

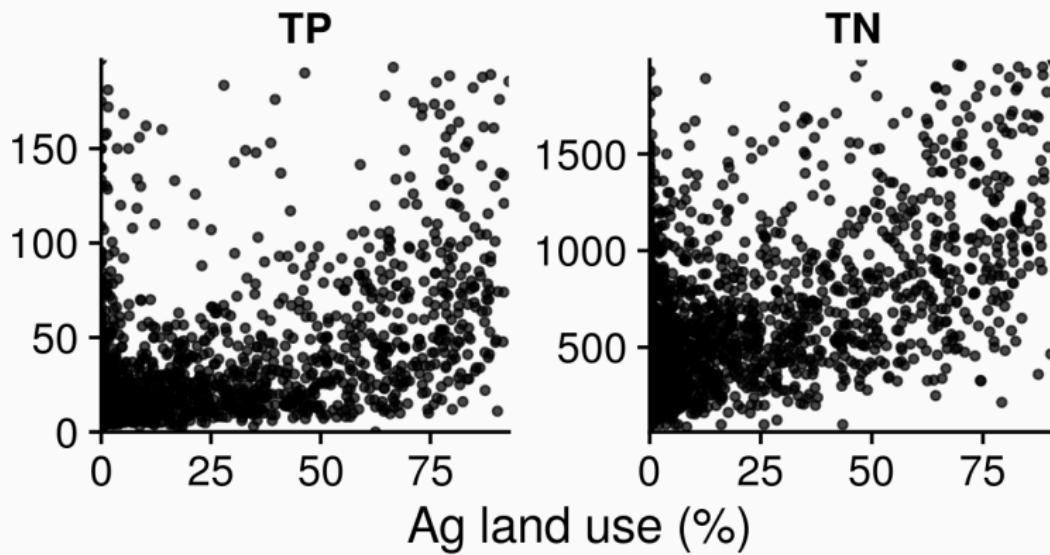
Analysis of 500 lake catchments reveals the relationship between crop type, fertilizer and manure inputs and lake nutrient concentrations

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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.



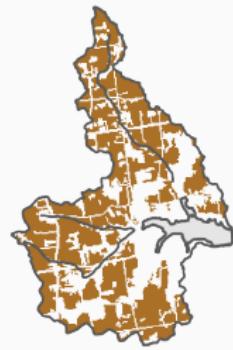
Buffer composition - Land-use cover - Specific crops



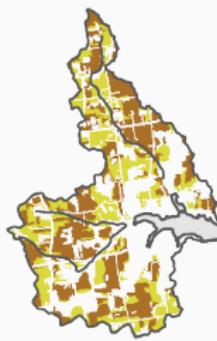
Lake characteristics - Depth, area, etc.

Background - Land-use cover

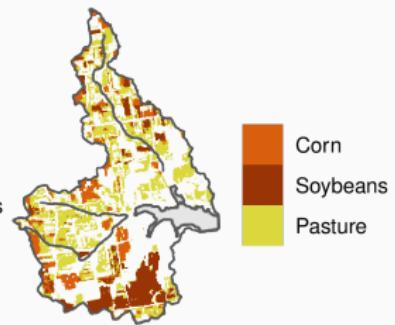
Total Ag



Ag Cover Type



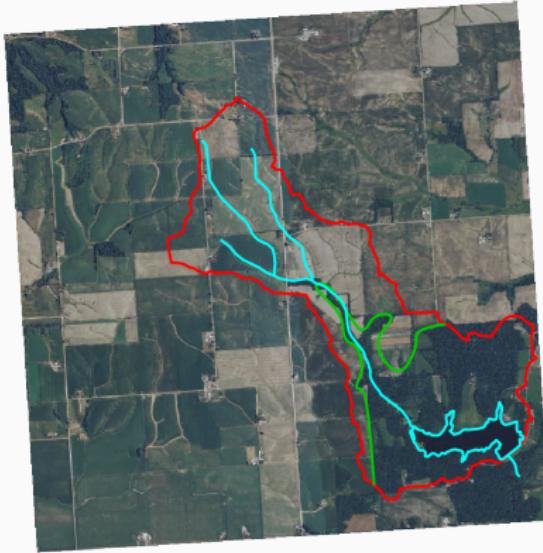
Individual Crops



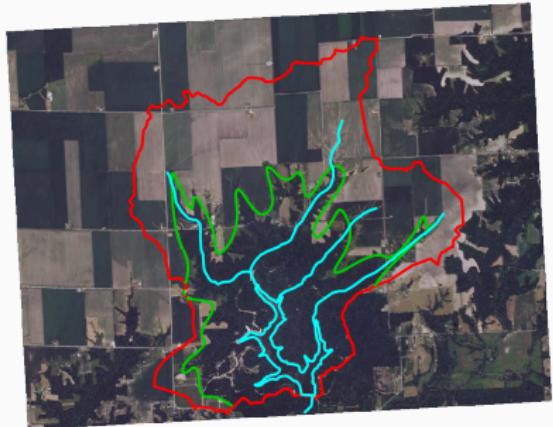
Background - Spatial resolution

Lake Carlton – IL

Poorly Buffered



Argyle Lake – IL



Background - The macroscale

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

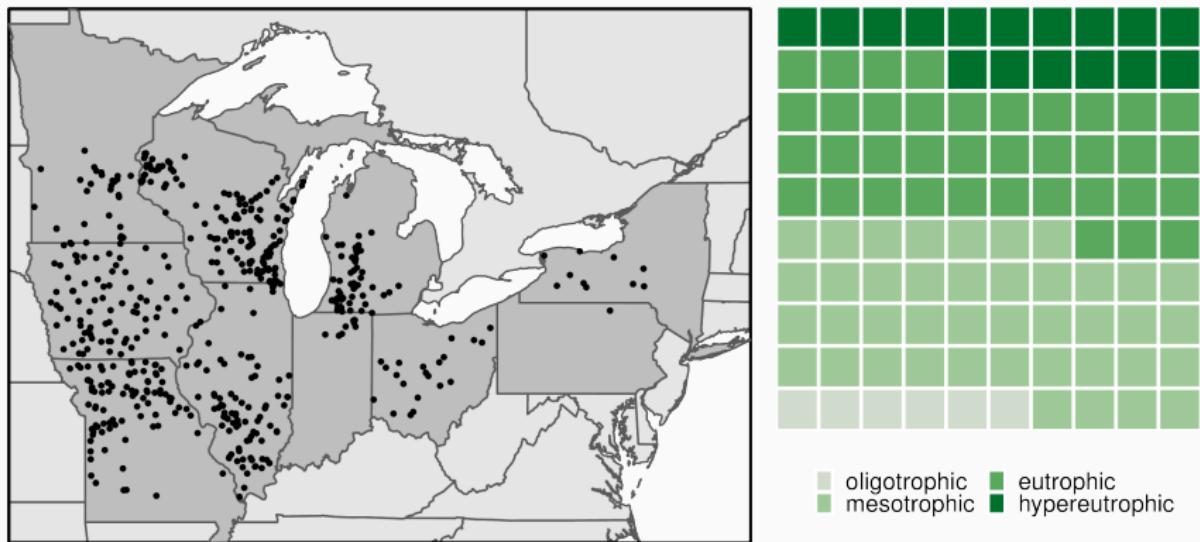
What are some things we've learned from fine scale, granular-data studies?

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)

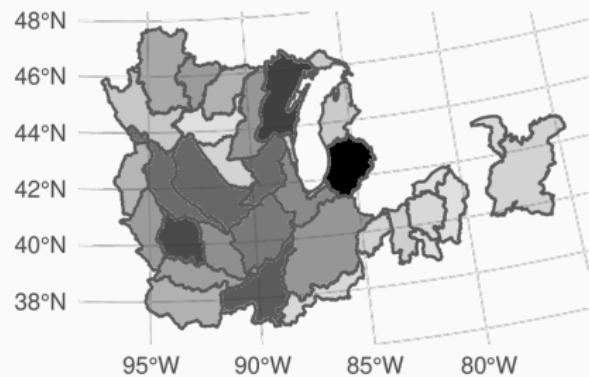
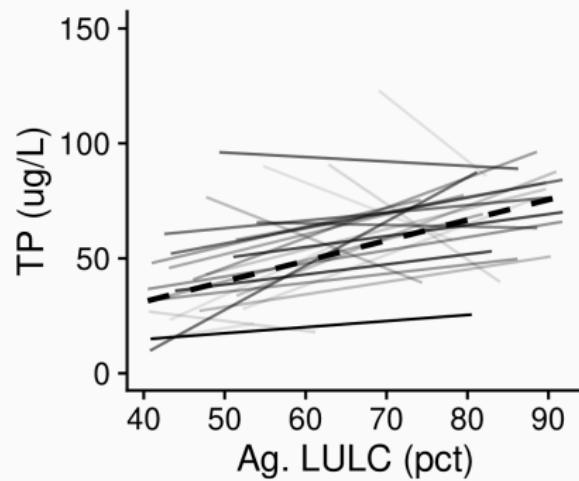
Regional predictors: 7 Watershed land-use variables

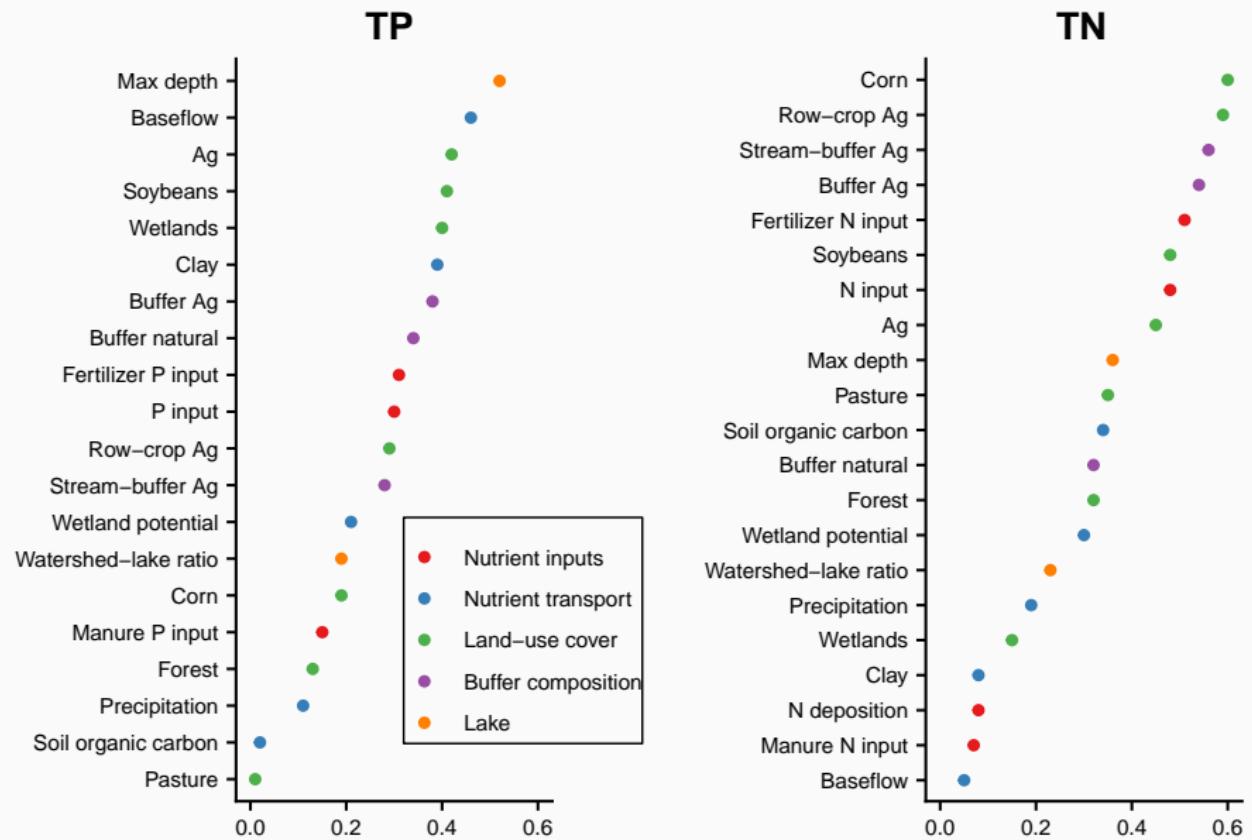
Model selection: Cross-validation on watershed land-use

Methods - Regionally varying predictors

Watershed land use is a proxy for many different specific activities which are likely to be regionally variable.

(Burcher, Valett, and Benfield 2007)

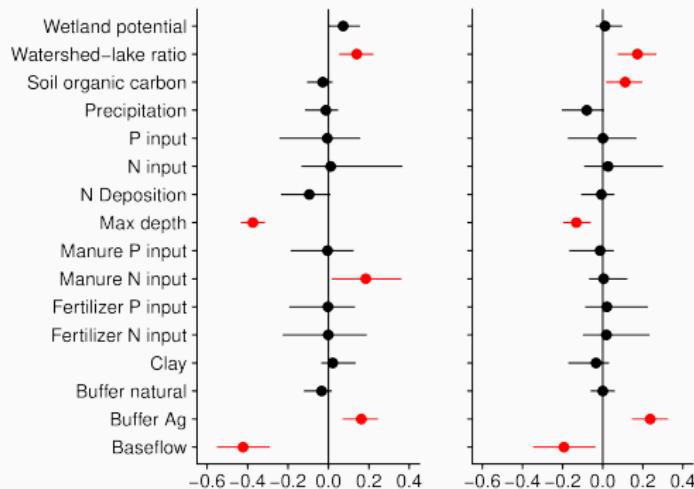




Results - Fixed effects

Baseflow and Max depth had a strong influence on predicted TP concentrations.

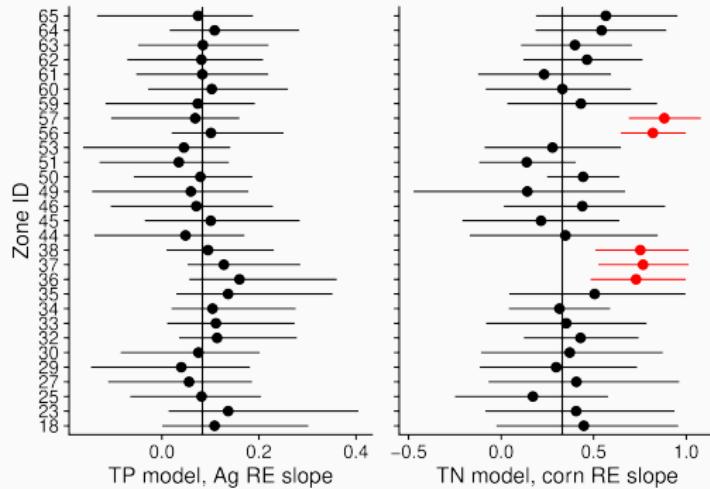
Buffer Ag land had a stronger influence on predicted TN concentrations relative to TP.



Results - Regionally varying effects

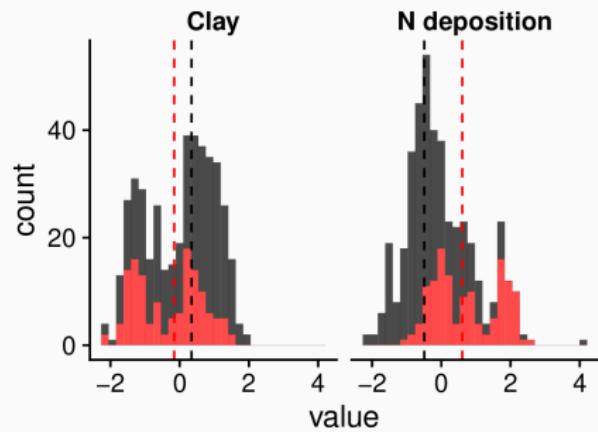
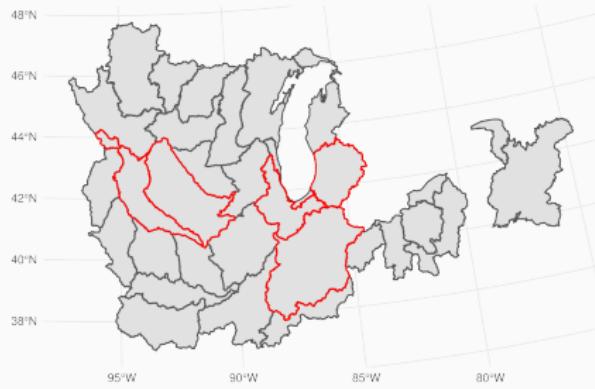
No evidence for spatial variation in the relationship between watershed Ag land use and TP.

Several regions appear to be more sensitive to watershed corn land use cover.



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.

Methods - Data

- Inputs - Fertilizer and manure applications
- Land use - Ag, Pasture, Row crop, Corn, Soybeans,
 N-fixers, Small grains
- Transport - Baseflow, Soil characteristics, Precipitation
- Buffers - See *Land use*
- Lake - Max depth, Area, etc.

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](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>.