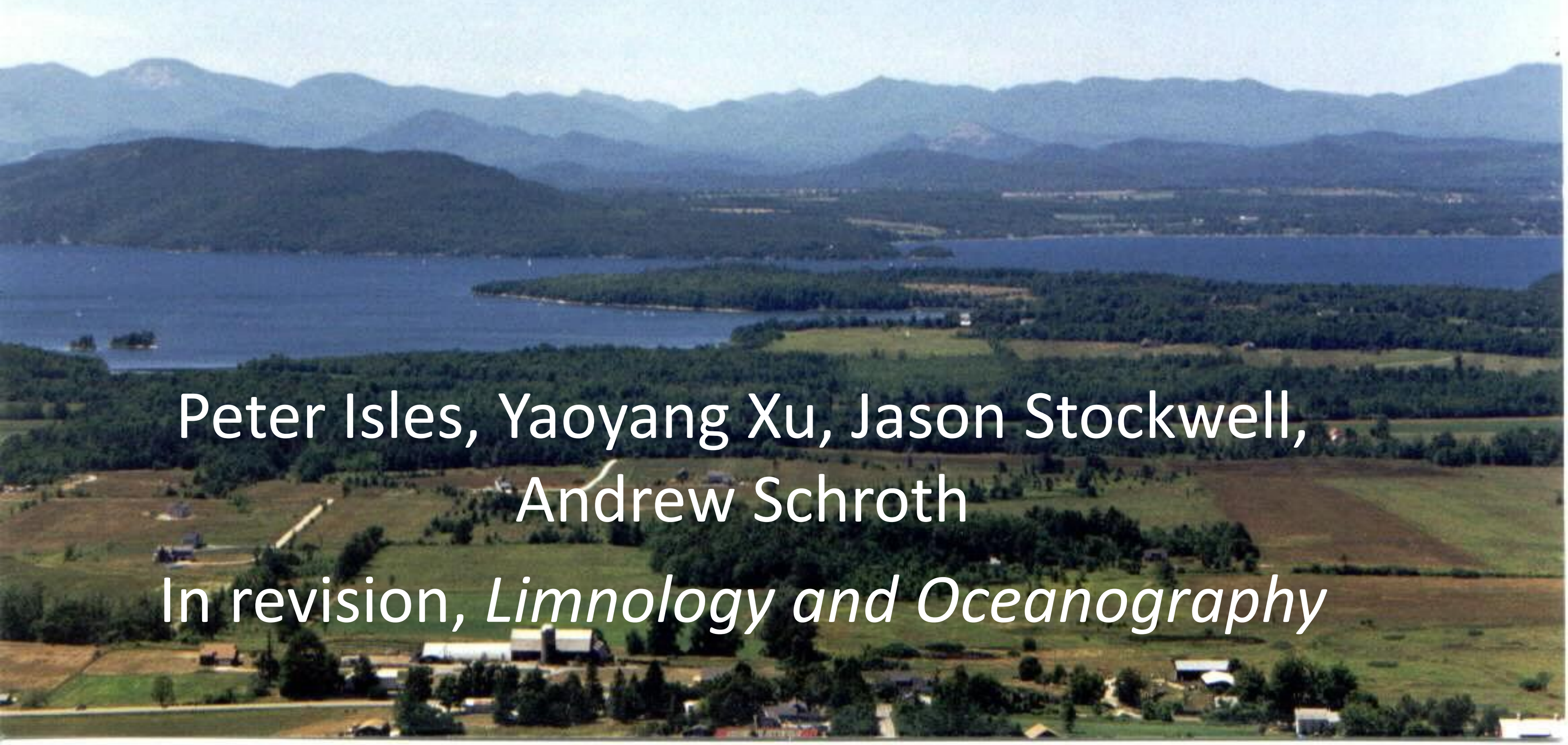
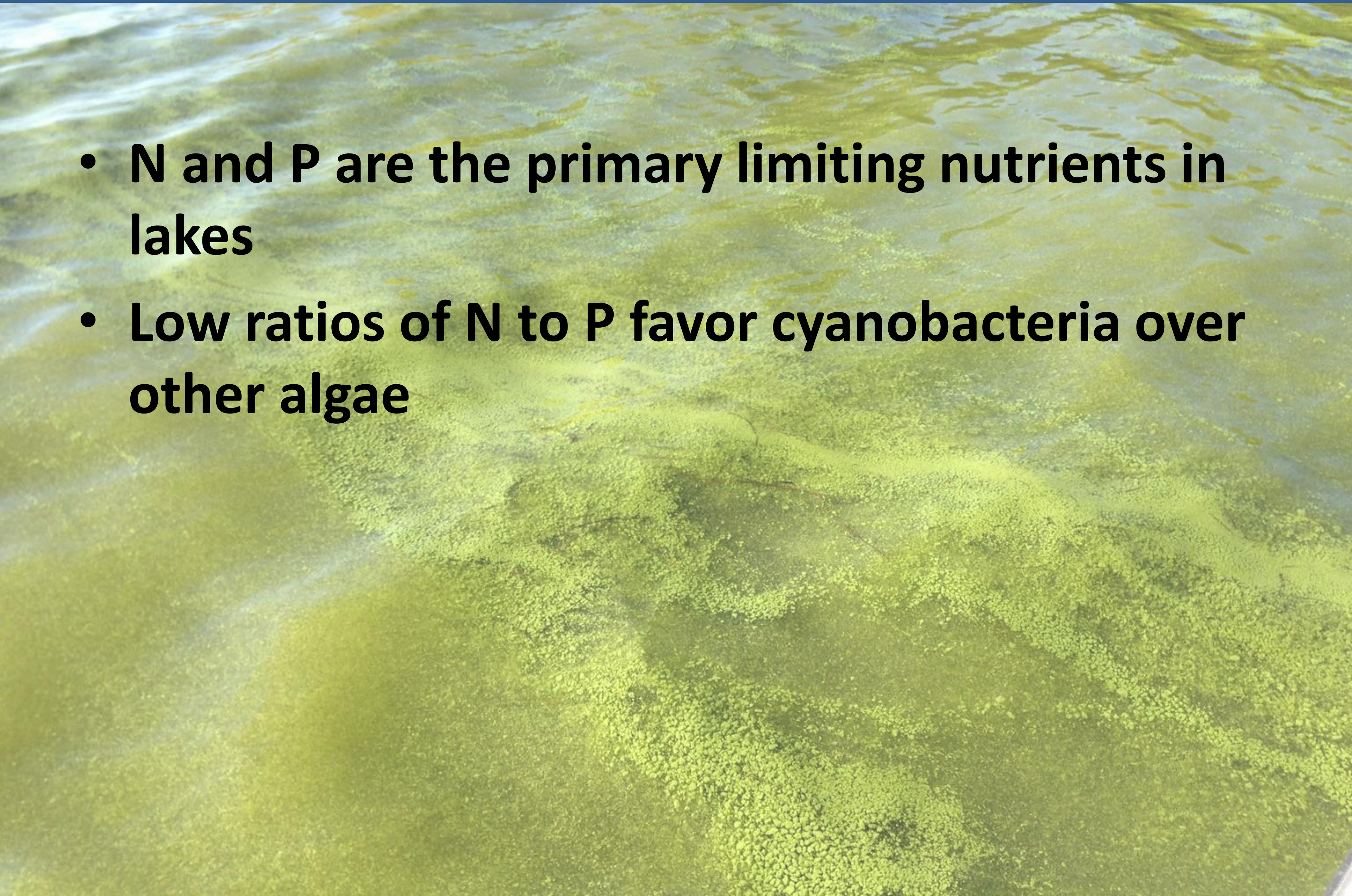
Climate-driven changes in energy and mass inputs systematically alter nutrient concentration and stoichiometry in deep and shallow areas of Lake Champlain



Peter Isles, Yaoyang Xu, Jason Stockwell, Andrew Schroth

In revision, *Limnology and Oceanography*

N,P and Cyanobacteria



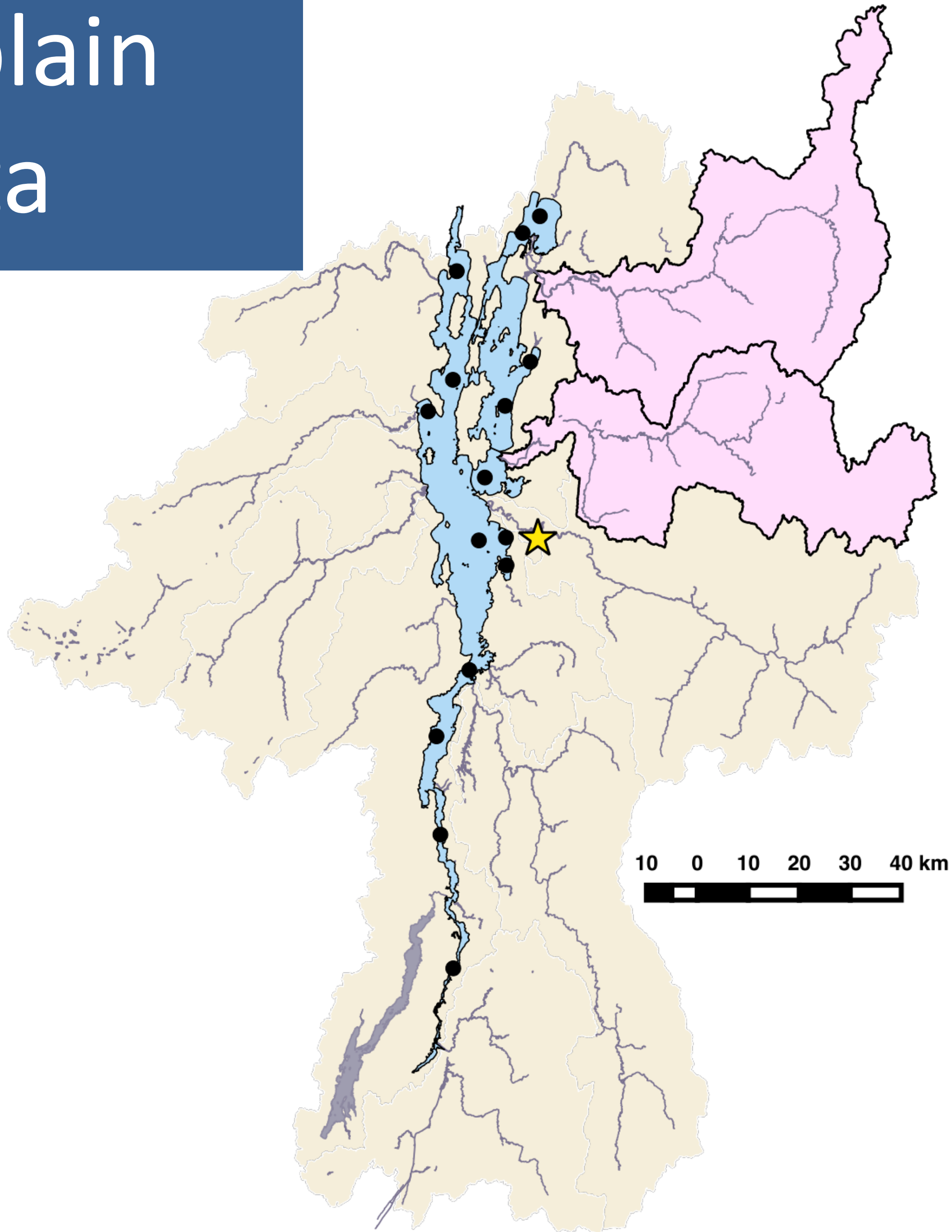
- **N and P are the primary limiting nutrients in lakes**
- **Low ratios of N to P favor cyanobacteria over other algae**

Key Questions

- Climate change is expected to increase temperature and precipitation in our region
- **How will these changes affect the balance of N and P in Lake Champlain?**
- **Will these effects be different in shallow and deep areas?**
- **How will this affect the frequency and severity of harmful algal blooms?**

Lake Champlain LTMP Data

- **15 Sites**
- **1992-present**
- **Tributaries, too**

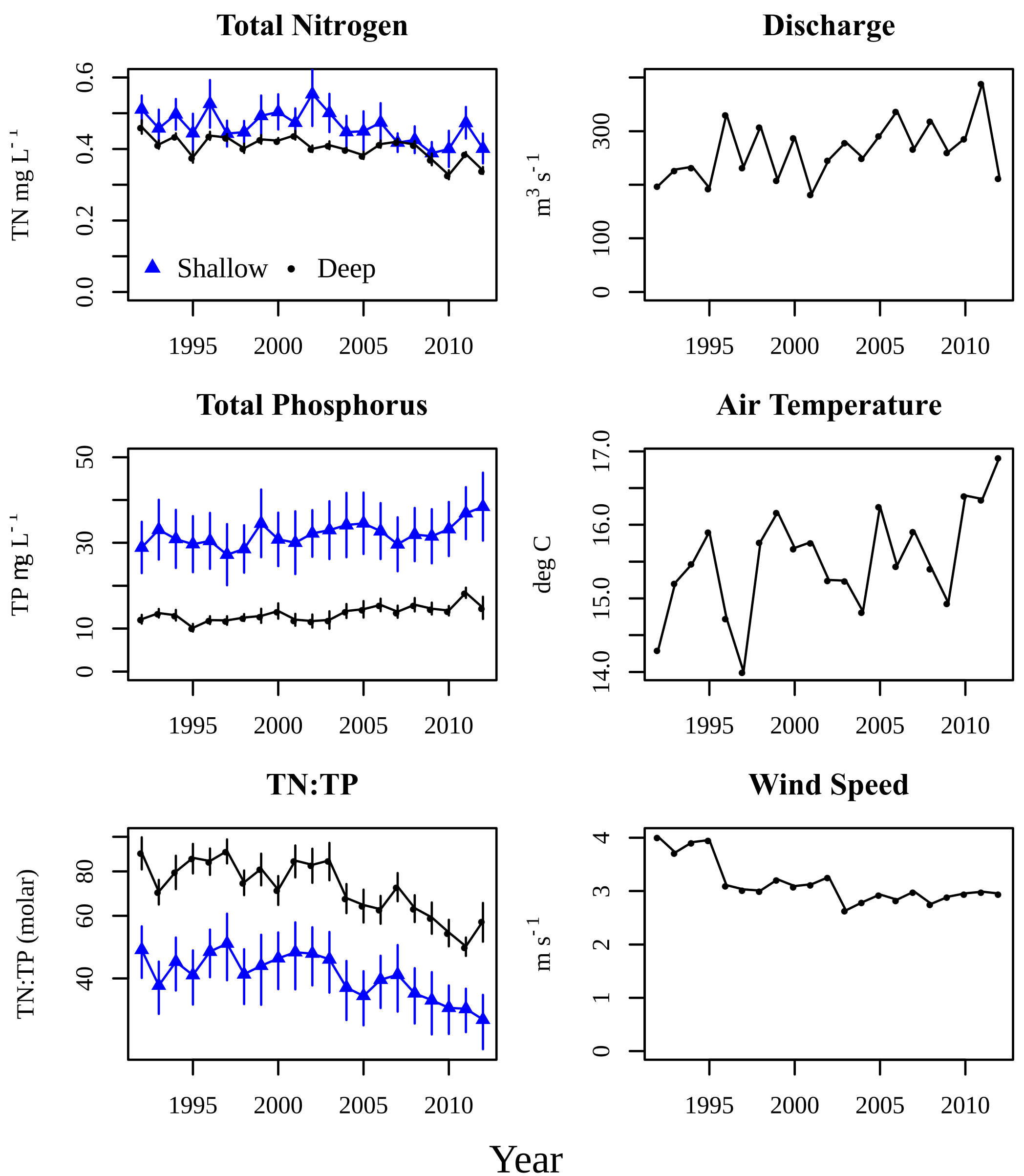


Long-Term Trends

Decreasing N

Increasing P

Decreasing N:P



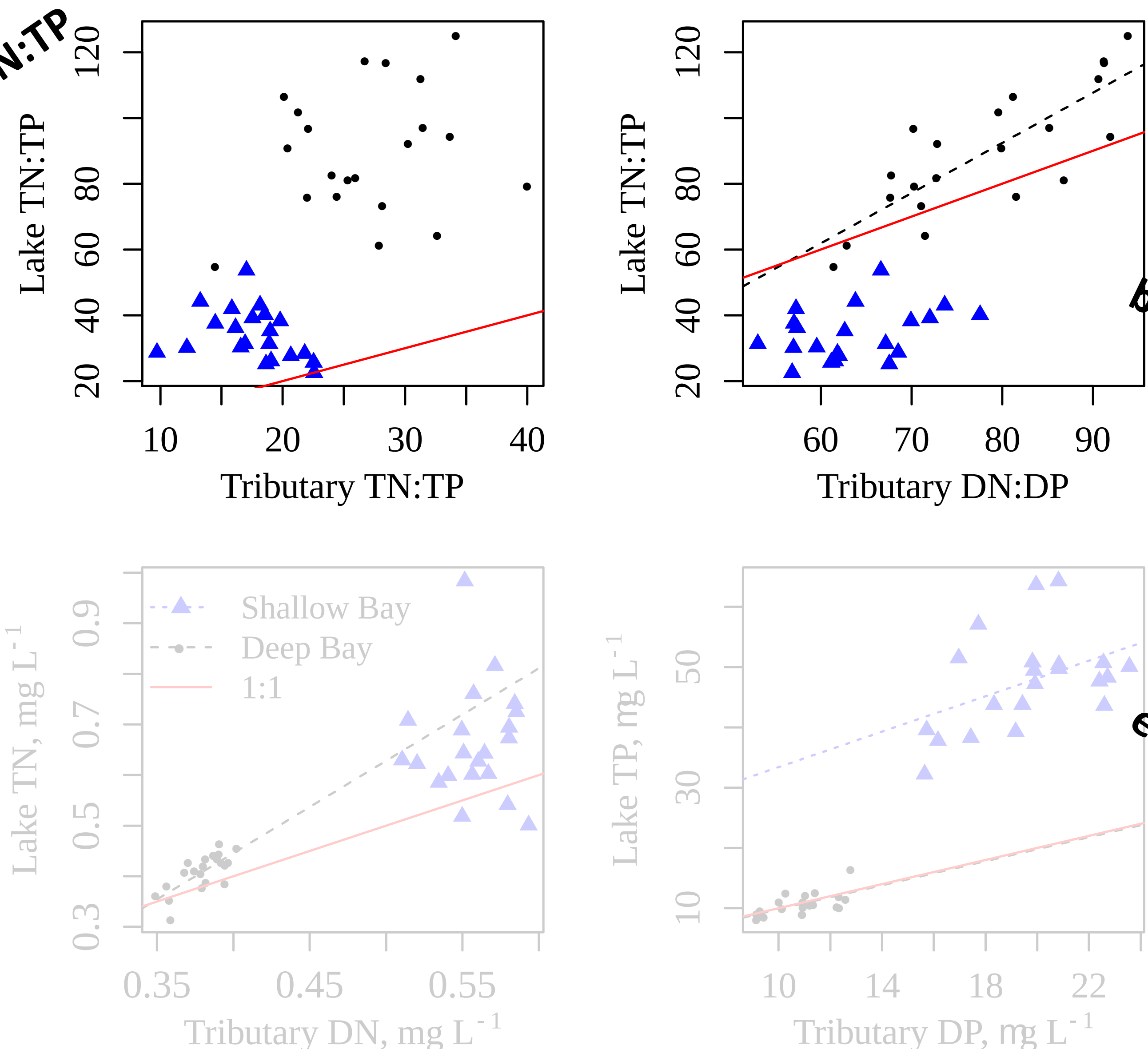
Does River N:P control Lake N:P?

No effect of TN:TP from rivers

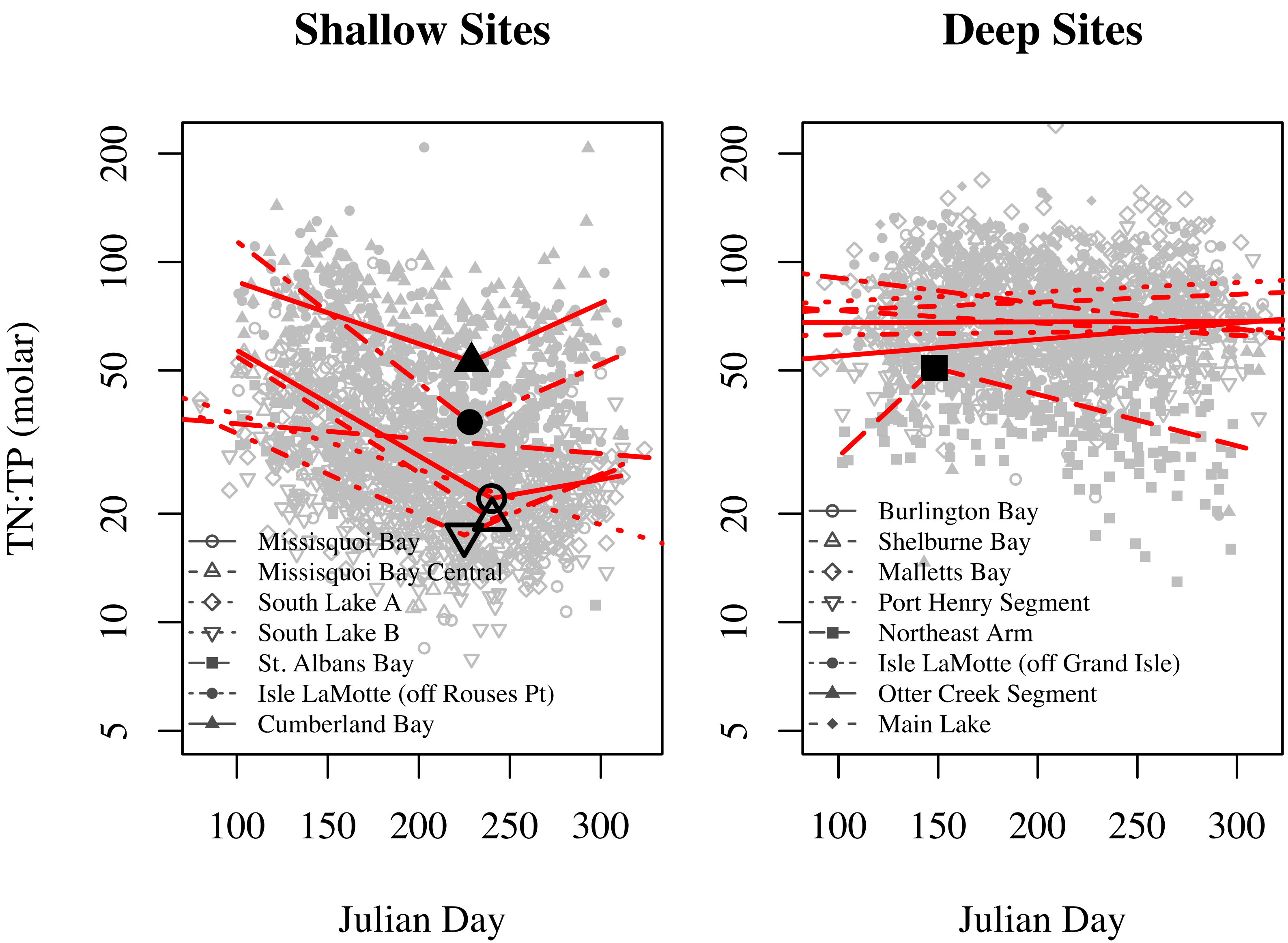
Big effect of DN:DP from rivers in deep bays

[DN] in rivers controls lake TN in deep sites

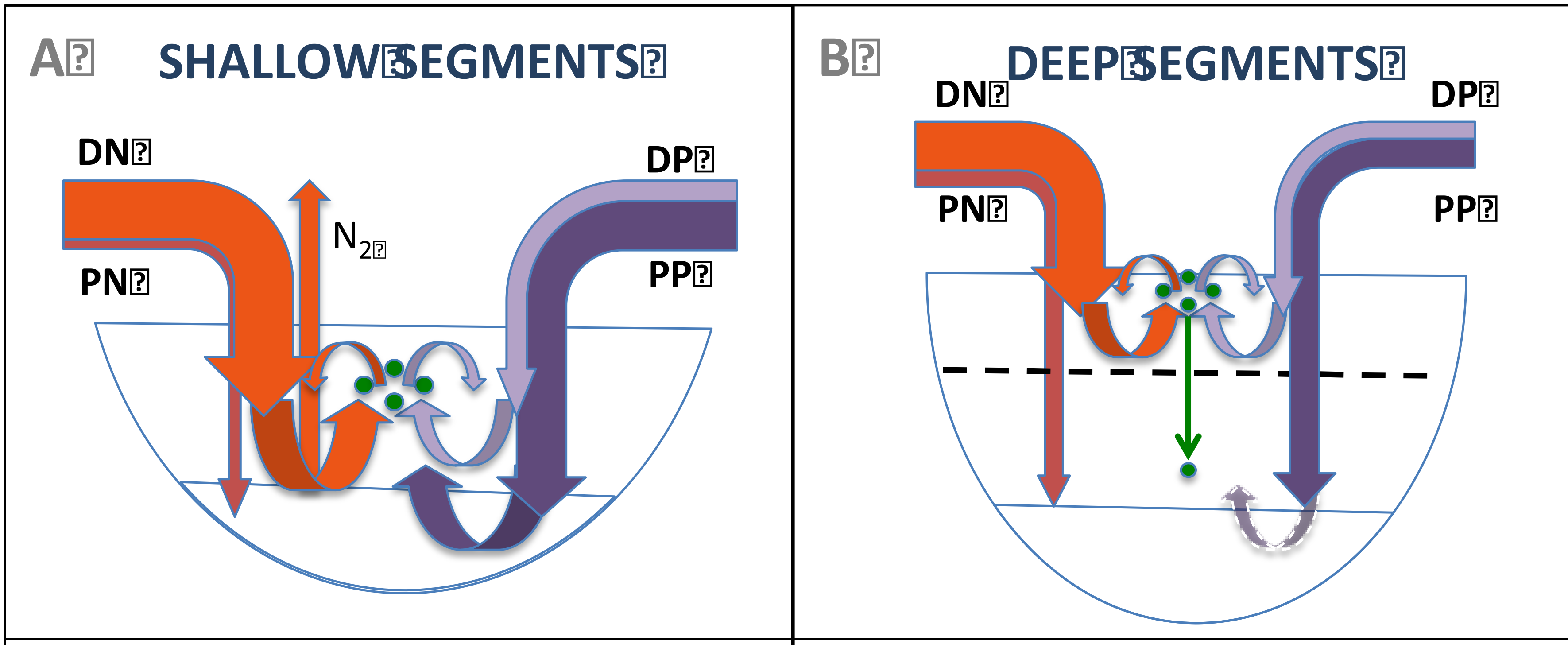
[DP] in rivers affects lake TP everywhere



Intra-annual trends



Conceptual Model

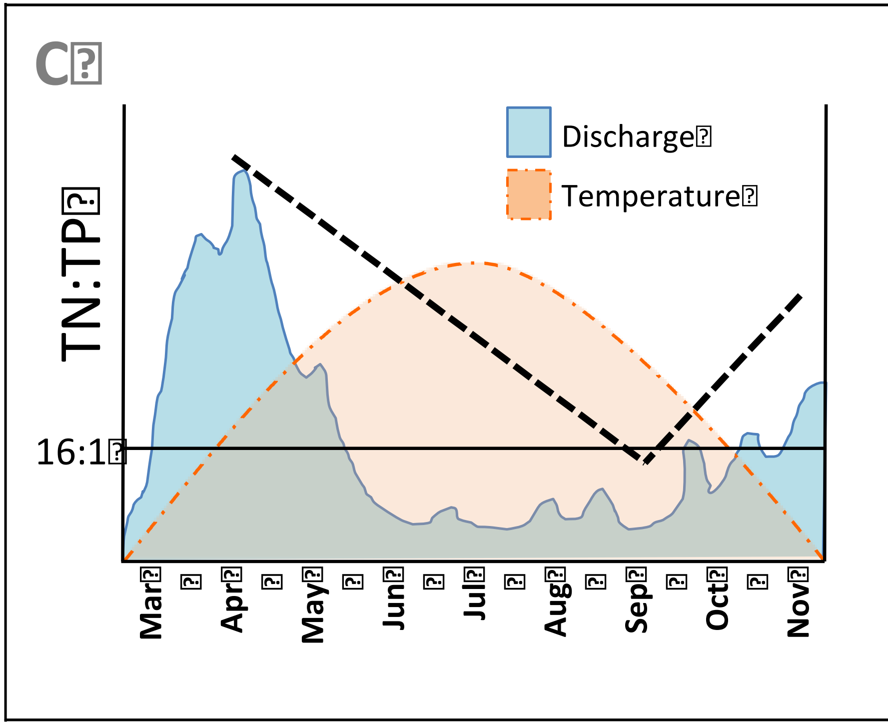


- Dissolved nutrients available immediately (in spring)
- Particulate nutrients available when Temp, O2 conditions allow

- Dissolved nutrients efficiently recycled
- Particulate nutrients mostly lost to the sediments

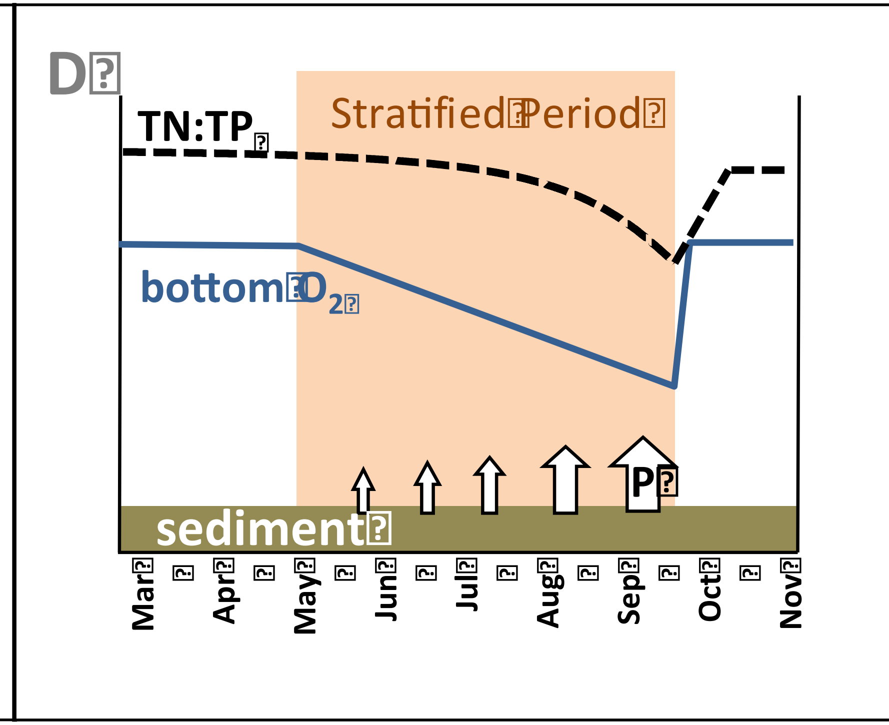
Conceptual Model

Shallow



- TN:TP drops following decreasing N inputs and increasing temperatures during the summer
- TN:TP usually approaches Redfield ratio in late summer (Missisquoi)

Deep

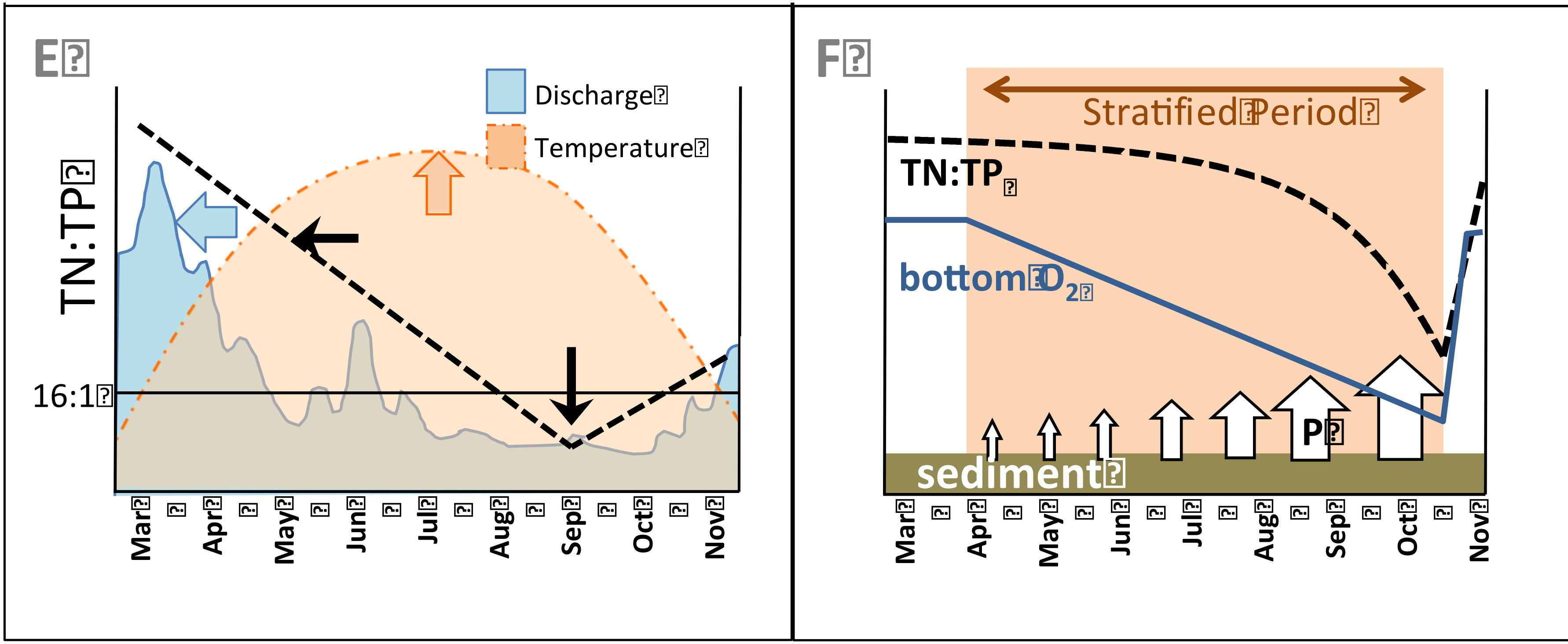


- Bottom water O2 gradually declines during summer stratification due to sedimenting OM from epilimnion
- If O2 falls enough, pulse of P from sediment in late summer drops N:P

Conceptual Model

Shallow

Deep



- With climate change, peak discharge is earlier, and warm temps start earlier and last longer
- This leads to prolonged period of declining N:P

- Longer stratified period leads to more bottom O2 depletion and consequent P release in late summer (also more denitrification).

Other projects

- **Understanding the drivers of lake metabolism and bloom progression using high-frequency data and advanced statistical techniques**
- **Cyanobacterial buoyancy regulation and wind mixing control net ecosystem production during strong blooms**
- **Modeling the impacts of climate change on cyanobacteria bloom dynamics in Missisquoi Bay**

Thanks!

The UNIVERSITY of VERMONT

RACC
Research on Adaptation to Climate Change

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