Controls of Nitrogen to Phosphorus Stoichiometry in a Canadian Prairie Watershed

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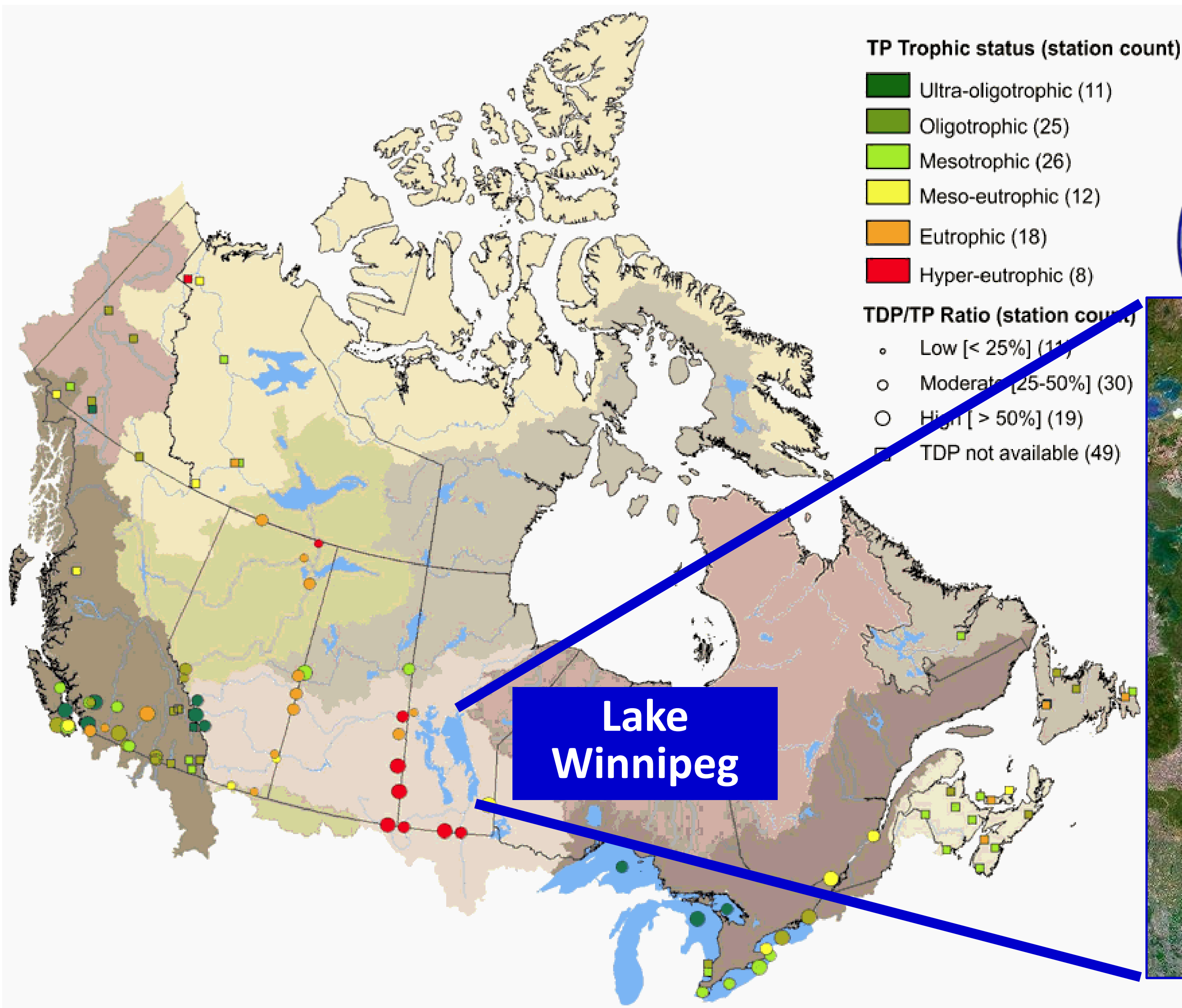
Total Phosphorus Concentrations in Monitored Canadian Rivers and Lakes (2004-2006)



Government of Canada

https://www.canada.ca/en/environment-climate-change/services/freshwater-quality-monitoring/publications/phosphorus-aquatic-ecosystems/chapter-3.html

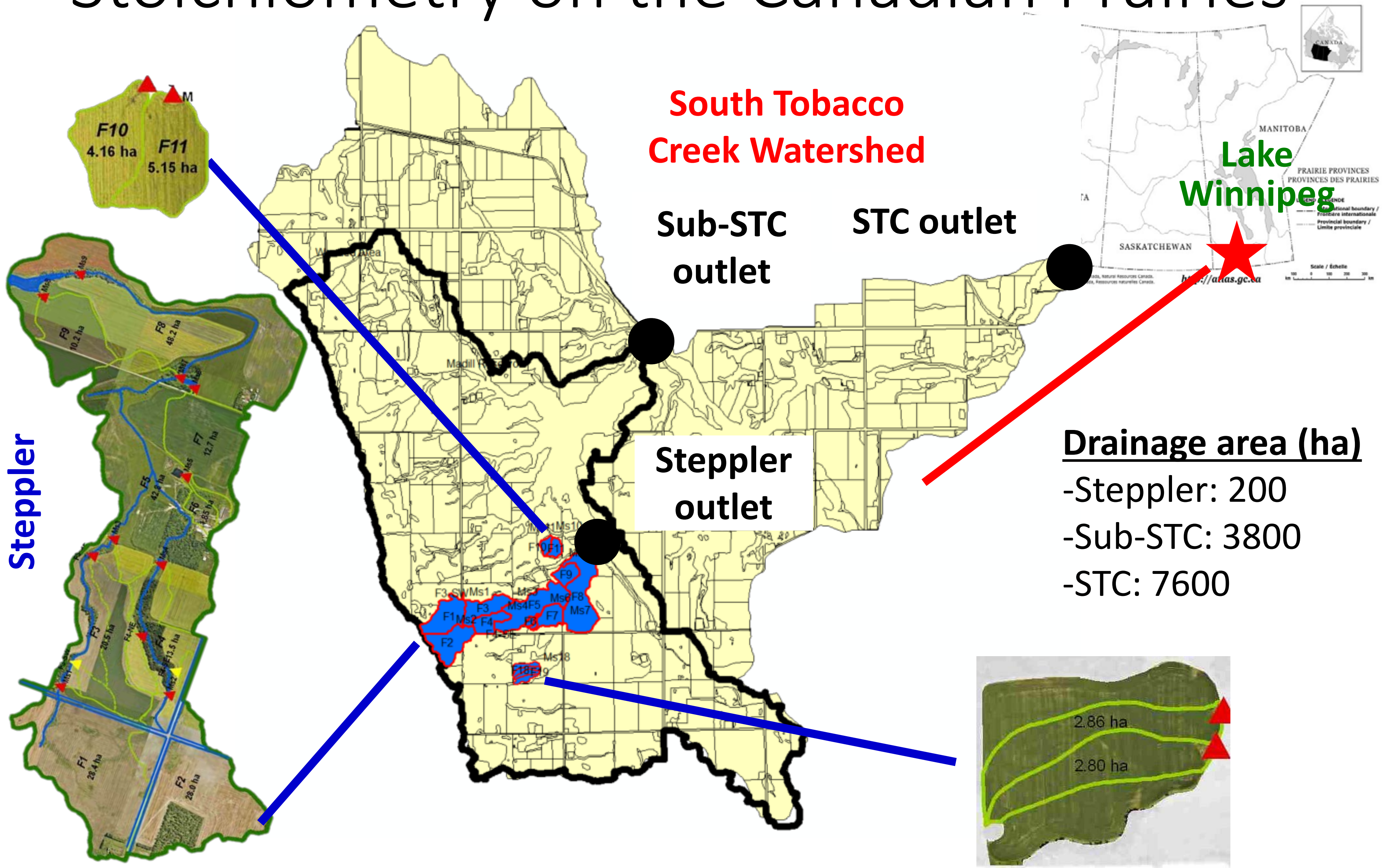
Why is N:P Stoichiometry Important?

- There is remarkable congruence between the chemistry of the deep ocean and the chemistry of phytoplankton in the surface ocean (Redfield, 1958).

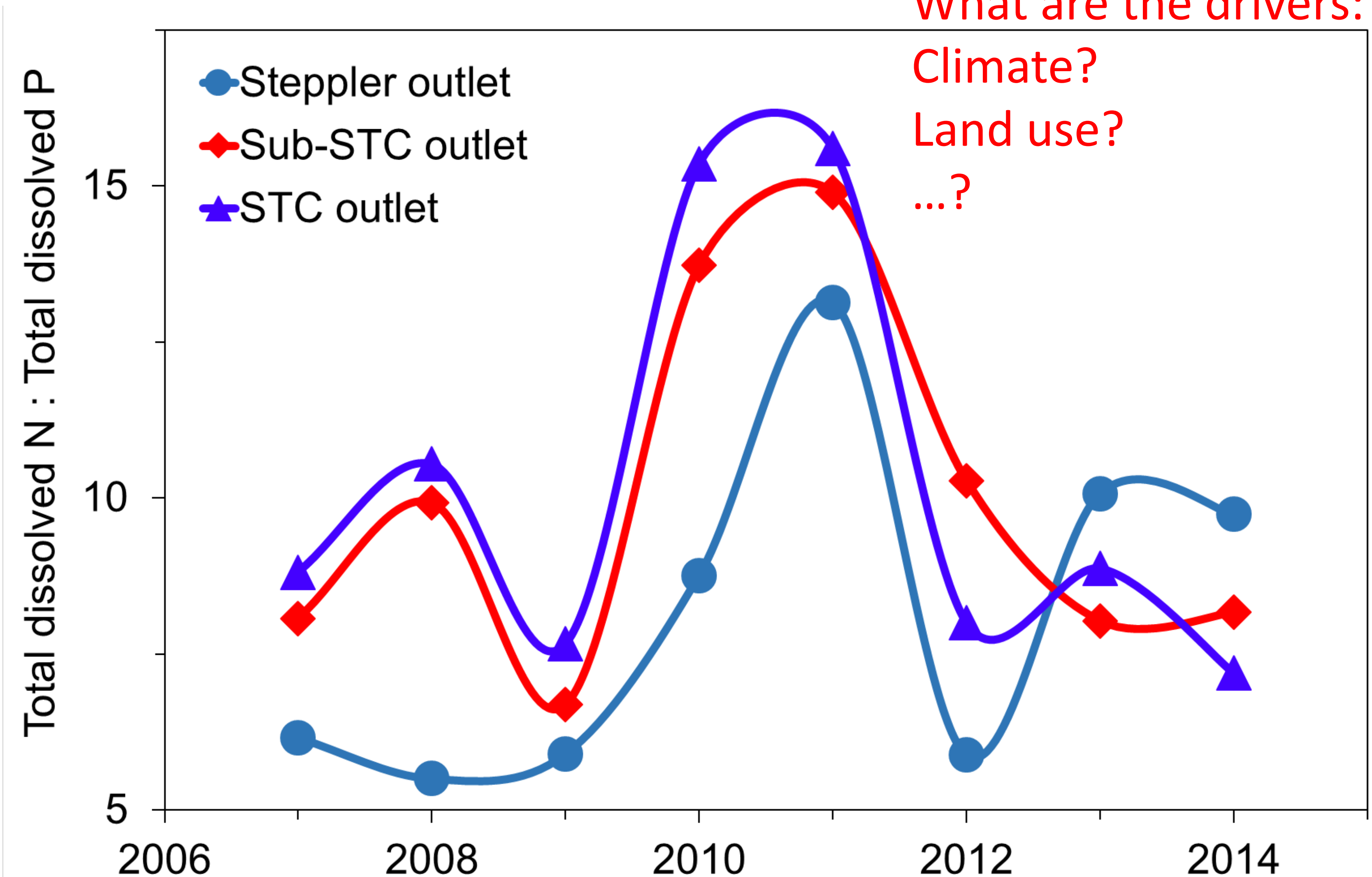
- N:P ratio (i.e., the Redfield ratio) may indicate the nutrient limitation status in surface waters (e.g., N:P > 16, P limiting; N:P < 16, N limiting; Redfield, 1958).

- N:P ratio may influence algal communities and bloom risks.

Aim to Understand Drivers for N:P Stoichiometry on the Canadian Prairies



N:P Ratios in Stream Flow



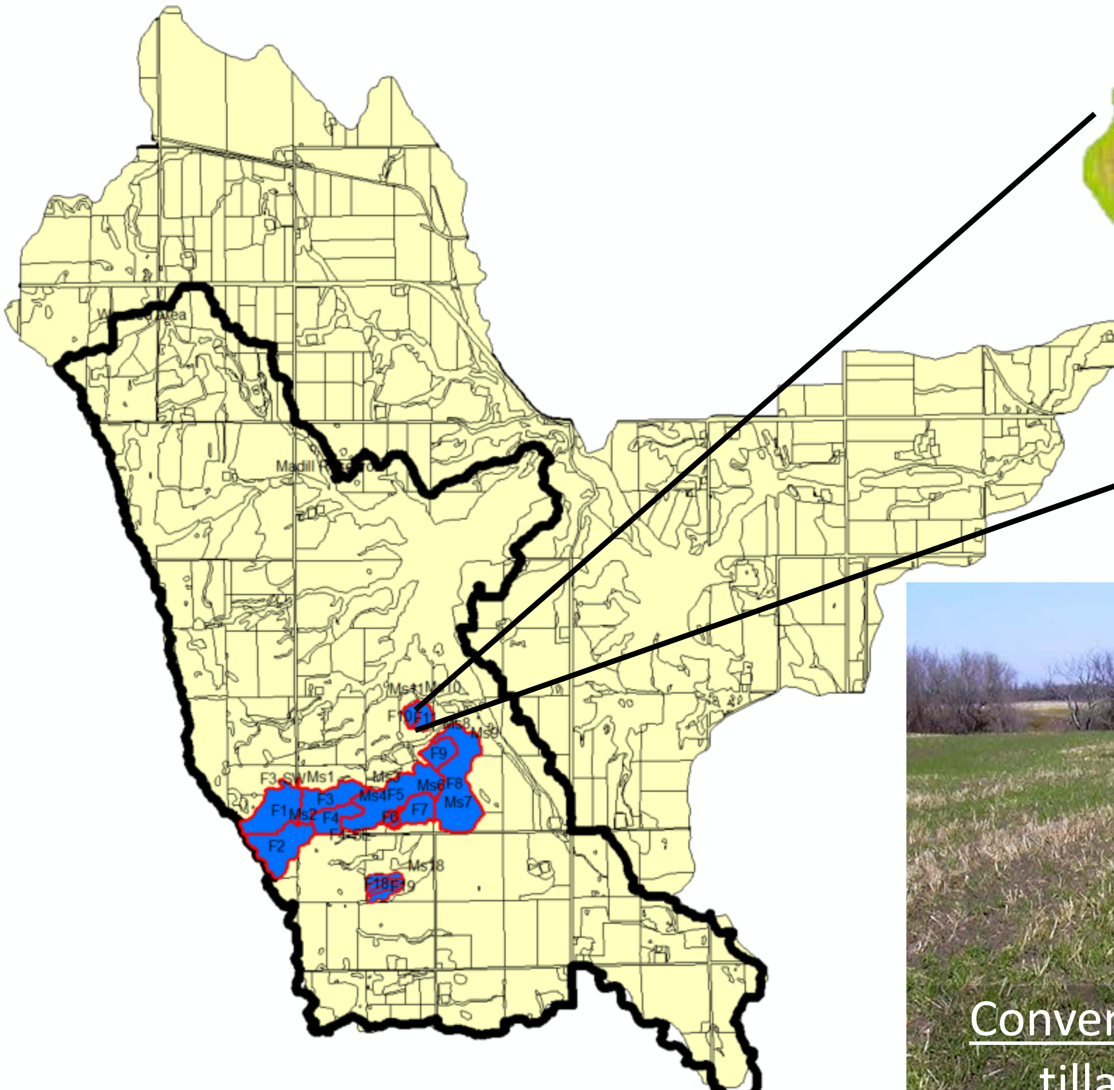
What are the drivers:

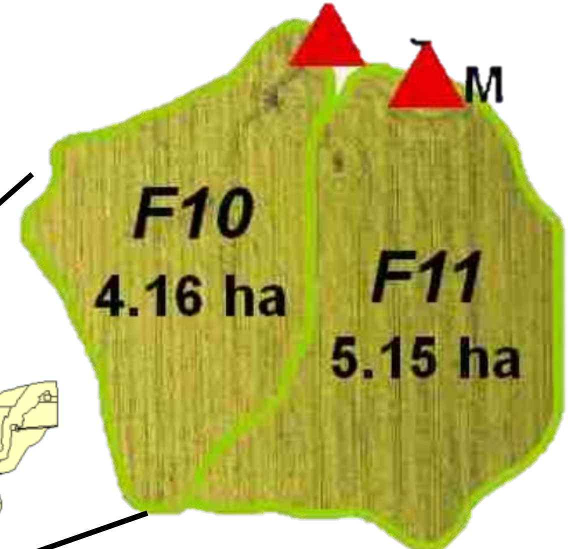
Climate?

Land use?

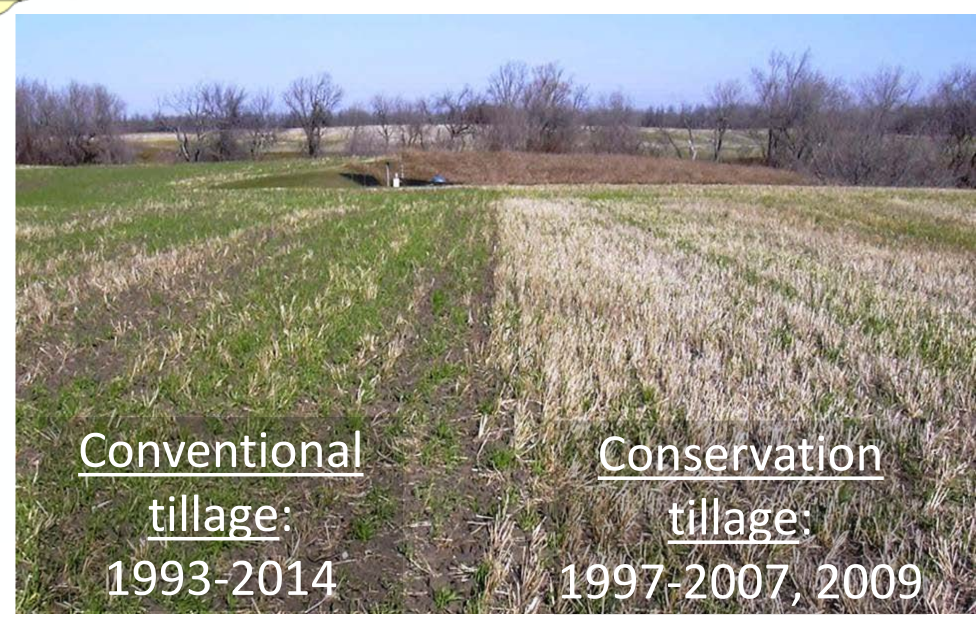
…?

Long-term Tillage Experiment

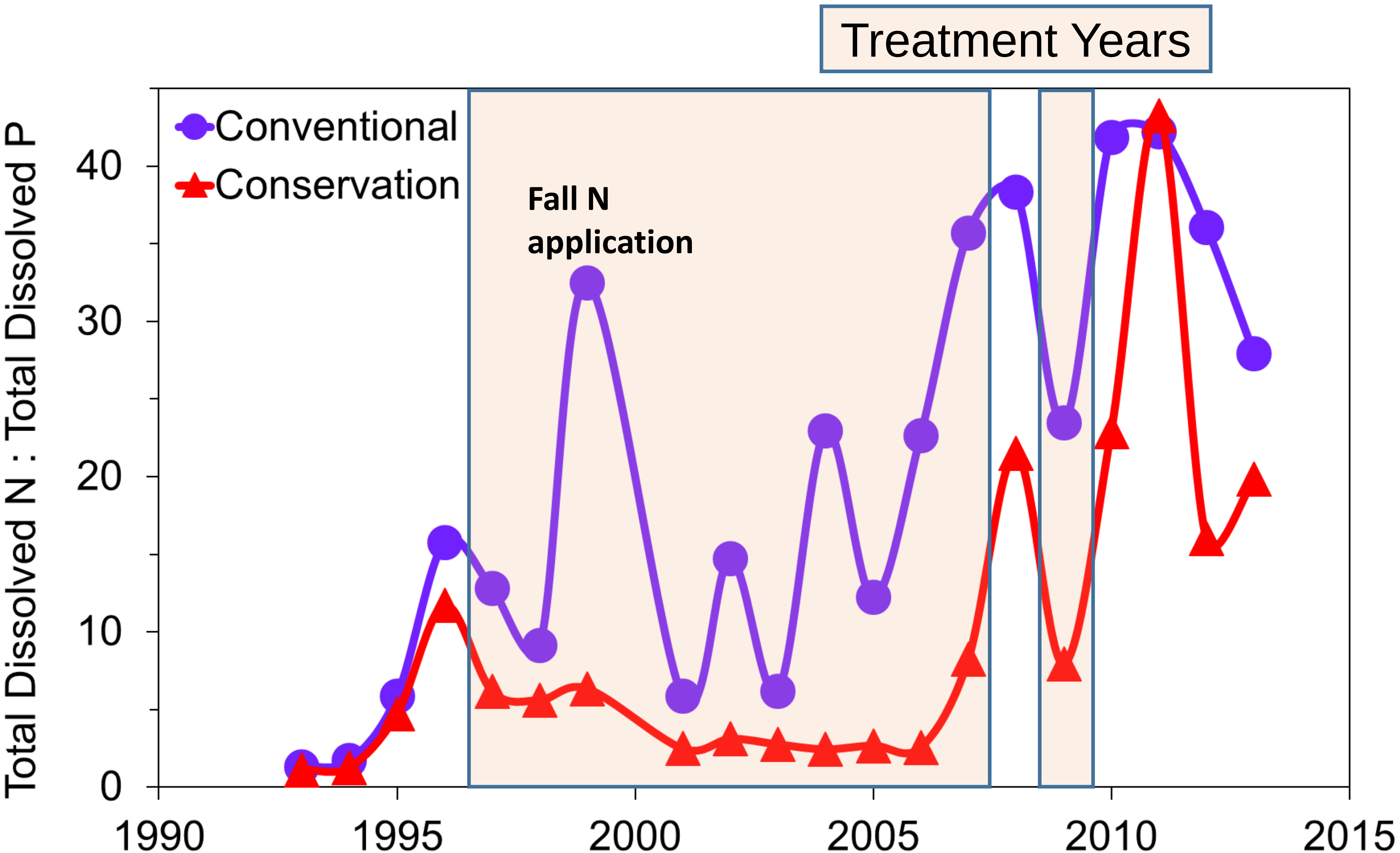




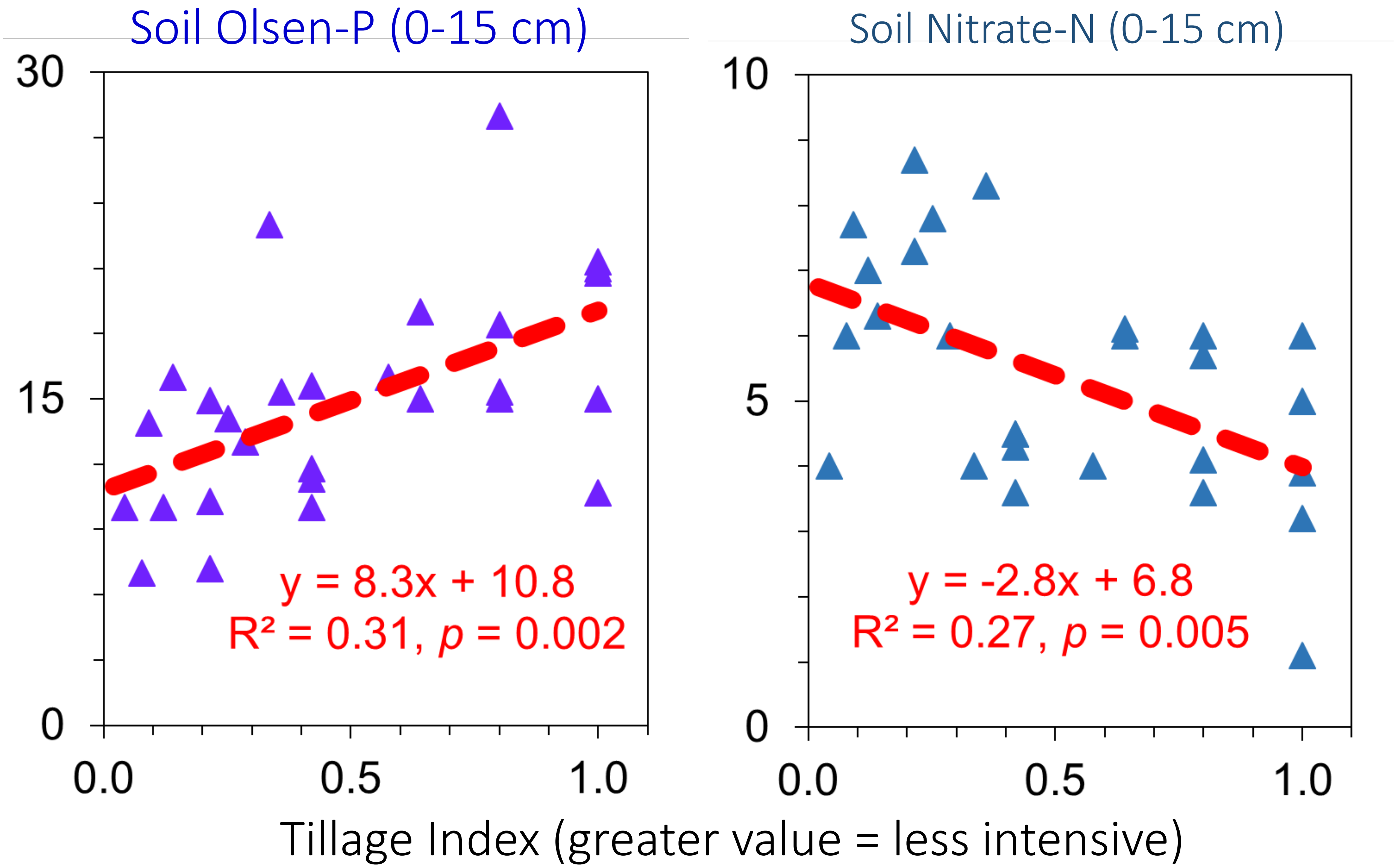
Grain crops



N:P Ratios Increase with More Intensive Tillage

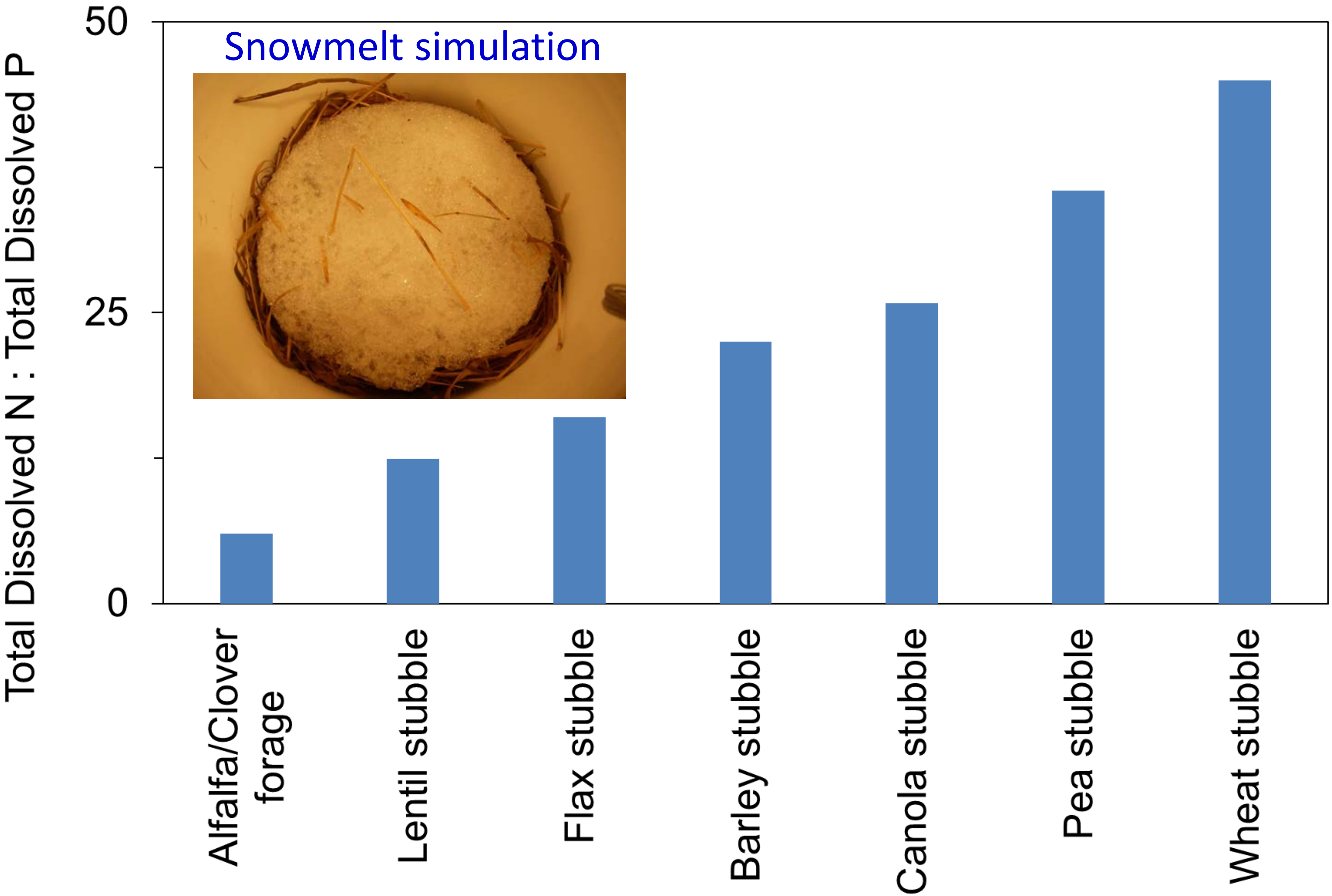


Tillage Affects Nutrient Accumulation in the Surface Soil



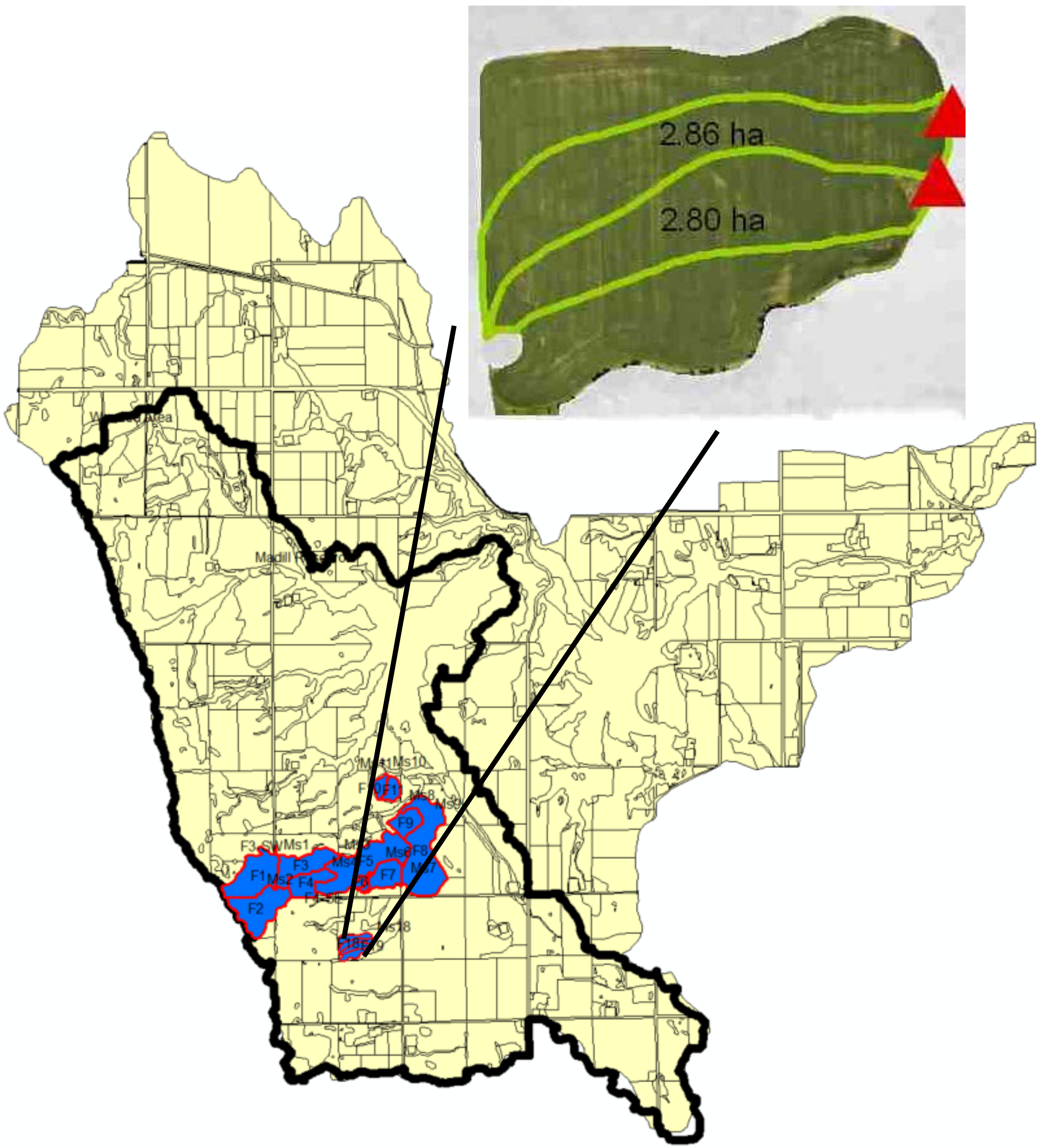
Tillage also affects nutrient losses from crop residues

Crop and Residue Impact on N:P Ratios



(Based on Elliott, Can. J. Soil Sci. (2013) 93: 435-443)

Nutrient Inputs: e.g. Winter Bale Feeding



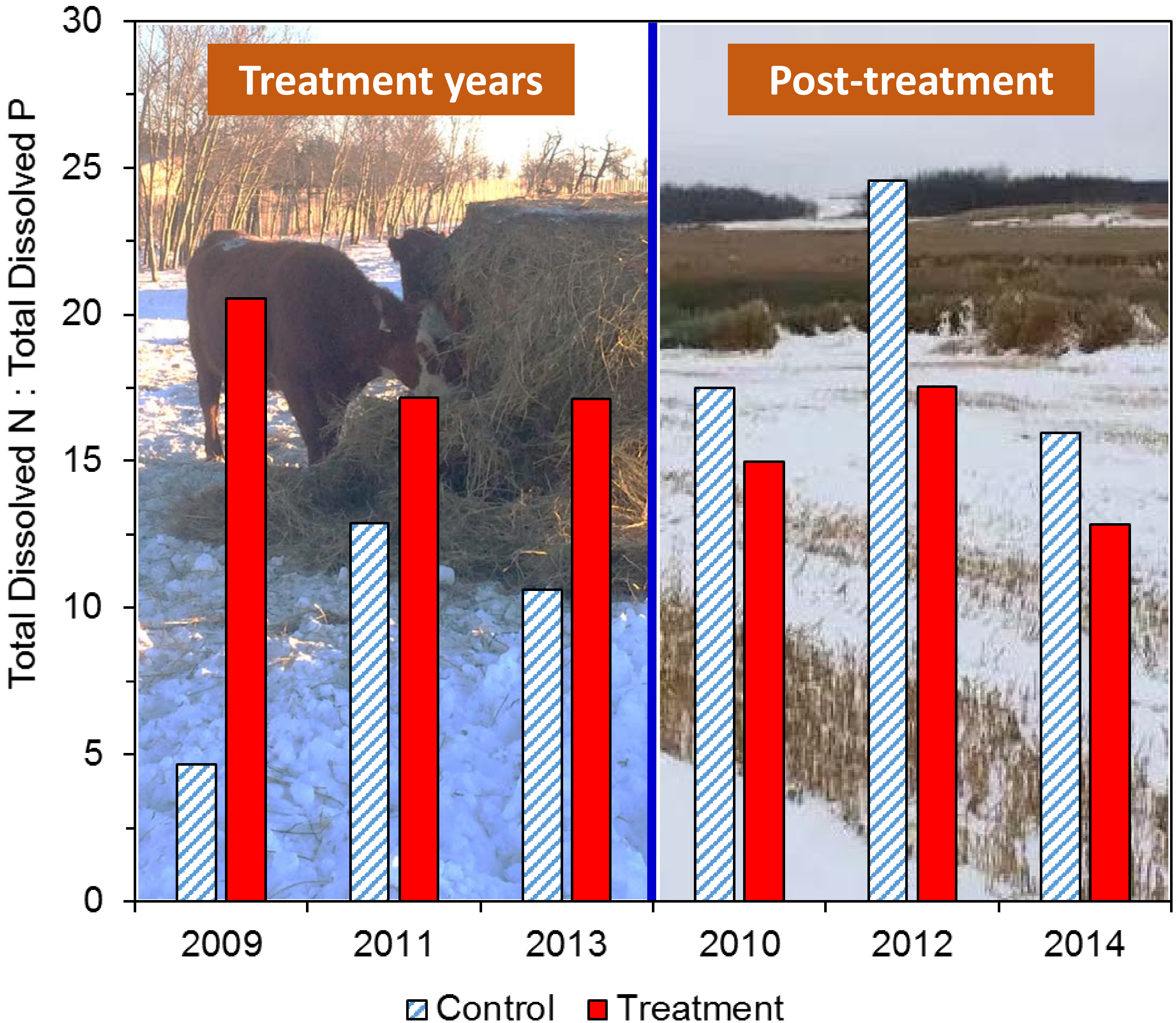
<u>Treatment site:</u>

cl. 60 cows for a month Nov.-Dec. in 2008, 2010, 2012

<u>Control site:</u>

Canola – wheat rotation with no manure 2008-2014

Manure Inputs Shift N:P Ratios



Manure "age" matters

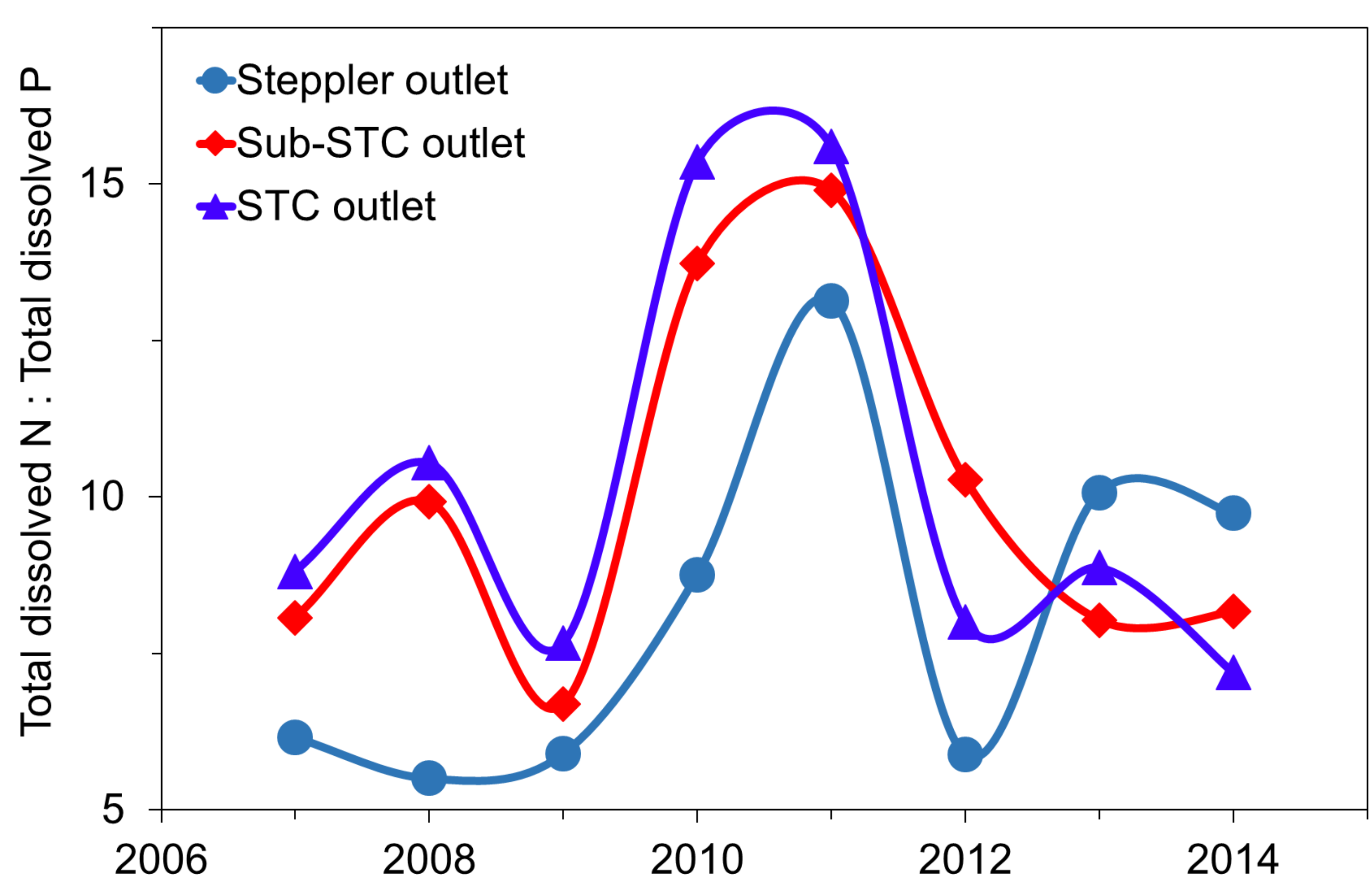
Snowmelt N:P for All Monitored Fields in STC

Multiple Regression Analysis (62 site-years)

Variable	Partial R-Square	Model R-Square	*p* value
Tillage index in fall	0.24	0.24	<.0001
Residue handling	0.06	0.30	0.03
Soil P content	0.05	0.35	0.04
Soil N content	--	--	N.S.
Snow water	--	--	N.S.

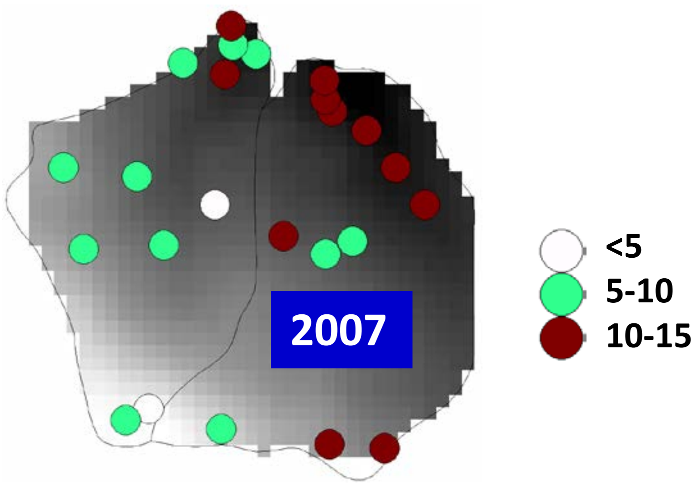
Data-analysis in progress

N:P Ratios in Stream Flow

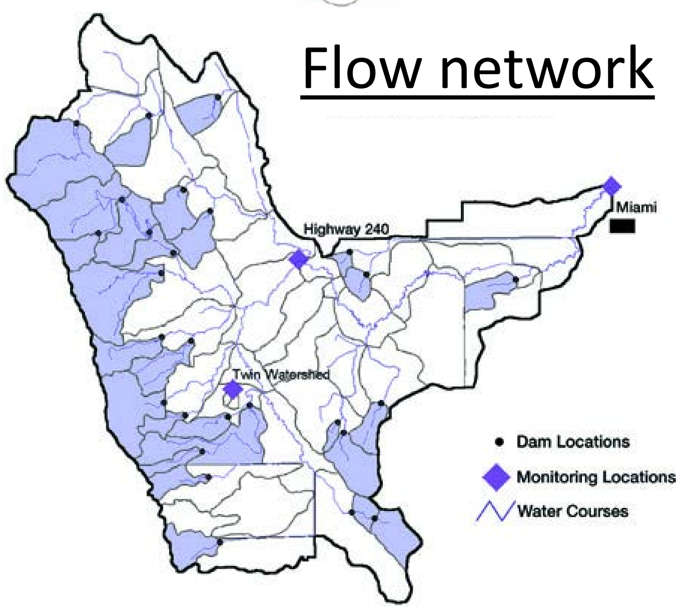


Potential Drivers for Stream N:P Stoichiometry
- Weather and Hydrology

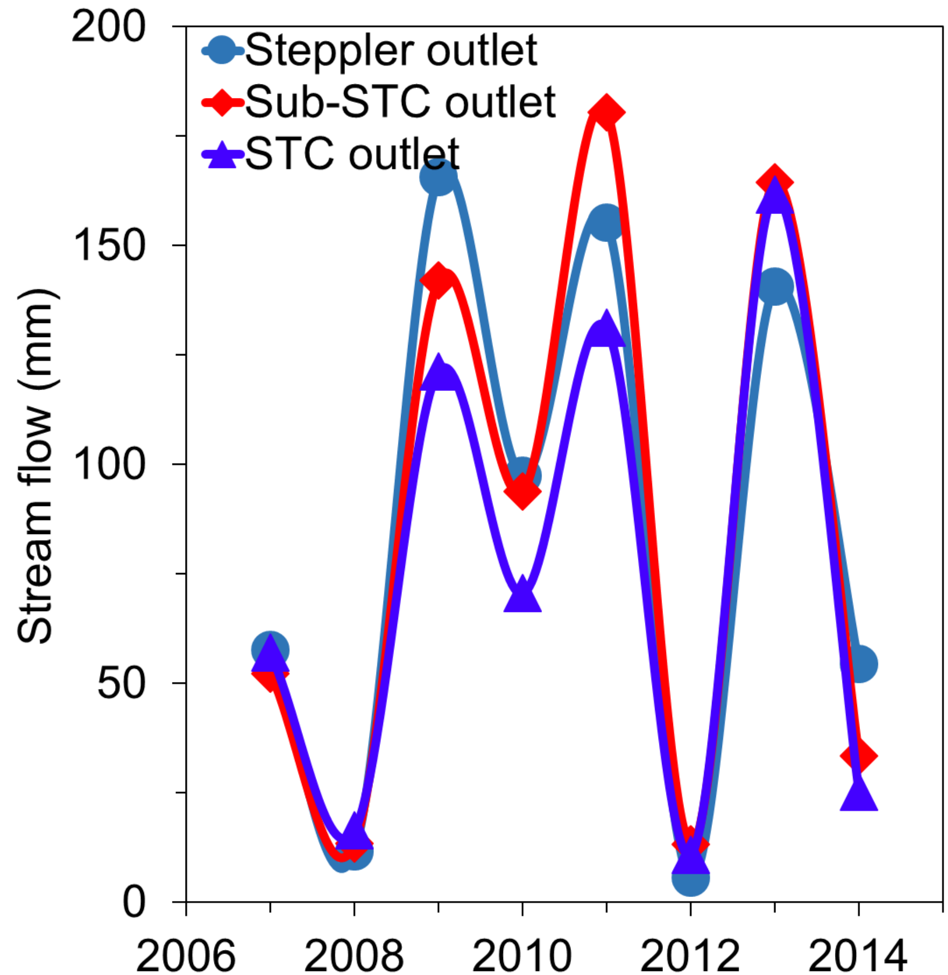
Snow water equivalence (cm)



Flow network



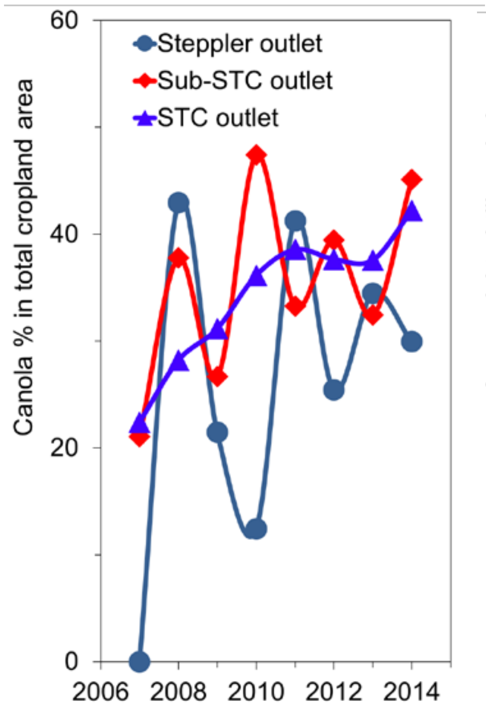
Stream flow



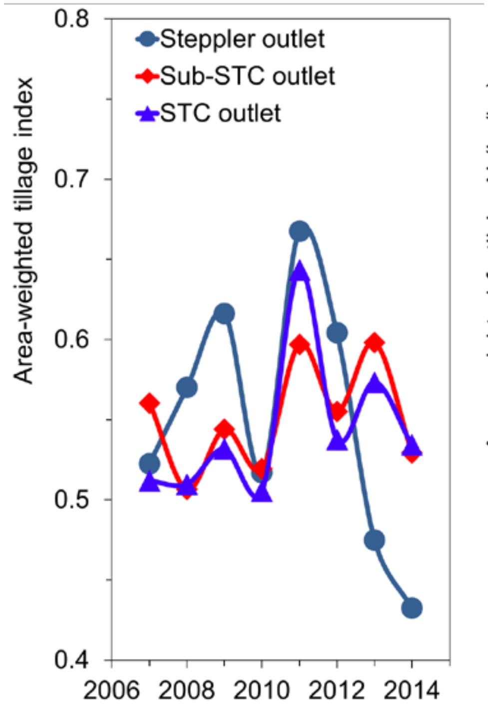
Data-analysis in progress

Potential Drivers for Stream N:P Stoichiometry
- Agricultural Practices

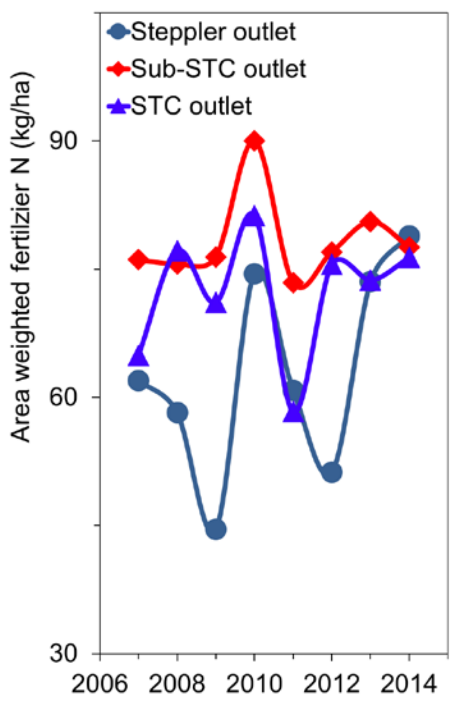
Canola Land (%)



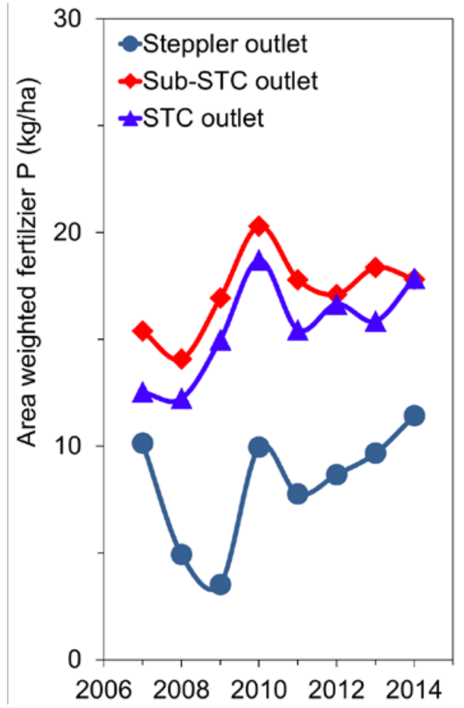
Tillage Index



Fertilizer N (kg/ha)

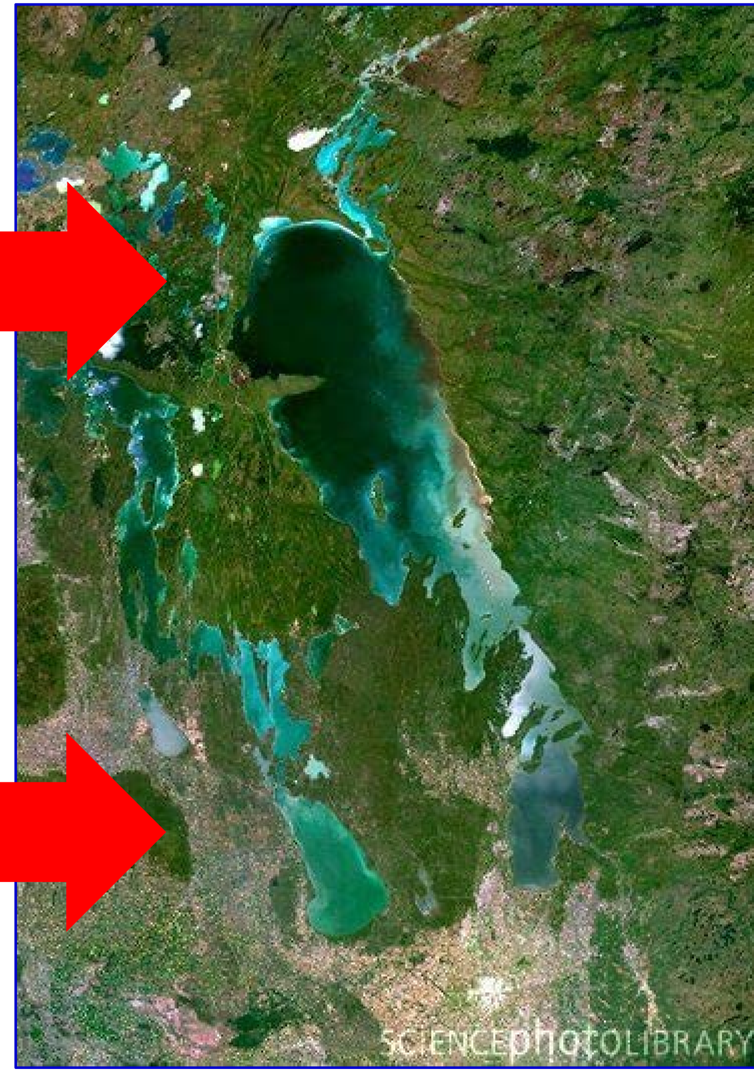


Fertilizer P (kg/ha)

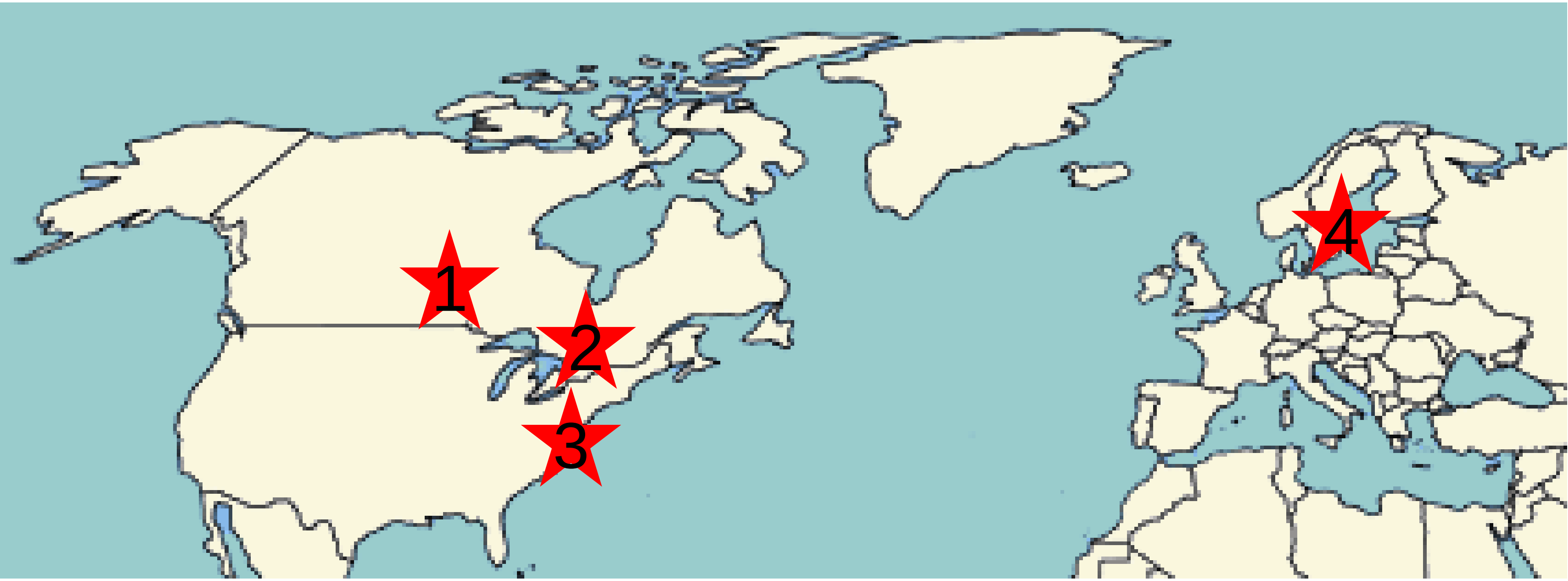


Data-analysis in progress

A Systematic Driver – A Changing World



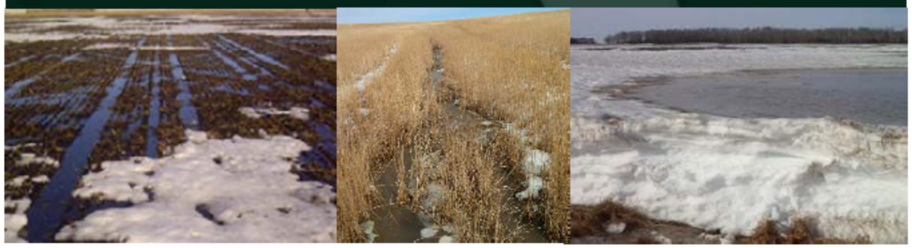
Management Impacts on N:P across Climate Gradients and Geophysical Regions



1. Canadian Prairies (Authors of this presentation)
2. Lake Erie Region (Merrin Macrae, University of Waterloo)
3. Chesapeake Bay Region (Peter Kleinman, USDA – Agricultural Research Service)
4. Baltic Sea Region (Helena Aronsson, Swedish University of Agricultural Sciences)

Invitation to submit to a Special Collection of papers in JEQ: "<u>Agricultural Water Quality under Cold Conditions</u>"

JEQ JOURNAL OF ENVIRONMENTAL QUALITY



<u>Guest Editors:</u>

Dr. Jian Liu (University of Saskatchewan, Canada)

Dr. Helen Baulch (University of Saskatchewan)

Dr. Jane Elliott (Environment Canada)

Dr. Merrin Macrae (University of Waterloo, Canada)

Dr. Henry Wilson (Agriculture and Agri-Food Canada)

<u>Technical Editor:</u> Dr. Peter Kleinman (USDA-ARS)

<u>Invitation to submit short abstracts for consideration before June 30, 2018</u>

We invite authors to provide abstracts of papers they intend to submit for the Special Collection to Dr. Jian Liu (jian.liu@usask.ca) before June 30, 2018. Abstracts must reflect original research related to objectives in Special Section Rationale, below. Submissions should include a list of contributory authors and their affiliations, an appropriate title, and a brief abstract of < 250 words.

<u>Suitable abstracts invited to submit full manuscripts by November 30, 2018</u>

Submitted abstracts will be considered by the Guest Editors and Technical Editor. The corresponding authors will be informed of the suitability of the paper to the Special Collection within two weeks of abstract submission. Those deemed suitable will be invited to submit full manuscripts to the Journal before November 30, 2018 at https://mc.manuscriptcentral.com/jeq. The review process starts at submission, and accepted papers will be published online shortly after acceptance before publication of the full issue. All full manuscript submissions will be subject to the JEQ peer review process. Author instructions can be found at https://dl.sciencesocieties. org/publications /jeq/author-instructions

Special Section Rationale:

Despite the tremendous progress in understanding mechanisms and trends of agricultural water quality and success in implementing mitigation strategies in recent decades, there are still many scientific unknowns with respect to agricultural water quality in regions with cold winters. Under cold conditions, patterns and pathways of nutrient cycling and losses to water are different from those in warmer regimes, due to effects of soil freeze–thaw processes, snow fall and melt, and minimal nutrient uptake and retention by plants. Even within stream networks, transport of nutrients can be influenced by freeze-thaw of sediments, water, and aquatic plants. Correspondingly, special considerations are needed for monitoring, predicting, and remediating water quality under cold conditions.

This special section of papers in JEQ will span the current state of the science on agricultural water quality under cold conditions. In particular, we expect submissions that can enhance our knowledge of water quality trends and controlling mechanisms at various temporal and spatial scales, and development and application of monitoring and prediction approaches as well as mitigation strategies, in the context of cold conditions.

Example contributions include:

- Processes influencing agricultural water quality under cold conditions
- Nutrient cycling in the plant-soil-water continuum under cold conditions
- Patterns and pathways of nutrient transport under cold conditions
- Approaches to monitoring and predicting agricultural water quality under cold conditions
- Beneficial management practices for agricultural water quality under cold conditions
- Climate change impacts on agricultural water quality under cold conditions, and adaptive mitigation strategies

Thank You for Your Attention!

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