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

Joe Stachelek, Cayelan C. Carey, Kelly M. Cobourn, Armen R. Kemanian, Tyler Wagner, Kathleen C. Weathers, Weizhe Weng and Patricia A. Soranno

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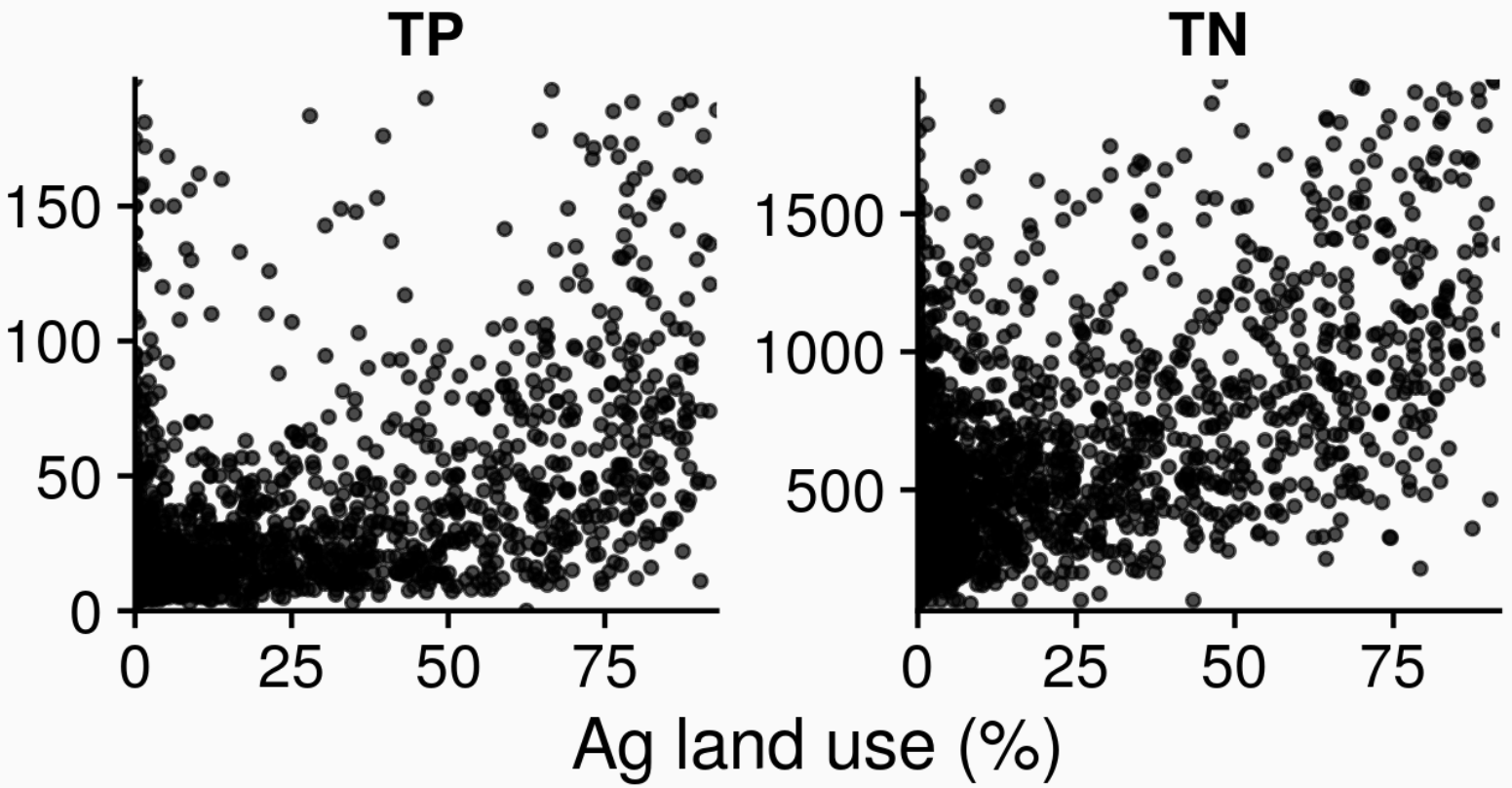
Introduction

Ag land-use is associated with higher lake nutrient concentrations (Soranno et al. 2017)



Introduction - Nutrient predictors

Nutrient inputs - Fertilizer and manure applications

Nutrient transport - Baseflow, soils, precipitation

Land-use cover - Specific crops, etc.

Buffer configuration - Land-use cover, specific crops

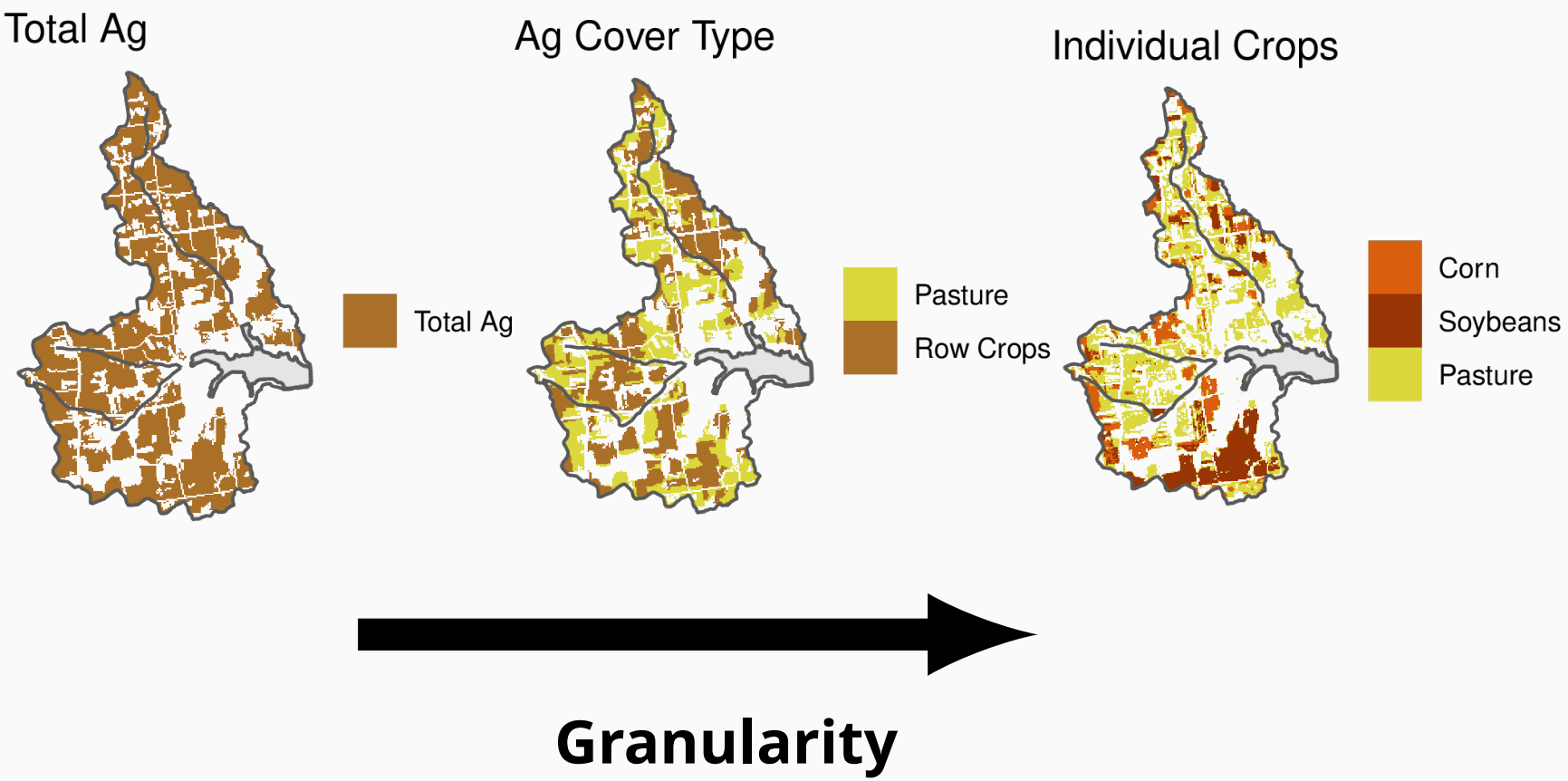
Lake characteristics - Depth, area, etc.

(Collins et al. 2017)

Background - The macroscale

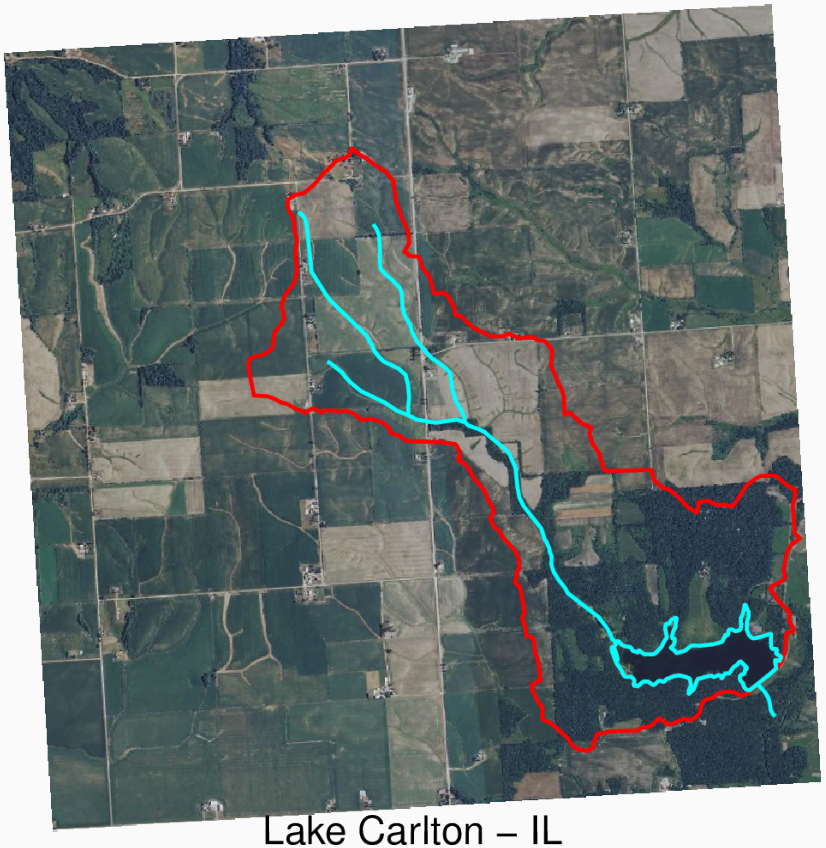
	Fine scale (few watersheds) (one region)	Macroscale (many watersheds) (many regions)
Granular	Many studies	**Rare**
Aggregated	Few studies	Some studies

Background - Granular Ag data

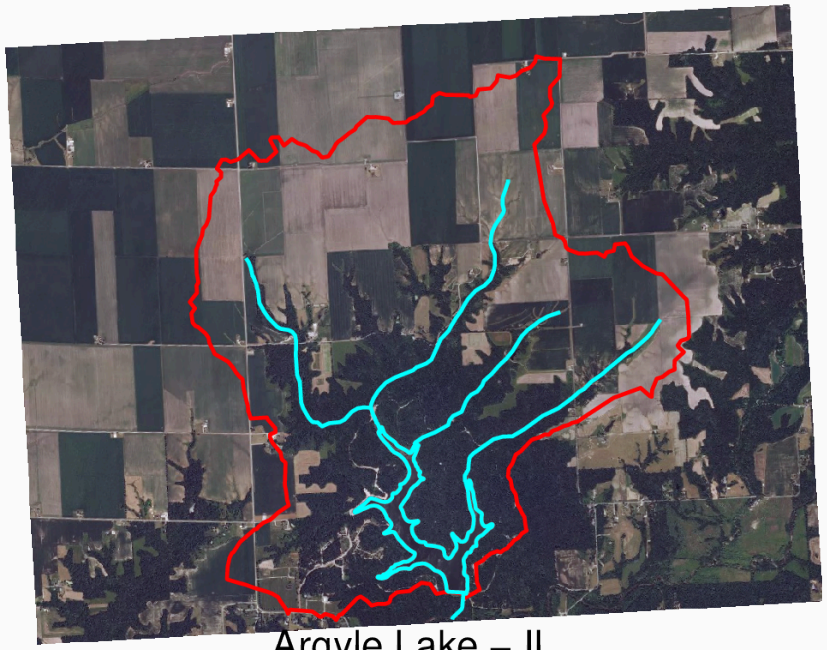


Background - Granular Ag data

Poorly Buffered Stream



Lake Carlton – IL



Argyle Lake – IL

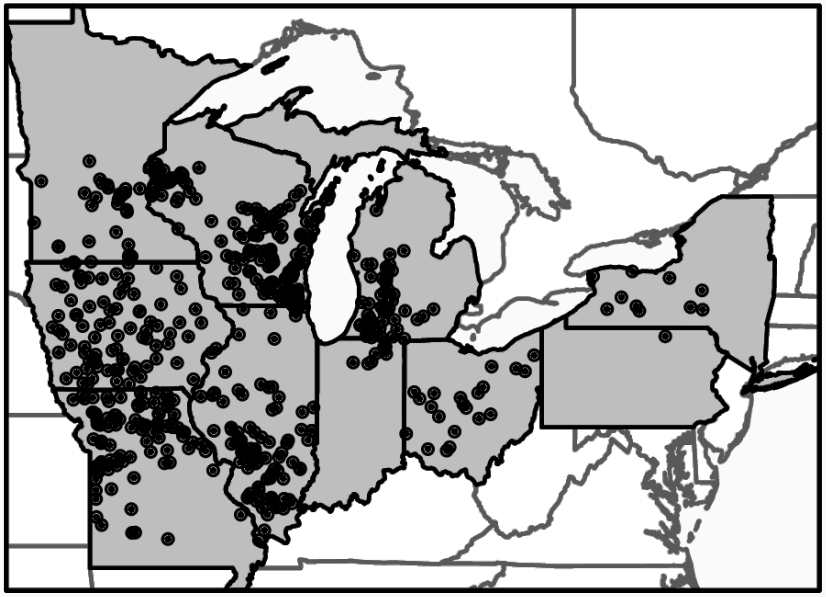
Well Buffered Stream

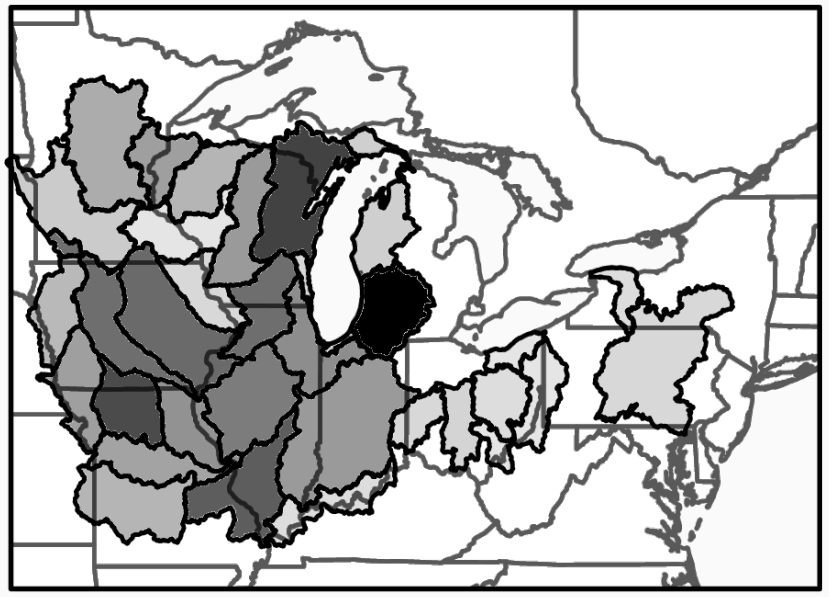
Research Question(s)

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





Land-use cover data (CDL) (USDA-NASS)

Soils data (gSSURGO) (USDA-NRCS)

Fertilizer and manure data (USGS) (Ruddy, Lorenz, and Mueller 2006)

Lake nutrient data (LAGOSNE) (Soranno et al. 2017)

Methods - Regression Modelling

Model type: Hierarchical Bayesian

Response variables: TP, TN

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

Variable selection: None (*horseshoe* shrinkage)

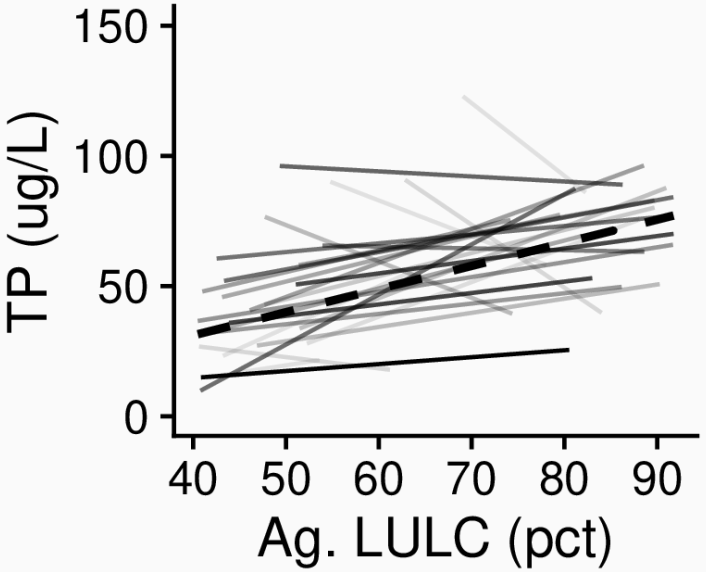
Regional predictors: 7 Watershed land-use variables

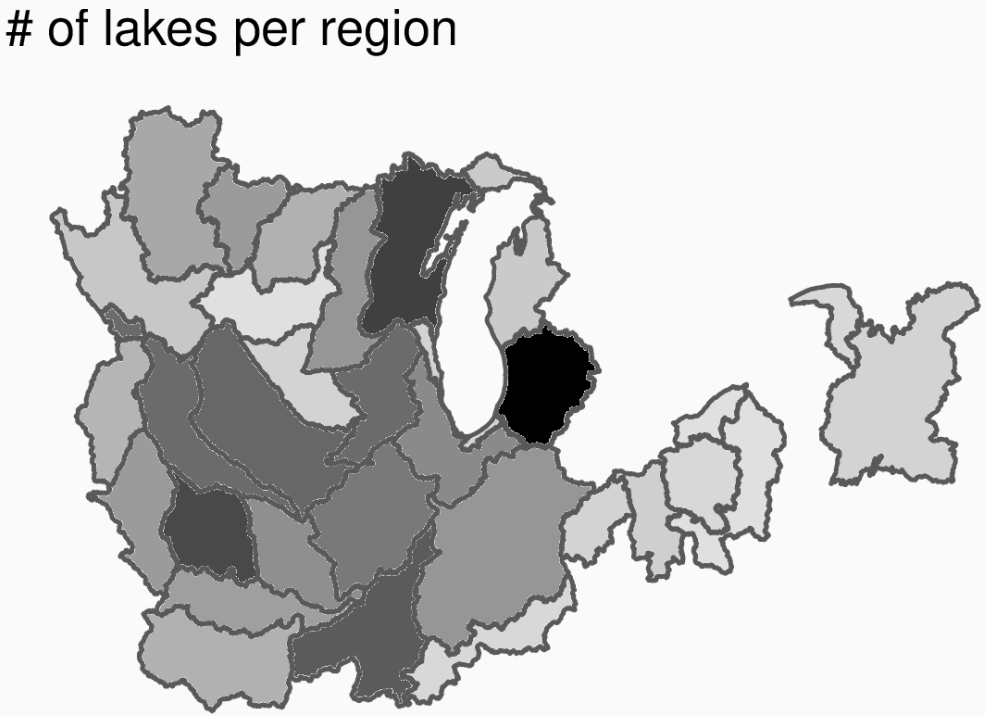
Model selection: Cross-validation on watershed land-use

Methods - Regression modelling

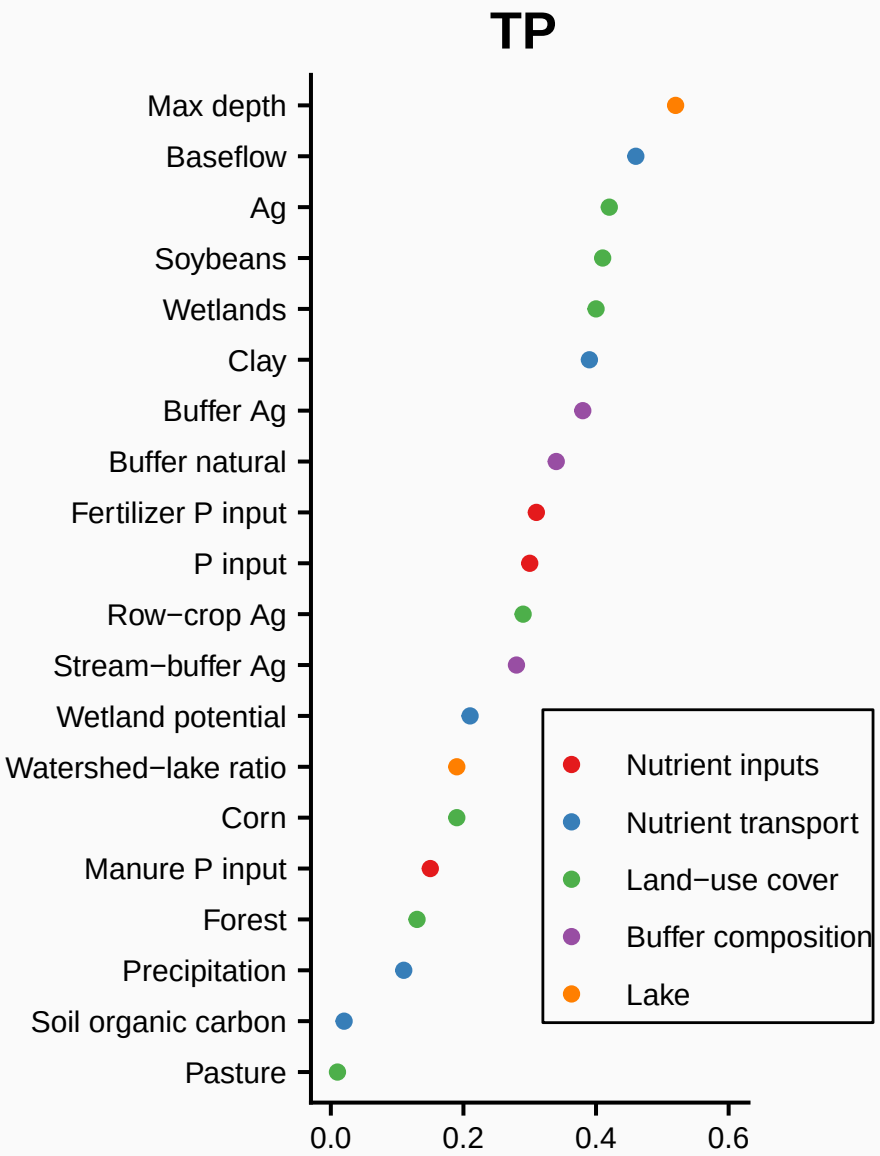
Watershed land use as a regionally varying predictor.

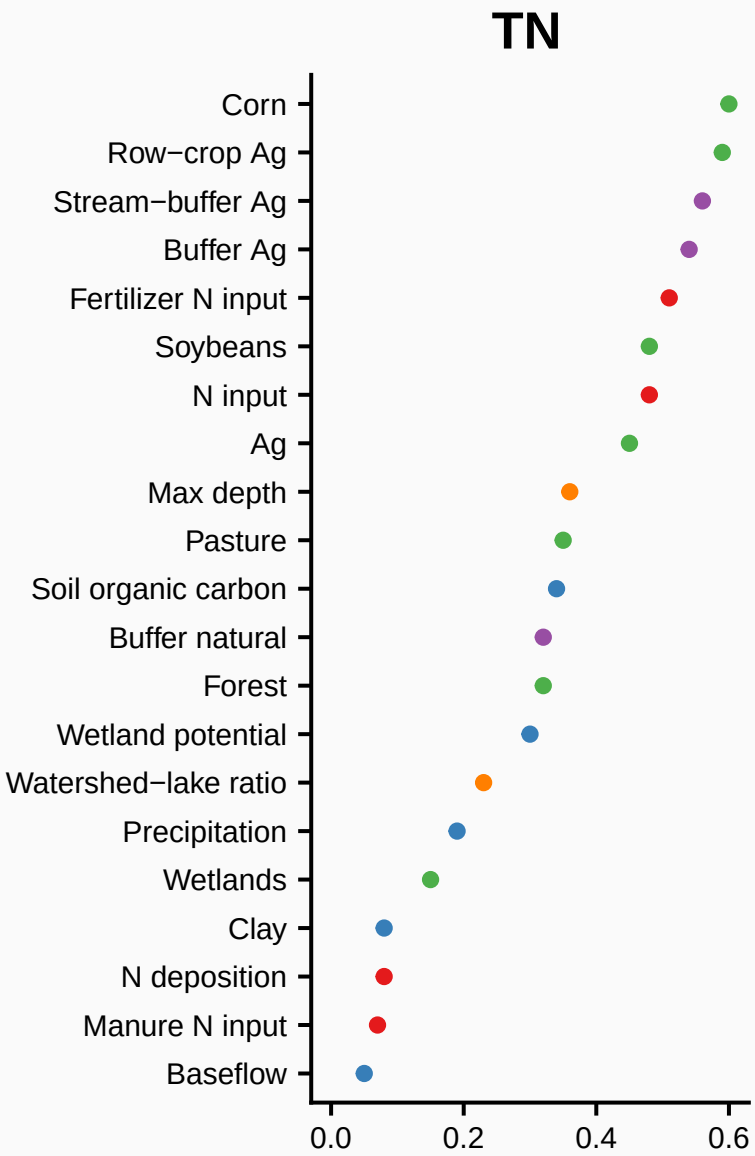
(Burcher, Valett, and Benfield 2007)





Results - Nutrient correlations

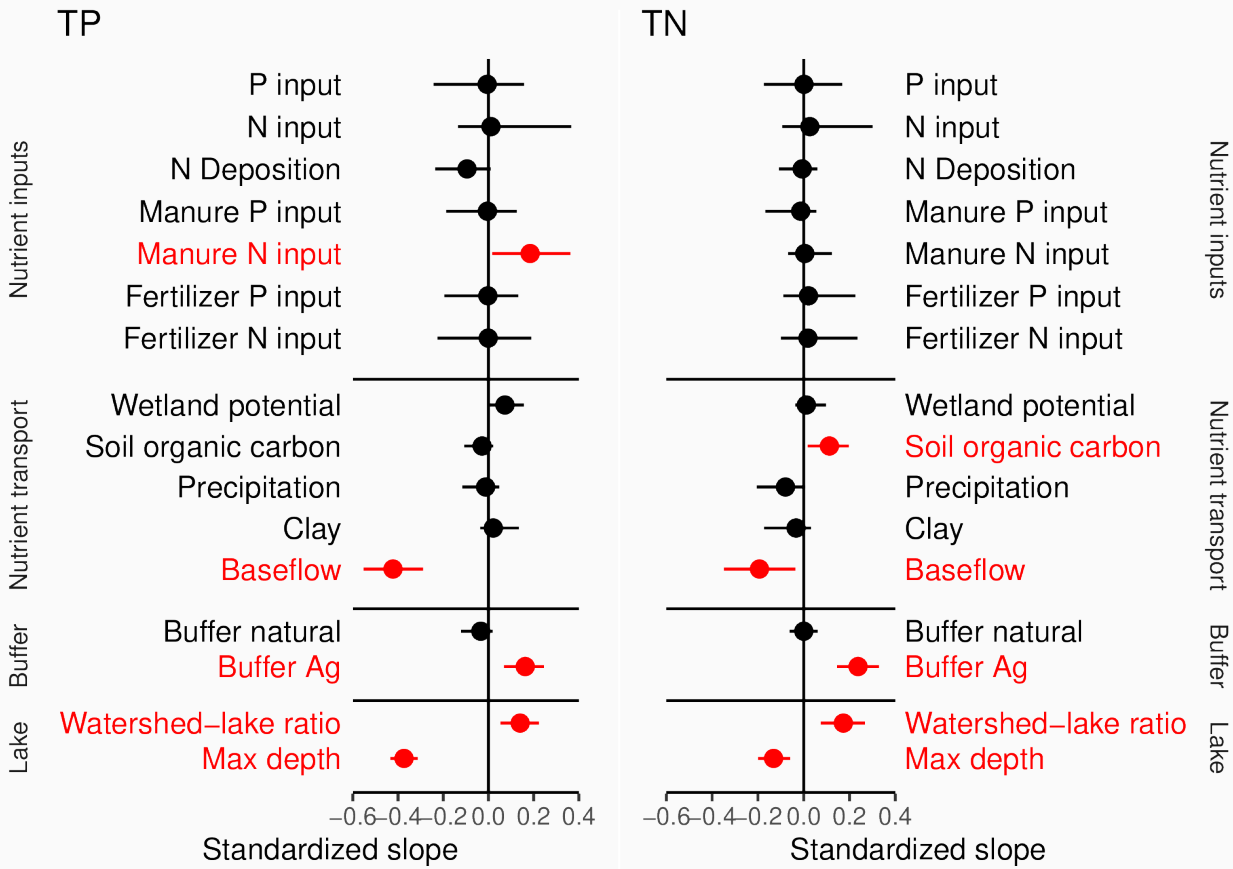




Results - Fixed effects

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

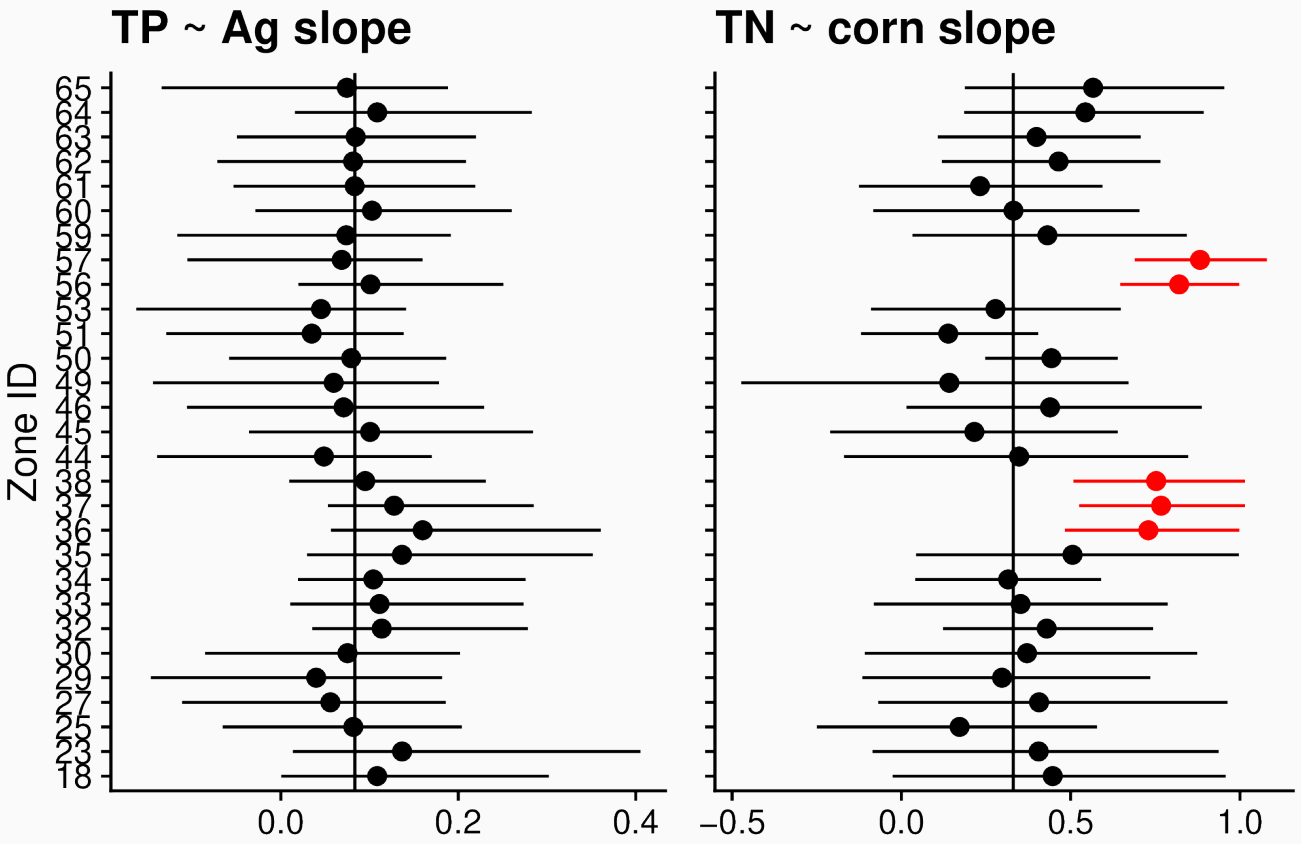
TN: Buffer Ag land has a strong(er) leverage on predicted values.



Results - Regionally varying effects

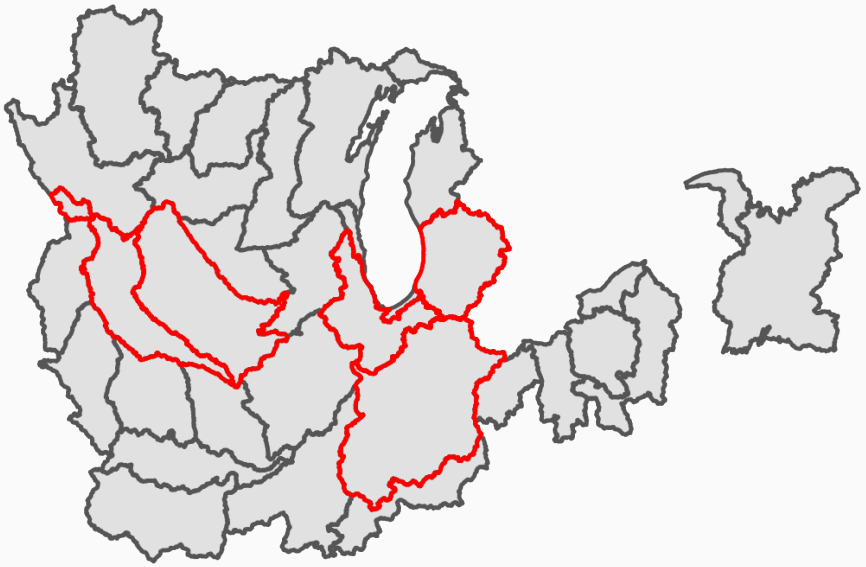
TP: No evidence for regional variation in Ag slope

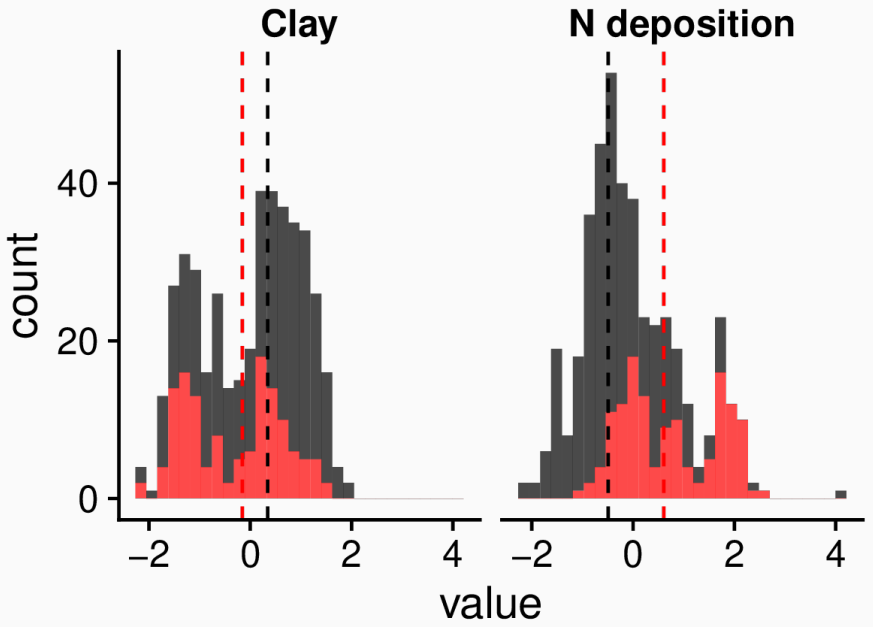
TN: Evidence for regional variation in corn slope



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 configuration 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.

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