Analysis of 500 lake catchments reveals the relationship between crop type, fertilizer and manure inputs and lake nutrient concentrations

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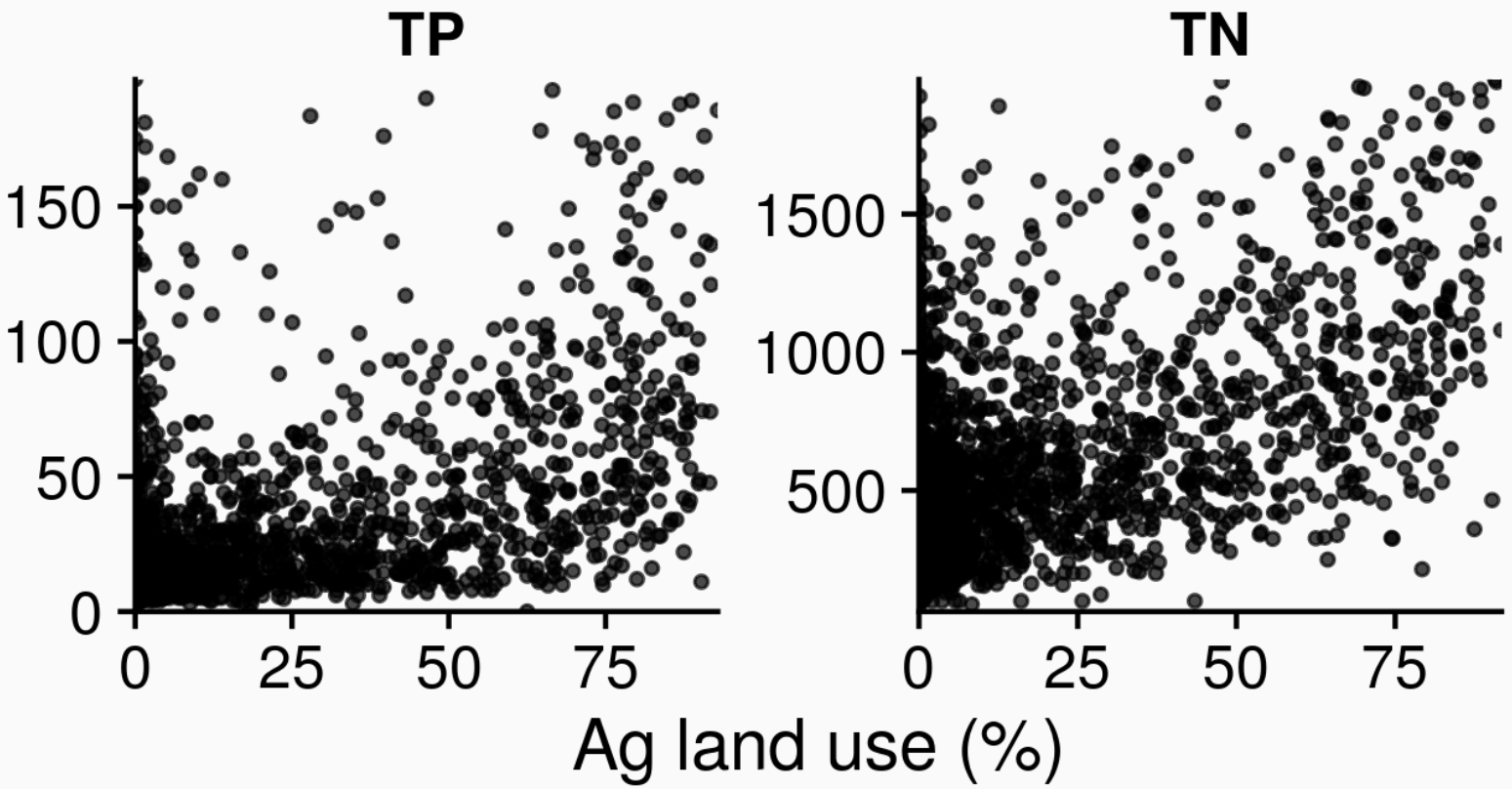
Introduction - Lake nutrients



Introduction - Nutrient predictors

Nutrient inputs - Fertilizer and manure applications

Nutrient transport - Baseflow, soils, precipitation

Land-use cover - Specific crops, etc.

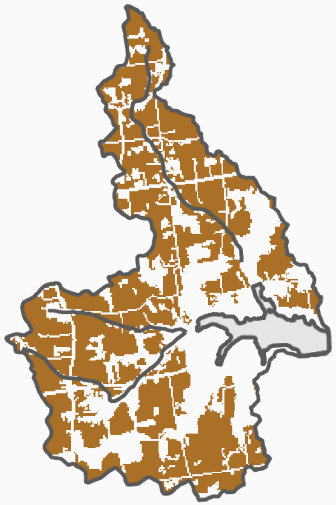
Buffer composition - Land-use cover - Specific crops

Lake characteristics - Depth, area, etc.

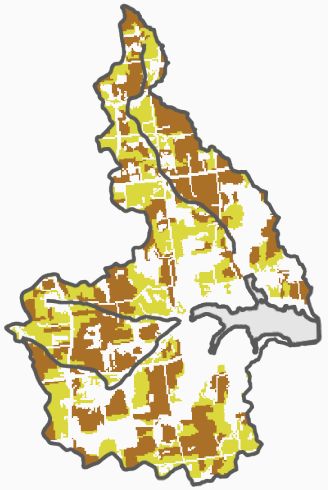
(Collins et al. 2017)

Background - Land-use cover

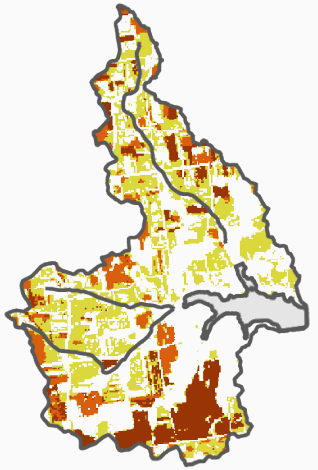
Total Ag



Ag Cover Type



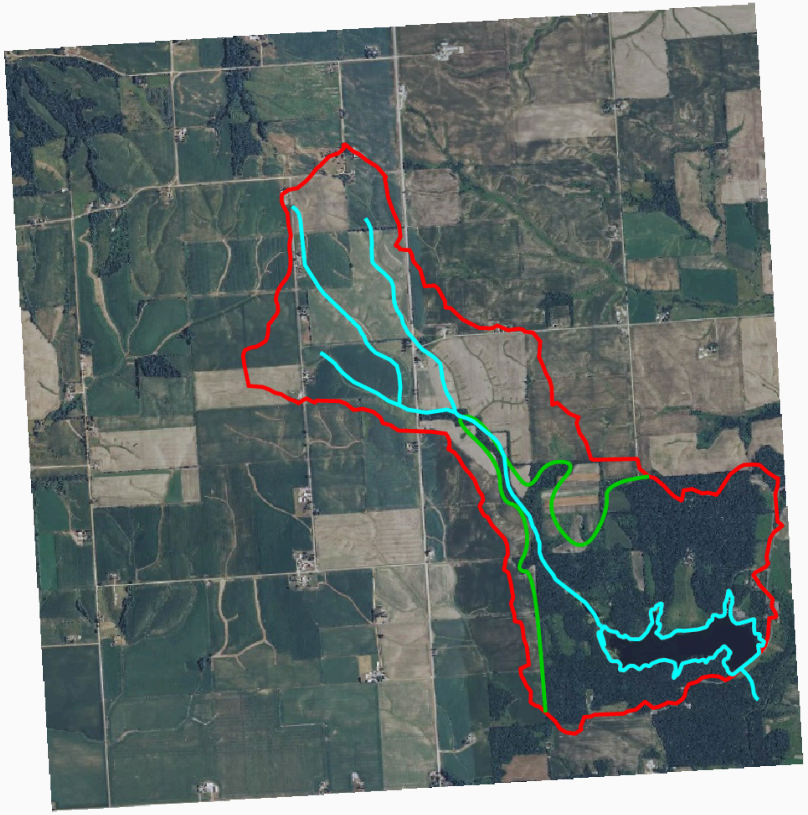
Individual Crops



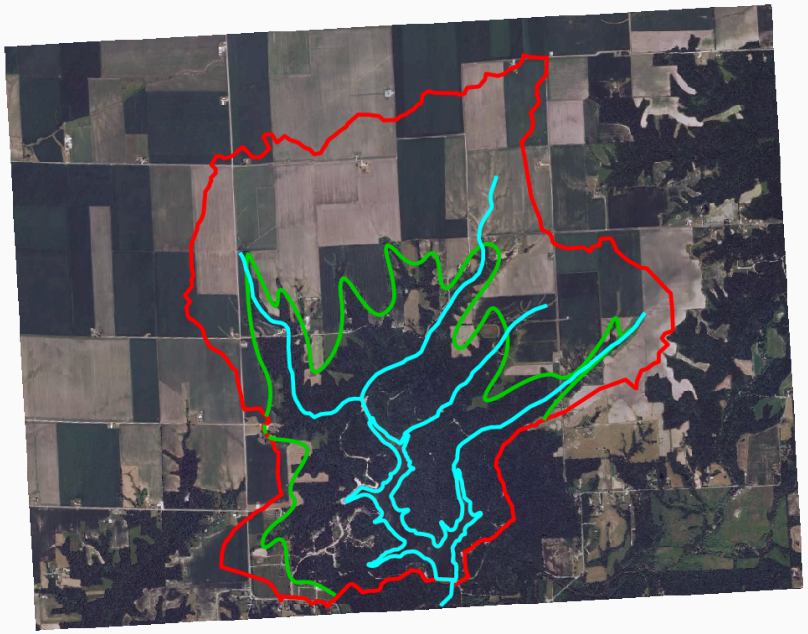
Background - Spatial resolution

Poorly Buffered

Lake Carlton – IL



Argyle Lake – IL



Background - The macroscale

	Fine scale (1 watershed)	Macroscale (many watersheds)
Granular	Many studies	??
Aggregated	Few studies	Some studies

What are some things we've learned from fine scale, granular-data studies?

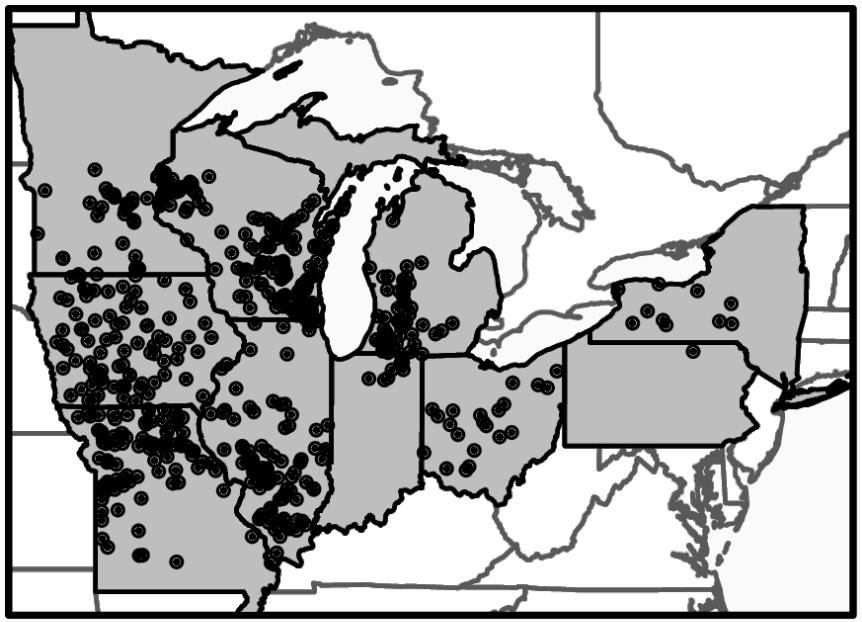
What are some things we've learned from macroscale, aggregated-data studies?

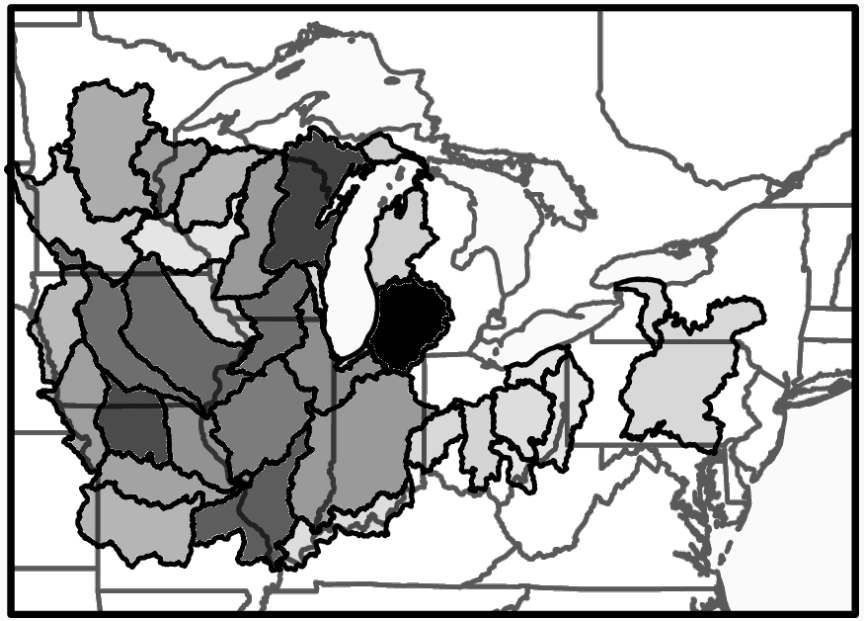
Research Question(s)

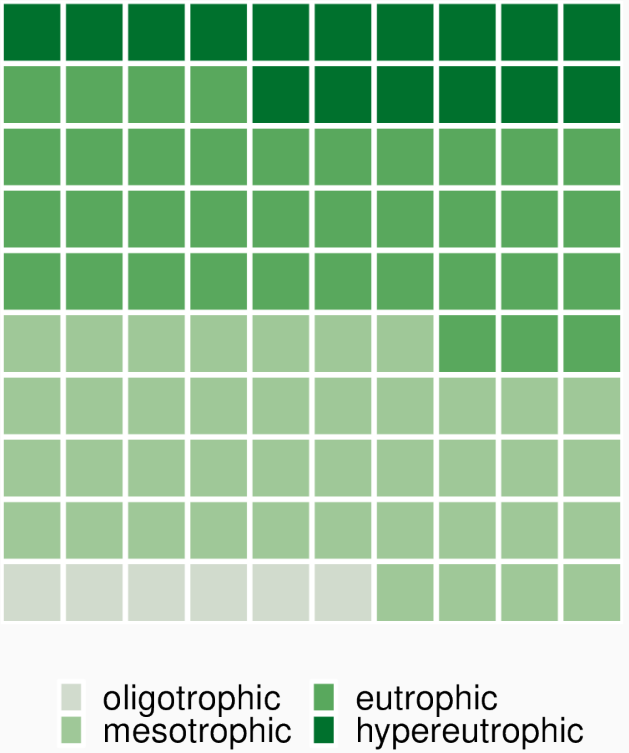
1. **Are more granular measures of Ag activity related to lake water quality (TN, TP) across hundreds of lakes and their watersheds?**

2. **Do relationships between watershed land use and lake water quality vary spatially among hydrologic and climatic regions?**

Methods - 500 lake catchments







Methods - Regression Modelling

Model type: Hierarchical Bayesian

Predictands: TP, TN

Global predictors: 12 Granular Ag variables
3 Lake and watershed characteristics

Variable selection: None (*horseshoe* shrinkage)

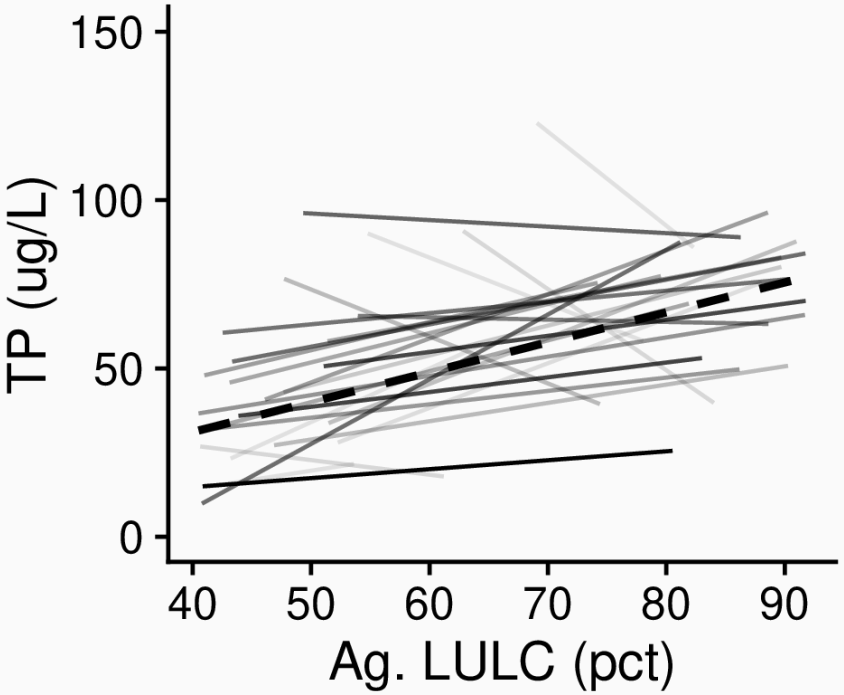
Regional predictors: 7 Watershed land-use variables

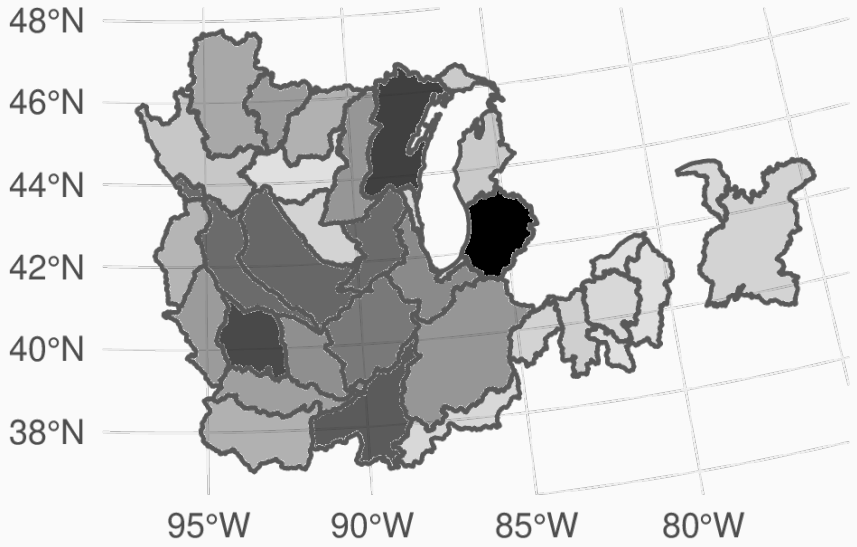
Model selection: Cross-validation on watershed land-use

Methods - Regression modelling

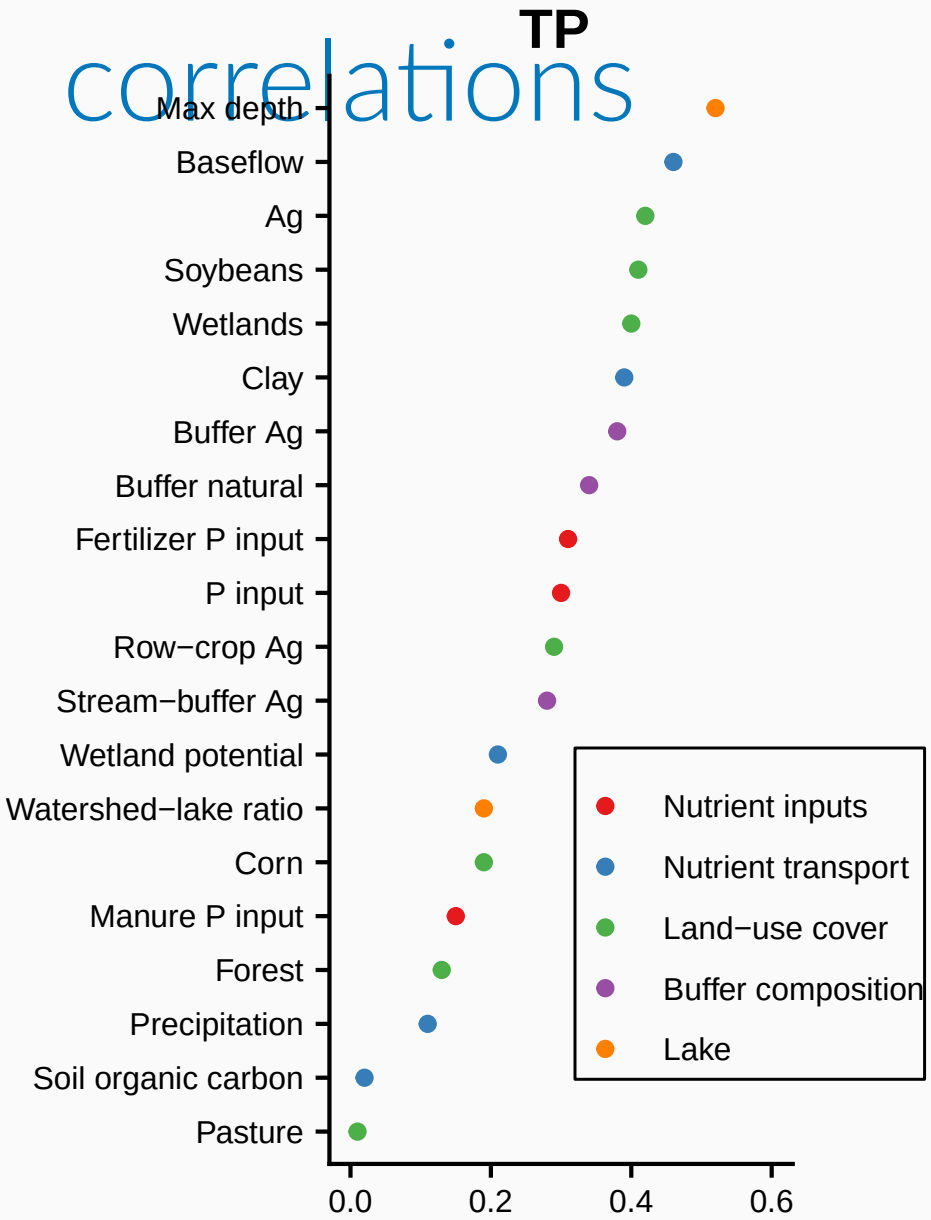
Watershed land use as a regionally varying predictor.

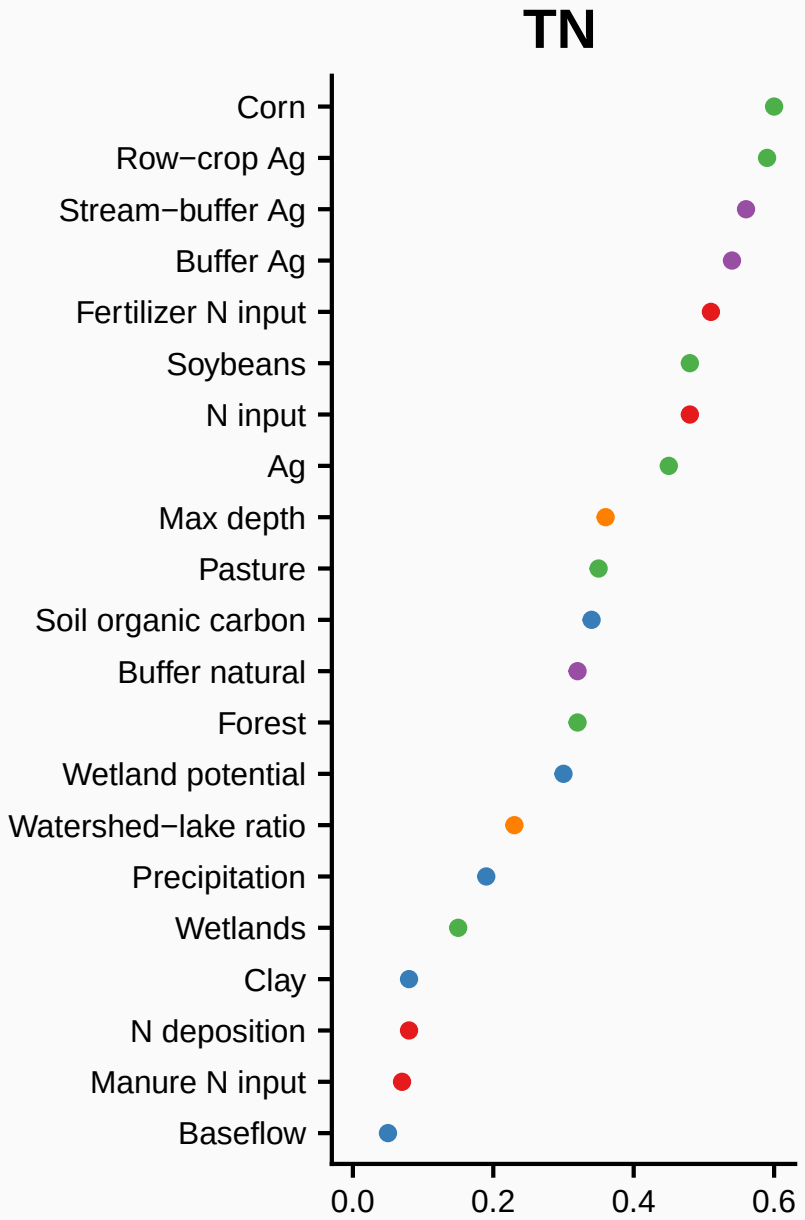
(Burcher, Valett, and Benfield 2007)





Results - Nutrient concentration correlations

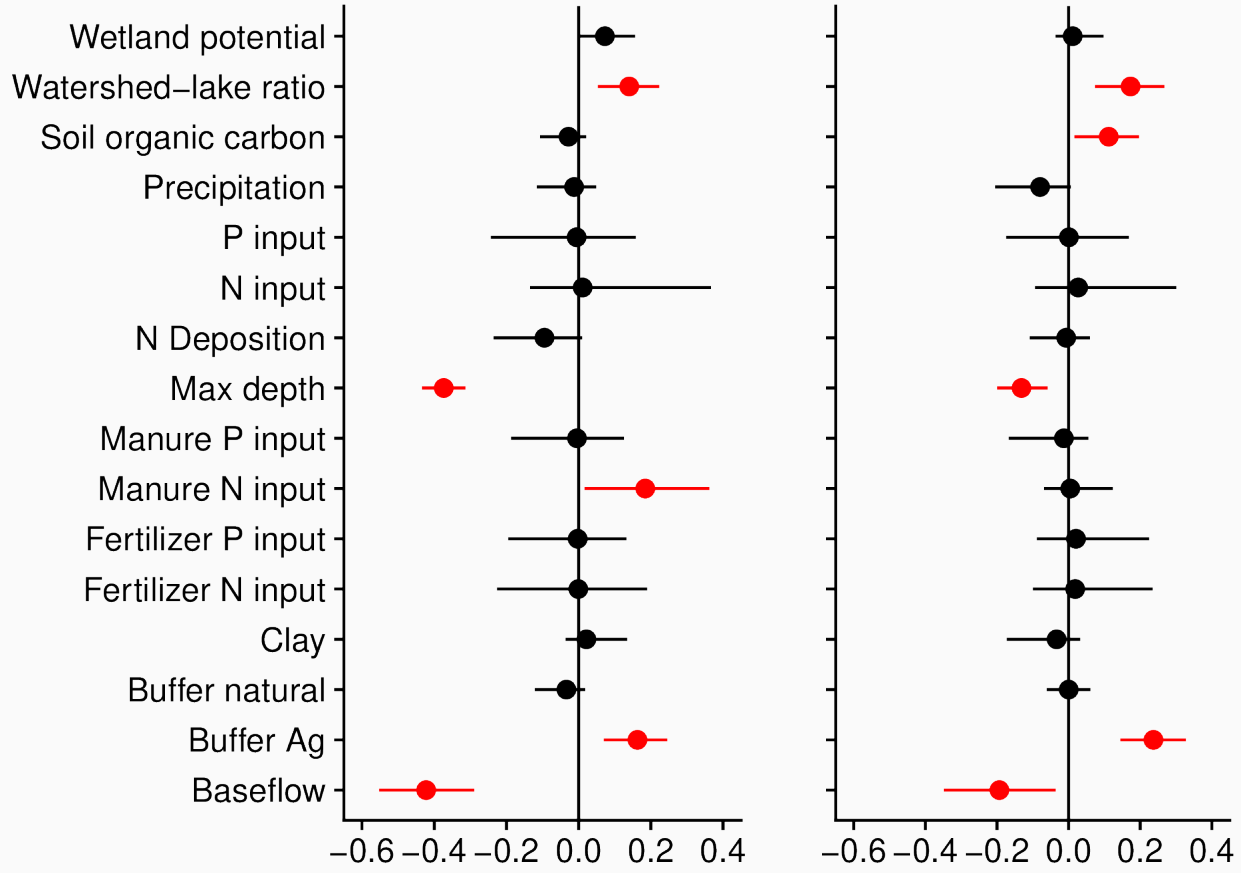




Results - Fixed effects

TP: Baseflow and Max depth have high leverage on predicted values.

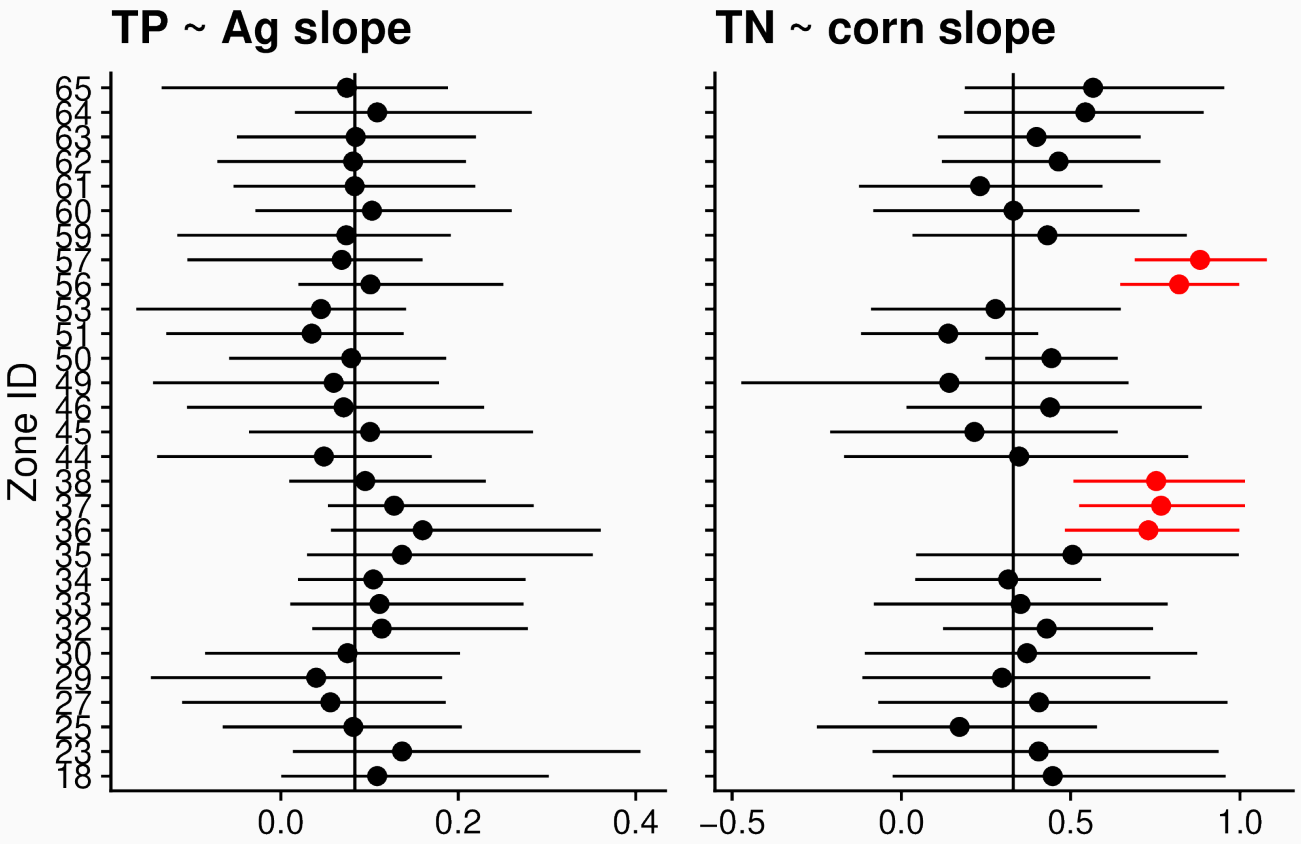
TN: Buffer Ag land has a strong(er) leverage on predicted values.



Results - Regionally varying effects

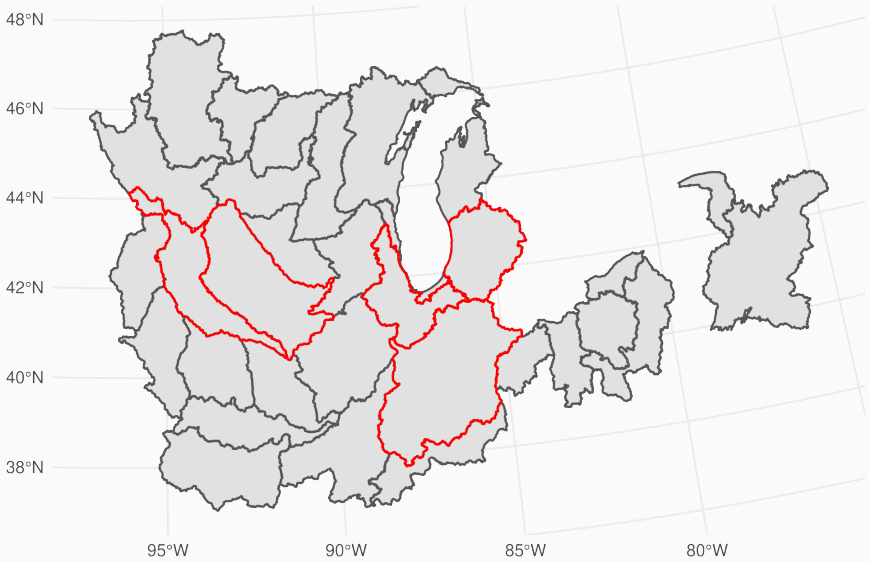
TP: No evidence for regional variation in Ag slope

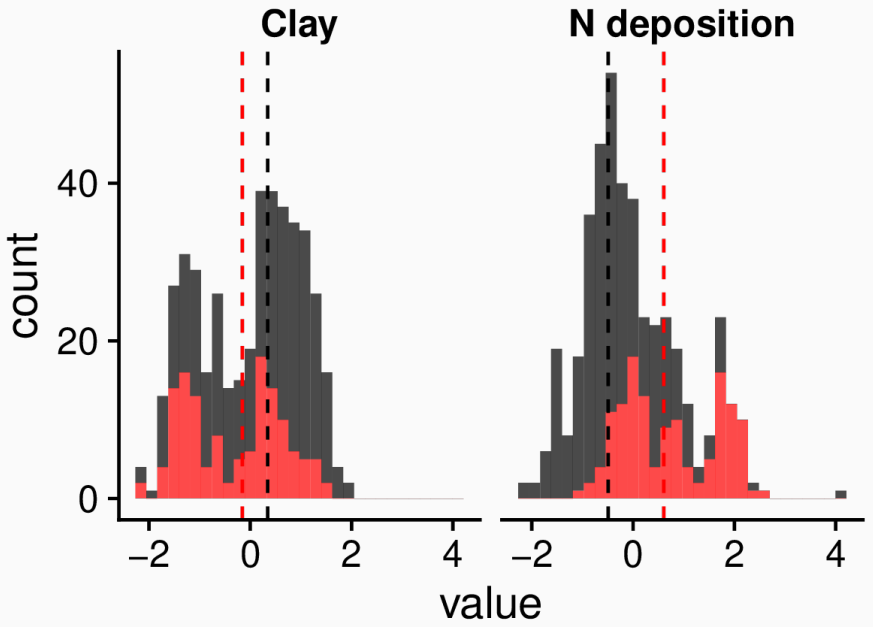
TN: Evidence for regional variation in corn slope



Results - TN Model

Ag sensitive regions have lower soil clay content and higher N deposition rates.





Conclusions

1. Are more granular measures of Ag activity related to lake water quality (TN, TP) across hundreds of lakes and their watersheds?

Yes, both lake TP and lake TN were related to granular measures of Ag activity.

But, specific crop land use and riparian buffer composition was more influential in the lake TN models.

2. Do relationships between Ag activities and lake water quality vary spatially among hydrologic and climatic regions?

Yes, in the case of lake TN concentrations.

References

Burcher, C. L., H. M. Valett, and E. F. Benfield. 2007. “THE LAND-COVER CASCADE: RELATIONSHIPS COUPLING LAND AND WATER.” *Ecology* 88 (1): 228–42. https://doi.org/10.1890/0012-9658(2007)88[228:TLCRCL]2.0.CO;2.

Collins, Sarah M., Samantha K. Oliver, Jean-Francois Lapierre, Emily H. Stanley, John R. Jones, Tyler Wagner, and Patricia A. Soranno. 2017. “Lake Nutrient Stoichiometry Is Less Predictable Than Nutrient Concentrations at Regional and Sub-Continental Scales.” *Ecological Applications* 27 (5): 1529–40. https://doi.org/10.1002/eap.1545.