

Mechanistic Modeling of Mercury Cycling and Bioaccumulation in the South River

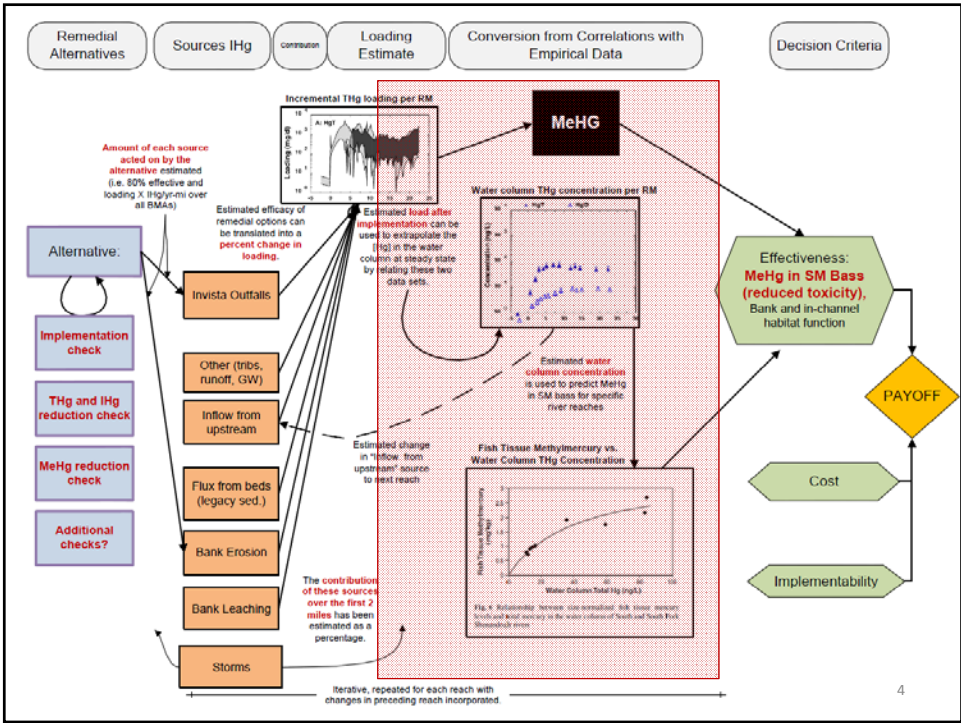
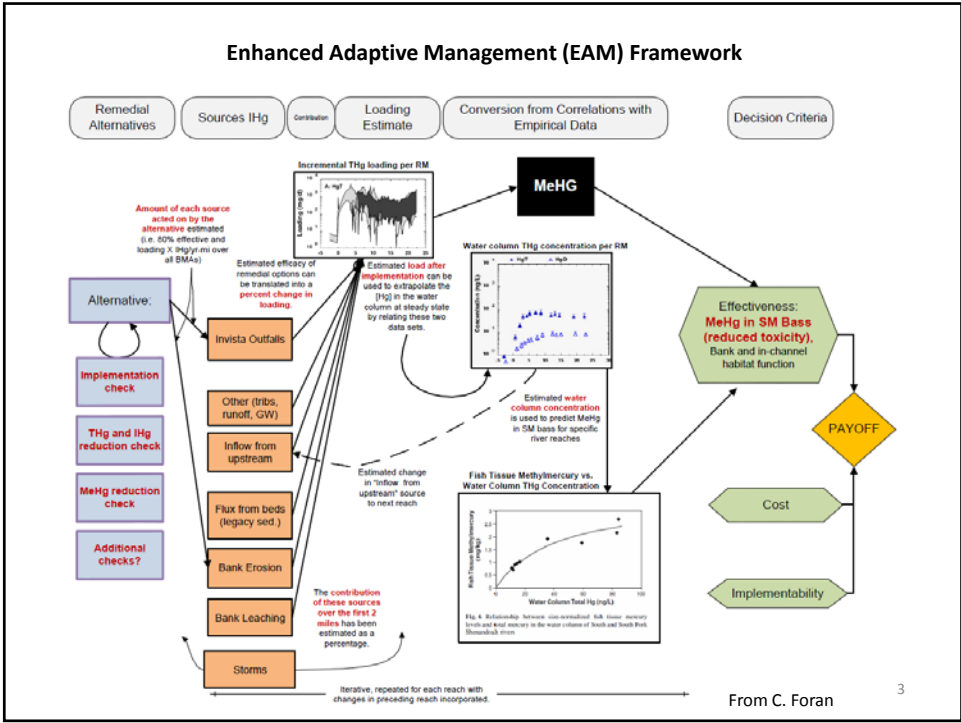
South River Science Team
Expert Panel Meeting
October 9, 2014

Presentation by:
Reed Harris



Objectives

- Help predict and assess the benefits of bank stabilization.
- Help interpret monitoring data.
- Help integrate multi-disciplinary studies carried out on the South River. Do the pieces fit together?
- Help address uncertainty
- Provide another line of support for decisions.



How would D-MCM fit with EAM?

Remediation Scenario

Hg loading

Response in water and sediments

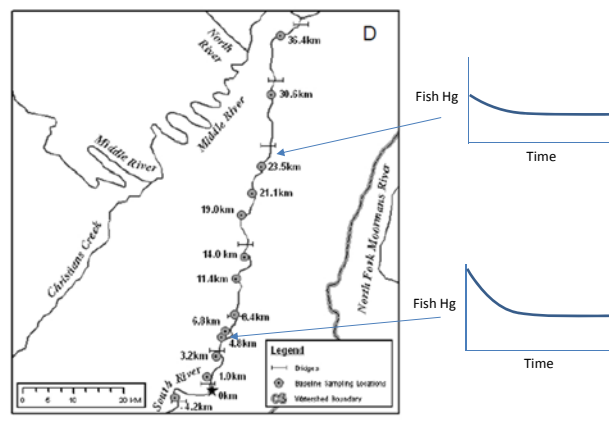
Response in food web
(or pass results to BASS)

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Key question to help address with a model:

What will happen to fish mercury levels after bank stabilization?

- Magnitude
- Timing
- Effects at different locations

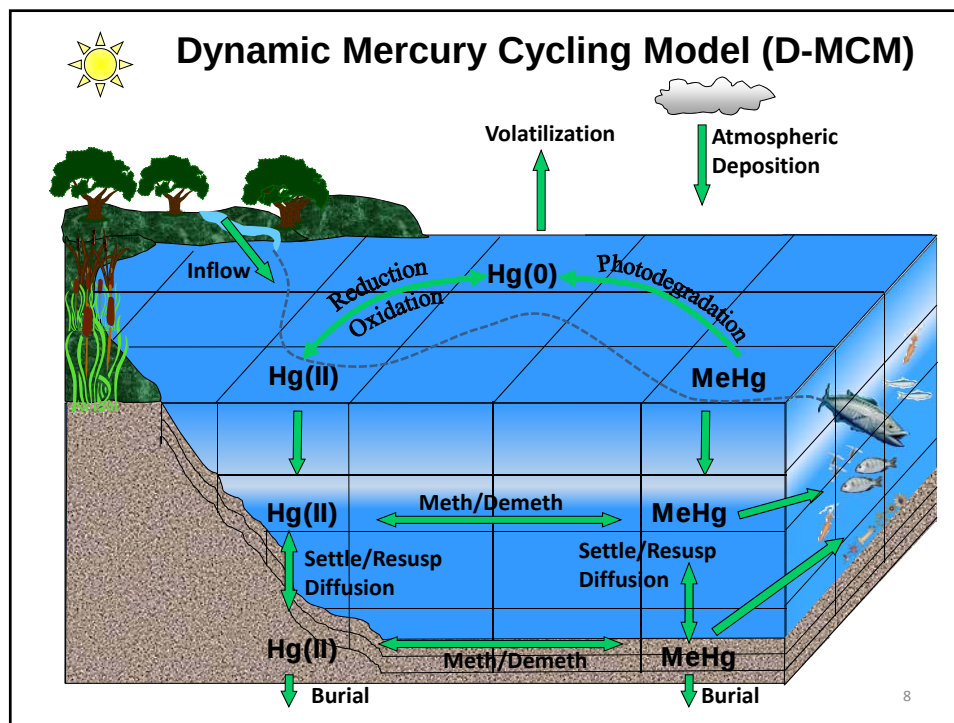


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Other questions that could be examined with modeling:

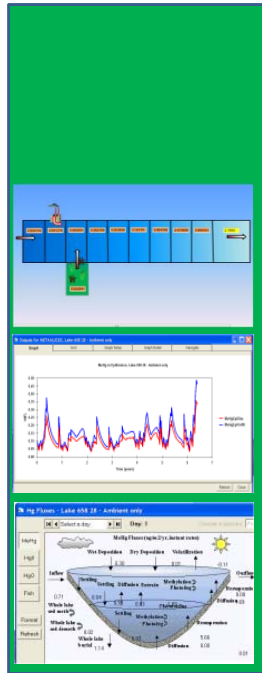
- Where does mercury in fish originate?
- What processes control the natural recovery of the system?
- What processes can be altered to accelerate recovery?
- What do the monitoring data tell us?
- Confounding factors: e.g. effects of climate change?

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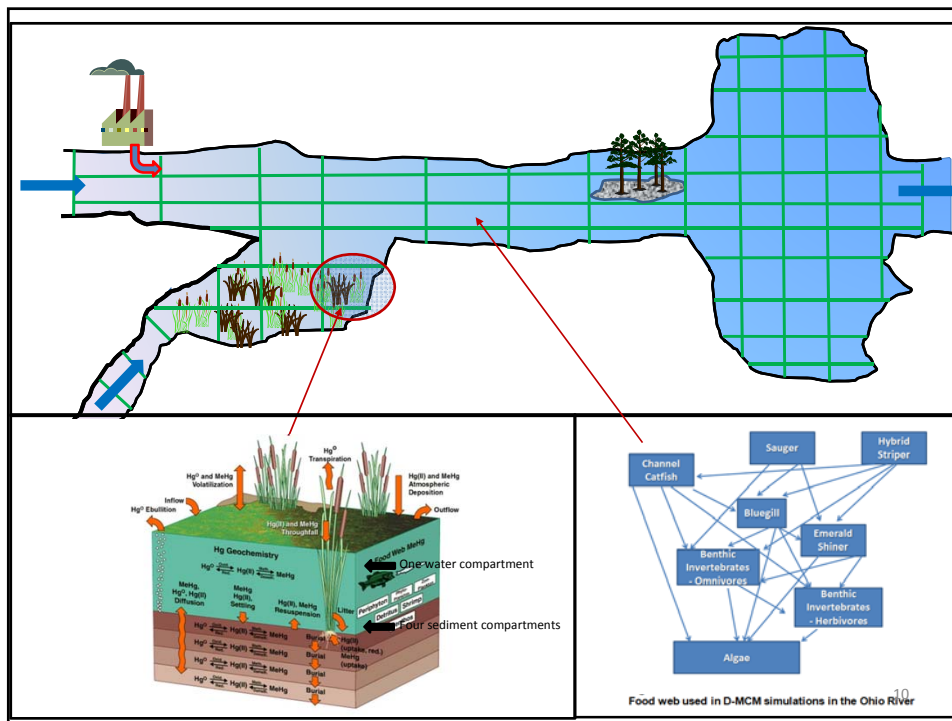


What Does D-MCM do?

- Predicts Hg cycling & bioaccumulation in aquatic systems
- Predicts response to Hg loading and changes to environmental conditions.
- Includes water, sediments, and food web
- Methylmercury, inorganic Hg, elemental Hg
- Outputs through time
- Focuses on Hg: does not model environmental conditions that are inputs (e.g. pH, temperature).

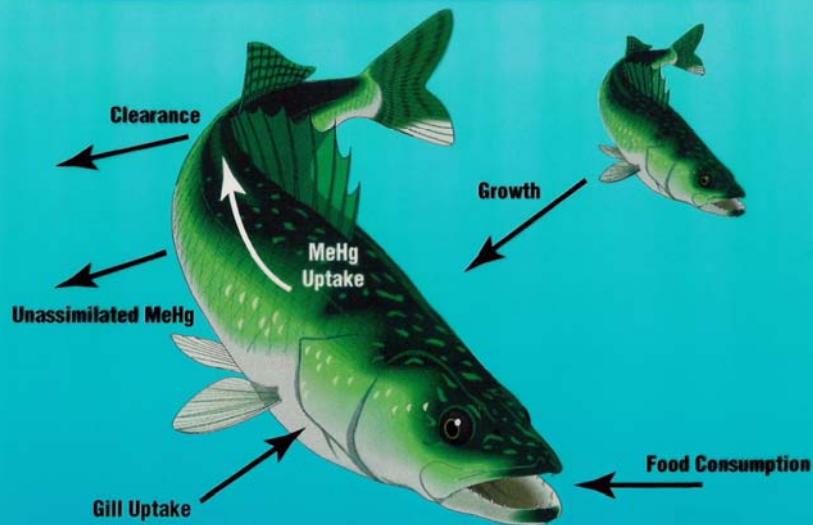


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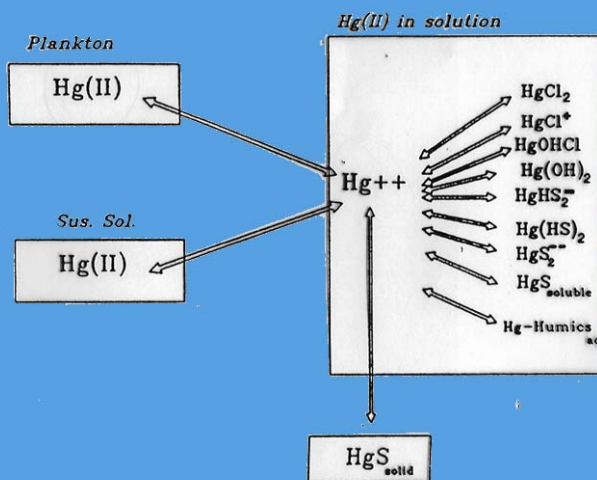


Food web used in D-MCM simulations in the Ohio River

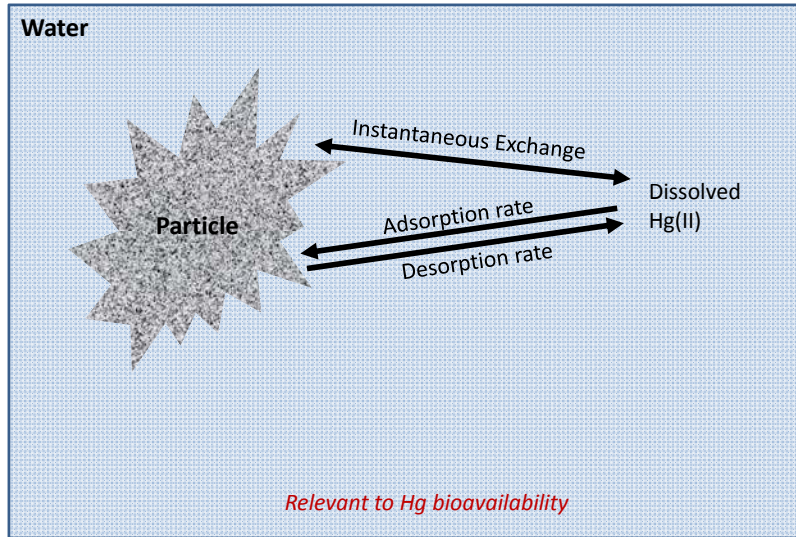
Figure 1: Processes Included in Bioenergetic Analysis



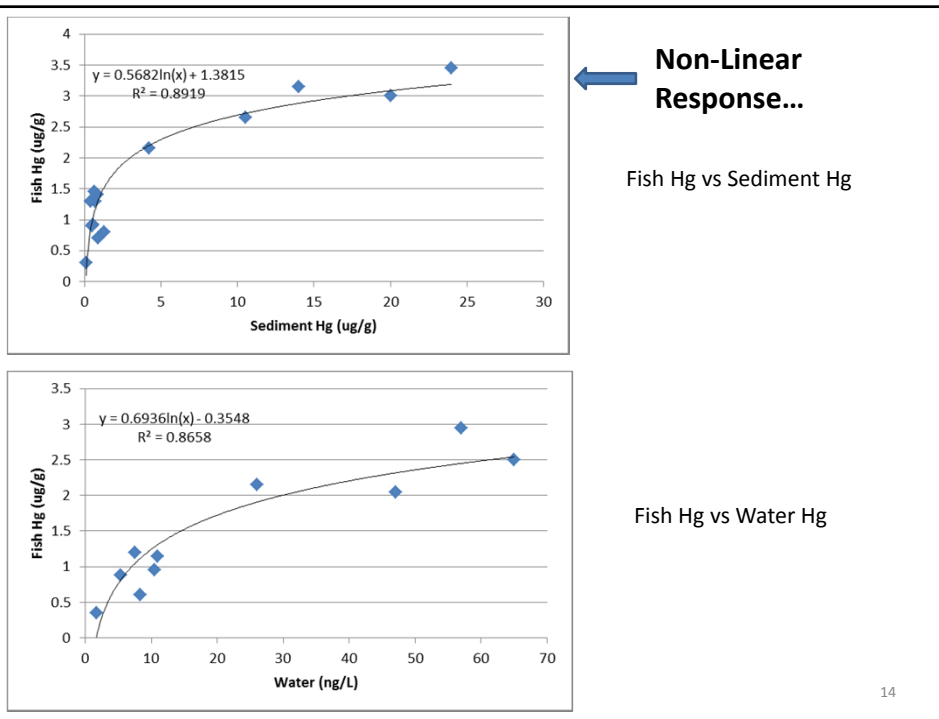
Surface Water Hg(II) Equilibria



Slow and Fast Hg exchange on particles in D-MCM

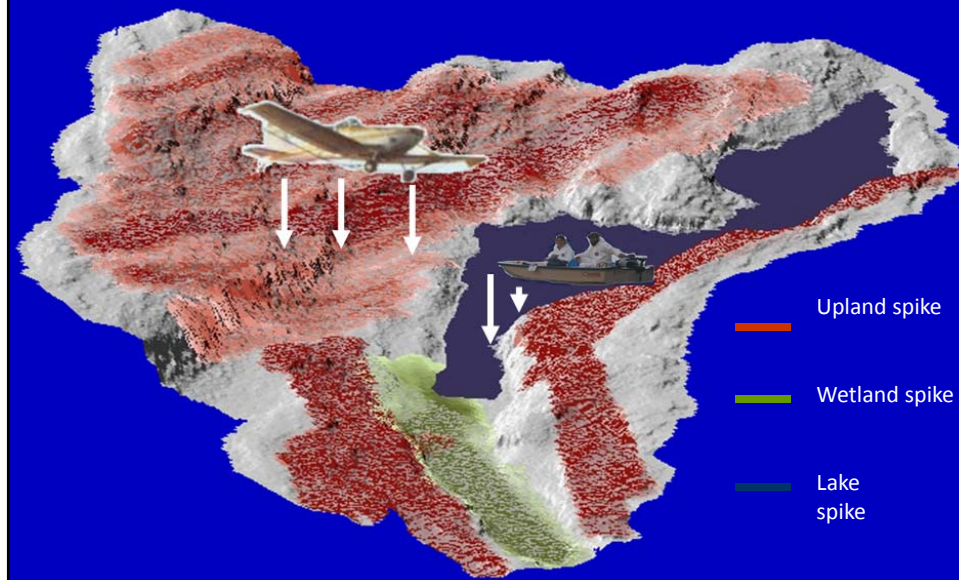


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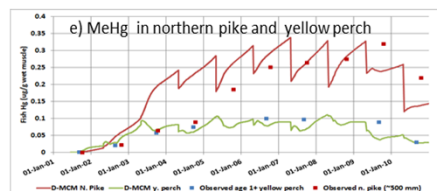
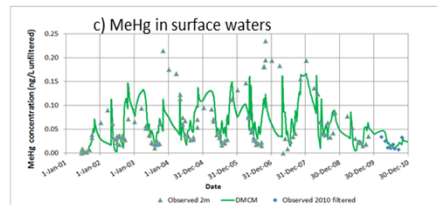
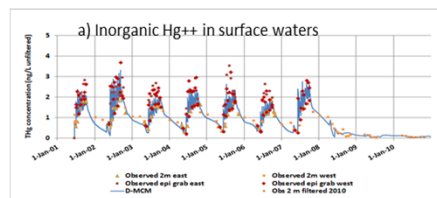
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METAALICUS: Hg was applied 2001-07 by plane and boat..

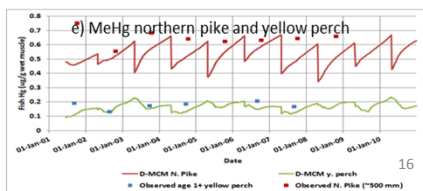
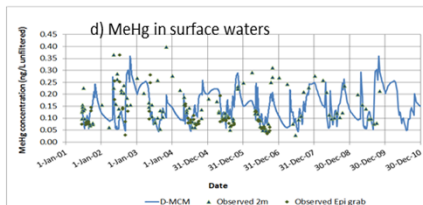
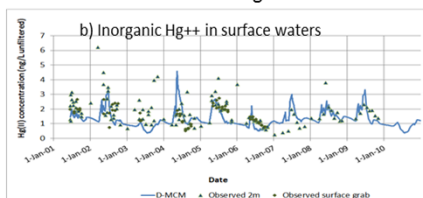


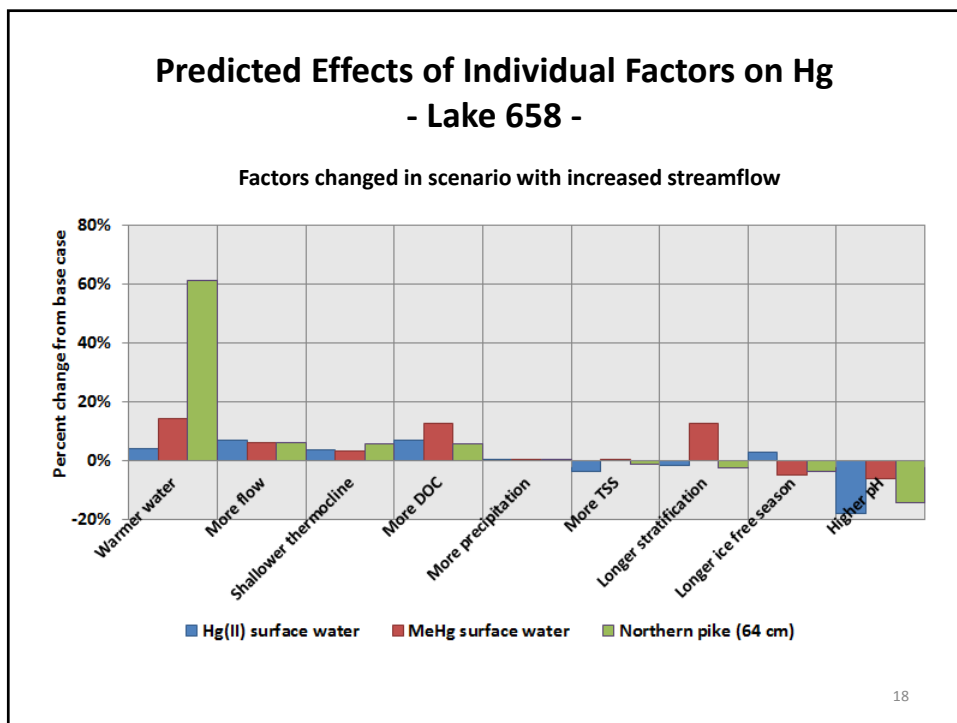
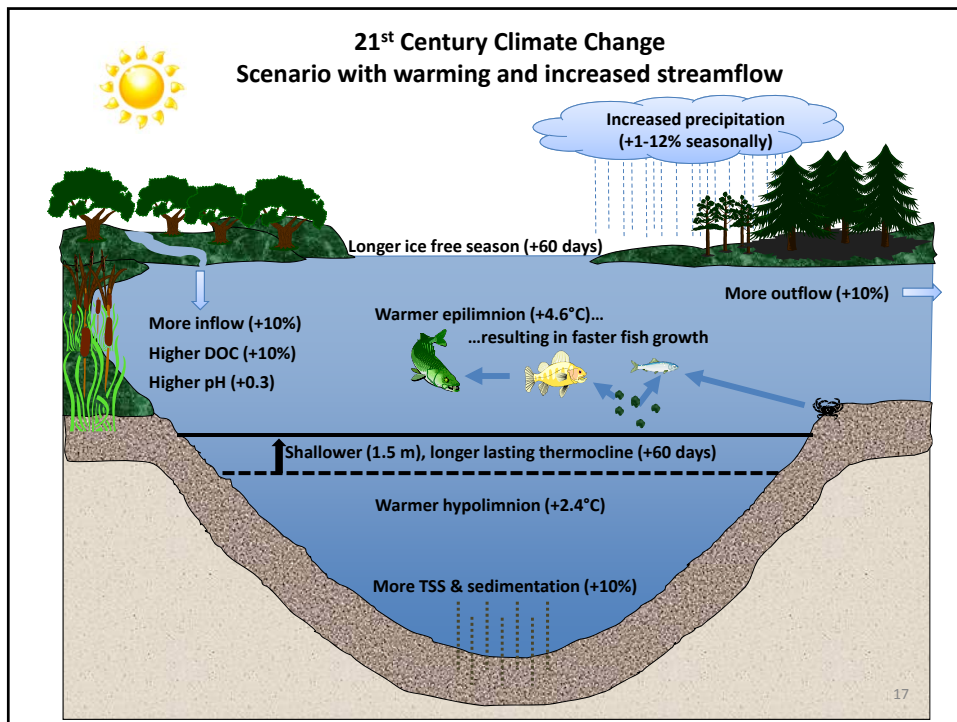
METAALICUS Lake Simulations

Lake Spike

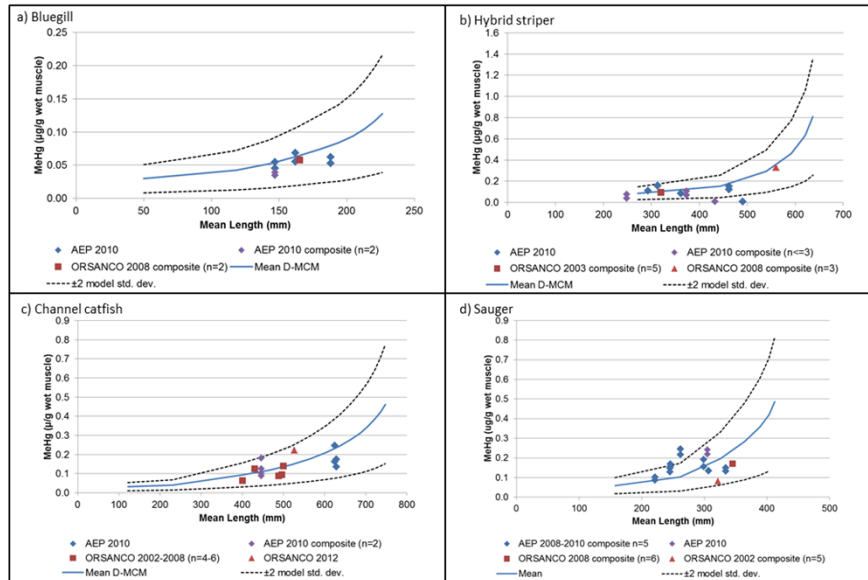


Ambient Hg





Predicted and Observed MeHg in Fish in Ohio River (R.C. Byrd Pool)



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Uncertainty

- How many significant digits associated with fish Hg predictions?
 - 1
 - 1.1 $\square$ ————— ...Somewhere in this range
 - 1.01
- Can use probabilistic (Monte-Carlo) approach to help quantify uncertainty.

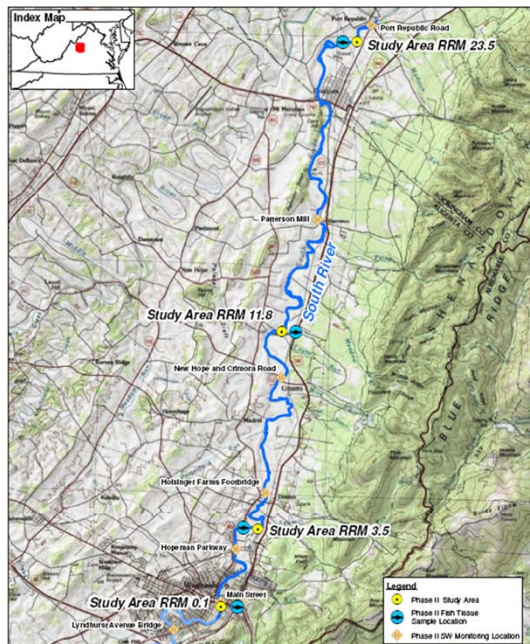
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Model Spatial Resolution for South River

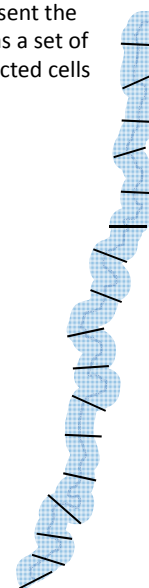
Conditions should be similar throughout each cell

1. One box – not enough.
2. High resolution (1000's of cells) is probably too many for mercury (not clear that predictions would be better).
3. Modest spatial resolution, e.g. 10-50 cells, may be appropriate?

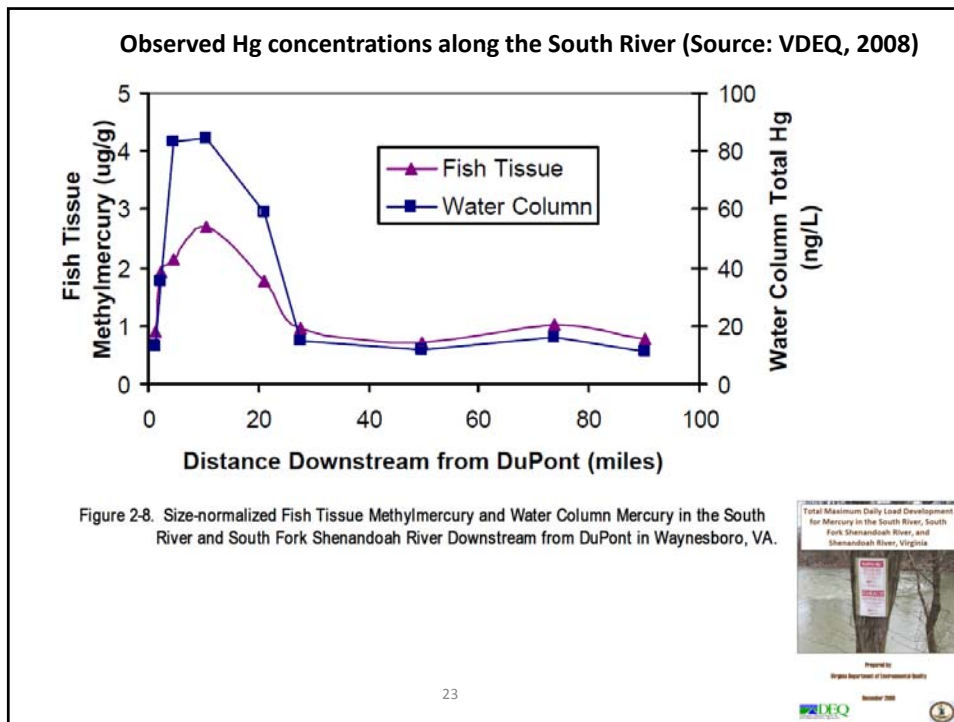
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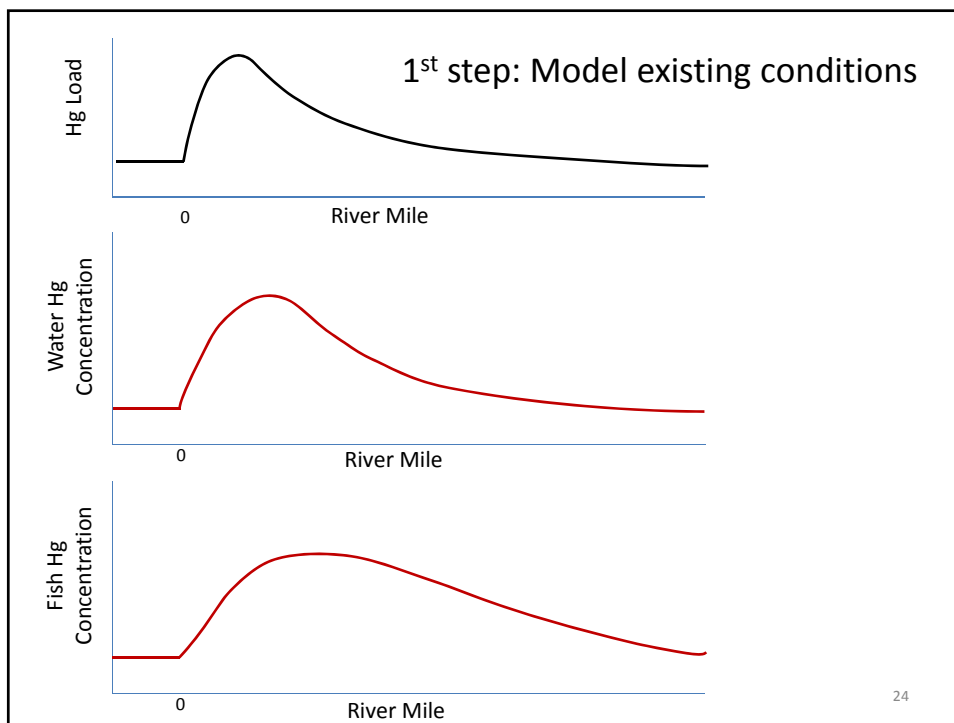
Represent the river as a set of connected cells



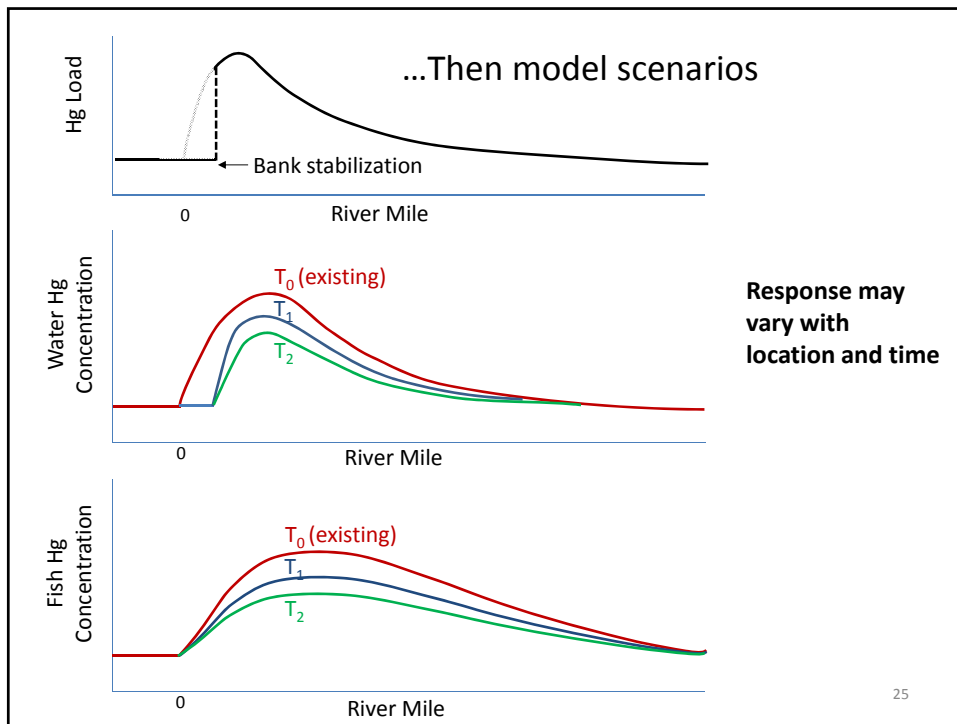
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Next Steps

- Discuss how to best model food web.
- Discuss how to estimate sediment transport
- Develop proposal.