

Multiple Models for Management in the Chesapeake Bay

February 25-26, 2013
Annapolis, Maryland



*Scientific and Technical Advisory Committee
to the Chesapeake Bay Program*

Welcome!

Steering committee members

Don Weller (SI-SERC)

Brian Benham VT

Marjy Friedrichs VIMS

Ray Najjar (PSU)

Pasky Pasquale (EPA)

Kevin Sellner (CRC)

Gary Shenk (EPA-CBP)

Natalie Gardner (STAC)

Matt Ellis (STAC)



Outline

- What is multiple modeling?
- Pros and cons of multiple modeling
- Genesis of this workshop
- Workshop plan



Some acronyms

- MM multiple models
- M3 multiple models for management
- M3.2 this workshop
- M3.1 an earlier workshop



What is MM?

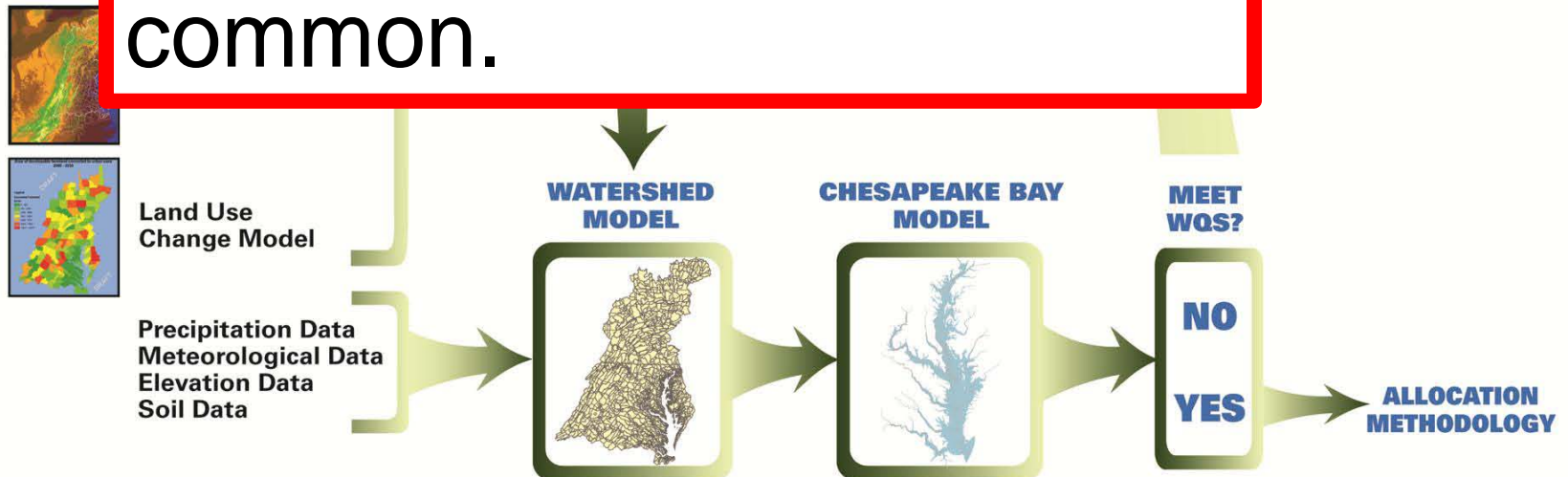


What is **not** MM?



What is **not** MM?

MM involves the analysis of a set of models that make some predictions in common.



Two steps in MM application

- Model comparison
- Decision making and regulation



Ensemble MM

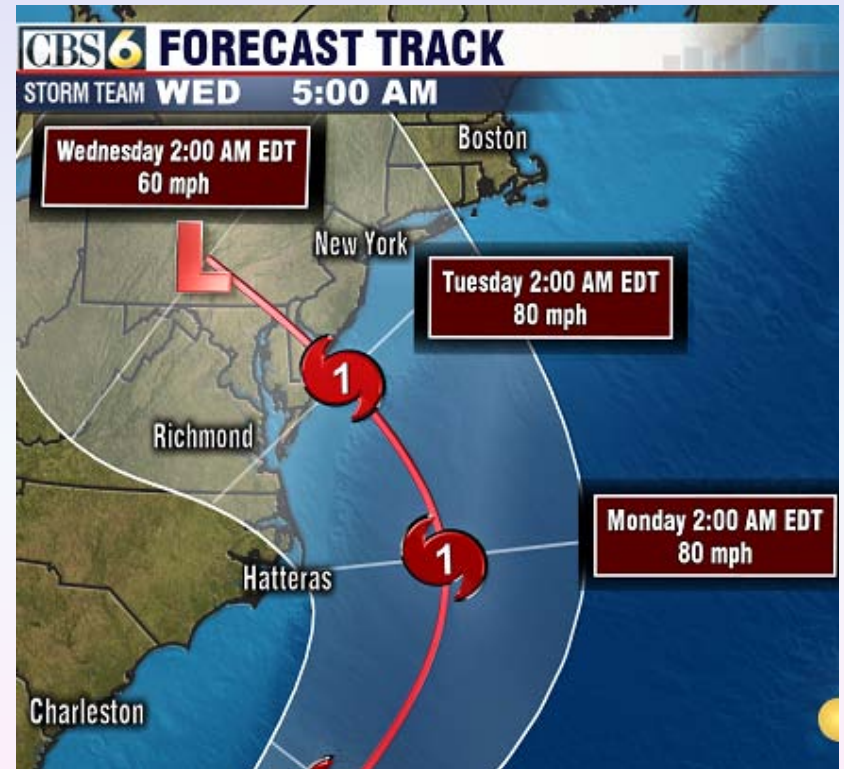
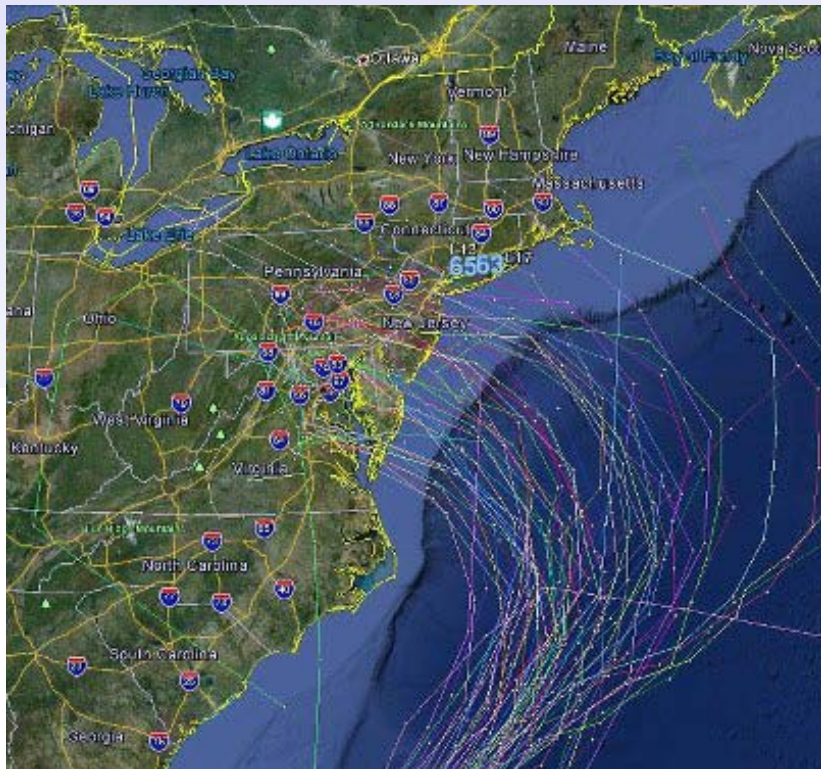
- Need to know X
- A set of models predict X
- Together the models provide an average and distribution (uncertainty)
- Decisions could be based on
 - one model
 - all the models (model average)
- Weighted average or Bayesian methods can improve model integration



Ensemble MM is way out of the ivory tower

Multiple model tracks

Official Sandy forecast



MM supporting a single decision model

- Need to know X
- Decision model predicts X and Y
- Other models predict Y
- Comparison of Y predictions evaluates decision model's prediction of X



Multiple decision models

- Need to know X and Z
- Some models predict X and Y
- Other models predict Y and Z
- Comparison of Y supports both models in predicting of X and Z



MM supporting models can be

- Mechanistically simpler
- Implemented for only some areas or times



Scientific advantages of MM

- Compares hypotheses about system function
- Identifies agreements (high confidence)
- Identifies disagreements (low confidence)
- Helps quantify uncertainties
 - Prediction uncertainty
 - Model selection uncertainty
- Guides research and data collection
- Fosters continual synthesis and model development that improves predictions
- Builds community



Possible objections to MM

- More work, costs more
- Highlights uncertainties
- May confuse public and decision makers
- May provoke legal challenges
- May be incompatible with CWA and TMDL rules



Proactive MM for self defense

- Other models exist
- Can be integrated to inform and support decisions OR
- Can be left for use in challenging decisions



For example . . .

Comparison of Draft Load Estimates for Cultivated Cropland in the Chesapeake Bay Watershed

Prepared for:
Agricultural Nutrient Policy Council

December 8, 2010

Review of the LimnoTech Report, "Comparison of Load Estimates for Cultivated Cropland in the Chesapeake Bay Watershed"

A report of the independent review conducted by the Chesapeake Bay Program's Scientific and Technical Advisory Committee

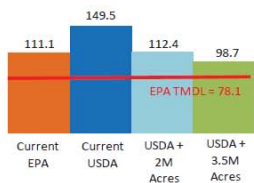
And prepared by the Committee for the ANPC/LimnoTech Review

September 26, 2011

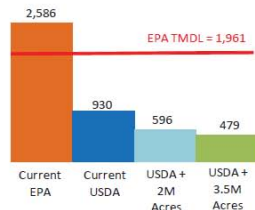


STAC Publication 11-02

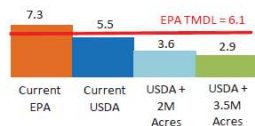
Agricultural Nitrogen
(million pounds)



Agricultural Sediment
(1,000 tons)



Agricultural Phosphorus
(million pounds)



STAC recommendations to CBP

- Apply MM
 - Demonstrate skill of CBP models
 - Bolster community-wide support of model and TMDL decisions
- Quantify model uncertainties
- Both needed to support claim of "best science"



CBP response . . .

- M3.1 workshop (shallow water MM pilot project)
- This M3.2 workshop
- Gather technical experts and managers with experience using MM in regulation to consider how MM could be used in the CBP



CBP workshop issues

- M3 methods
- Scientific benefits
- Prediction uncertainty & outliers
- Regulatory examples & outcomes
- Especially water quality, air quality, or TMDLs
- Benefits and challenges for Chesapeake Bay TMDL



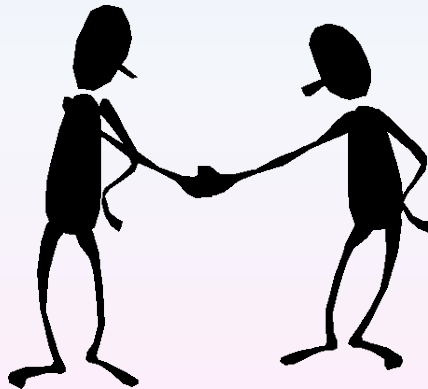
Workshop plan

- Introduction
- Case studies
- Perceptions of MM by public and decision makers
- Legal issues
- Discussion, discussion, discussion



Workshop report

- What was presented?
- What was discussed?
- What did we agree on?
- What did we disagree on?
- What final consensus was reached?





Possible management benefits

- Demonstrate skill of decision model (as good or better than others)
- Bolster confidence (scientists, managers, & public) in model and decisions based upon it

