IMPROVING MODELING PRACTICE TO IMPROVE WATER QUALITY

—AN INTRODUCTION TO TODAY'S SESSIONS

Steven Patterson
April 5, 2017
OCLWA 2017
Stillwater

bioXdesign

EPA releases program for the Illinois River Basin

By D.E. Smoot Phoenix Staff Writer Oct 2, 2015

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Tenkiller Lake.

PHOENIX ADVANTAG

A three-dimensional lake model to support total maximum daily load development for Lake Wister

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Lake Thunderbird Report for Nutrient, Turbidity, and Dissolved Oxygen TMDLs

What can we learn from this recent work?

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  - (Thad Scott, Baylor University)

- Reconstructing water quality conditions using Reservoir Limnology Theory: An empirical approach to phosphorus load reduction estimates for Beaver Lake, Arkansas
  - (Matthew W. Rich, Beaver Water District and University of Arkansas and J. Thad Scott, Baylor University)

- Model My Watershed--a new, user-friendly, online modeling platform
  - (Anthony Aufdenkampe, LimnoTech)

- Fine-scale (HUC 12) watershed sampling to complement or in place of watershed modeling
  - (Brad Austin and Brian Haggard, University of Arkansas)

- Learning from recent modeling projects—results of a survey
  - (Shanon Phillips, Oklahoma Conservation Commission, and Steve Patterson, Bio x Design)

- Panel discussion with session speakers-- Improving modeling practice for water quality improvement

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- The uses of models
- Types of models

- The uses of models
  - Understanding
  - Management
  - TMDLs

ODEQ:

TMDLs & Water Quality Modeling

DEQ manages the Total Maximum Daily Load program for the State of Oklahoma. A TMDL is the process of establishing the sources of impairment in a given waterbody, whether from point sources (discharges) or non-point sources (runoff), determining the amount of reduction necessary to meet water quality standards in that waterbody, and allocating the loads to the various contributors of pollution. A margin of safety is also included in the TMDL calculation process.

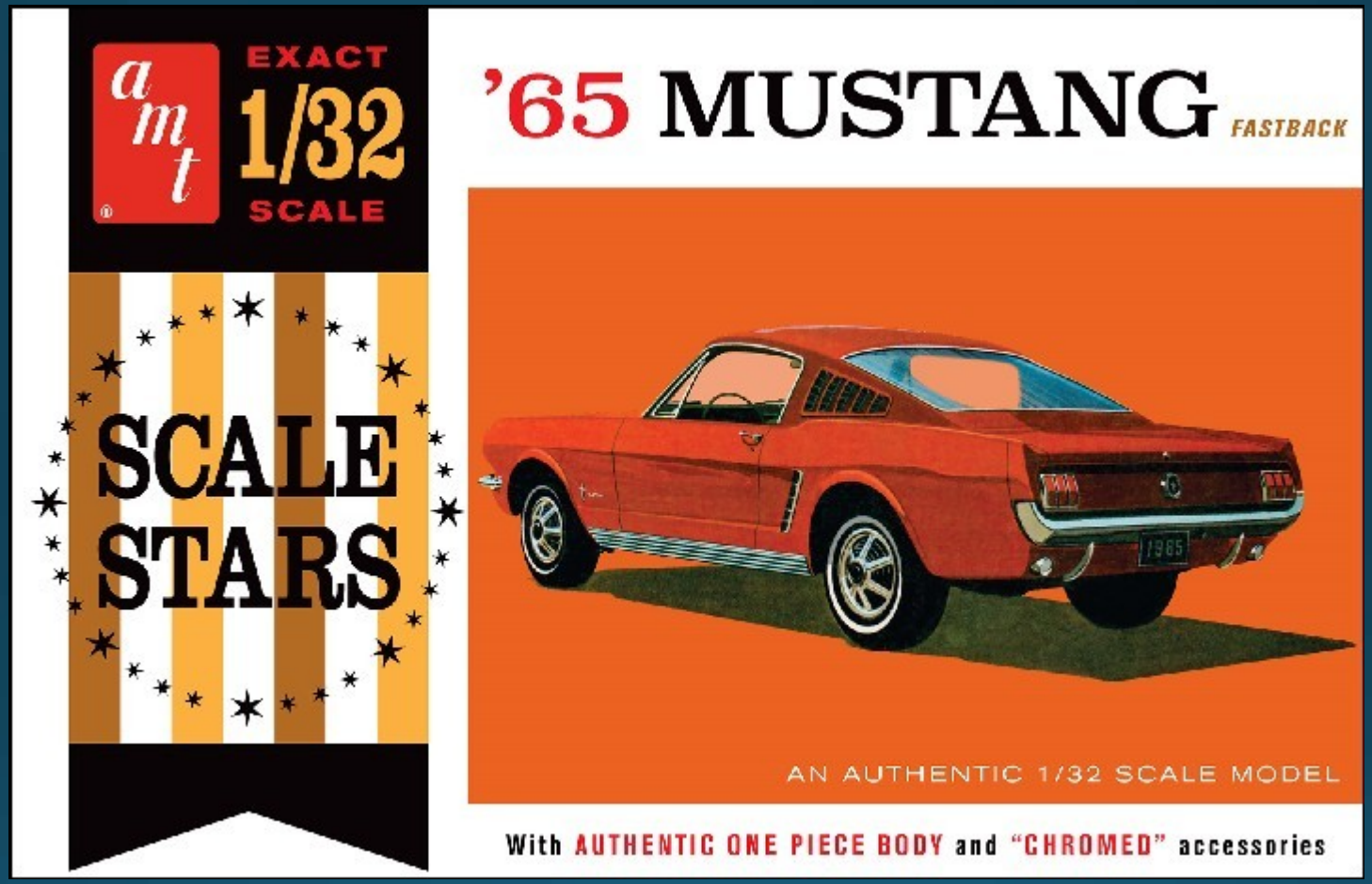
Water-quality modeling is the linkage between the sources of pollution and the instream water quality of a given waterbody. A model is a representation of the water-quality processes that occur in a given waterbody.

Water-quality modeling can be resource-intensive. Different levels of complexity may be used depending on the level of confidence required in a given situation.

http://www.deq.state.ok.us/wqdnew/tmdl/index.html

- Models provide a linkage between loads and receiving waters
- Models allow the testing of various load reduction scenarios

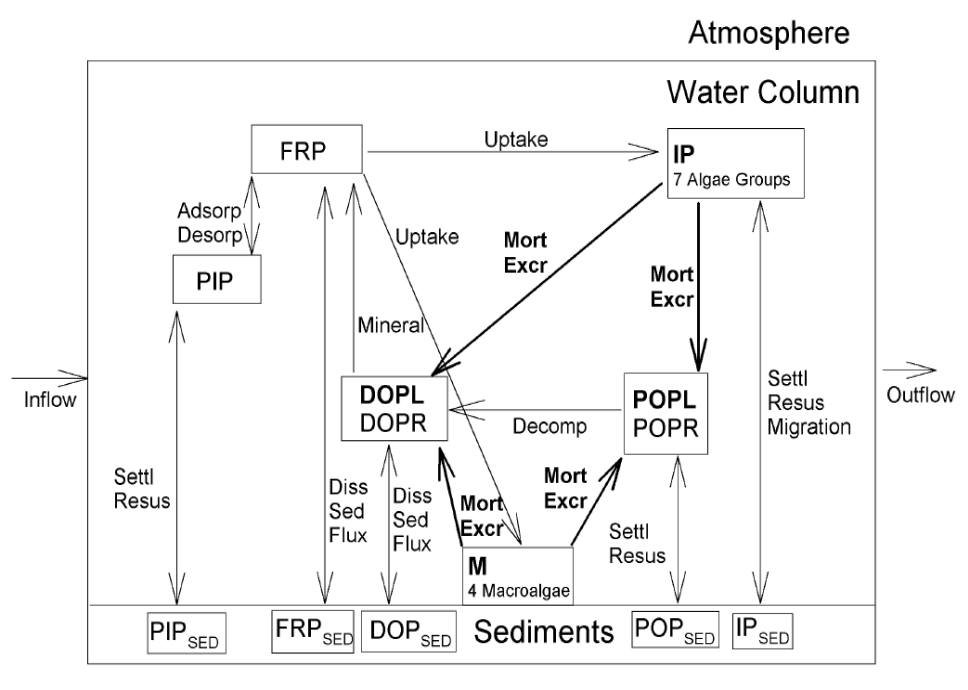
- Types of models
  - Physical models
  - Conceptual models
  - Empirical models
  - Process-based models
  - Numerical simulation models



Physical models

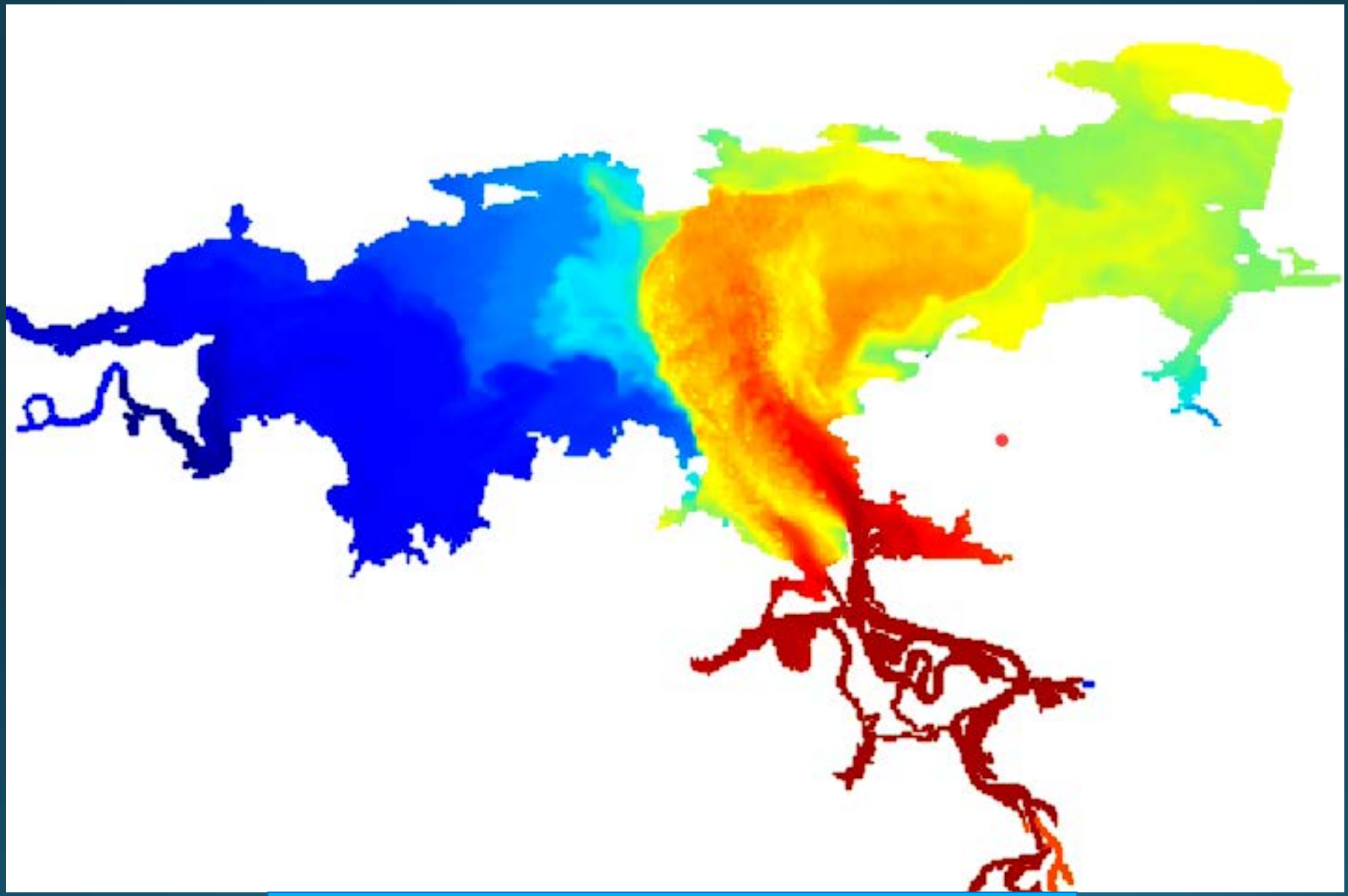
U.S. Army Corps of Engineers Bay-Delta Model
Sausalito, CA

Numerical simulation models



Flow diagram of the P cycle and its interaction with algal biomass in ELCOM-CAEDYM

Imerito 2013. Dynamic Reservoir Simulation Model: DYRESM v4; v4.0 Science Manual, Centre for Water Research, University of Western Australia.



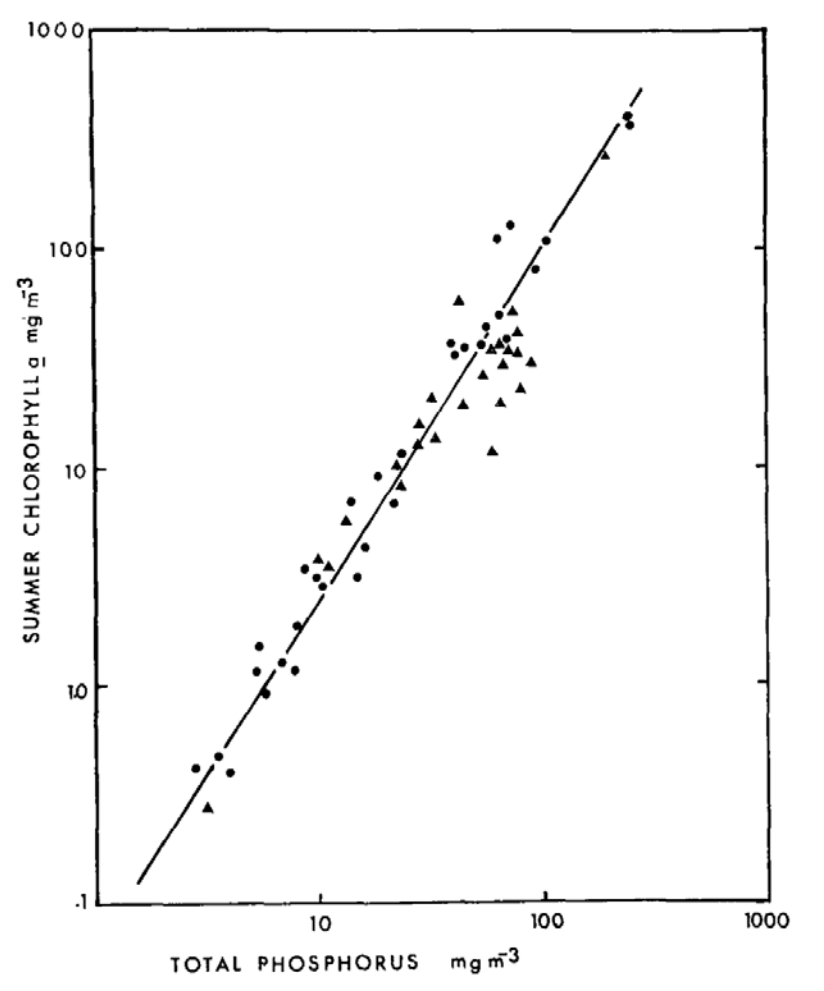
Lake Wister ELCOM-CAEDYM tracer inflow studies.
Scott et al.

The phosphorus–chlorophyll relationship in lakes[1,2]

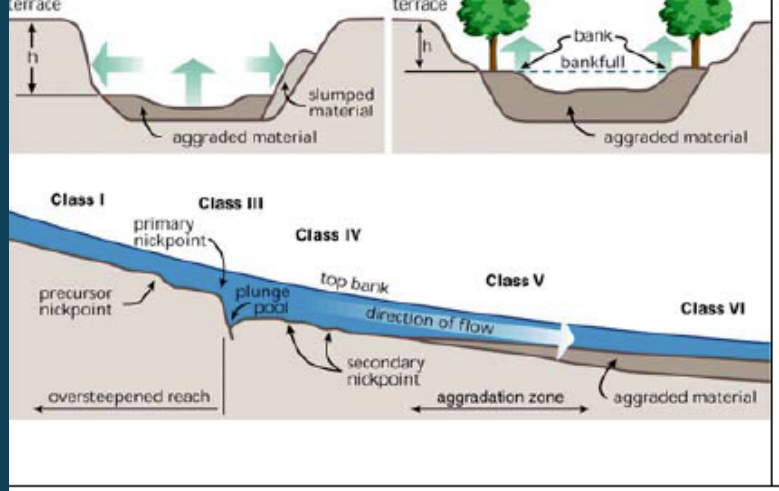
P. J. Dillon[3] *and F. H. Rigler*
Department of Zoology, University of Toronto, Toronto, Ontario

Limnology & Oceanography 1974. 19(5): 767-773.

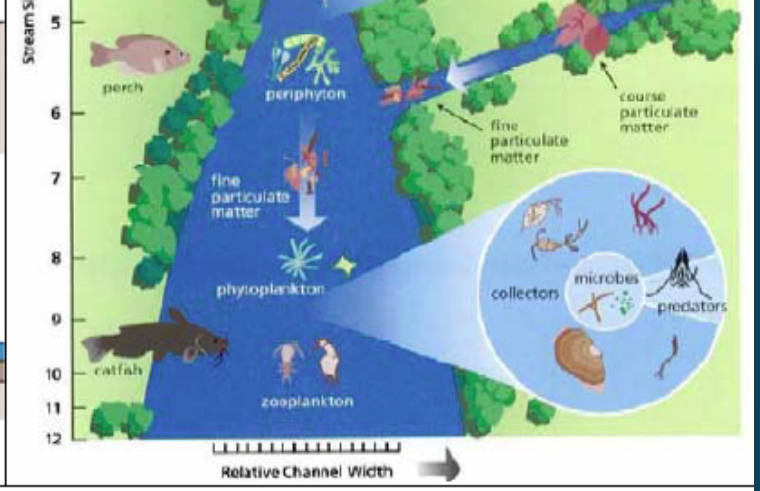
Empirical models



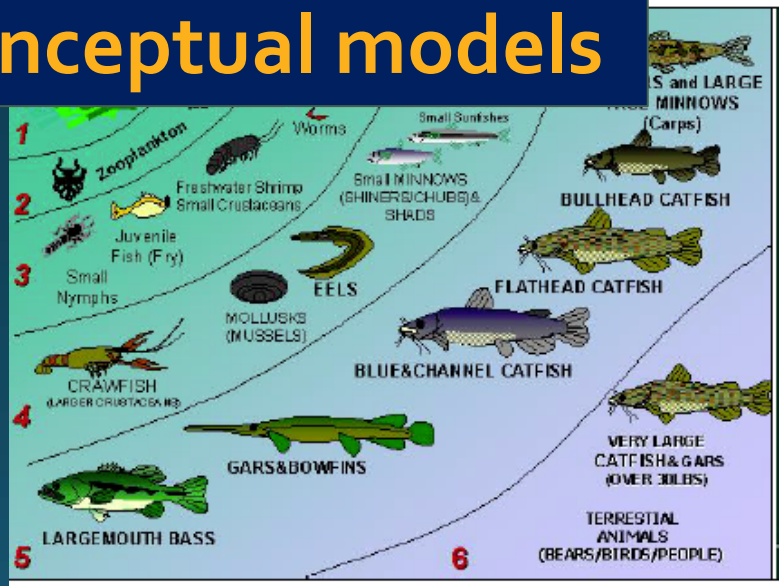
Conceptual models



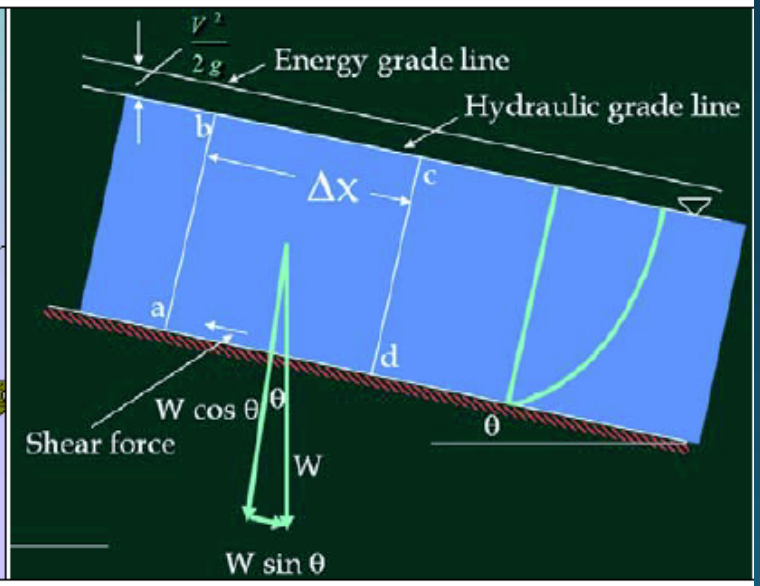
a. Geomorphologists rely upon the Channel Evolution Model (Schumm et al. 1984) to help explain and predict channel form response to perturbations that trigger degradation



b. Ecologists use the River Continuum Concept (Vannote et al. 1980) as a scientific framework for describing the predictable ways in which flowing ecosystems are expected to change spatially



c. Biologists organize systems and pathways according to trophic structure



d. Engineers idealize forces and geometries in order to calculate hydraulic conditions

Fischenich 2008. Application of conceptual models to ecosystem restoration. ERDC TN-EMRRP-EBA-01. US Army Engineer Research and Development Center.

esa

ECOSPHERE

CONCEPTS & THEORY

Process-based models are required to manage ecological systems in a changing world

K. CUDDINGTON,[1,†] M.-J. FORTIN,[2] L. R. GERBER,[3] A. HASTINGS,[4] A. LIEBHOLD,[5] M. O'CONNOR,[6] AND C. RAY[7]

Ecosphere 2013. 4(2): 1-12.

Process-based models

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Process-based models

- Built on transparent assumptions and processes

Operational Ecosystem Modeling to Support Adaptive Management – Lessons from 40 Years of Decision Support in the Great Lakes

- Bay Delta connections
  - Weather
  - Flows
  - Physical impacts
  - Chemical impacts
  - Ecosystem impacts
  - Invasives
- Multiple stakeholders
- Requires integrative modeling, cooperative planning, and adaptation

Wolfe, J.R., J.V. DePinto, D.W. Dilks, and T.A.D. Slawecki. Presented at the Bay Delta Science Conference, Sacramento, CA. October 30, 2014.
http://www.limno.com/pdfs/2014_Wolfe_BayDeltaSci_Conf.pdf

https://mavensnotebook.com/2014/11/25/ecosystem-modeling-to-support-adaptive-management-lessons-from-40-years-of-decision-support-for-the-great-lakes/

Questions?