Cycles Team

- Define Representative Land Areas
  - **Analyze PIHM outputs to identify hydrologically distinctive areas – 0%**
  - Overlay ‘fields” so that the management units resemble actual fields – 50%
    - We obtained the last public CLU database (Common Land Unit from 2008)
    - Now we have actual “fields” (not pixels) that can be associated to rotations (completed last year). Map above shows coverage for the US.
  - Completion: desired May 31st
    - It does not slow down SDP, although SDP would be more polished with “fields”
    - I am short of hands for this task

Cycles Team

- Select feasible BMPs **(bold)**
  1. **Corn N mgmt improvement** (this is the first round of SDP as a first cut)
  2. **Winter cover crop, incorporated** (interseeded or planted after harvest)
  3. **Winter cover crop, harvested** (interseeded or planted after harvest)
  4. Forest riparian buffer
  5. Non-forest riparian buffer
  6. Harvestable riparian buffer (switchgrass, if there is a market, difficult to put a price on sw)
  7. **CRP (land retirement)**
  8. Denitrification traps (great approach, but beyond what we can do now)
  9. Tillage? (from what to what?)
  - Note: the CAST summary reports an average effectiveness at reducing N, P and Sediments
- Objectives for Quarter 2
  - Run Cycles for 2 and 3, similar to what we did before for corn
  - End May 31st

Cycles Team

- Model yield effects of BMPs
  - We have not run them yet, see below (0%)

- Objectives for Quarter 2
  - Run Cycles for 2 and 3, similar to what we did before for corn
  - End May 31st (perhaps earlier)

Cycles Team

- P work continues
  - Conceptually, well advanced (0%)
  - Prototype stand alone in place, but very incomplete
  - So far includes P in solution, microbial pool, residues pool, organic matter pool, labile turnover inorganic pool (Melich III – sort of), and occluded. This is clearly too simple, but a place to start. Management of liming complicates matters.

- Objectives for Quarter 2
  - April 30th for Cycles incorporation
  - (I promised one for January, but it is still on the works.)

PIHM Modeling Team

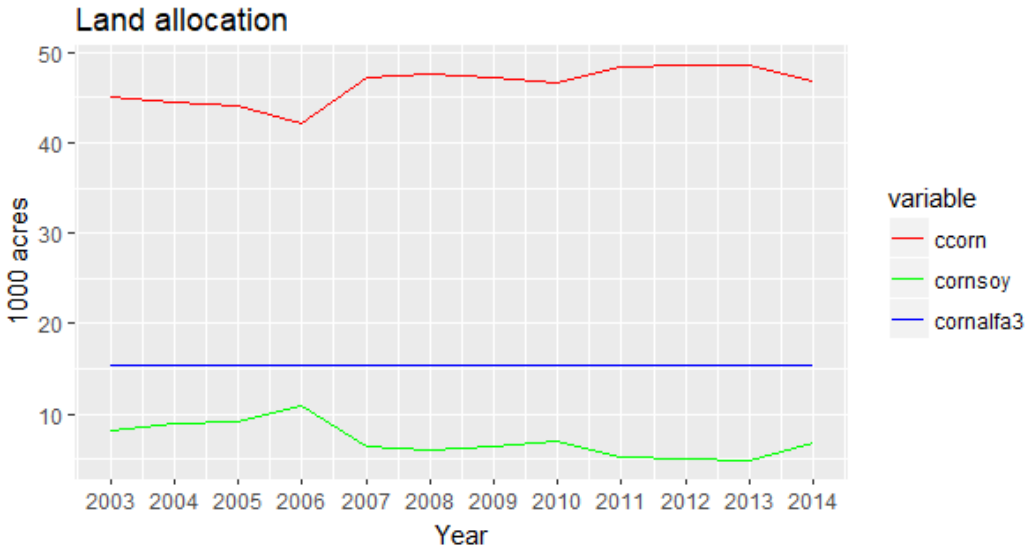
- Q1 Objective 1: PIHM Sunapee Calibration
  - Progress to date: Initial model implementation from HydroTerre was completed by Yu Zhang (Duke U.) in Jan 2018. Parameter sensitivity and calibration are currently being carried out by Lele Shu (UC Davis).
  - Anticipated timeline for completion of calibration/sensitivity is March, 2018
  - Analysis of combined PIHM-GLM modeling should occur 1st -2nd quarter 2018.
- Q1 Objective 2: PIHM Mendota Analysis
  - Progress to date: Final model calibration was completed by Yu Zhang and passed to GLM modeling team in January. GLM team is currently completing their model runs and paper ideas are currently being developed.
  - Analysis of combined results is expected to be complete during the 1st and 2nd quarter of 2018.
- Q1 Objective 3: Simplified PIHM model (emulator for water & nutrients)
  - The simplified hydrology/DOC model was developed in 2017
  - A paper was submitted to Limnology and Oceanography Letters 2nd quarter 2017 and accepted Feb 2018.
  - The model extensions are now under development. 1) fully dynamic hydrology/surface runoff

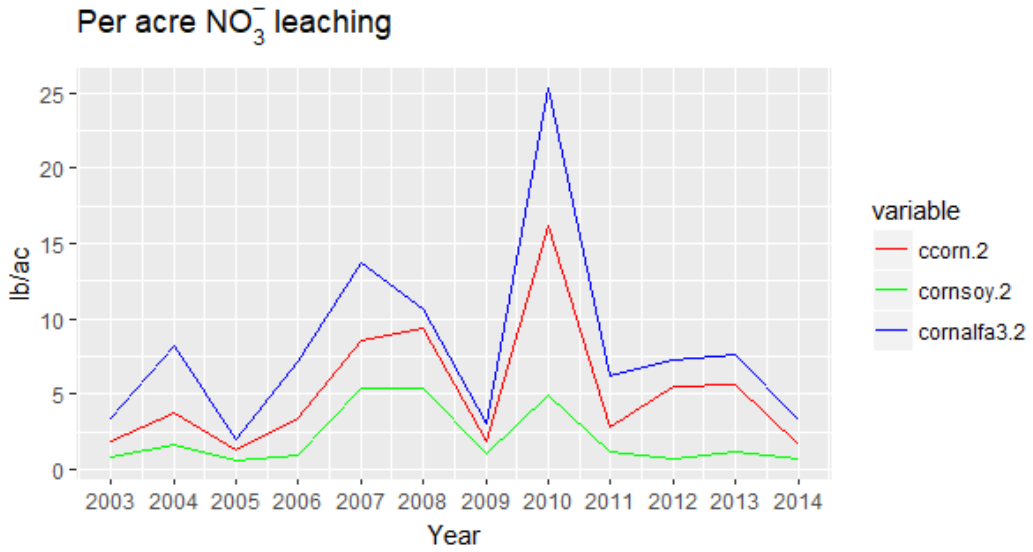
PIHM Modeling Team

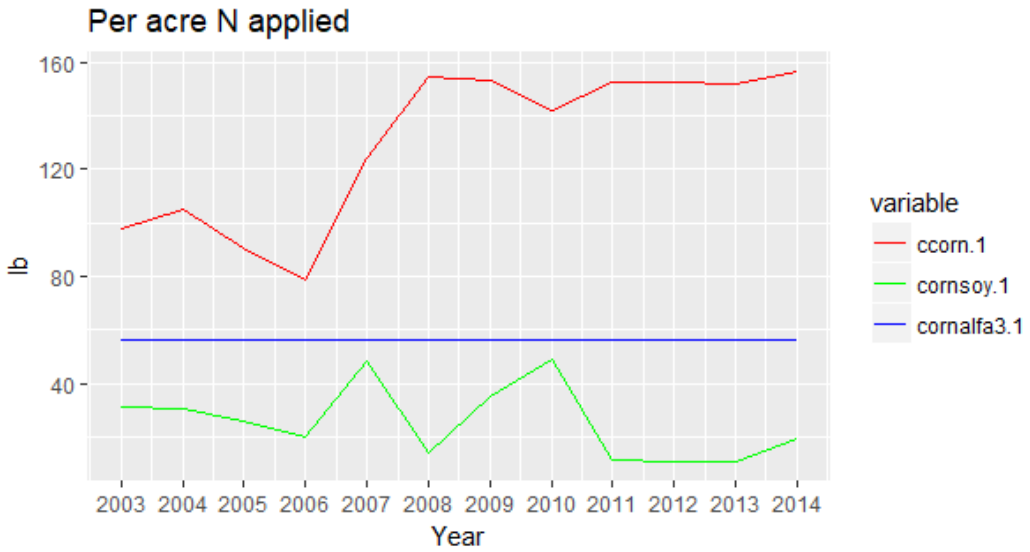
- Objectives for Quarter 2
  - Q2 Objective 1: PIHM Sunapee Calibration & Analysis, anticipated timeline 2nd quarter 2018. Write up and paper development 2nd-3rd quarter 2018.
  - Q2 Objective 2: PIHM Mendota Analysis and paper development anticipated timeline 2d quarter 2018
  - Q2 Objective 3: Simplified PIHM model (emulator for water & nutrients), anticipated timeline (under discussion)

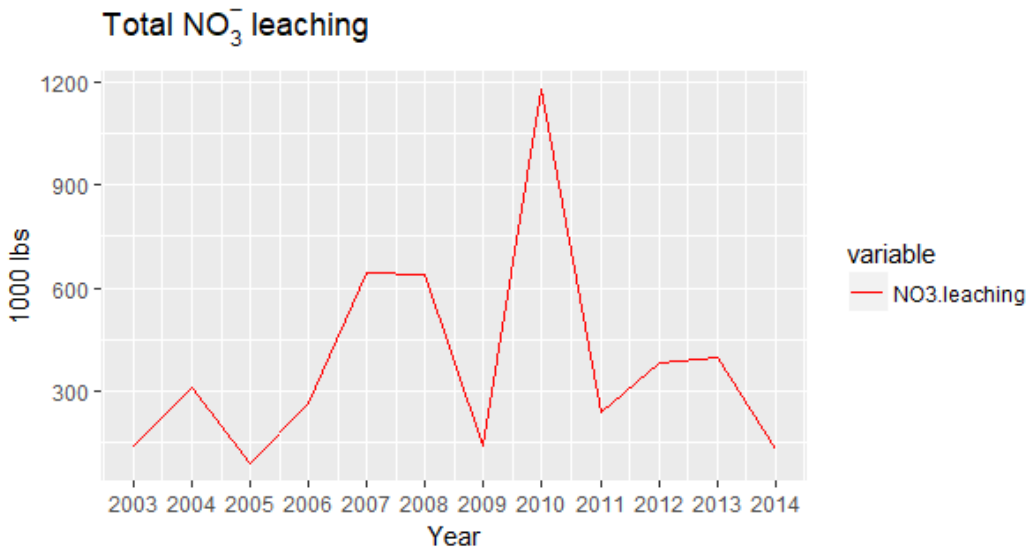
SDP Q1 Object : Calibrate Model for Mendota

- Progress
  - Calibrated model for Mendota
  - Simulated land allocation and nitrogen usage for year 2003 to 2014
  - Passed model results to Cycles
  - Obtained a potential list of BMP from Cycles team
- Next Step
  - Simulate the supply curve for N reductions
  - Work with Cycles team for different BMP scenarios
  - Pass model results to GLM team


Land allocation
1000 acres
50
40
30
20
10
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
variable
ccorn
cornsoy
cornalfa3


Per acre NO_3^- leaching
lb/ac
25
20
15
10
5
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
variable
ccorn.2
cornsoy.2
cornalfa3.2


Per acre N applied
lb
160
120
80
40
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
variable
ccorn.1
cornsoy.1
cornalfa3.1


Total NO_3^- leaching
1000 lbs
1200
900
600
300
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Year
variable
NO3.leaching

SDP Q2 object: Cycles-SDP Land management Study

- Determine set of BMPs to consider as a means of reducing N
- Simulate production effects of each BMP
- Simulate cost of implementing each BMP
- Simulate water quality improvement from each BMP

Hedonic Q1 objective1: GLM-Hedonic Coupling

- Progress
  - Link GLM and Hedonic model
  - Calculate implicit price under different nutrient loading scenarios
- Next step
  - Calculate property value increase for Madison city
  - Manuscript writing
- Timeline
  - Manuscript ready by May 20th

Hedonic Q1 objective2:Hedonic Model for Lake Sunapee

- Progress
  - Model set up and running for secchi depth, chlorophyll-a measurement at 0.1m, total phosphorus at 0-2m
- Next step
  - Calculate “view” of Lake based with Lidar Data
  - Communicate with LSPA for data and reality check
  - Try other water quality variables and functional forms
- Timeline
  - Final model confirmed before May workshop

Hedonic Q2 Objective

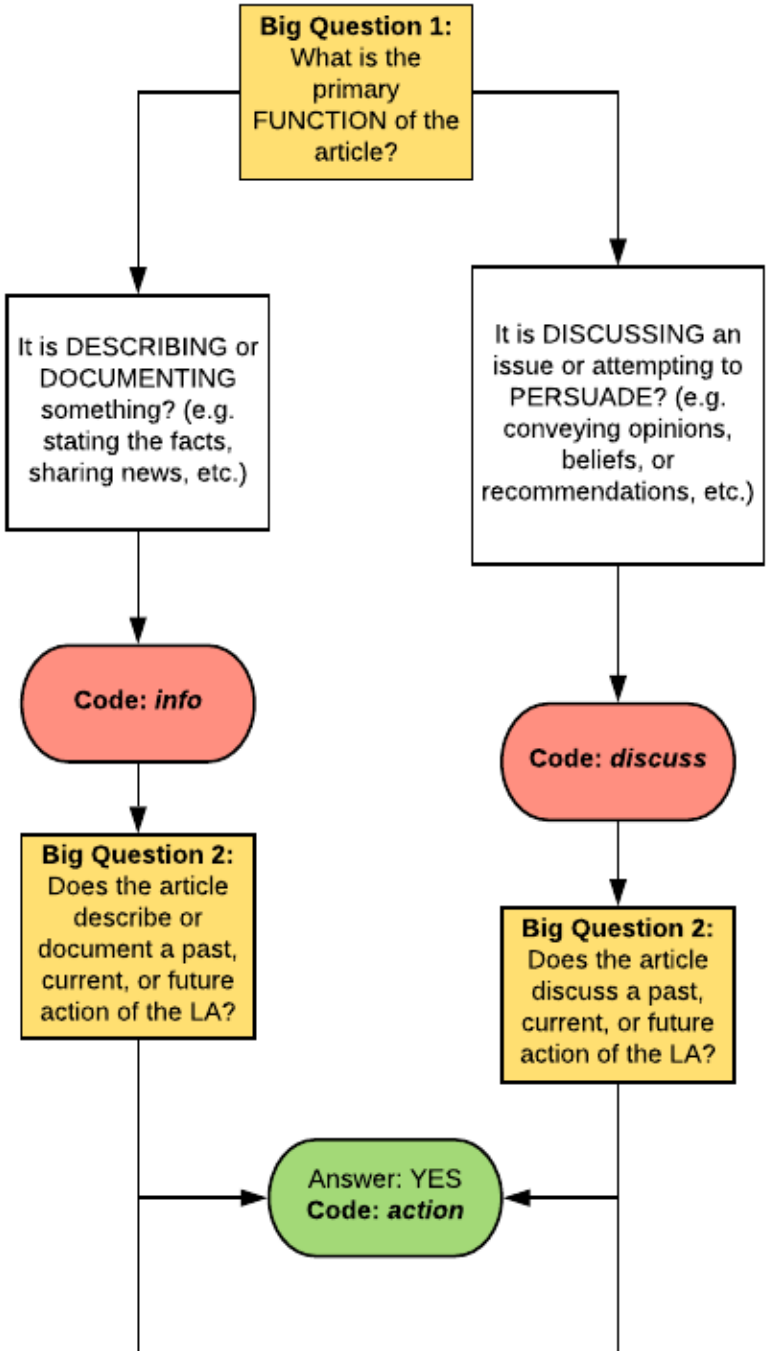
- Confirm Hedonic model results for Lake Sunapee
- Using machine learning techniques to provide a potential list of essential management variables
- Manuscript for GLM-Hedonic coupling paper

Civic Engagement

Objective 1: Design protocol to code documents.
Status: Initial Design phase
Expected Completion: April/May

Objective 2: Create plan for summer field season
Status: Developing as needs identified
Expected Completion: May

Objective 3: Code lake association documents
Status: Begins after protocol completed
Expected Completion: September

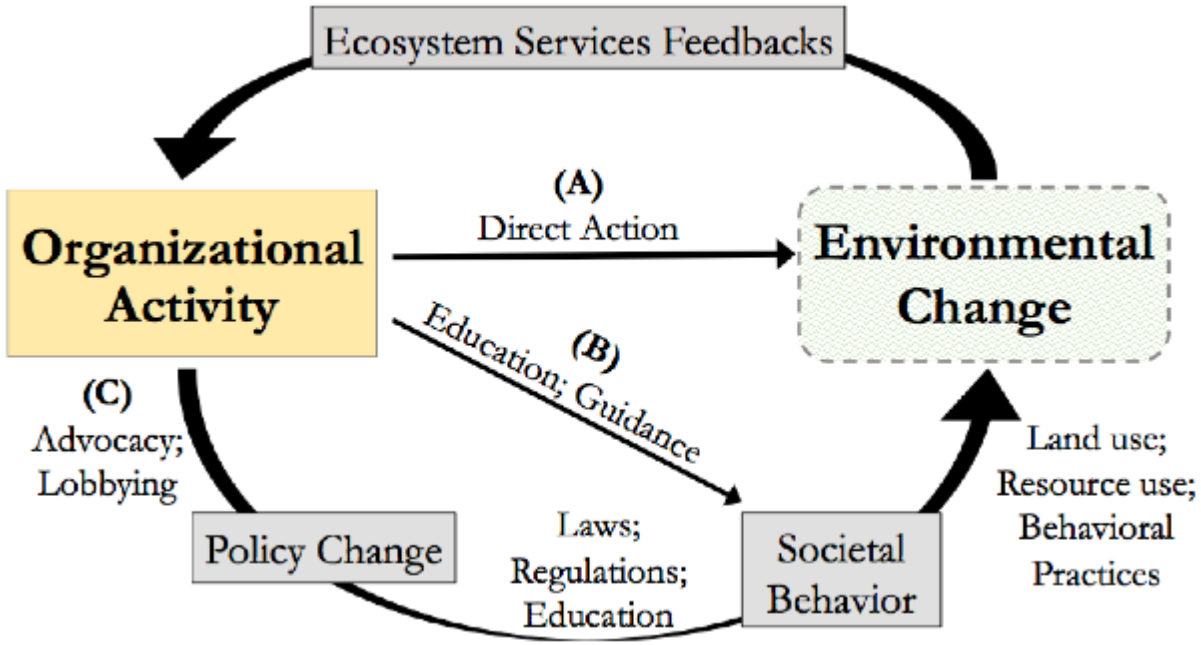


Civic Engagement

New Objective: Develop framework manuscript about lake associations

Status: Incomplete rough draft

Expected Completion: April/May



Team: Scaling Up

Objective 1

Does lake and stream connectivity control phosphorus retention in lakes?

Progress:

Analysis completed

Completion timeline:

ms submitted by June 2018

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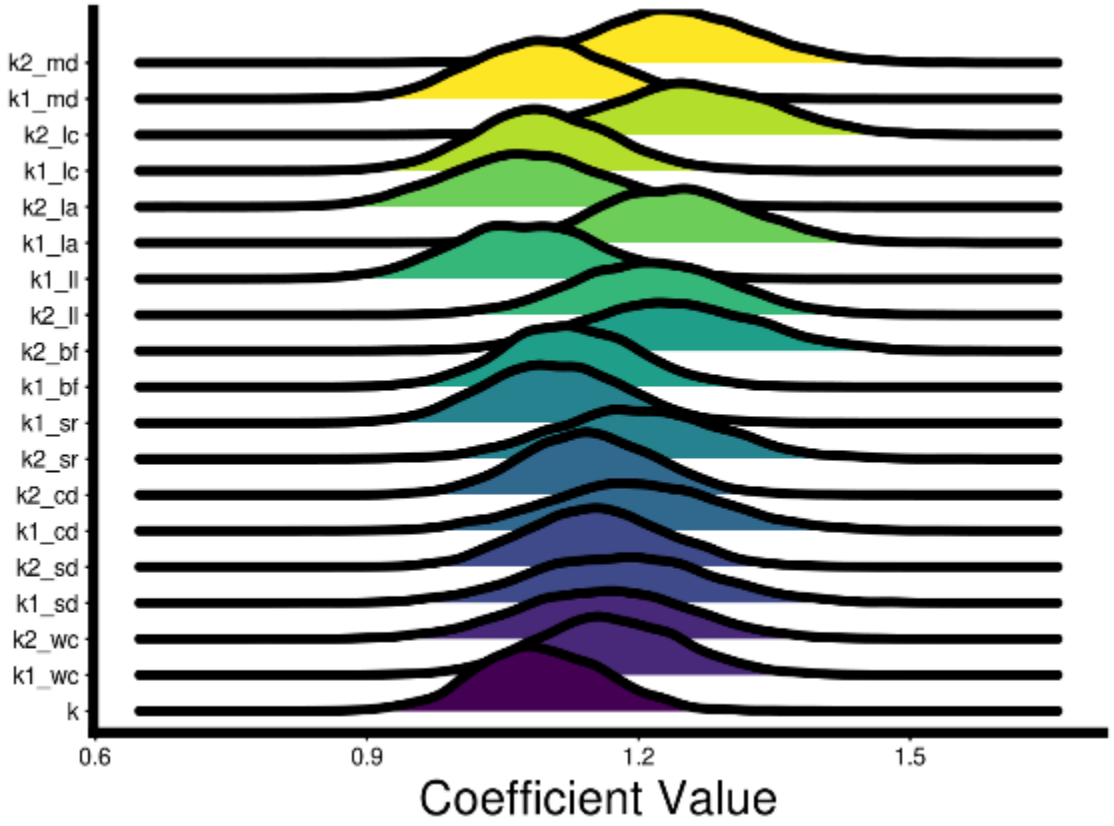

Team: Scaling Up

Objective 2

Can we approximate mean annual P loads to the three focal lakes (and beyond) with a very simple modelling approach?

Progress:

Survey of analytical methods underway

Completion timeline:

Proof of concept by 2018 workshop

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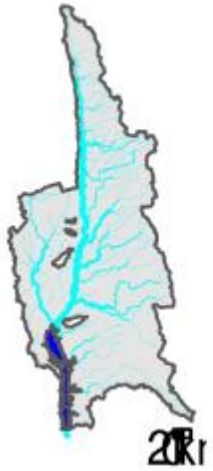

Team: Scaling Up

Objective 3 (primary objective for Q2)

What are the implications of differential retention for overall mass balance among lakes?

Progress:

Analysis underway

Completion timeline:

ms submitted by September 2018

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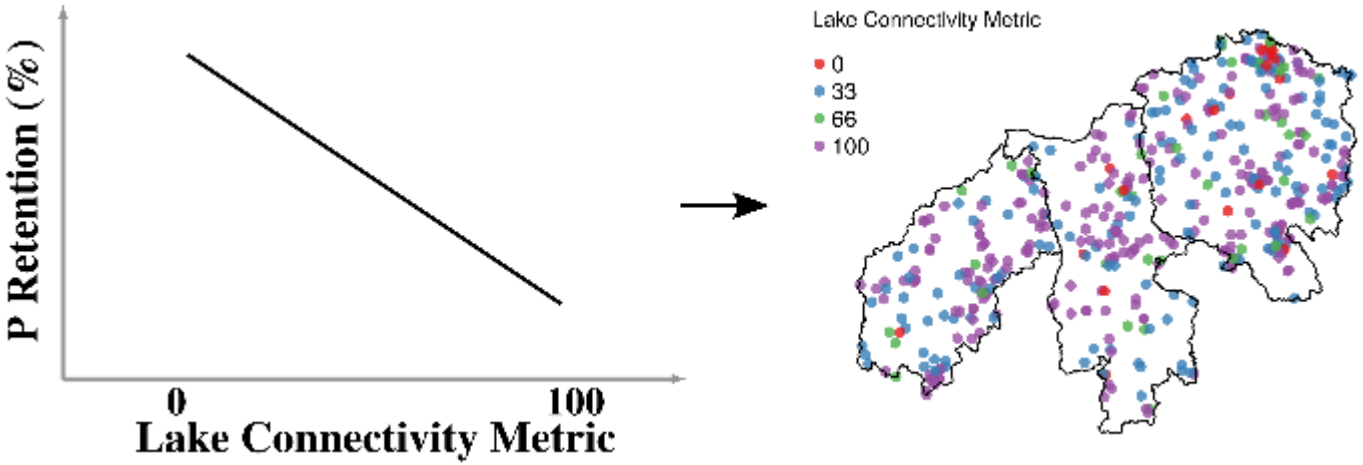


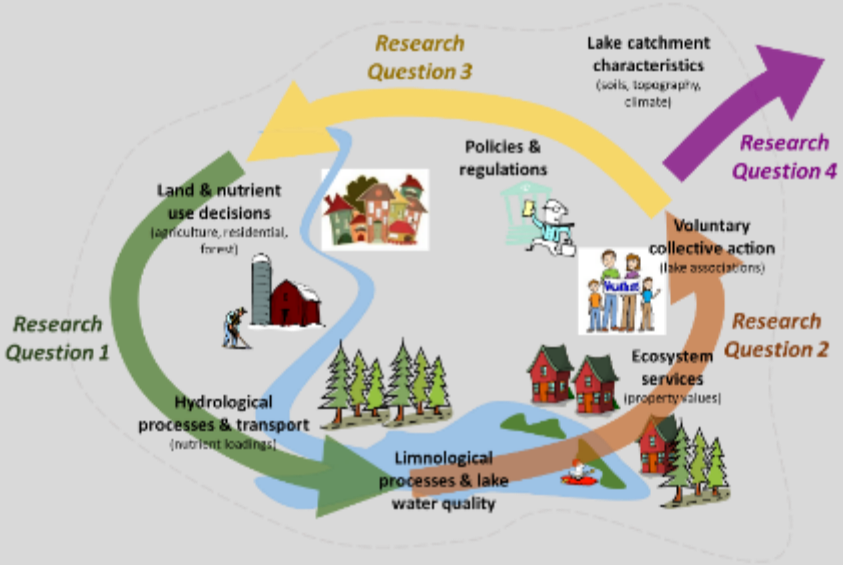
CNH Lakes Workshop

Modeling & Analysis of Lake Catchment CNHS

16-18 May 2018

Lake Sunapee Protection Association

Sunapee, NH



Workshop Highlights

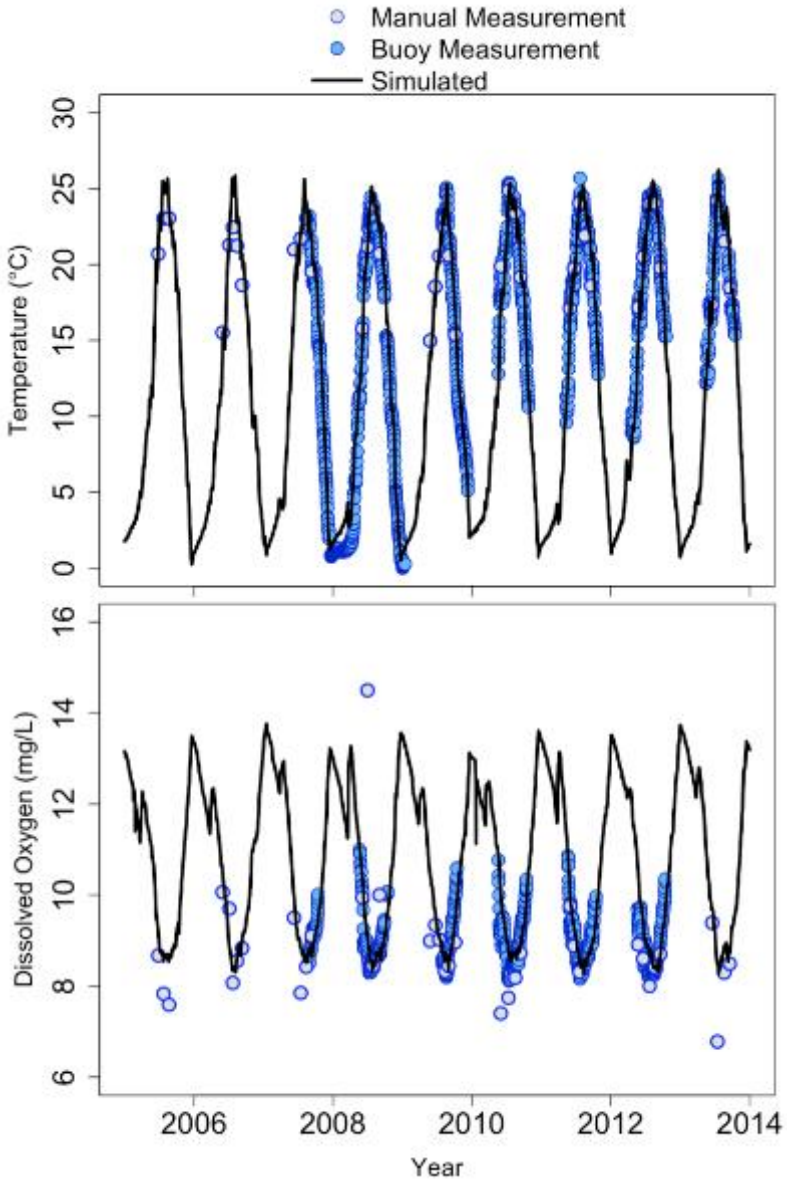
- Meet at and with Lake Sunapee Protective Association (LSPA)
  - Research updates
  - Association engagement
- Accommodations at Sunapee B and B
- Boat tour of Lake Sunapee
- Plan for Workshop 4 and greater Association engagement

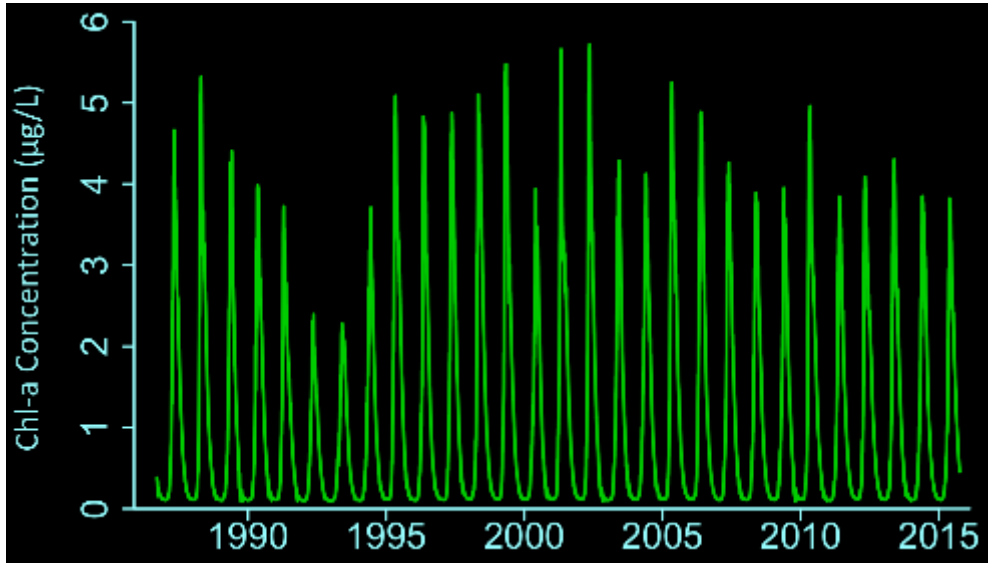
Establishing GLM versioning plan

The issues the GLM team is grappling with for versioning:

- In the past six months, the GLM developers have released multiple new versions of the model
  a. When we started the project, we calibrated v.2.1.8 for Sunapee/Mendota
     i. Nicole's 30-yr Sunapee GLM model is v.2.1.8, as is Julia/Paul's 1-yr 2016 model
     ii. It has taken ~1-2 years to get calibrated model versions up and running for the two lakes
  b. New functionality built into newer versions, so Hilary's 30-year GLM model will be v.2.7
- However, each model version has different driver file formatting, different underlying equations, and different module capacities, making it challenging to move between versions
  a. Most importantly, the same driver data will yield different water quality output with different versions!
- The question then is: which model to use? How best to compare models among lakes?
  a. To answer this question, GLM team needs to codify a defined parameter set for each lake and model version, as well as develop a how-to guide for how to move between versions.
  b. Need feedback from Hedonic team as to how important it is that each model version is the same among lakes
- Timeline: have this how-to guide/parameter set done at or just after the CNH workshop (likely need to meet at workshop to finalize plans)

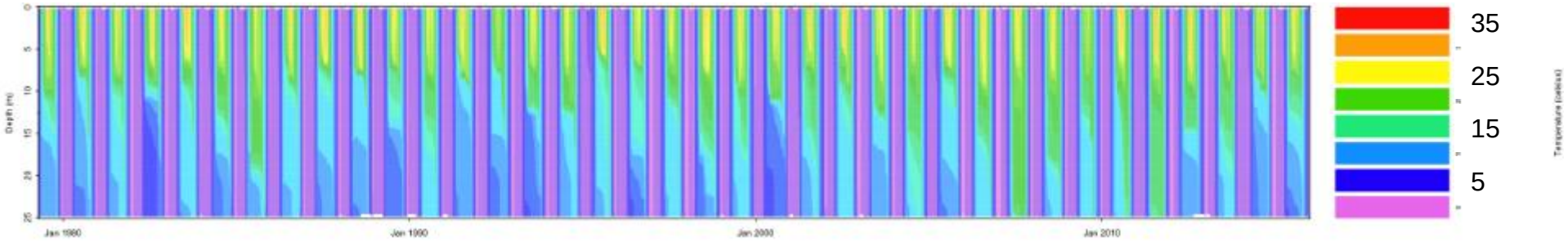
GLM Sunapee Calibration-Nicole



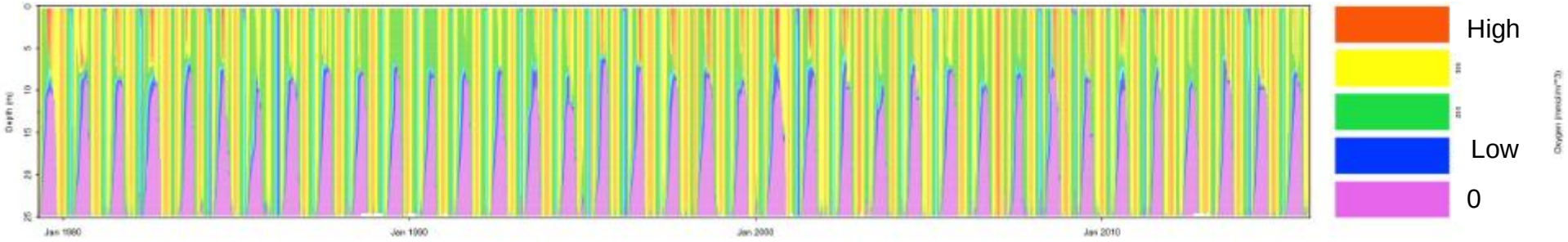


GLM-AED2, v.2.7 for Mendota: 38 years of…

Temperature

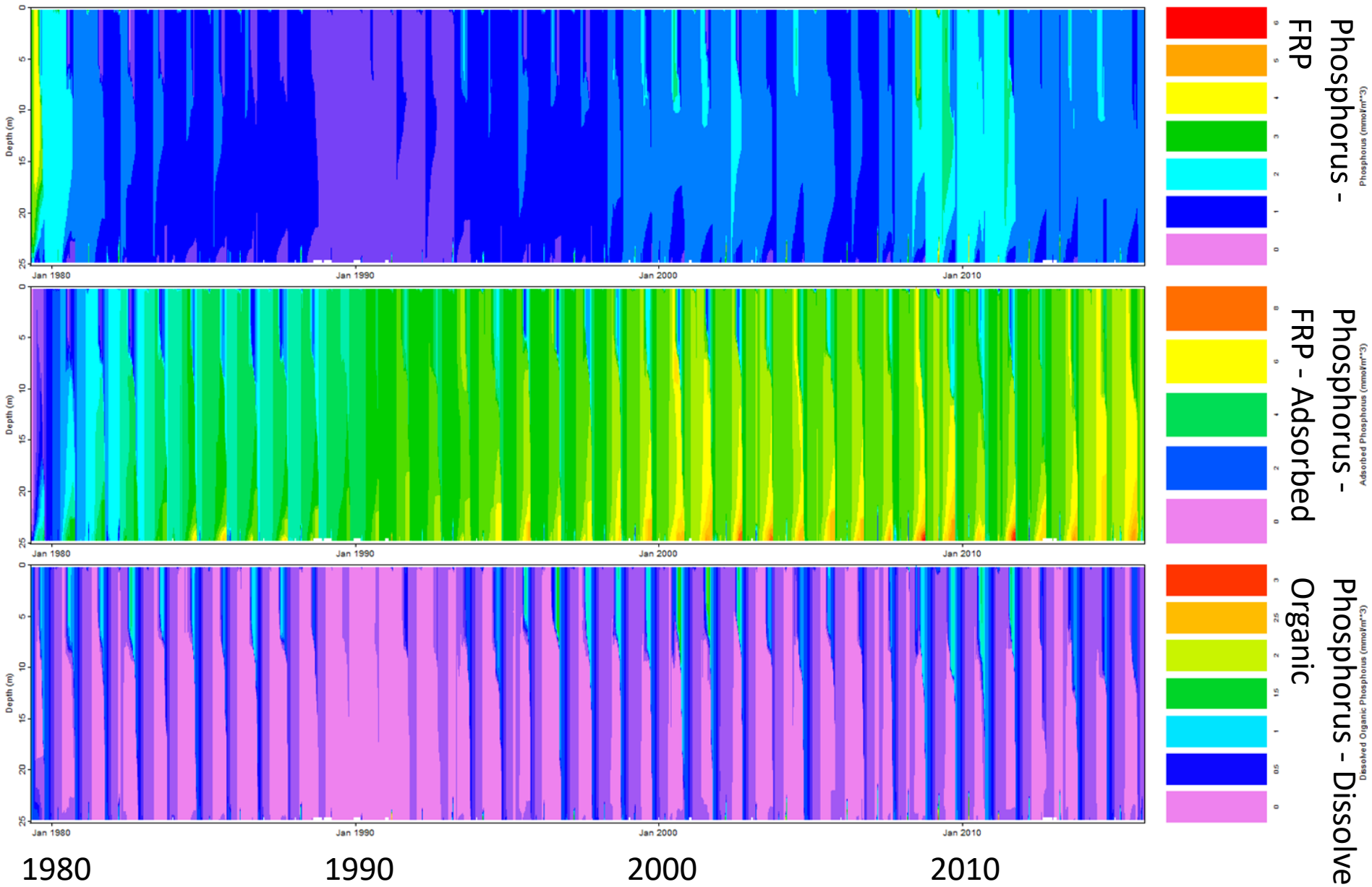


Dissolved Oxygen



Phosphorus… what? ← Totals aren't calculated in 2.7

1980 1990 2000 2010


Phosphorus - FRP
Phosphorus (mmol/m^3)
Phosphorus - FRP - Adsorbed
Adsorbed Phosphorus (mmol/m^3)
Phosphorus - Dissolved Organic
Dissolved Organic Phosphorus (mmol/m^3)
Depth (m)
Jan 1980
Jan 1990
Jan 2000
Jan 2010
1980
1990
2000
2010

Mendota Calibration

38 year run is slow

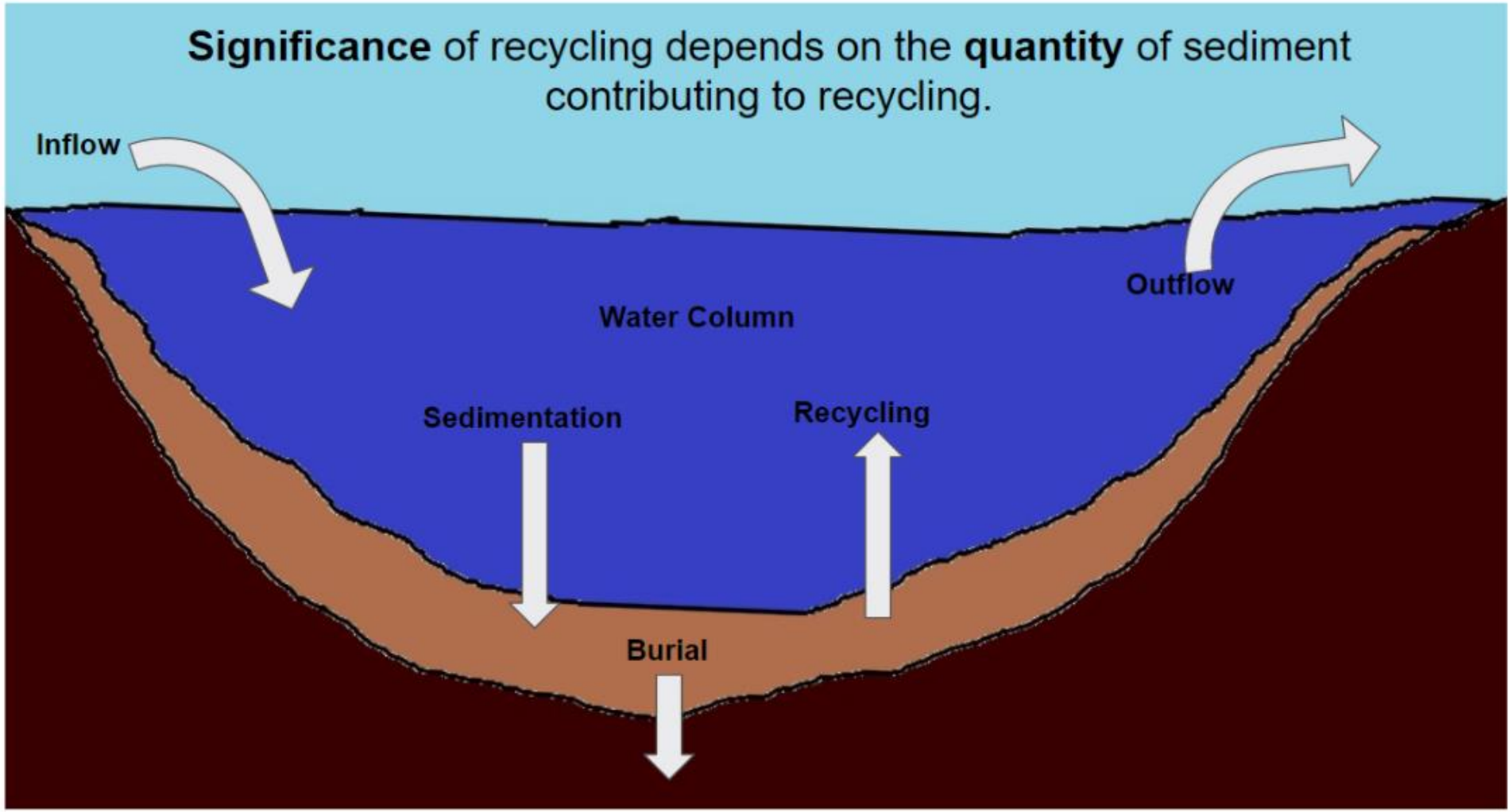
And even slower to plot figures

Will have to come up with a better workflow for calibration

Simple Lake Phosphorus Cycling Model

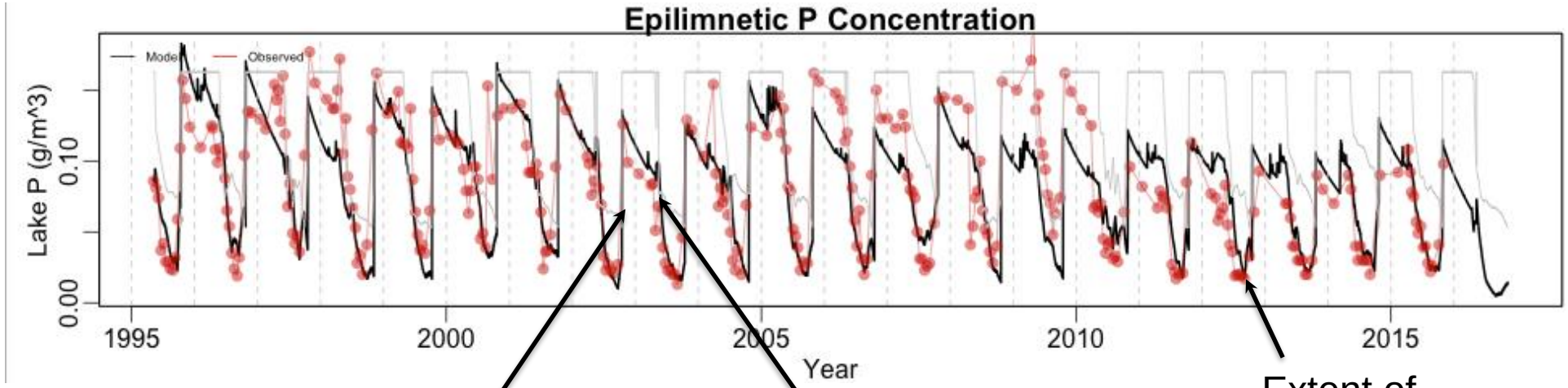
Aviah Stillman and others

Phosphorus Model - Setup - Conceptual Diagram



Simple Lake Phosphorus Cycling Model

Aviah Stillman and others



Abrupt increase in autumn due to mixing

Abrupt decrease in spring/summer due to sedimentation (of phytoplankton), which is the product of [P] and a temperature-adjusted coefficient

Extent of summer-time low due to temperature & time

Rudstam, Jackson, Schneider. Climate change and invasive species. 2011-2014 and 2014-2017.
Cornell University Hatch Grant 25k/yr

Chris Hotaling
Kristen Holeck

Belarus Lakes Workshop 2017

Oneida Lake GLM - where are we?

- Data collection ongoing - In lake and streams
- Measured groundwater P content (Schneider, Jackie Doer Honors thesis)
- Ongoing - P budget for 2017 to estimate internal P loading - Nurnberg model. (Susan Chen Honors thesis). Previous years internal loading about 50% but issues identified this year. Includes water budget
- Comparisons of fluoroprobe, in situ chlorophyll sensor, microscope counts and FlowCams for bluegree assessment (Sophie Hearns Honors thesis)
- Growth measurements for mussels ongoing (Alvarez intern project)
- Timing of bluegreen blooms in relation to wind and P inflow from streams. Wind events versus stream loading.
- GLM model tested for Oneida (Bruce et al. 2018), but not running with correct inflow files on our own computers.
- GLM-AED not implemented, but Hipsey has added mussels component to GLM-AED for Oneida Lake.

- NEW FUNDING?
- New York State push for understanding bluegreen blooms state wide
- Grant accepted for modeling effort on Oneida Lake by New York Central Planning Board (Saltman) with our input. RFP not yet out.
- The plan: Todd Walter and one student, Cornell, watershed), Dave Matthews (Upstate Freshwater Institute - lake model) and Rudstam and one student (data+ lake model)
- The goal: To construct a coupled watershed - lake model. Choice of lake model is WQUAL 2-D model which UFI already have implemented for Cayuga Lake with mussels.
- Discussion: If funded - how connect with CHNS?

Special session:

Freshwater mussels – ecosystem disruptors or ecosystem restorers?

Xiufeng Zhang, Lars Rudstam, Vladimir Razlutski, Irina Feniova
Jinan University, Guangzhou, China,
Cornell Biological Field Station, Cornell University
National Academy of Sciences of Belarus