

# Chesapeake Bay Program Modeling in 2025 and Beyond: A Proactive Visioning Workshop

January 17-19, 2018, National Conservation Training Center, West Virginia

Report to STAC

Tag Team Presentation: Raleigh Hood, Gary Shenk, Lisa Wainger, Lee Currey



**CSDMS**  
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

# Steering Committee

Steering Committee: Raleigh Hood (co-chair)  
Gary Shenk (co-chair)  
Bill Ball  
Peter Claggett  
Lora Harris  
Tom Ihde  
Lewis Linker  
Chris Sherwood  
Lisa Wainger

STAC: Rachel Dixon  
Elaine Hinrichs

# Description of Workshop:

The Chesapeake Research Consortium (CRC), the Chesapeake Bay Program (CBP), along with the Chesapeake Community Modeling Program (CCMP) and CSDMS/Chesapeake Focus Research Group (CFRG), convened a three-day workshop.

***Our goals were to review the status of the current CBP management modeling system and discuss future directions for management modeling with a view toward developing a roadmap for future CBP modeling in 2025 and beyond.***

# Overarching questions:

## **Description of needs:**

What are the likely management needs of the CBP partnership over the next decade? What are the challenges the CBP faces in the coming years?

## **Review of advice:**

How can information and recommendations from previous workshops and committee reports be brought to bear to address these needs?

## **Description of resources:**

What human and infrastructure resources are going to be available to meet these future needs and challenges?

## **Visioning for 2025 and beyond:**

What well-informed, realistic, and unified vision for future modeling will guide the CBP into the future?

# Organization:

**Day 1** was to learn about the current CBP modeling system and the management context.

**Day 2** was to get into the details of each small breakout and draft the recommendations.

**Day 3** was to make sure that the recommendations stood after ‘sleeping on them’ and for discussing with large breakouts. We also heard reactions to the workshop discussion and recommendations from Cross-Cutters\*.

\*Cross Cutters (Wainger, Currey, Hutton, Davis-Martin, Montali) were charged with observing, collecting impressions, interjecting now and then, and reporting out on day 3.

# Day 1 Presentations

- Management goals (Currey)
- Management challenges (Batiuk)
- Panel discussion on cross-cutting topics (Phillips, Wainger, Voinov, Hutton, Harris, Shenk)
- Reviews of the existing CBP models (Bash, Claggett, Shenk, Cerco, Ihde)
- Review of previous STAC advice (Wainger)
- Strawman for 2025 models (Linker)
- Science Keynote (Rose)
- Happy hour breakout group meetings (all)

# Breakout Groups:

## Land Use

(**Peter Claggett**, Claire Jantz, Andrew Elmore, Lara Lacher, Scott Drzyzga)

## Hydrology

(**Larry Band**, Zach Easton, Chris Duffy, Clair Welty, Andrew Sommerlot, Ted Tesler)

## Nitrogen

(**Don Weller**, JK Bohlke, Kathy Boomer, Bill Ball, Rich Alexander, Dinorah Dalmasy, Ken Heyer, Amir Sharifi)

## Phosphorus

(**Peter Kleinman**, Ken Staver, Gary Shenk, Tamie Veith)

## Sediment

(**Andy Miller**, Jim Pizzuto, Katie Skalak, Sean Smith, Greg Noe)

# Breakout Groups:

## Hydrodynamics

(**Joseph Zhang**, Harry Wang, John Warner, Richard Tian, Jian Shen, Courtney Harris)

## Biogeochemistry

(**Marjy Friedrichs**, Jeremy Testa, Chris Sherwood, Raleigh Hood, Carl Cerco, Julia Moriarty, Damian Brady)

## Ecosystem Approaches

(**Elizabeth North**, Kenny Rose, Lora Harris, Tom Ihde, Walter Boynton, Kim de Mutsert)

# Estuarine Breakout Group Recommendations

Raleigh Hood

# Hydrodynamics

- Implement a next-generation unstructured-grid Bay modeling system
- CBP should consider the approach of a single primary model supported by multiple models
- Engage scientific communities and stakeholders
  - For evaluating performance of the new models
  - To ensure Bay's nutrient reduction plan and the local needs are adequately met
- Allocate more resources to support these efforts

# Biogeochemistry

- Use an estuarine management modeling framework with variable resolution (high-res where we need it, low-res where we don't)
- Implement a nimble, modular, experimental framework that allows for testing of new BGC processes to inform the management model
- Enhance working relationship between BGC & living resource groups
- Provide resources to accomplish above

# Ecosystem Approaches

- Establish an Ecosystem Modeling Subcommittee
- Adopt a portfolio of modeling approaches for living resources
  - Analyze CBP Modeling System output from a habitat perspective
  - Translate output to develop habitat suitability indices
  - Use output as input for ecological models
  - Integrate organisms into the water quality model
- The Subcommittee should select a formal set of criteria to help guide which living resources to model, and when
- The Subcommittee should start by considering:
  - Non-linear responses to nutrients and sediment
  - New approaches for modeling primary producers
  - Explore integrating zooplankton into WQ model for higher trophic levels
  - Identify and address data gaps for living resources, ensure accessibility
  - Articulate mechanisms for communication and stakeholder involvement
  - Emphasize communication benefits of modeling living resources

# Watershed Breakout Group Recommendations

Gary Shenk

# Land use recommendations

- Land cover => Land use => Land dynamics
  - Development patterns (density, sewer or septic)
  - Animals (where and how many)
  - Crops (what types)
  - Forests (health)
  - Stream corridor characterizations
- Enhance model transparency (e.g., modular design, open source - github, cloud-based)
- Leverage regional transportation model

# Phase 7 – Evolution

## Phase 8 - Revolution

- Phase 6 was a big jump, let's spend some time with that structure (managers agreed!)
- Hydrology, Sediment, and Phosphorus need a revolution, but the models don't exist
- Nitrogen continues to evolve

# Hydrology

Phase 7 – Evolution  
Phase 8 - Revolution

- Develop fine scale models in cooperation with local stakeholders
- Incentivize the development by allowing greater credit for spatially-targeted BMPs
- Use these models as testbeds for an eventual large-scale implementation

- Build on Phase 6 platform
  - More formal modular system
  - Ensemble of models for each process
- Examine Processes with multiple models
  - Develop multiple dynamic models
  - Bring in more data
  - Investigate BMP performance

- Build on Phase 6 platform
  - Upscale local work to Bay
- Examine Processes with multiple models
  - Pay more attention to fluvial P processes
  - Examine critical source areas
  - Land use history is important

# Sediment

Phase 7 – Evolution  
Phase 8 - Revolution

- Establish a sediment modeling work group
- Evolution by 2025
  - Replace RUSLE
  - Improve sediment delivery ratio
  - Improve representation of lowland sediment production and storage
- Revolution beyond
  - Build a conceptual model to rank governing processes
  - Develop a new computational model
- Incorporate linkage to nutrient and carbon flux, habitat and living resources

# Cross-Cutting Issues

Lisa Wainger

# Cross-cutting issues addressed

1. Beyond water quality: living resources and ecosystems – Tom Ihde (PEARL) for Scott Phillips
  2. Socio-Economics – Lisa Wainger (UMCES)
  3. Participatory modeling/Stakeholder engagement – Elizabeth North (UMCES) for Alexey Voinov
  4. Nimble modeling: modularity/linkages – Eric Hutton (CSDMS)
  5. Local scale decision support – Lora Harris (UMCES)
  6. Uncertainty/Risk – Gary Shenk (USGS)
- Intro videos:
  - <https://www.youtube.com/playlist?list=PLwTknLjLDdA5xXGk7t7v6lGxUCLikKTI>

# Incorporating Living Resources

1. Secondary models
2. Choose primary model structure based on ability to couple with living resources
3. Nimble modular models
4. Engage external modelers



# Supporting Social & Economic Analysis

## 1. Modeled outcomes reflect peoples' *utility*

- Likes and dislikes - water clarity, ecosystem resilience
- Inputs to production - sediment in shipping channels, fish abundance

## 2. Model behavioral *inputs* = better projections

- Peoples actions can exacerbate / alleviate change (e.g., climate change stressors)

## 3. Sufficient spatial / temporal resolution

- Supports more refined management choices (e.g., compare buffer types)
- Enables comparison to human use (recreation sites, shellfish beds, homes, etc.)

# Participatory Modeling



## A Definition

- Participants co-formulate the problem and use modeling practices to aid in the description, solution, and decision-making actions of the group.

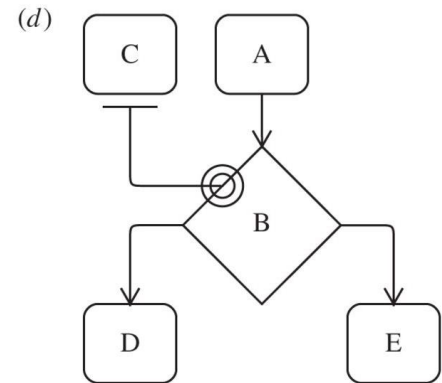
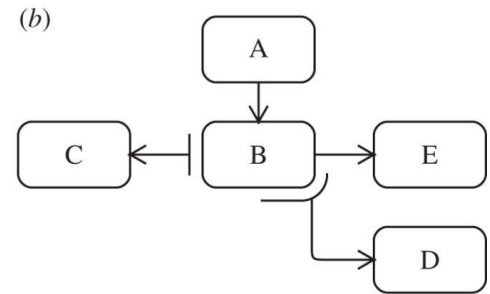
## Outcomes

- CBP does already elicits stakeholder concerns and adapts models as needed/appropriate
  - models have sufficient buy-in that they are using it to allocate pollution reduction effort
- More could be done to work with stakeholders on designing solutions
- Examples of tailoring participatory activities to specific management needs are available to spur new ideas
- <https://www.participatorymodeling.org/node/2>

# Nimble Modelin

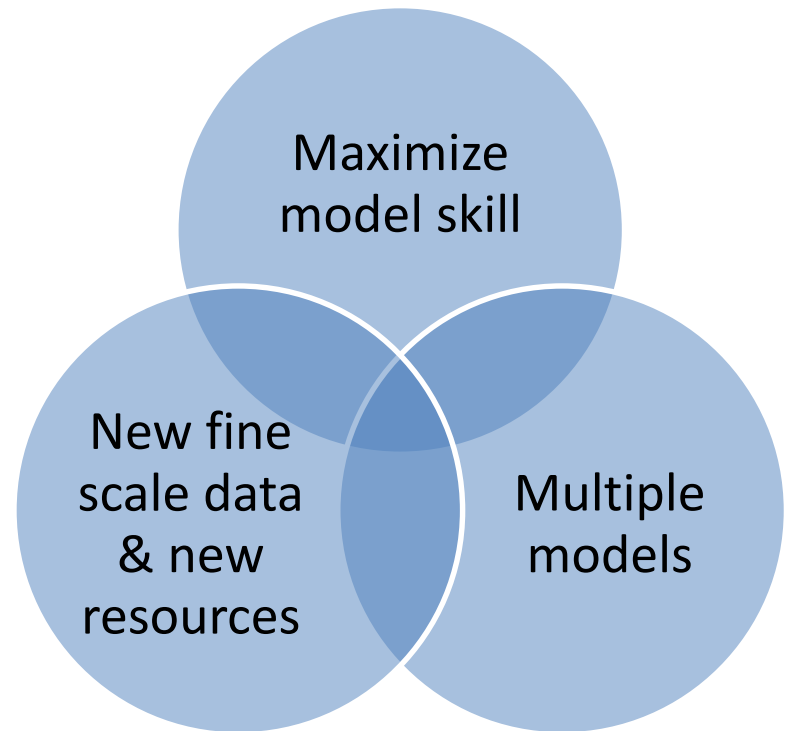
- Models that play well with other models
- Requires system of rules/protocol for model development

1. Promotes openness and transparency of methods
2. Enables easier connections to monitoring and the research community
3. Key - Are we talking about an incremental approach or a wholesale change?

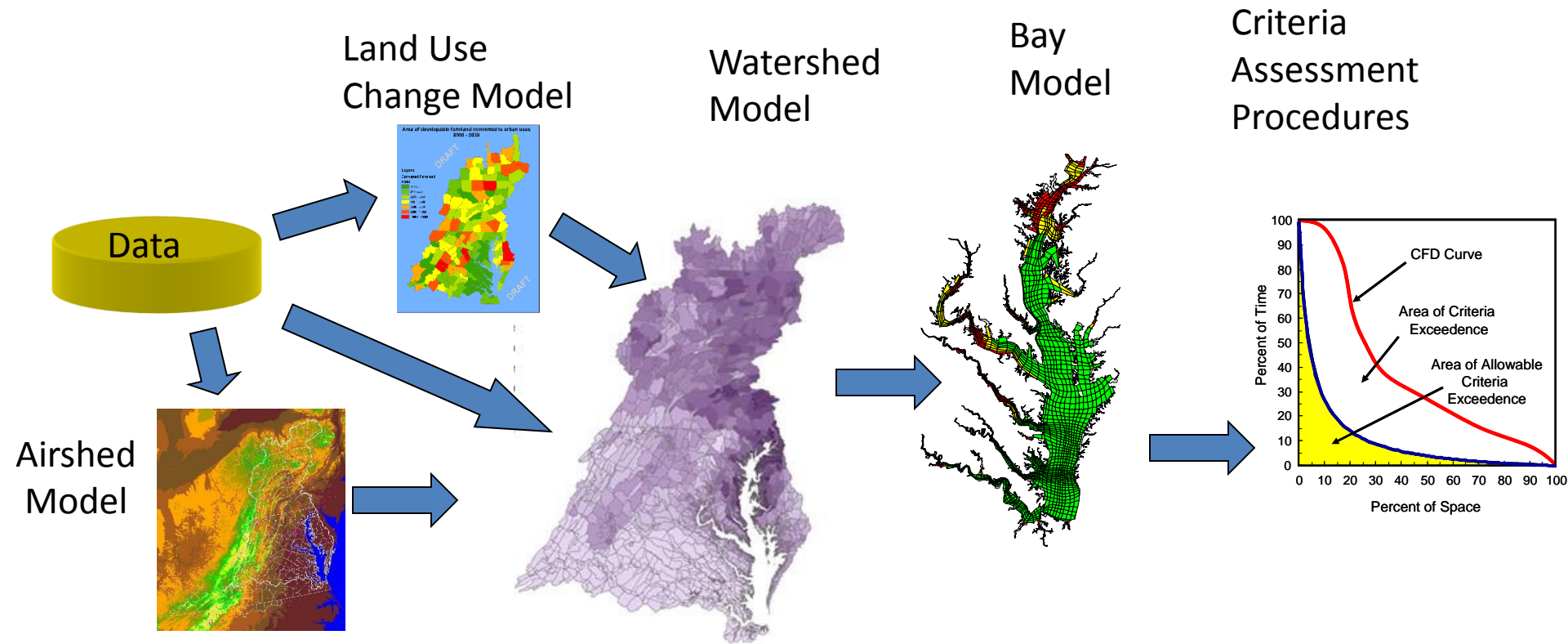


# Local Scale

- Local managers want access to tools for decision making, with flexibility to assess multiple scenarios
- Modelers proposed multiple approaches for improving representation at local scale
- Exception - Watershed group promoted a mid-scale watershed to enable integration with data sources
- Can models be made scaleable? Modular?



# Uncertainty Estimation – CBP Decision Support System

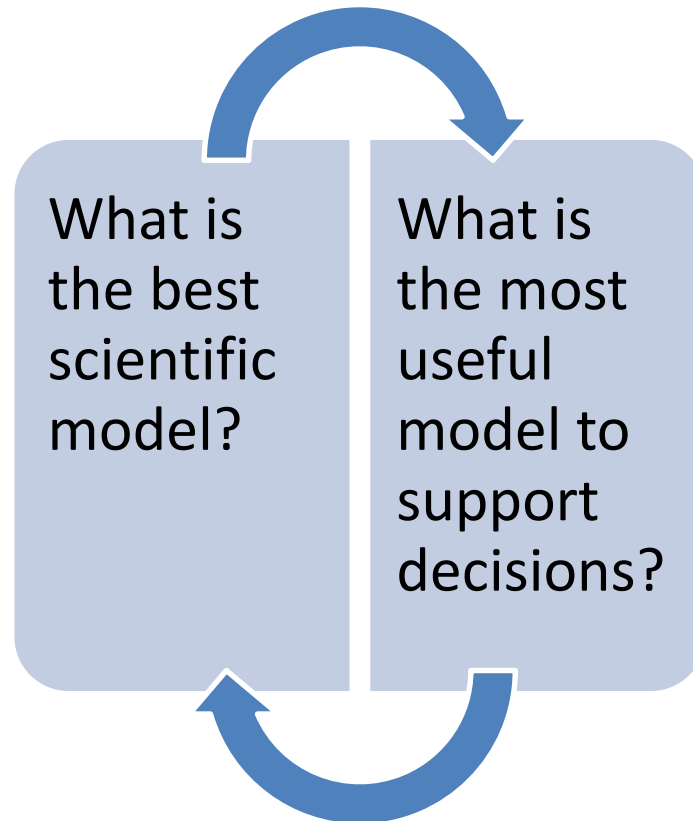


What is the confidence that a certain set of management actions will result in a particular amount of standards attainment?  
Where should the CBP spend resources to increase that confidence.

# Questions that need more attention

- How do we allocate scarce modeling resources?
  - Which model changes “move the needle” on water quality or beneficial outcomes?
    - Add understanding that promotes substantial changes
  - What other decision benefits arise from each suggestion?
  - How well will the model respond to new questions?
  - Are incremental steps needed to bring managers on board?
- Under which conditions do models need to be coupled?
  - run in sequence / pipeline / forcings
  - vs coupled / integrated (have feedbacks)

# An ongoing debate

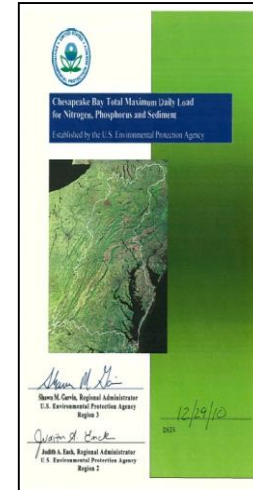


# Management Perspectives

Lee Currey

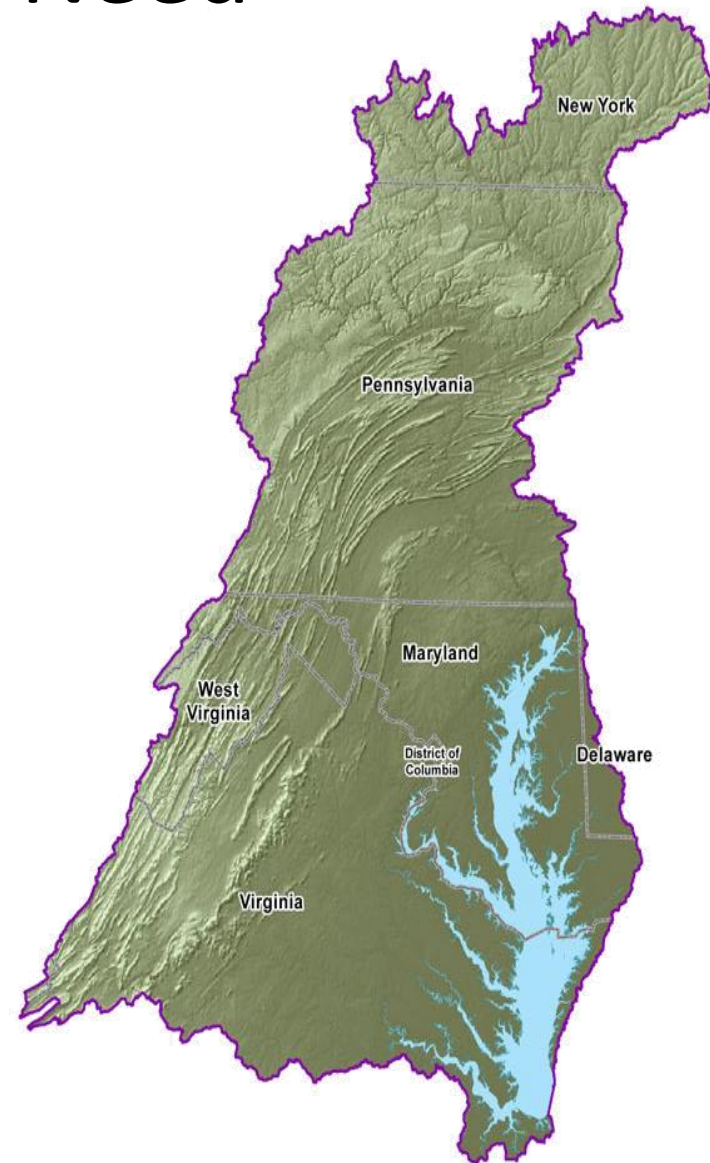
# Today's Partnership Models Are Driving Significant Bay Policy And Funding Decisions

- In 2010 and 2012, a federally-mandated comprehensive set of restoration plans was developed
- These plans drive **billions of dollars** in environmental investments
- The scientific underpinnings to these jurisdictional plans **are the CBP Partnership models**



# For Success, Bay Managers Need

- Political, financial and science support
- Science that has relevance, integrity and is timely
- Tools that
  - Foster collaboration and innovation
  - Are transparent, relevant, straight-forward and stable
  - Quantify benefit, cost and risk



# Workshop Observations as a Manager

- What? Phase 7?!!!
- Actually, the workshop was timely
- Affirmed no “fatal flaws” in Phase 6, but opportunities for improvement – “evolution” – by 2025
  - Watershed – Current structure is agile and expandable
  - Bay hydro and water quality – Grid structure is a limiting factor for finer tributary resolution
  - Ecosystem response – needs more focused effort as we near 2025
- New Subgroups means Modeling WG will have an important role in facilitating cross communication

The recently approved Phase 6 suite of models are better and have more buy-in because of review and feedback, from two key groups. This approach works!

- **Scientists: Scientific and Technical Advisory Committee**
- **Managers: Water Quality Goal Implementation Team**



# Summary - Informing Next Gen Bay Models

- The CBP suite of models drive investment and change
- Visioning workshop was timely and provided direction to modeling team and workgroup
- Need to address recent PSC charge regarding climate change
- Need to synthesize and implement recent STAC workshop recommendations
- Over the next year Federal, State and Local jurisdictions will extensively use Phase 6. Their feedback is essential.

# Products:

- A STAC workshop report.
- A synthesis / review article for the journal *Ecological Modeling*.

# Thank You



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