

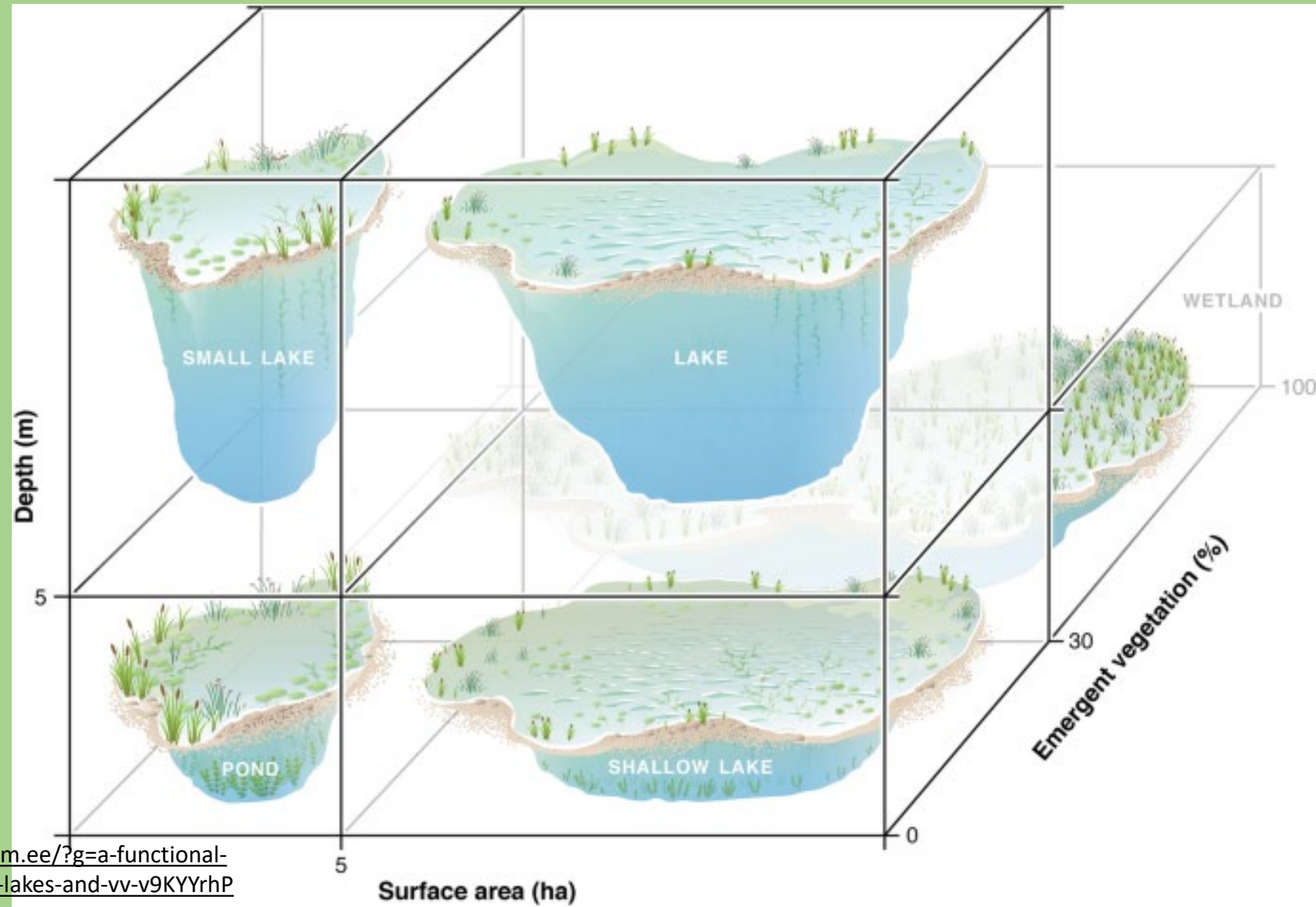


Lake Modeling Capacity and the LAKE2K Model

Ben Cope, EPA Region 10, LSASD

October 2, 2024

There's a lot of lakes out there to protect...



Lake Nutrient Impairments

- TMDL development can be resource-intensive
- Water quality models are essential
 - Limited technical capacity in many state/tribal agencies
 - Current models are limited – very simple or very complex
- Increasing risks
 - HABs
 - Climate Change

EPA's Water Modeling Workgroup (WMW)

- Chartered in 2017
- Goal – Improving water quality modeling capacity
- Annual modeling training workshop
- WMW webinar series – Big Hit!

<https://www.epa.gov/waterdata/surface-water-quality-modeling-training>

Zero D – *BATHTUB*

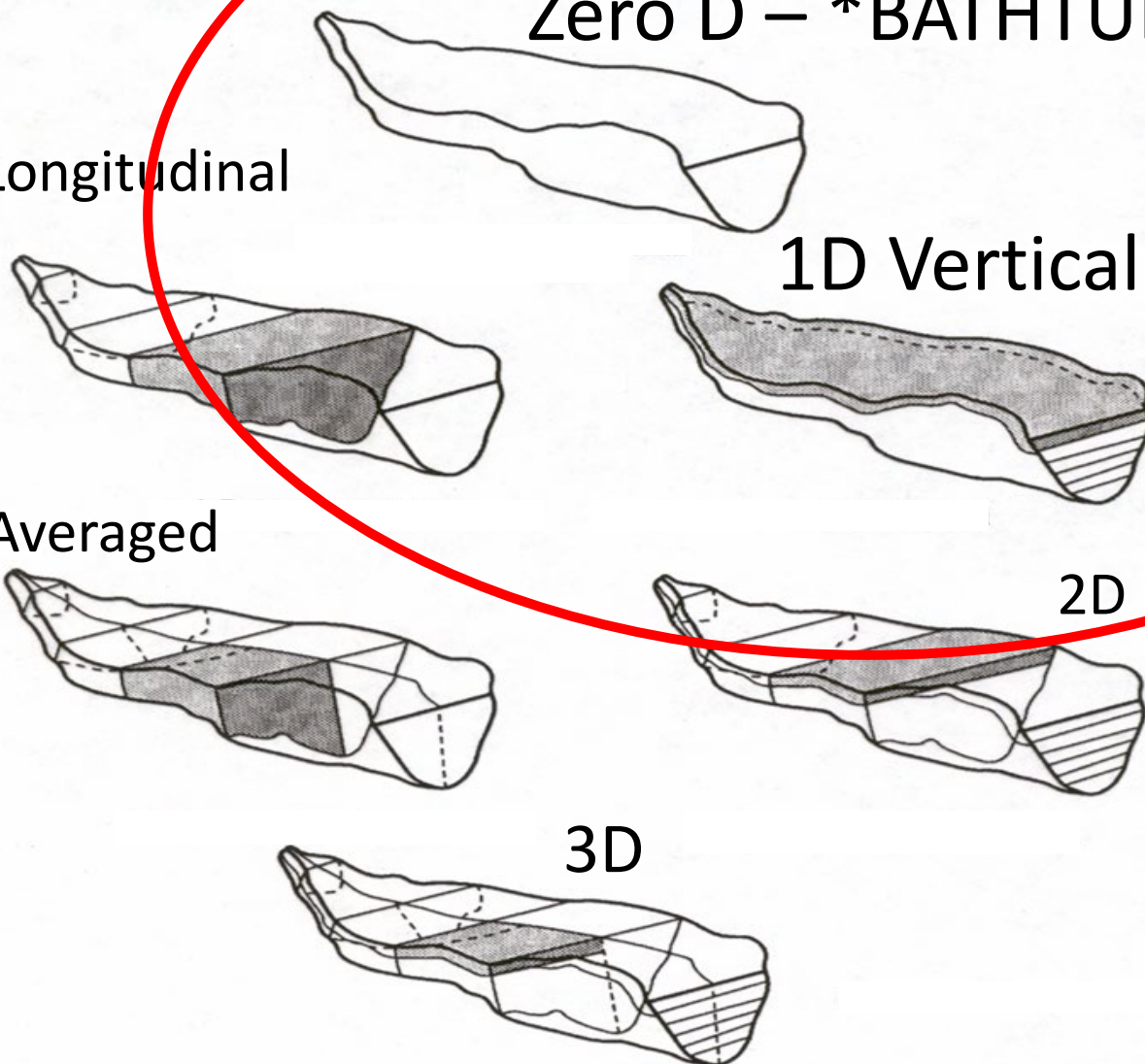
1D Longitudinal

1D Vertical – *LAKE2K*

2D Vertically Averaged

2D Laterally Averaged
CE-QUAL-W2

3D



Water Modeling Workgroup (WMW) Activities

- Updating Old Workhorse Model: BATHTUB
 - Zero dimensional – complete mix
 - Steady state – simulates seasonal average
- Peer Reviewing New Model : LAKE2K
 - One dimensional – 3 vertical layers
 - Dynamic simulation – daily simulation
- Research proposal
 - Applied model comparison and companion guidance on model selection

LAKE2K - 3 Vertical Layers

Epilimnion, Metalimnion, Hypolimnion

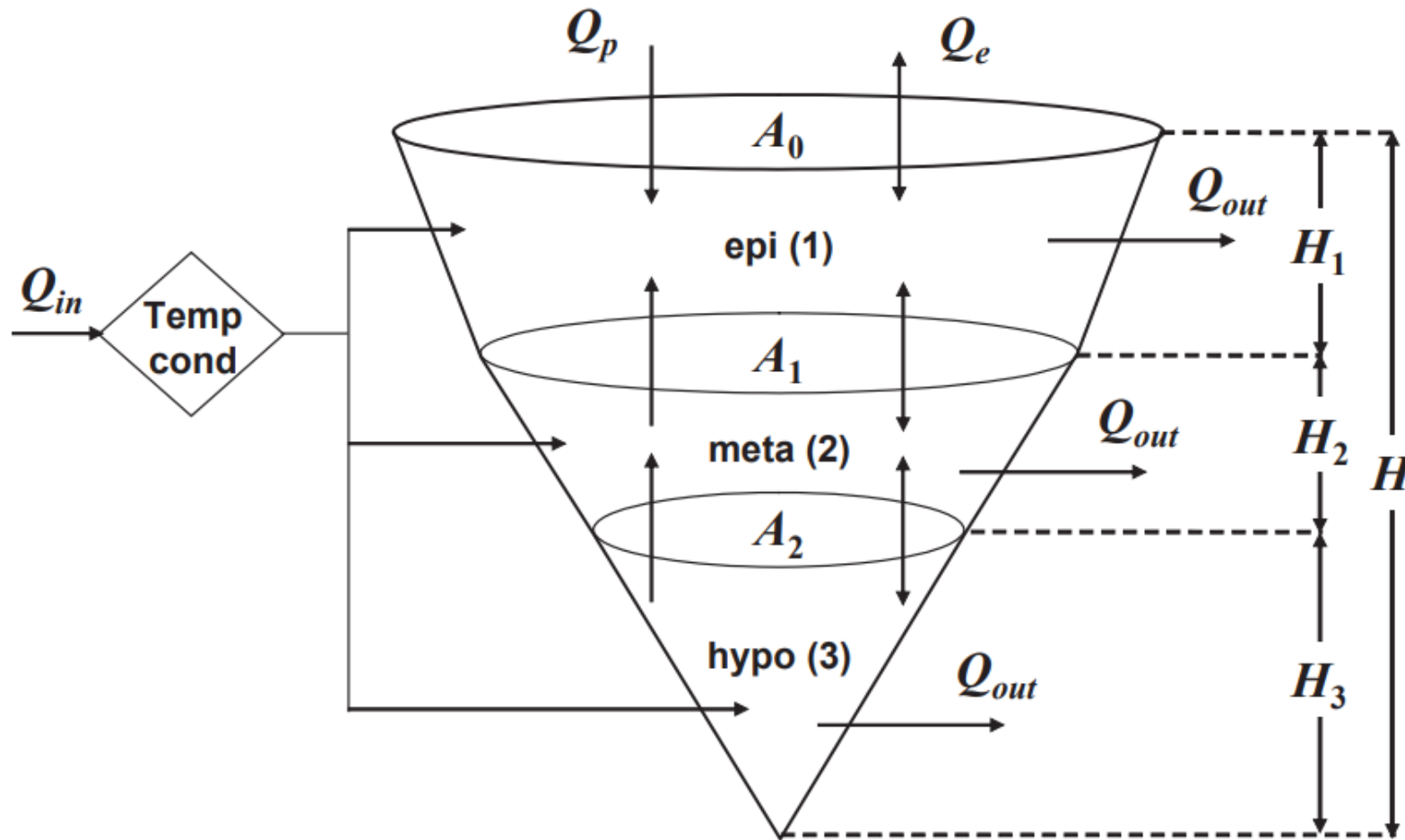


Figure 29 LAKE2K water balance and vertical segmentation scheme.

LAKE2K – Processes Simulated

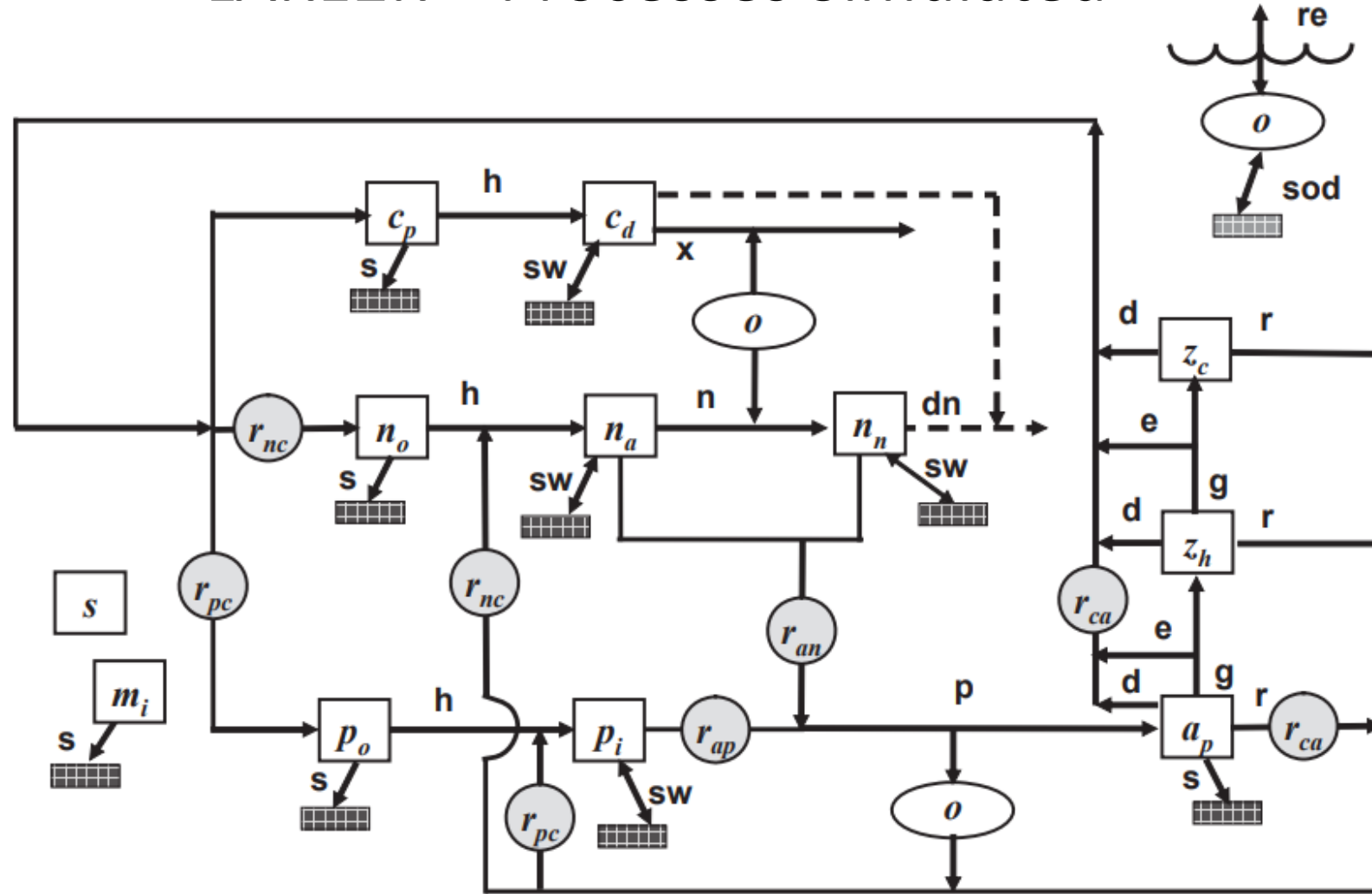


Figure 32 Model kinetics and mass transfer processes. The state variables are defined in Table 3. Kinetic processes are hydrolysis (h), oxidation (x), nitrification (n), denitrification (dn), photosynthesis (p), respiration (r), death (d), grazing (g), and egestion (e). Mass transfer processes are reaeration (re), settling (s), sediment oxygen demand (sod), and sediment-water exchange (sw).



LAKE2K Model Results (epilimnion algae)



Northeastern Pennsylvania
Lake Wallenpaupack nutrient model
Lake2K
Phytoplankton calibration

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Paste

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Styles

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Editing

Sort & FilterFind & Select

Analysis

Sensitivity

Add-ins

A2

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Lake Water Quality Model

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	LAKE2K (v1.05)														
2	Lake Water Quality Model														
3	Steve Chapra, James Martin, & Kyle Flynn														
4															
5															
6															
7	System ID:														
8	Lake name	Lake Neiwpc													
9	File name	L2KCalibr													
10	Directory where file saved	ers\kylef\Dropbox\business\lake2k													
11	Latitude	Average value of surface of lake above sea level	42.000	degrees											
12	Lake surface elevation		100.0	meters											
13	Calculation:														
14	Calculation step		0.12500	day											
15	Print step		2.00000	day											
16	Initial time		1/1/00												
17	Final time		12/31/00												
18	Time of last calculation		0.07	minutes											
19															
20															
21															
22															
23															

Thanks!

- EPA Water Modeling Workgroup – Amy King, John Johnston, Chris Knightes, Jason Gildea
- LAKE2K development team – Steve Chapra, James Martin, and Kyle Flynn
- Tetra Tech

