

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

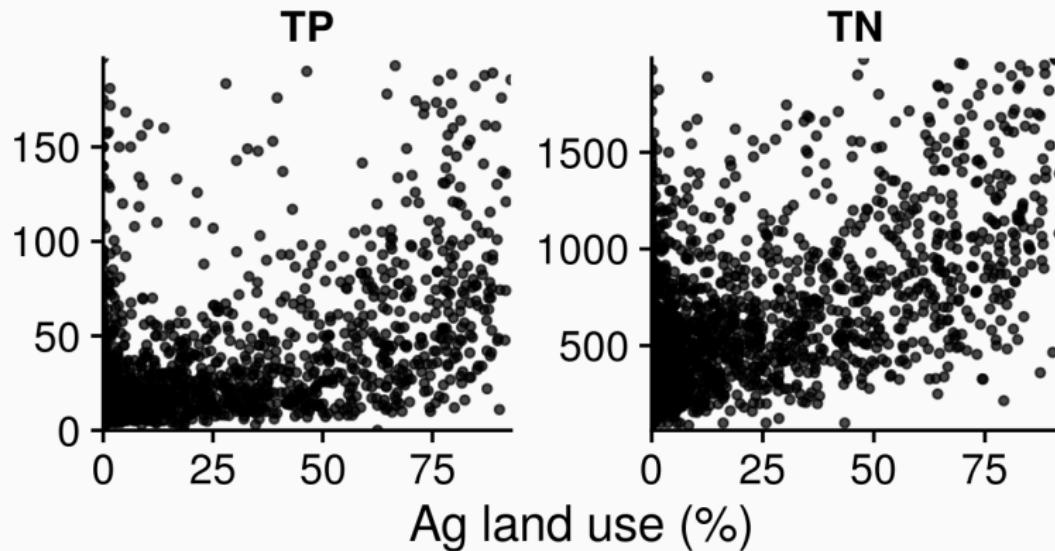
Joe Stachelek, Cayelan C. Carey, Kelly M. Cobourn, Armen R. Kemanian, Tyler Wagner, Kathleen C. Weathers, Weizhe Weng and Patricia A. Soranno

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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



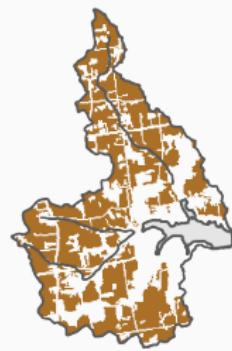
Lake characteristics - Depth, area, etc.

Background - The macroscale

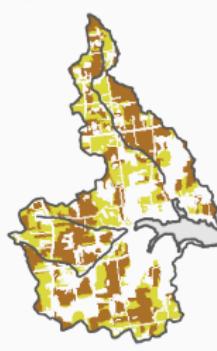
| | Fine scale (few watersheds) (one region) | Macroscale (many watersheds) (many regions) |
|------------|--|---|
| Granular | Many studies | Rare |
| Aggregated | Few studies | Some studies |

Background - Granular Ag data

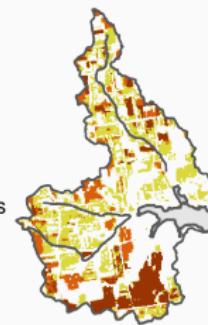
Total Ag



Ag Cover Type



Individual Crops



Total Ag

Pasture
Row Crops

Corn
Soybeans
Pasture

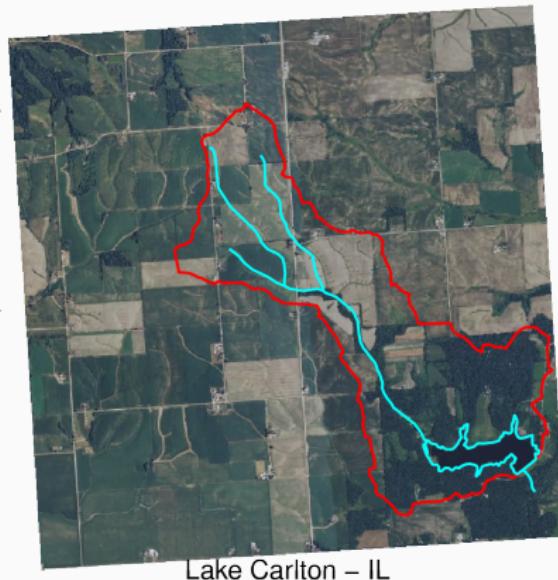


Aggregated

Granular

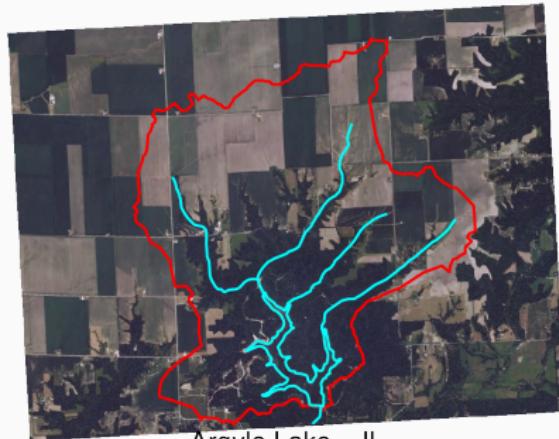
Background - Granular Ag data

Poorly Buffered Stream



Lake Carlton – IL

Well Buffered Stream

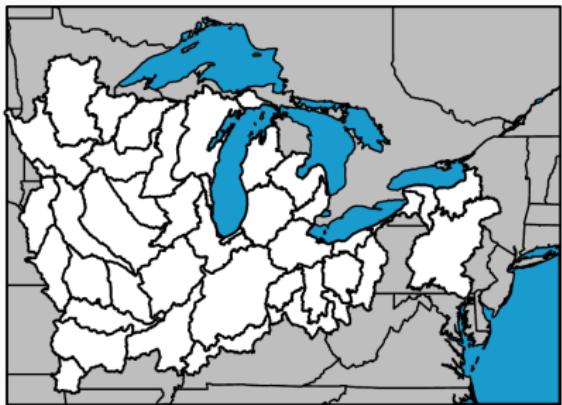
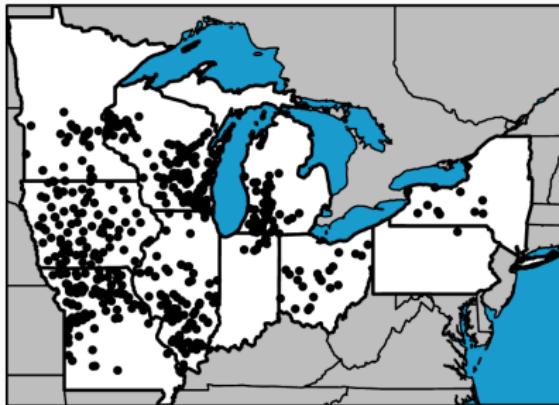


Argyle Lake – IL

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 - Data



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

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

Soils data (gSSURGO) (USDA-NRCS)

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

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)

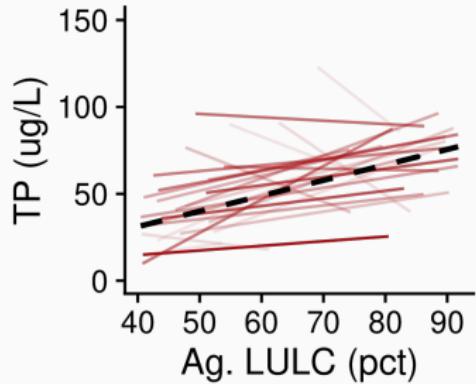
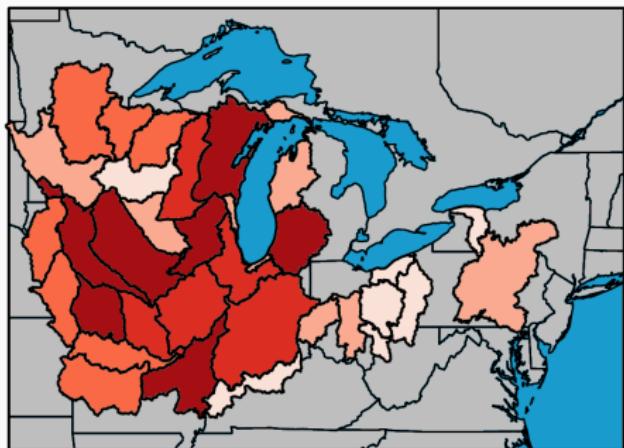
Regionally varying predictors: 7 Wtrshd land-use vars

Model selection: Cross-validation on watershed land-use

Methods - Regression modelling

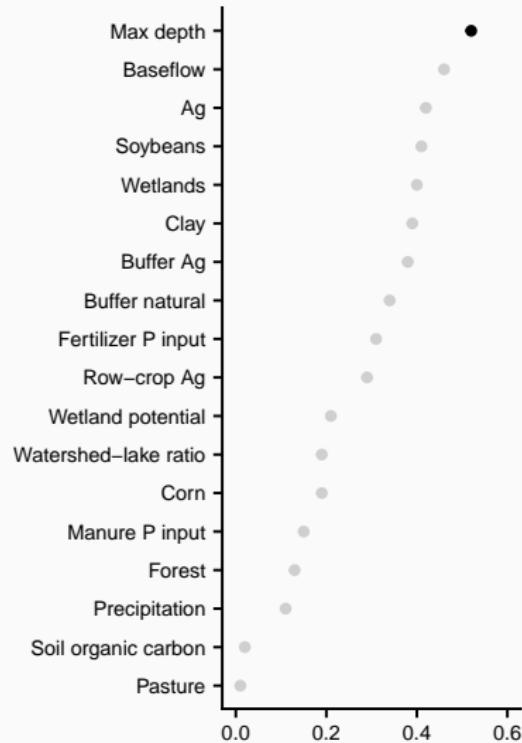
Watershed land-use as a proxy for unmeasured variables (Burcher et al. 2007; Hayes et al. 2015; King et al. 2005)

of lakes per region

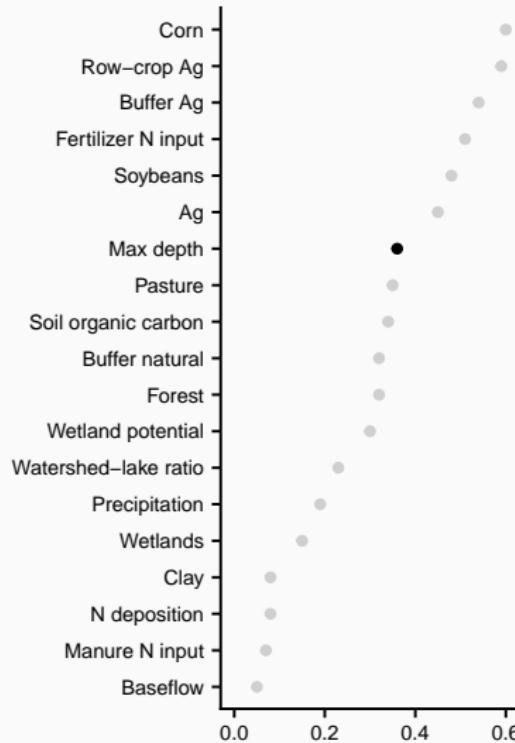


Results - Nutrient correlations

TP

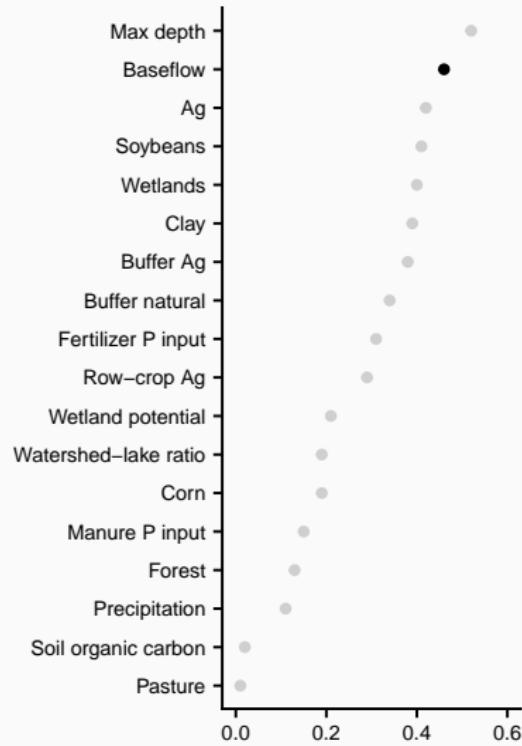


TN

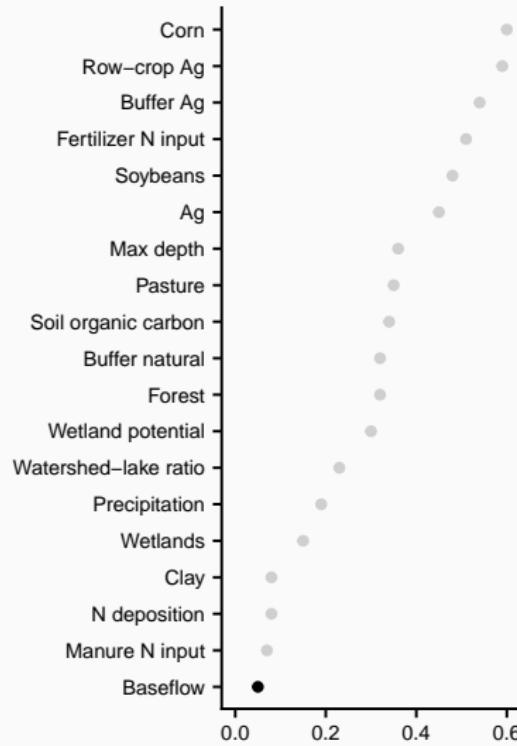


Results - Nutrient correlations

TP

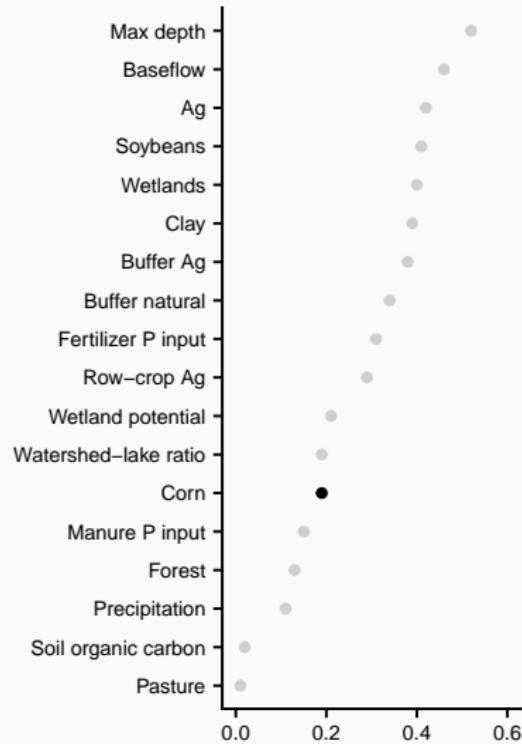


TN

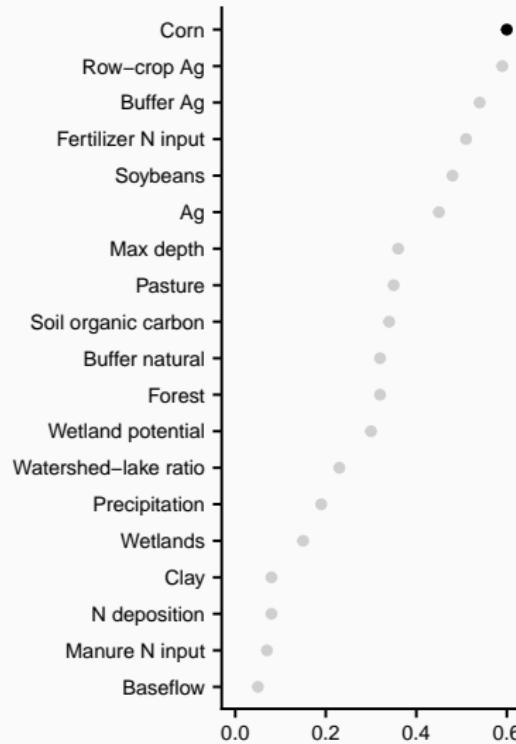


Results - Nutrient correlations

TP

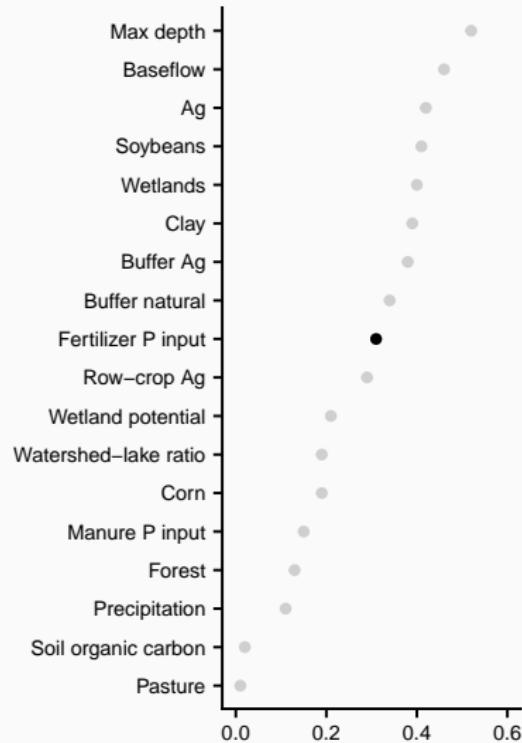


TN

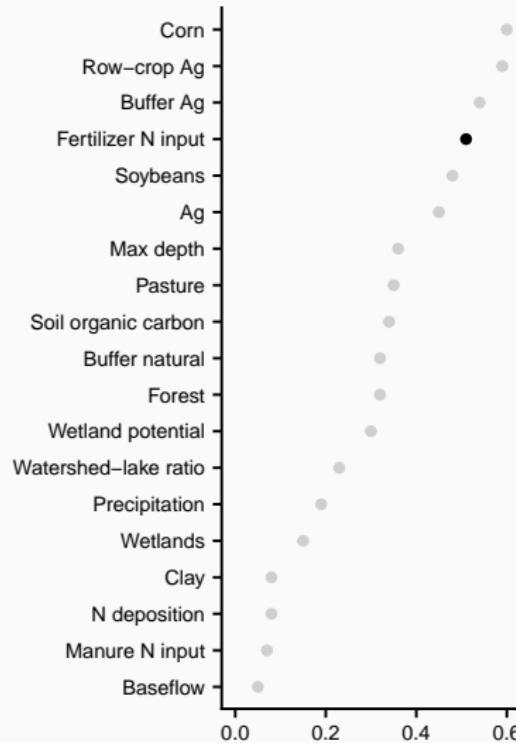


Results - Nutrient correlations

TP

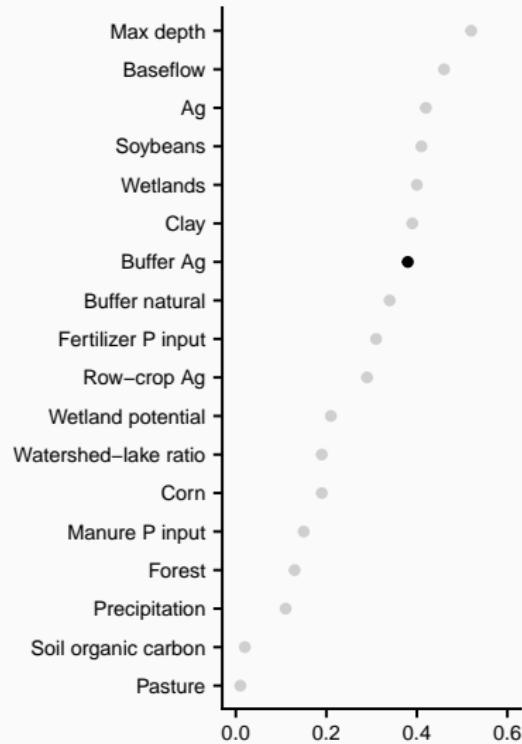


TN

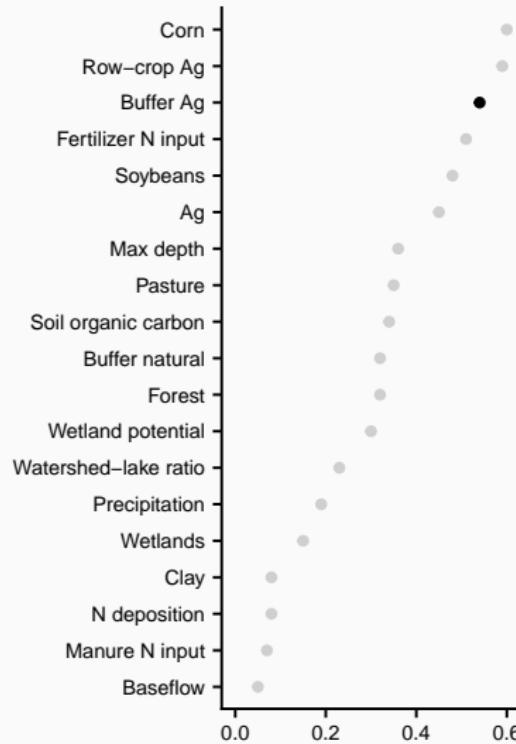


Results - Nutrient correlations

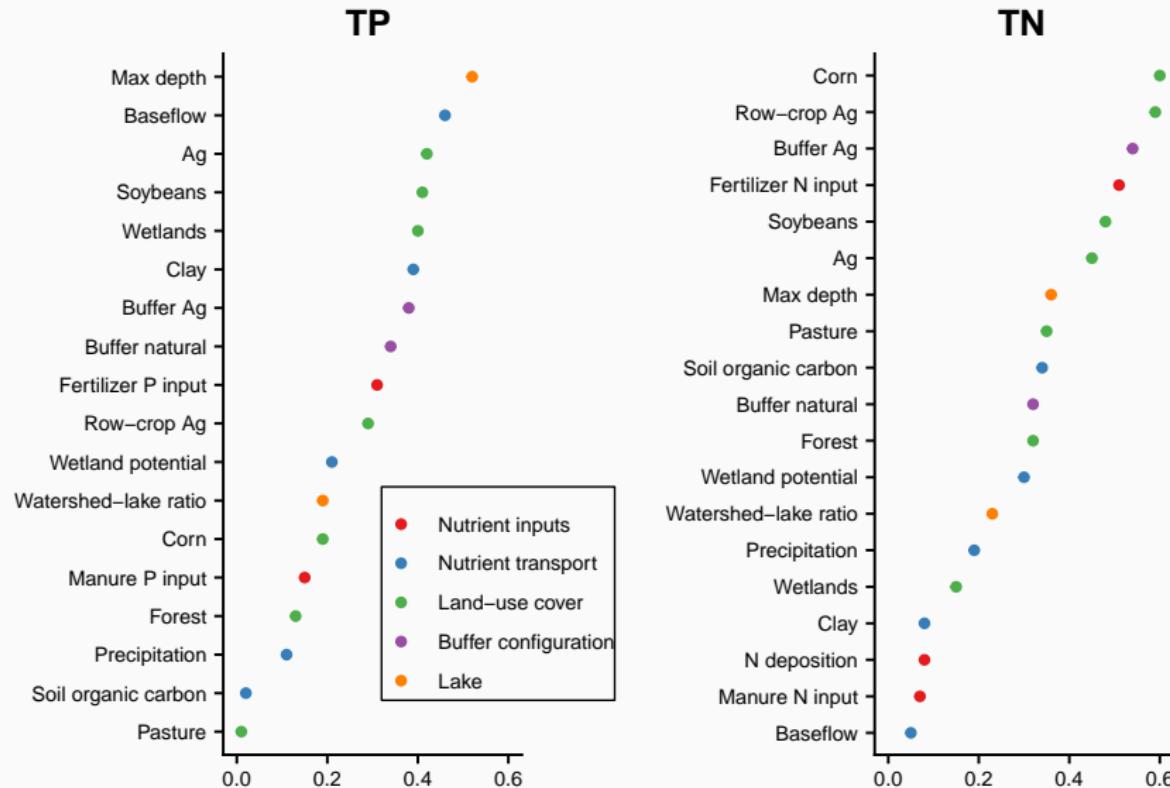
TP



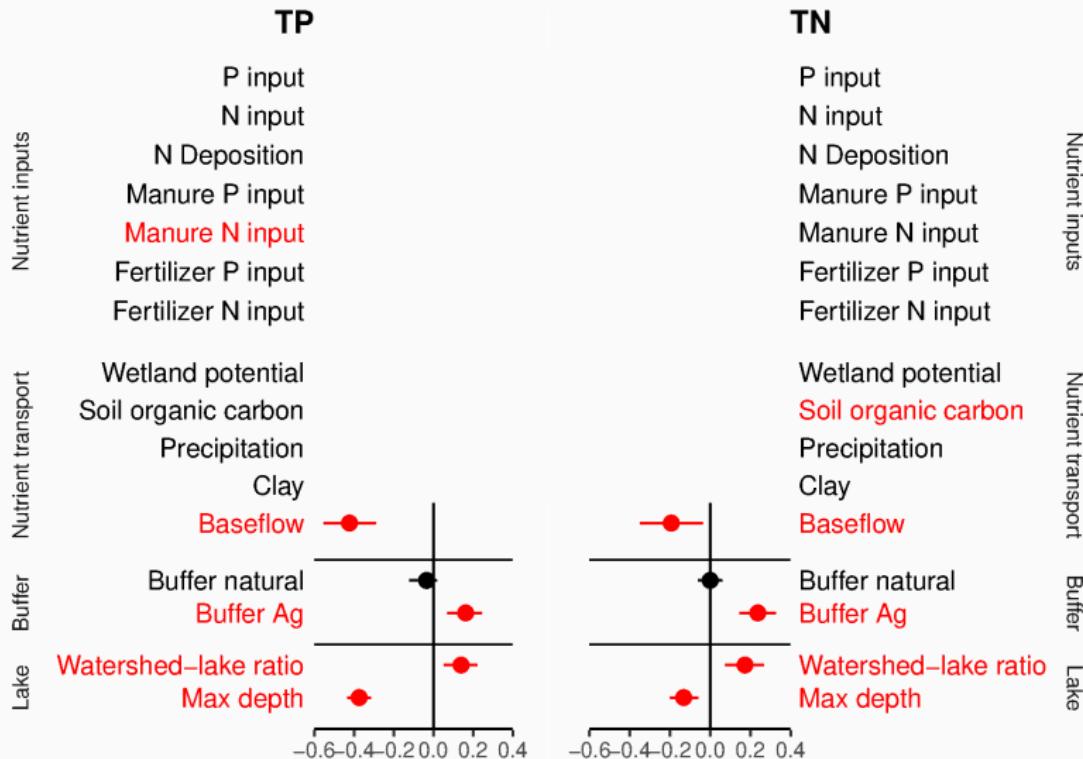
TN



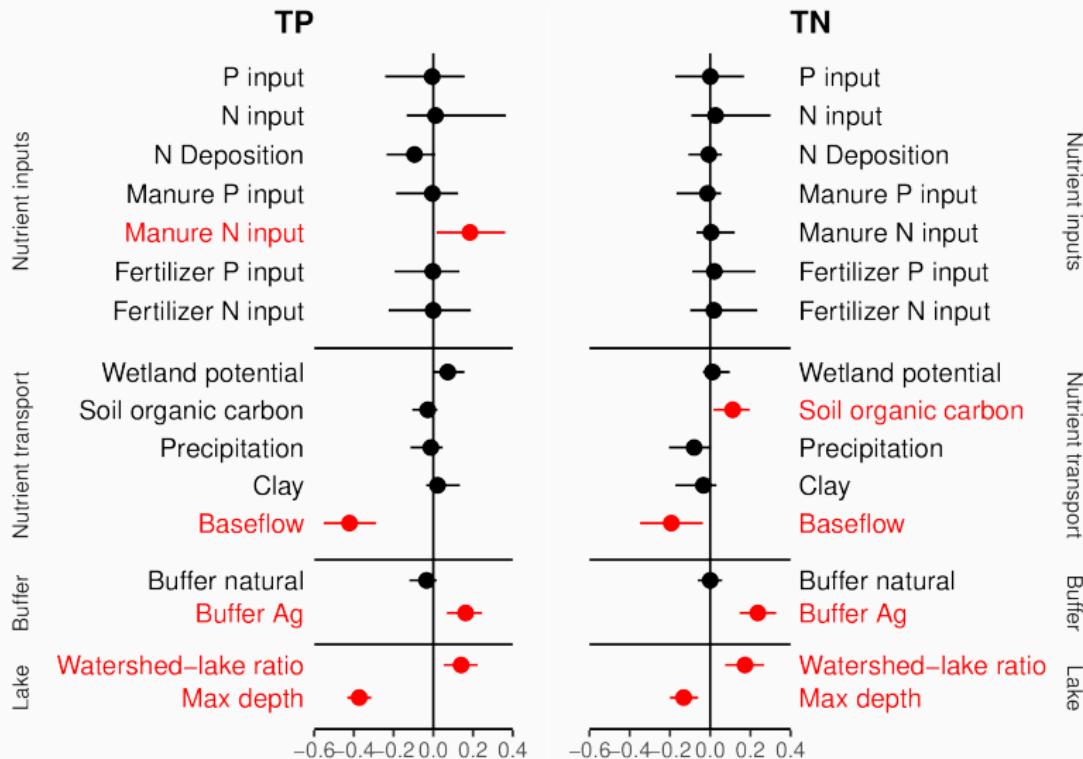
Results - Nutrient correlations



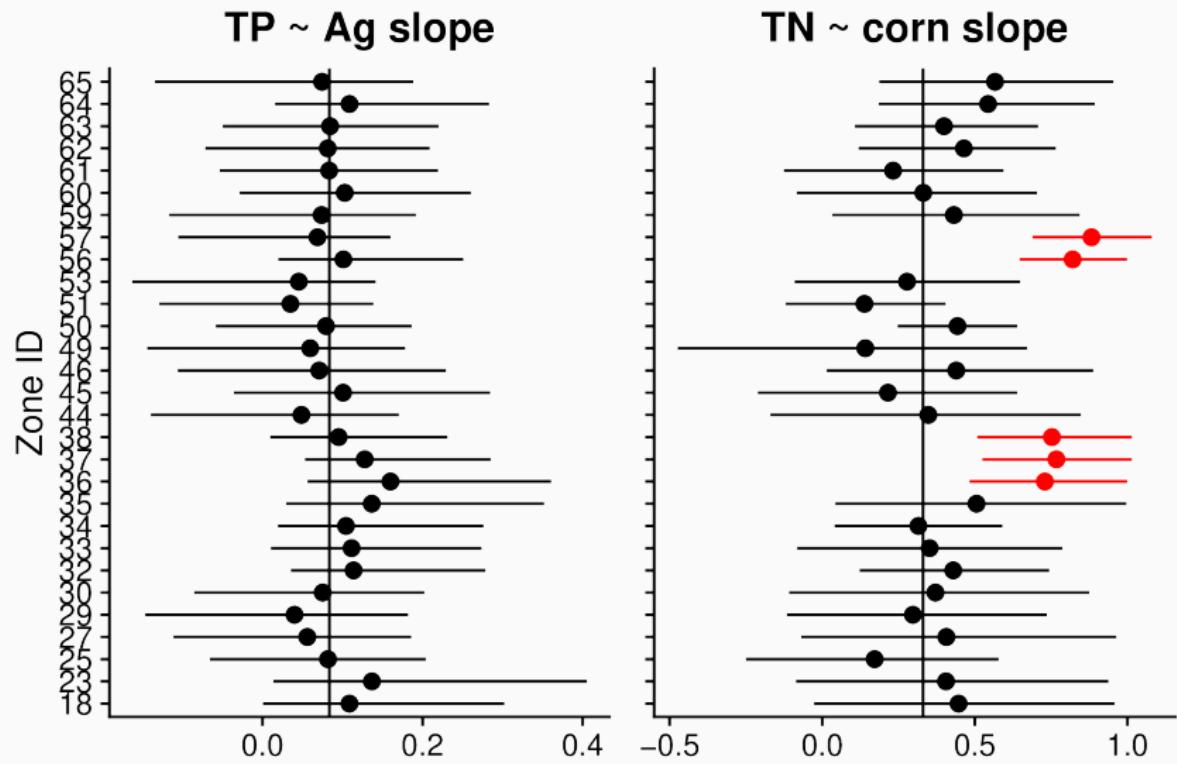
Results - Global effects



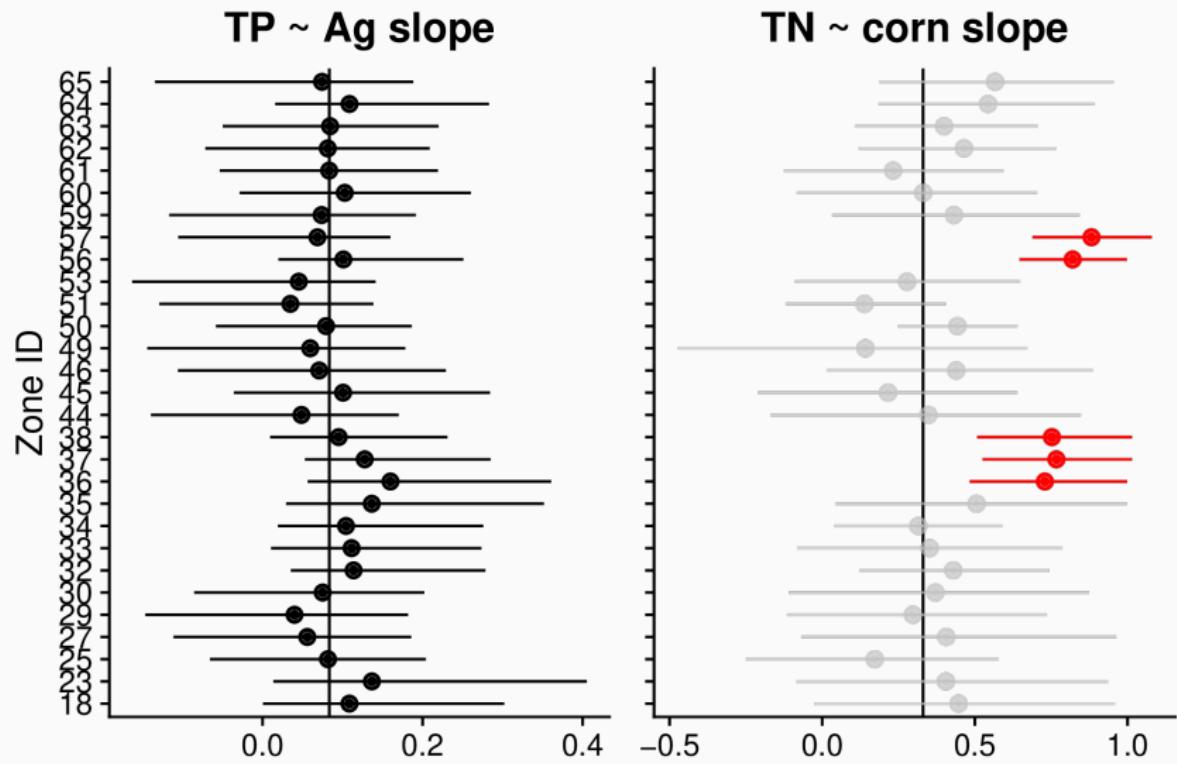
Results - Global effects



Results - Regionally varying effects

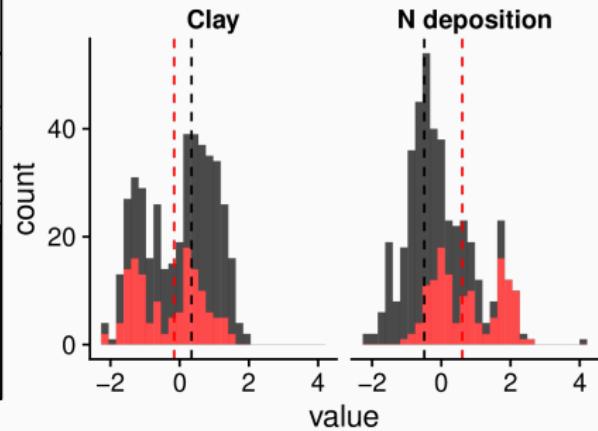
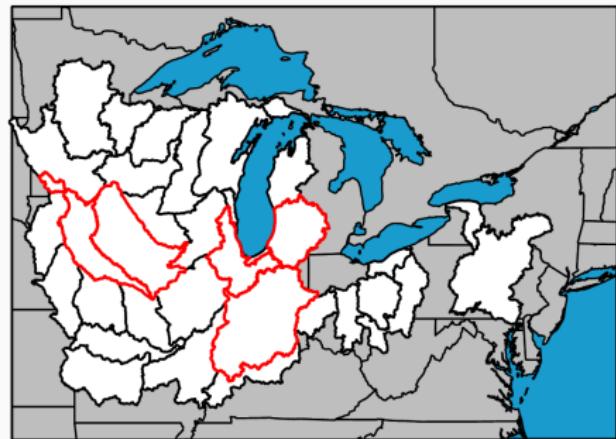


Results - Regionally varying effects



Results - TN Model

Ag sensitive regions



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.



References

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