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)
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Marjy Friedrichs VIMS
Ray Najjar (PSU)
Michael Paolisso (UMD)
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

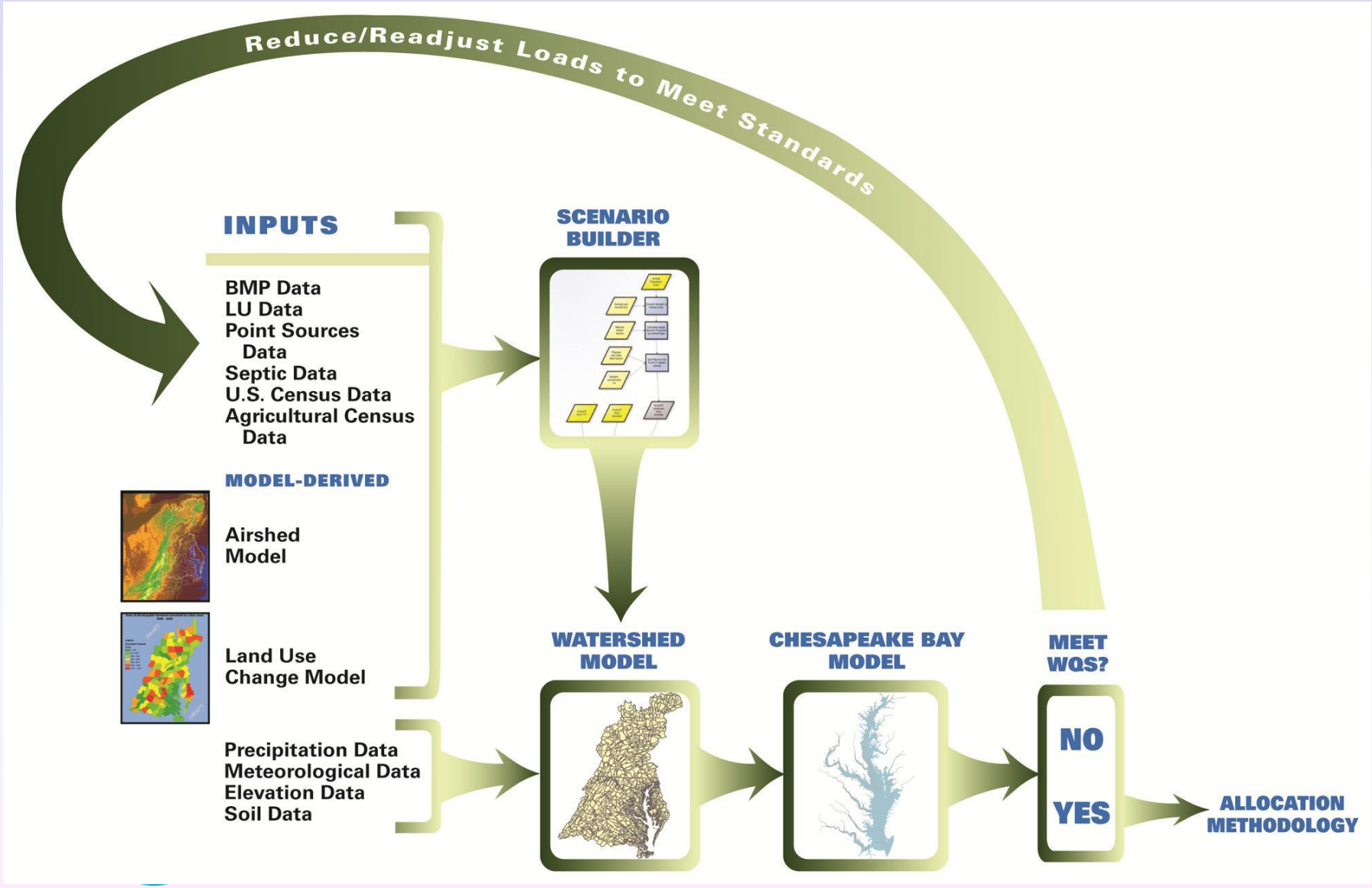
Some acronyms

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

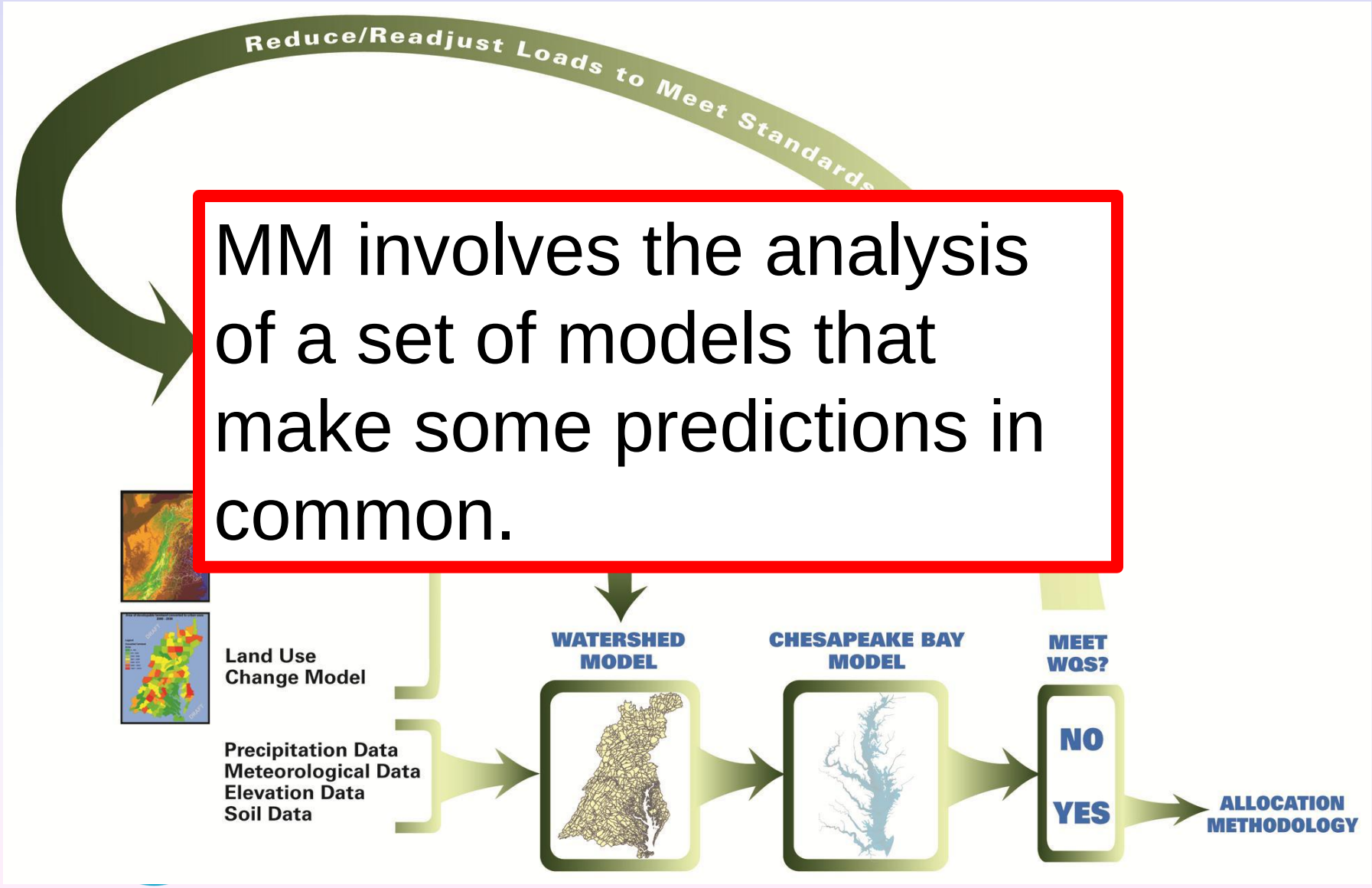
What is MM?

What is not MM?

What is not MM?



What is not MM?



Two steps in MM application

- Model comparison
- Decision making and regulation

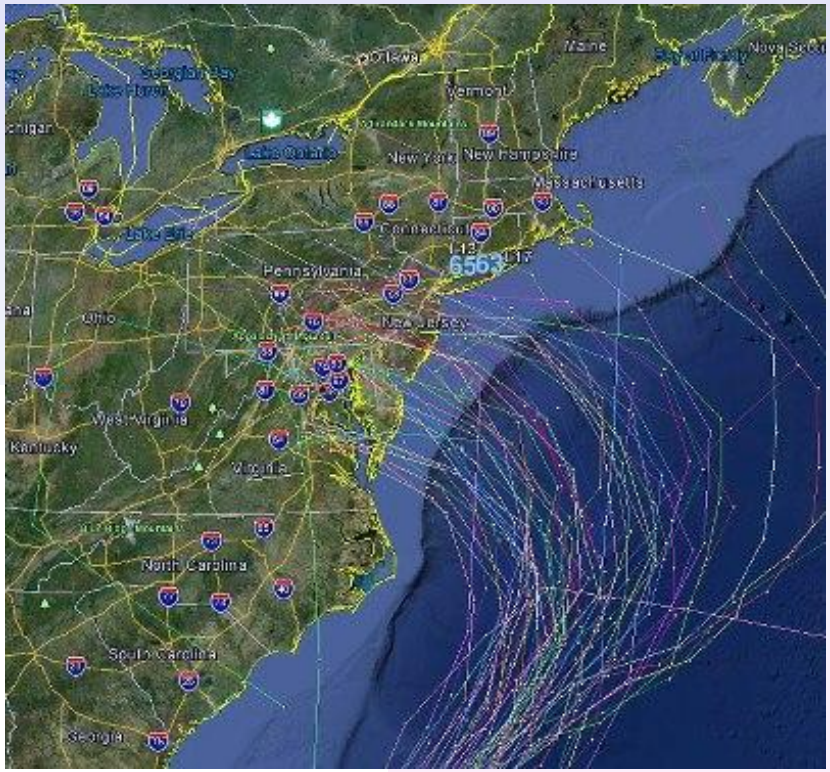
Ensemble MM

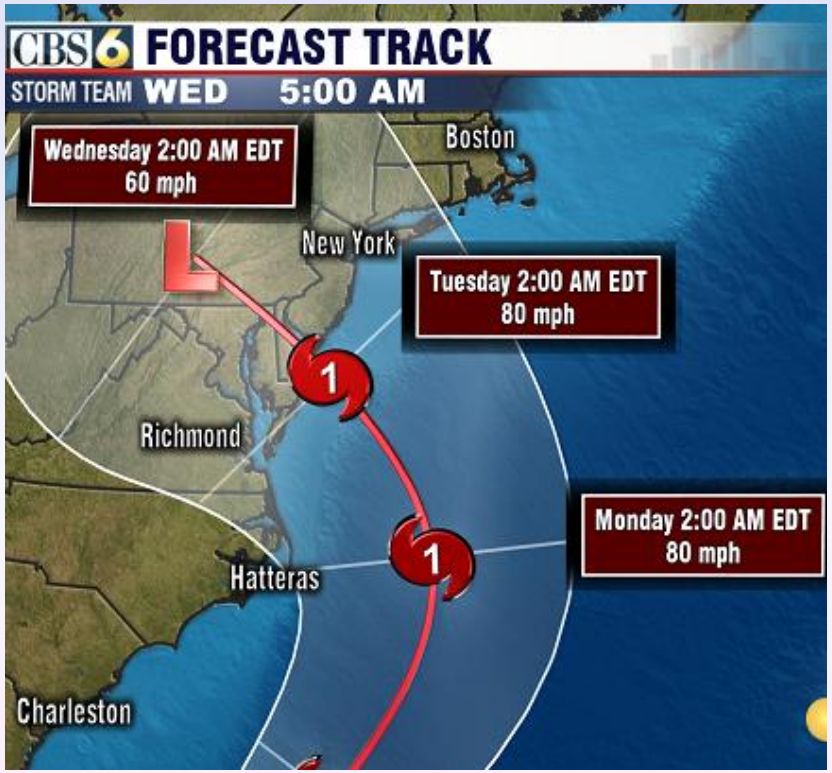
- Need to know *X*
- A set of models predict *X*
- Together the models provide an average and distribution (uncertainty)
- Decisions could be based on
  - one model
  - all the models (model average)
- Weighted average or Bayesian methods can improve model integration

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

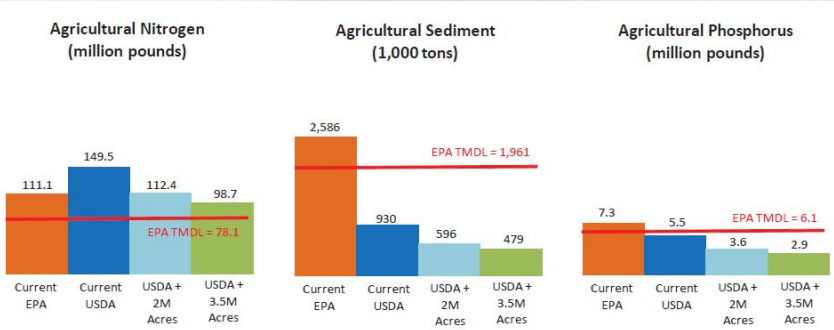
- Other models exist
- Can be integrated to inform and support decisions OR
- Can be left for use in challenging decisions

For example . . .

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

Prepared for:
Agricultural Nutrient Policy Council

December 8, 2010



LimnoTech
Water | Environment | Scientists | Engineers

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

STAC Publication 11-02

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?