Producing Policy-Relevant Scientific Knowledge via (Multiple) Environmental Models: Challenges and Opportunities

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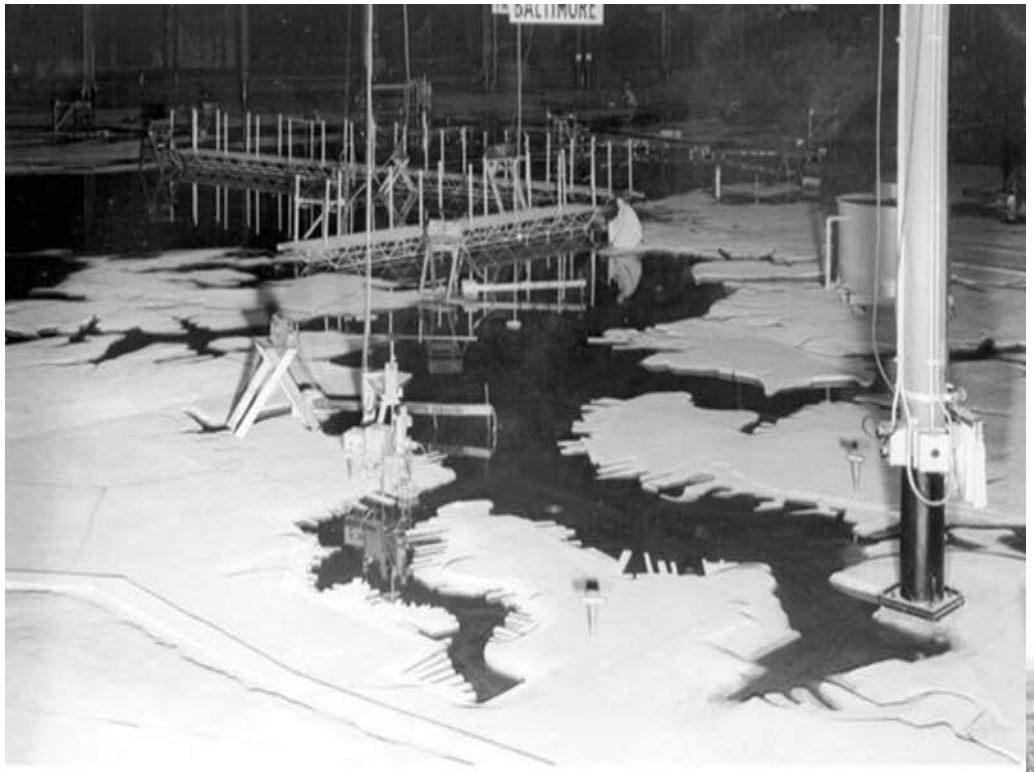
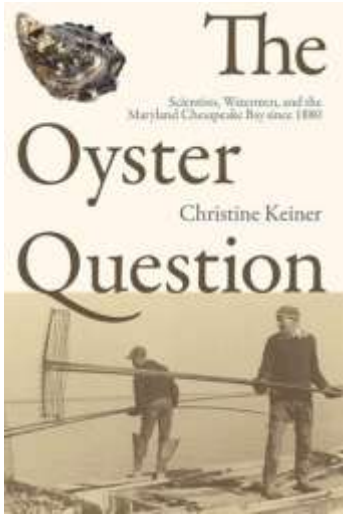


Cheasapeake Bay model

"Modeling Neptune's Garden: The Chesapeake Bay Hydraulic Model, 1965-1984" in *The Machine in Neptune's Garden: Historical Studies on Technology and the Marine Environment*, ed. David van Keuren and Helen Rozwadowski (Science History Publications, 2004), 273-314

Aerial view, Chesapeake Bay model facility



http://chl.erdc.usace.army.mil/Media/8/5/5/images/Chap7_img_9.jpg
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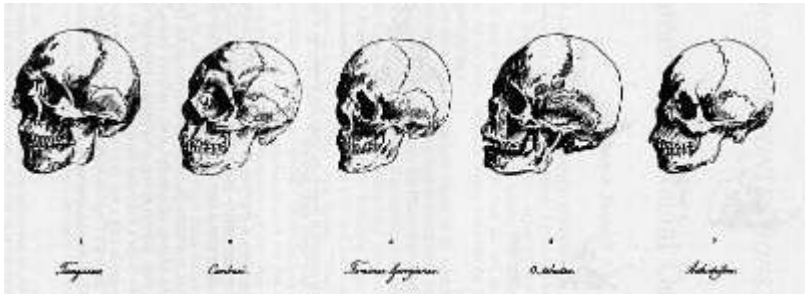
STS: Multi- and Inter-Disciplinary



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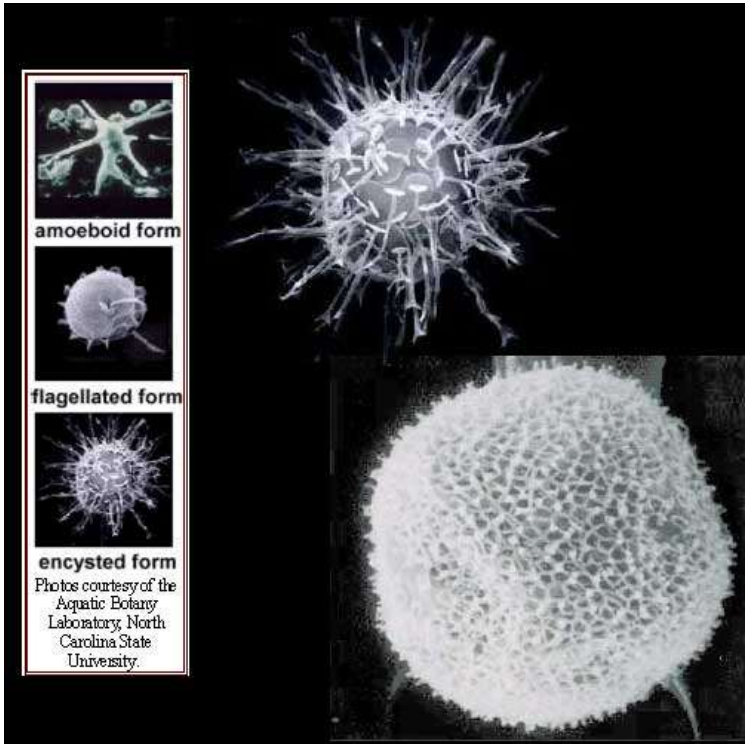
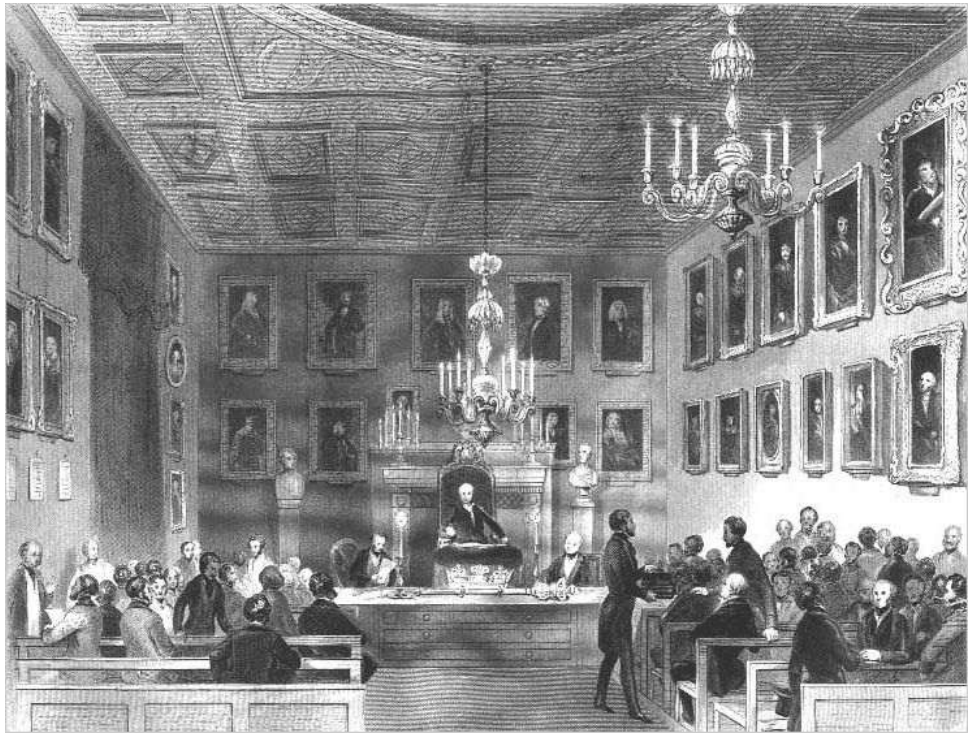
Nature & the physical reality of technological artifacts exist…



http://en.wikipedia.org/wiki/File:Pfiesteria_large.jpg
http://mdsg.umd.edu/CQ/V06N1/

But our knowledge & understanding of nature, science, & technology are *socially-mediated* processes.



Meeting of the Royal Society of London for Improving Natural Knowledge

http://yargb.blogspot.com/2011/10/royal-society-archive-in-now-online.html

"[Science and society] are now entangled to the point where they cannot be separated any longer….

To the old slogan of science—the more disconnected a discipline from society, the better—now resonates a more realistic call for action: The more connected a scientific discipline, the better....

Scientists now have the choice of maintaining a 19th-century ideal of science or elaborating—with all of us, the hoi polloi—an ideal of research better adjusted to the collective experiment on which we are all embarked."

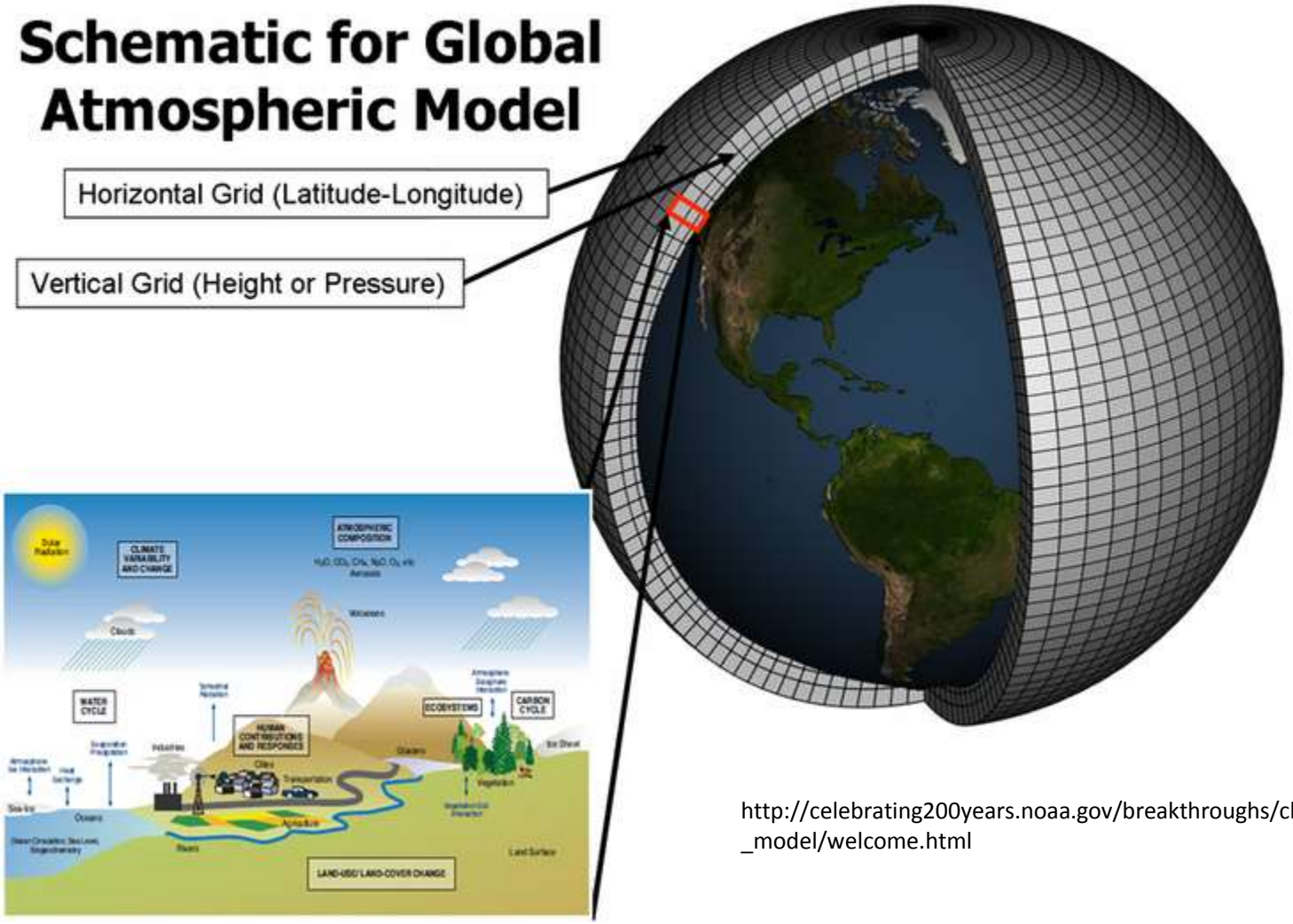
– Bruno Latour, "From the World of Science to the World of Research," *Science* 280 (1998): 208-09

"Though not all of us are going to be model builders, we all are becoming model consumers, regardless of whether we know it (or like it)….During our lives, each of us will be faced with the result of models and will have to make judgments about their relevance and validity. Most people, unfortunately, cannot make these decisions in an intelligent and informed manner, since for them computer models are *black boxes*: devices that operate in completely mysterious ways."

– John D. Sterman, "A Skeptic's Guide to Computer Models," *Managing a Nation: The Microcomputer Software Catalog* 2 (1991): 209-229

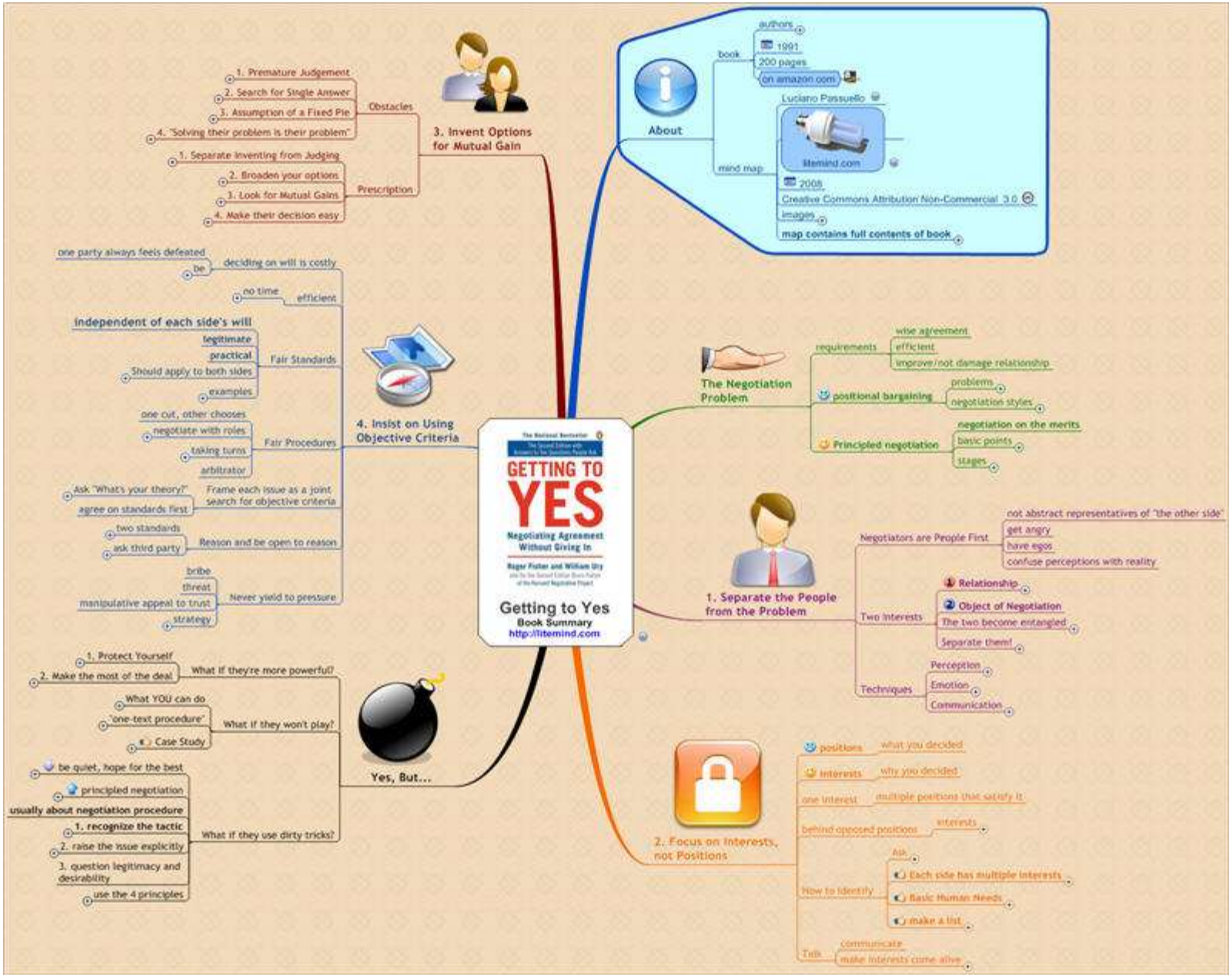
Image: http://upload.wikimedia.org/wikipedia/commons/thumb/f/f6/Blackbox.svg/500px-Blackbox.svg.png

Schematic for Global Atmospheric Model



http://celebrating200years.noaa.gov/breakthroughs/climate_model/welcome.html

"Climate models are systems of differential equations based on the basic laws of physics, fluid motion, and chemistry. To 'run' a model, scientists divide the planet into a 3-dimensional grid, apply the basic equations, and evaluate the results. Atmospheric models calculate winds, heat transfer, radiation, relative humidity, and surface hydrology within each grid and evaluate interactions with neighboring points." —NOAA Web site



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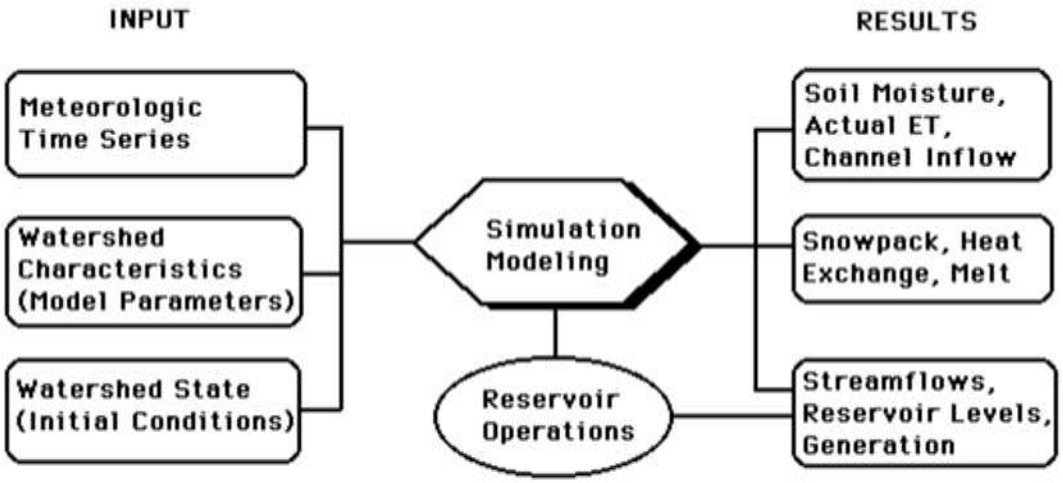

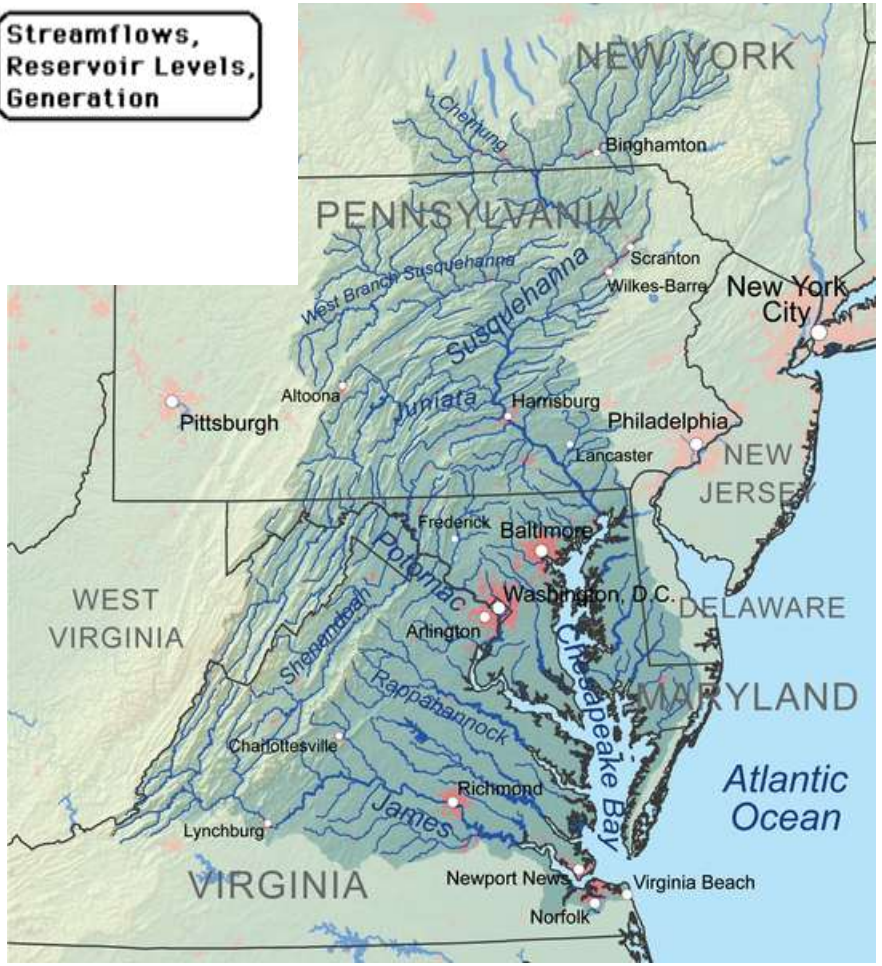

http://www.hydrocomp.com/Pictures/quarterly94.1/quart1_files/image005.gif
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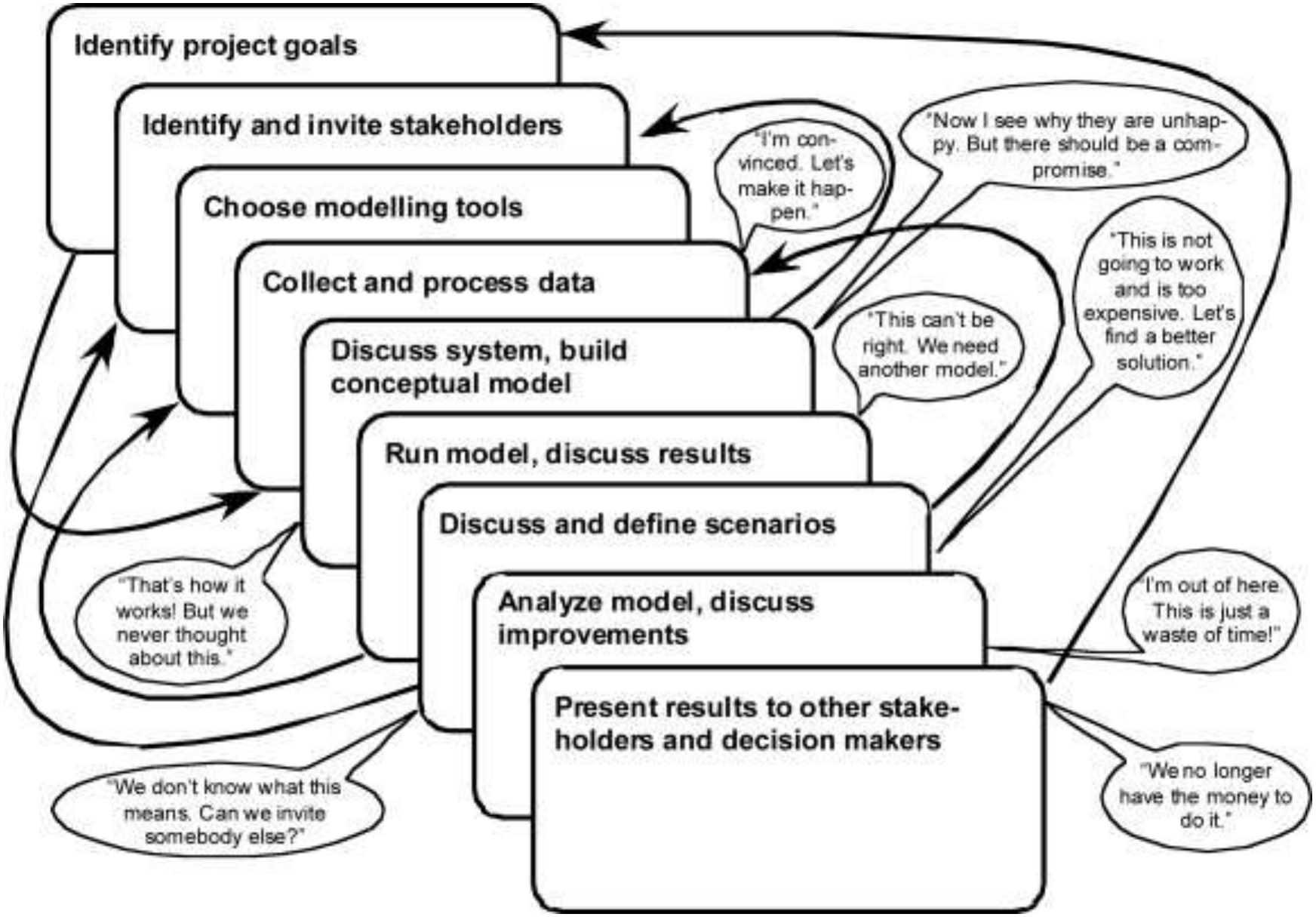
http://en.wikipedia.org/wiki/File:Runoff_of_soil_%26_fertilizer.jpg



Alexey Voinov and Francois Bousquet, "Modelling with Stakeholders," *Environmental Modelling & Software* 25 (2010): 1268-1281, http://www.sciencedirect.com/science/article/pii/S1364815210000538

In conclusion…

- Black box modeling—a policy-making failure
  - using model results without scrutinizing their assumptions & engaging the model builders in dialogue, i.e., as a Delphic substitute for critical thought rather than as a "what-if tool" for improving judgment & intuition (Sterman 1991)

- Opening the black box via participatory/stakeholder modeling
  - continuum of citizen involvement from passive → interactive
  - participatory models as (expensive, time-consuming, messy) tools of conflict resolution
  - participatory models as part of a suite of multiple/diverse models

References

- Arnstein, Sherry. “A Ladder of Citizen Participation,” *Journal of the American Planning Association* 35 (1969): 216-224
- Fisher, Roger, William Ury, and Bruce Patton. *Getting to Yes: Negotiating Agreement Without Giving In* (Penguin, 1991)
- Korfmacher, Katrina Smith. “The Politics of Participation in Watershed Modeling,” *Environmental Management* 27 (2001): 161-176
- Latour, Bruno. “From the World of Science to the World of Research,” *Science* 280 (1998): 208-09
- Sterman, John D. “A Skeptic’s Guide to Computer Models,” *Managing a Nation: The Microcomputer Software Catalog* 2 (1991): 209-229
- Voinov, Alexey and Francois Bousquet. “Modelling with Stakeholders,” *Environmental Modelling & Software* 25 (2010): 1268-1281