compare and contrast these to current small and large-scale modeling efforts. Topics could include controls on biomass and reproduction, effects of oysters on algal biomass and composition, use of oysters for nitrogen removal, and identification of the state of the art regarding oysters, oyster conservation and restoration strategies, and water quality.

Water Clarity in Chesapeake Bay: trends, drivers and research priorities

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Water clarity is widely recognized as an important indicator of the health and trophic state of aquatic ecosystems. The propagation of light through water affects biogeochemical cycles, the distribution of aquatic organisms, and aesthetic human judgments regarding the suitability of water for different uses. Patterns in water clarity are generally understood to be a function of a suite of conditions and processes, such as bed resuspension, shoreline erosion and sediment runoff, nutrient loads driving planktonic algae, and additional feedbacks driven by biological communities. However, in spite of a general understanding of what drives water clarity, explaining patterns in water clarity within and across different physical habitats remains a challenge. The goal of this session is to build on recent discussions of water clarity trends and their drivers, to inform conceptual and numerical for explaining observed patterns in water clarity within and across diverse estuarine habitats of Chesapeake Bay. We anticipate that the session will include presentations on spatial and temporal trends in water clarity, as well as the value of various physical and biological drivers in explaining those trends.

Understanding Nutrient Transport in the Chesapeake Watershed: Legacies, Lag Times, Mechanisms, Drivers and Solutions

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There is increasing evidence of widespread and significant accumulation of pollutants in the critical zone of anthropogenic landscapes, including excess nutrients from fertilizer and atmospheric deposition. Nitrogen (N) cycling has been well studied for decades, but little information is yet available in regard to transport times and storage within the watershed. Meanwhile, factors affecting the cycling and delivery of phosphorus (P) to streams and rivers have been less well studied and remain poorly understood, even while the transport, storage and residence time distributions of sediment-bound P (often a major portion of the load) are different and more complex than those for dissolved N species. This session includes presentations on the latest findings, empirical evidence and modeling approaches being used to understand and address mechanistic drivers and trends for N, P and other pollutants in the Chesapeake Bay watershed system.

Using environmental biomarkers to study Chesapeake Bay's ecosystems

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Chesapeake Bay's ecosystems are complex systems structured by a wide array of natural and anthropogenic factors. This complexity results in spatially variable environmental conditions and biological communities whose characteristics determine the identity and strength of ecological processes at multiple spatial scales. Low frequency dynamics that manifest over multiple years to decades interact with seasonal dynamics, driving temporal variability in estuarine ecosystems. Further, long-term directional trends due to anthropogenic disturbance underlie and influence the timing and magnitude of annual process cycles. Describing and quantifying environmental or ecological relationships across relevant spatial and temporal scales in an estuary the size of Chesapeake Bay becomes logistically difficult using traditional methods. Environmental biomarkers (including biochemical markers) offer a powerful suite of tools that scientists at institutions throughout the Chesapeake Bay region are using in conjunction with more traditional approaches to understand ecological connectivity, hydrology and biogeochemistry. Environmental biomarker approaches include relatively well-established techniques such as bulk stable isotope measurements, fatty acid profiles, and bioaccumulating contaminants (e.g., PCBs, Hg) as well as emerging techniques that include compound-specific stable isotope analysis, DNA barcoding, and optical characterization of dissolved organic matter pool constituents. This special session will provide an opportunity for researchers currently using environmental biomarkers to study Chesapeake Bay to highlight their efforts to the modeling community. We hope that this session will facilitate a dialogue between researchers conducting empirical studies with biomarkers and researchers in the modeling community and, by doing so, foster collaborations that will ultimately support better parameterized and more informative models of Chesapeake Bay's ecosystems.

Building useful decision support tools with monitoring and modeling data

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Data visualization and decision support tools are an important bridge between the scientific, management, and practitioner communities. A vast amount of observational and modeling data is available to managers throughout the Chesapeake Bay watershed to inform decisions, including those on restoration efforts, priorities, and resources. However, information needs to be consolidated, distilled, and often visualized in order to be understandable and accessible to managers. Tools can guide decision-making, explain complex processes, tell stories with case studies, visualize varying spatial scales, allow interaction with data, and much more.

This session will focus broadly on both visualization and decision support tools developed for use in managing coupled watershed/receiving water systems and especially those with special relevance to the Chesapeake Bay and its watershed. The session welcomes presentations on tools developed for those who benefit from using the data to inform decisions, such as managers, local areas, conservation practitioners, etc. Ideally presentations will showcase ways to interact with, visualize, and use monitoring and observational data as well as modeling data, including inputs, outputs, model processes, or the running of models. Discussions will include identifying ways to distill and visualize complex data for various users, building decision-support frameworks for using data, incorporating storytelling and management-relevant information into tools, and identifying complementary tools by the various organizations in the Bay watershed.

Evaluating current and future influences on James River Water Quality Condition

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James River is a western tributary of the Chesapeake Bay. Harmful algal blooms (HABs) have frequently occurred in both its upstream tidal fresh region and its downstream polyhaline and mesohaline regions, which have been attributed to excessive nutrient inputs from the watershed. However, the James River does not have a dissolved oxygen (DO) impairment like other tributaries, although its nutrient loads are high among Virginian tributaries. To accommodate future development of the region and improve transportation and navigation, construction of new infrastructure, including a new bridge tunnel, storm surge barriers, and channel deepening, has been planned in the James River. Considerable research, including field observations, data analysis, and modeling, has been carried out in the James to investigate the interactions of physical processes, biochemical processes, and human impacts on the ecosystem. In 2014, the State of Virginia decided to revisit the James River TMDL allocations by developing a site-specific James River water quality model, and to reassess the attainability of the chlorophyll-a criteria. In addition, the State convened a Scientific Advisory Panel (SAP) to review and confirm or adjust the James River chlorophyll-a standards. Evaluating current and future influences on the water quality conditions of the James is important so that decision makers can effectively manage the James River. We solicit speakers for all research activities, including observation, data analysis, modeling, engineering channel modifications, and estuary management using science and policy related to the James River. Speakers will highlight how scientists and decision makers can engage to solve environmental problems through observations, research, modeling, and managing to help identify mechanisms for targeted management actions.

Current State of Stormwater, Modeling and Research

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This Technical Session will provide an overview of the state of the art in Stormwater programs, modeling and research. It will highlight case studies, methods and programs from around the US as well as within the Chesapeake Bay watershed. The objective of this session is to support the conference theme by describing high performing Stormwater programs, monitoring approaches and research into BMP effectiveness. Improvement in water quality from MS4 discharges is a key element in the improvement of Chesapeake Bay.

Practical Advances in Regional Land Change Modeling: What's achievable now?

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Model developers are intimately familiar with the strengths and limitations of their models and often maintain short-term and long-term wish lists of analyses they would like to do or data they would like to obtain to improve their models. This symposium is focused on discussing the short-term wish lists of regional land change modelers in the context of the seven models that have been developed and applied throughout or in parts of the Chesapeake Bay watershed: SLEUTH, CBLCM, SPRAWL, Dinamica, SILO, and FORE-SCE, MDP Land Use Model. Modelers will present on and discuss realistic and achievable ways of improving current models over the next 3-5 years with a focus on the following topics:

- Land change simulation: population migration, agricultural land abandonment, silviculture, infill/redevelopment
- Land change consequences: ecological integrity, water quality, ecosystem services
- Big and/or new data: Google API- travel accessibility, Census-PUMS, Census-LEHD, IRS-migration, high-res land use/cover, LCMAP annual land cover change
- Open source software and computer languages: Python, R, C, Java, QGIS, SAGA, Apache Hadoop

Change in the Chesapeake: Moving Toward Finer Scales In Estuarine and Watershed Modeling

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This session examines new approaches in Chesapeake Bay Program management taken to respond to finding solutions in watershed and estuarine modeling and decision making at fine scales. Ongoing advances in computational power, data availability, and the interest of decision makers to resolve pollution management at local scales is leading to higher spatial resolution models and analysis with attendant advances needed in Chesapeake watershed, estuarine, and social sciences. Modeling watersheds and estuaries at fine scales has the potential for providing improved insight into water quality processes, increased utility of pollution control estimates to decision makers, and improving understanding of the overall transport, processing, and attenuation of nutrients and other pollutants in the coastal watershed system. However, many current modeling paradigms still present challenges for building, running, and interpreting models of large watersheds at fine resolutions. Research addressing the computational, software, scientific, and data limitations of fine scale resolution watershed modeling will contribute to building effective solutions in the Chesapeake Bay. Additionally, work focused on the challenges of interpreting and communicating fine scale outputs of complex models, especially within a scenario context, could increase the potential for stakeholder participation. Social science research into outreach, communication, and approaches to building trust around advanced watershed modeling technology at the local scale will be explored.

Explaining conditions and trends: Integrated monitoring and modeling approaches to describe water-quality change in the watershed and estuary

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We encourage submissions that include:

- Applications of empirical and process models to understand watershed and estuarine responses to management actions
- Innovative use of monitoring data to capture finer-scale variability in time or space
- Establishment of linkages between: reduction strategies and measured changes, nutrient sources and watershed export, nontidal and tidal conditions

Sediment-Process Studies in the Chesapeake Bay, Tributaries, and Marshes

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The importance of sediment transport and seabed processes in Chesapeake Bay and its many sub-environments has become increasingly recognized. Sediment transport and biogeochemistry can have a profound impact on geomorphology and water chemistry via nutrient and anthropogenic pollutant cycling within the sediment and across the sediment-water interface. Ecological restoration of the Chesapeake through the Chesapeake Bay total maximum daily load (TMDL) requires the reduction of nitrogen, phosphorus, and sediment loads in the Chesapeake watershed because of the water quality impairments and damage to living resources they cause. Understanding and quantifying these processes remain challenging, in part because much of the Chesapeake Bay is dominated by muddy sediment, whose cohesive nature often complicates attempts at numerical modeling and observation. Additionally, processes on or just above the seabed are difficult to observe and monitor, particularly during energetic conditions. However, recent advances in theoretical, observational, and numerical modeling techniques have led to increased understanding of these complex systems.

One example within the Chesapeake watershed, the Conowingo Reservoir, has been filling with sediment for almost a century and is now in a state of near-full capacity called dynamic equilibrium. The Chesapeake TMDL was developed in 2010 with the assumption that the Conowingo Reservoir effectively traps sediment and nutrients rather than the present state of dynamic equilibrium. Also, under high flow conditions, resuspended solids and nutrients from the Reservoir may be transported into the Bay's main channel, preventing achievement of water quality goals such as deep-channel dissolved oxygen standards. Within the past year a number of field, laboratory, and modeling studies have attempted to measure and quantify the bioavailability of these nutrients and the resulting impacts on water quality in Chesapeake Bay.

This combined session will highlight numerical models and field studies aimed at furthering our understanding of seabed, sediment-transport and depositional processes in Chesapeake Bay, its tributaries, and associated marsh systems. In particular, this session features studies related to the Conowingo Reservoir, from observations of nutrient flux and sediment diagenesis to modeling sediment transport and water quality, including projected impacts on Bay water quality.

Observations and Modeling of Chesapeake Bay Wetlands and Coupled Sub-estuaries: Advancing Understanding through Comparative Analyses

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Involving complex dynamics, physical, chemical and optical properties, wetlands and sub-estuaries are among the most challenging components of the Chesapeake Bay ecosystem to model. Nevertheless, these areas are hot-spots of biogeochemical exchange and including them is necessary to accurately model and predict changes in the sources, quality and fate of carbon, nutrients and pollutants in the Bay. This challenge can be met by sustained interaction between model development and observational validation. Supporting this goal are recent technological advances enhancing observations in the temporal domain using in situ sensors, in the spatial domain using remote sensing, and enhanced computing resources for simulation modeling.

This session aims to encourage the interaction between scientists using observational and modeling approaches (either or both) to study wetland and sub-estuary hydrodynamics, water quality and biogeochemical processes. Particularly relevant would be presentations that combine modeling results with comparative observations from in situ sensors, field studies and/or remote sensing.

Session format: Oral and poster session, with 2 to 3 invited speakers from different groups (using different observational and modeling approaches). Open discussion at the end of the session, to discuss issues, concerns and ideas for moving forward.

Modeling of Climate Change Consequences for Phase III Watershed Implementation Plans

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Anthropogenic climate change is expected to result in warmer temperatures on land and in the Bay, increases in the amount and intensity of precipitation, and rising sea level. Some of these changes are already evident and will change inputs and processes in the watershed and the estuary in complex ways, quite likely requiring more nutrient load reductions to meet and sustain water quality improvements by 2025 and beyond. Over the past decade, the Chesapeake scientific community has been addressing aspects of this challenge through workshops, reports and modeling (both research and management models). However, in December 2017, the Chesapeake Bay Program's Principal Staff Committee decided not to adjust the nutrient load reductions required under the Phase III WIPs to accommodate the effects associated with climate change at this time. Rather, it directed the Partnership to address the uncertainties in current scientific understanding in order to develop improved estimates of pollutant load changes (nitrogen, phosphorus and sediment) and a better understanding of the BMP responses due to changing climatic conditions. In 2021, the Partnership will consider the results of updated methods, techniques and studies and revisit estimated loads due to climate change. Jurisdictions would be expected to account for additional load reductions needed in modified WIPs and/or in two-year milestones beginning in 2022.

Session Format: BY INVITATION ONLY. Given the specific policy questions and short timeframe for this reassessment, the session will take a very directed approach rather than the traditional series of more-or-less independent presentations. The session will consist of:

1. A general overview by CBP managers and modelers of the context of management decisions and the current modeling approaches and results.

2. A facilitated discussion by a panel of experts in climate change science and watershed and estuarine modeling. The panelists will be well-briefed in advance of the conference and provided with relevant reports and model documentation and results. They will be asked to focus not on criticisms, but on identifying critical uncertainties and specific solutions that should be better resolved prior to the 2021 re-evaluation and beyond.
3. Ample time will be allotted for audience participation in the discussion. Registrants will be provided a written overview of the challenge to help orient them to the session.
4. With input and review by the expert panel, the Convener/Moderator, will prepare a summary of the session discussion for use by the CBP in responding the PSC directive.

Other Current and Emerging Issues in Chesapeake Bay Science and Modeling

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This session welcomes presentations describing new research, synthesis, or analysis on any topic that is of current or emerging relevance to the Chesapeake Bay system and that is not explicitly covered by other organized sessions for the 2018 Conference. Based on preliminary inquiries, some specific topics may include toxic contaminant fate and transport, chemicals of emerging concern (including pharmaceuticals and personal care products), plastics and microplastics, and sea level rise and other factors affecting coastal resiliency. Submitters should be prepared to consider poster presentations as a required possibility, depending on the number and nature of presentations submitted. (Note: Organizers are intending to promote a vigorous and well-attended poster session at this symposium.)

General Poster Session

Dave Jasinski (Green Fin Studio) dave@chesapeakedata.com

A general poster session.