Wetlands

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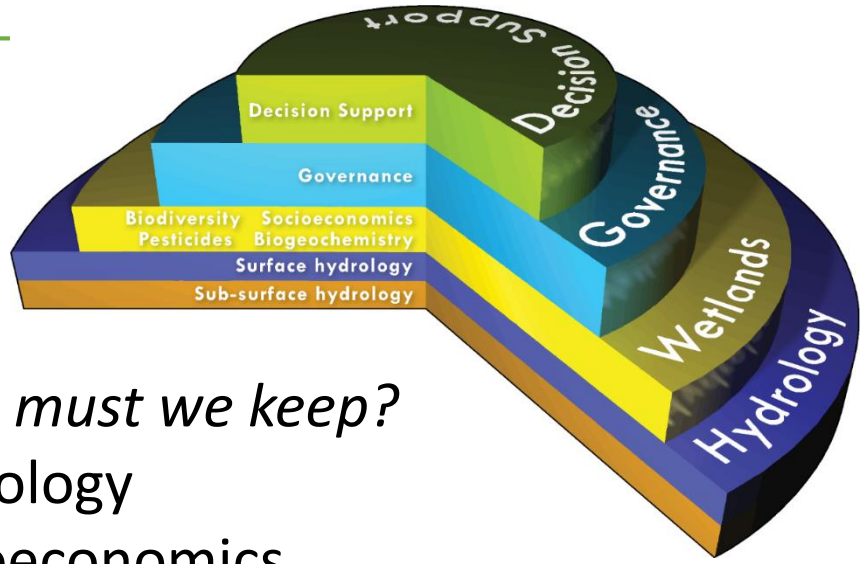
++….

Questions and Challenges

Questions

How do climate, land use, and socio-economics interact to affect wetland function and management?



Objectives

Improve understanding of

- Wetland ecosystem services
- Vulnerability
- & factors affecting conservation & decision making

What wetlands must we keep?

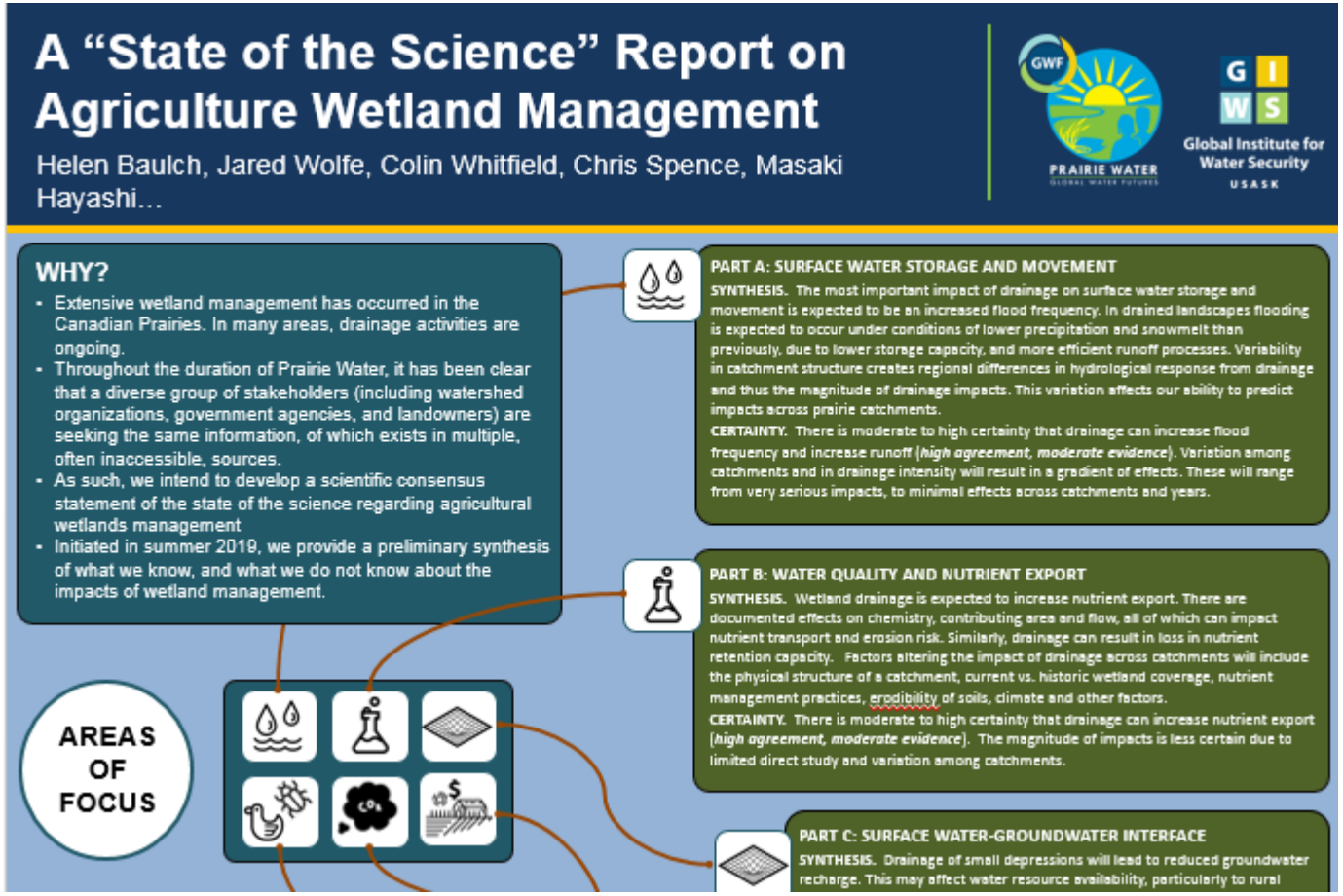
- Hydrology
- Socioeconomics
- Biogeochemistry (nutrients)
- Biodiversity
  - pesticides, habitat

Objectives & Progress

- What wetlands must we keep?

  Throughout the project, the theme has been emerging that we (all of us) need to be on the same page about what we know regarding wetland ecosystem services, costs, and management.

  2019, we initiated a consensus statement.



Progress - socioeconomics

Understanding how the variability in land value can be used to understand drainage-related decisions

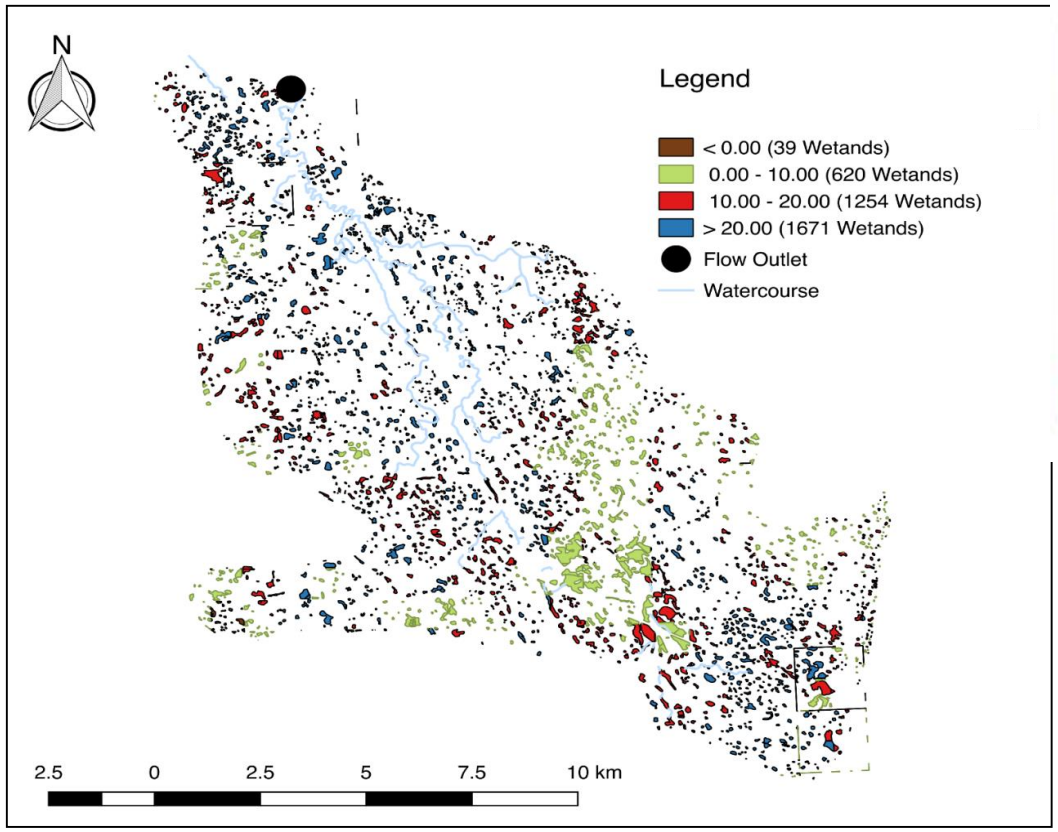
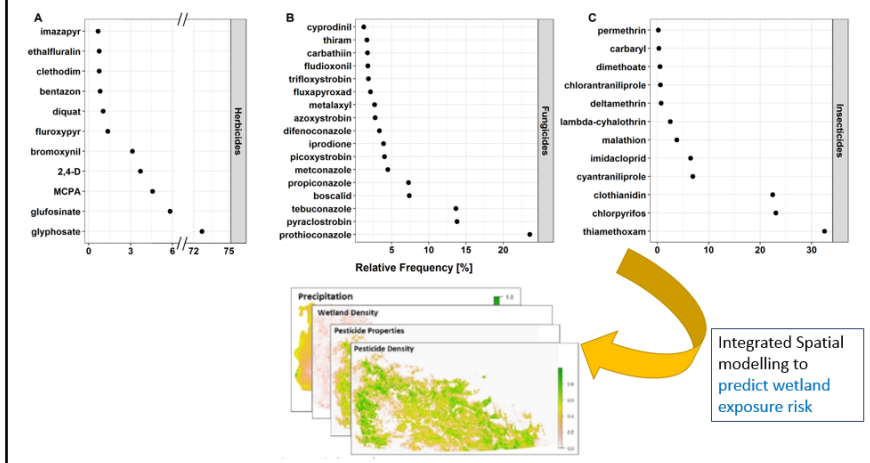


Figure 1. Spatial Heterogeneity in Present Value Net Revenues from Annual Crop Production from Drained Wetlands -- *$/Acre*

There is high spatial variability in the revenues that might be gained by producers from wetland drainage

Progress - pesticide exposure risk

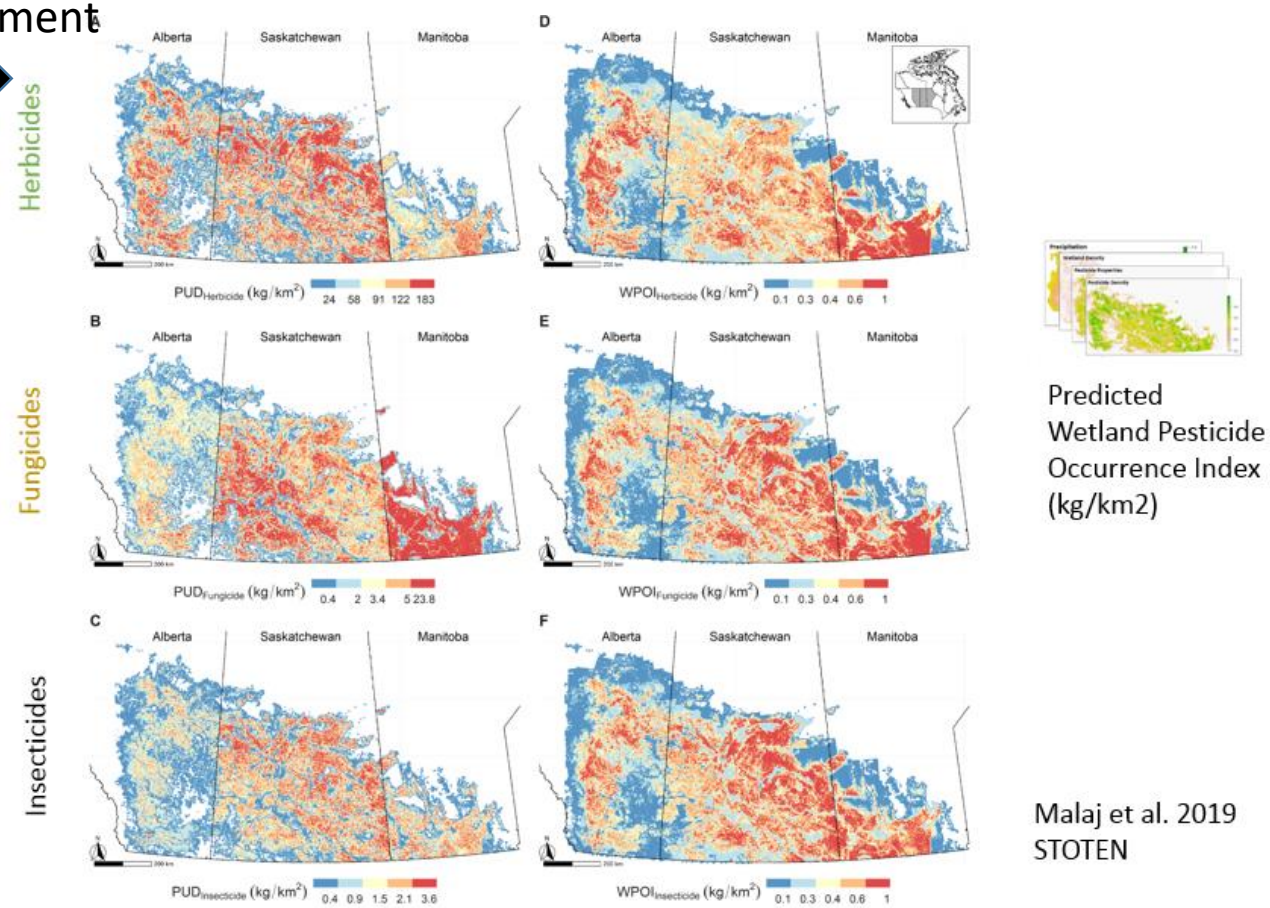
Pesticide Use in the Prairie region



Integrated Spatial modelling to predict wetland exposure risk

Model development

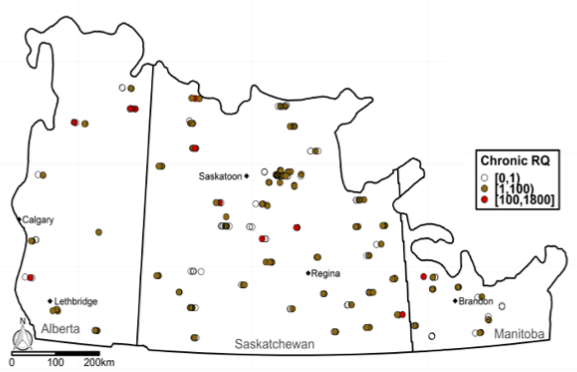
Spatial Pesticide Use Density (kg/km2)

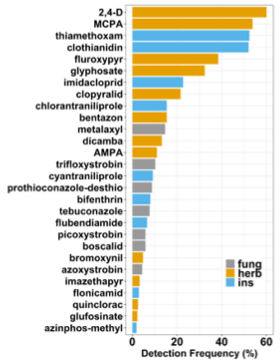


Predicted Wetland Pesticide Occurrence Index (kg/km2)

Malaj et al. 2019 STOTEN

Pesticide Monitoring in the Prairies (2018-19)

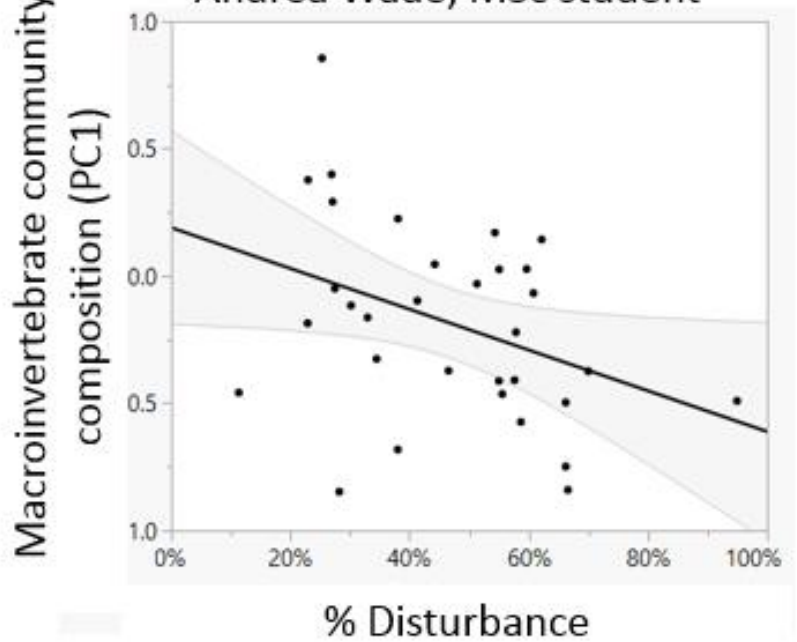




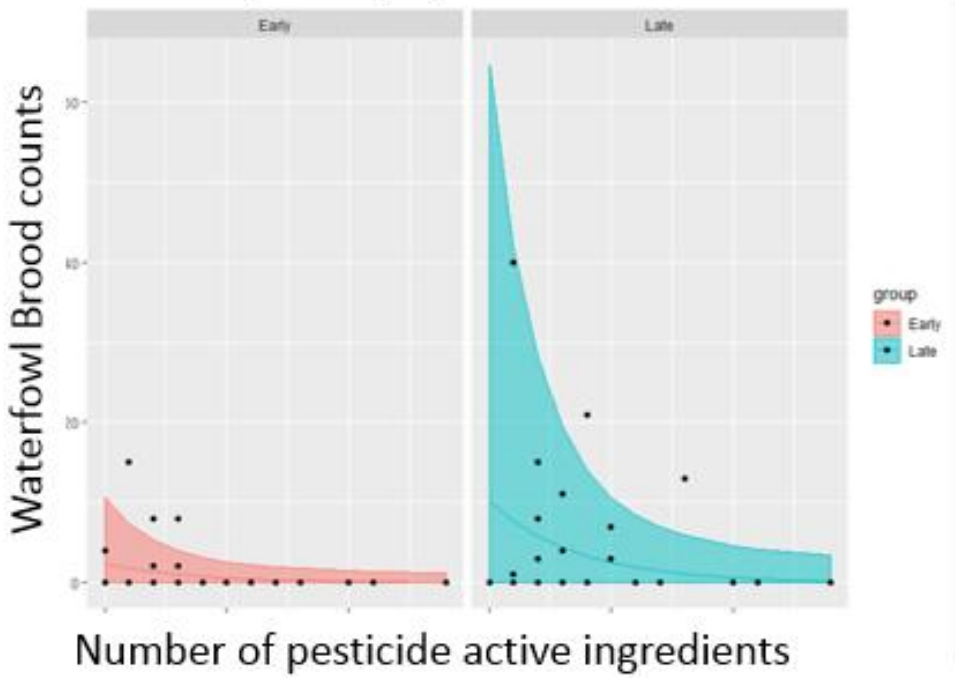
Model validation

Progress – pesticide vulnerability

Andrea Wade, MSc student



Tyler Bryan, MSc student

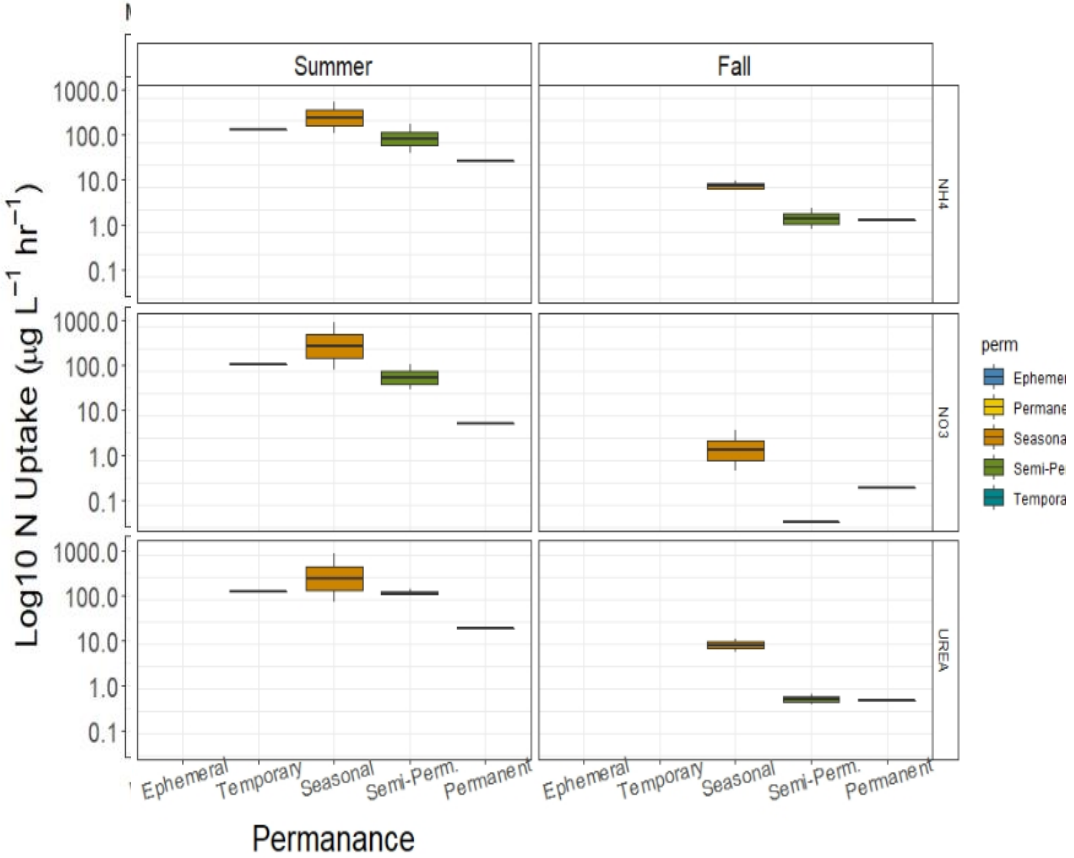


Invertebrate (left) and duck (right) communities respond negatively to water quality issues and wetland disturbance

Progress – nutrient retention behaviour

What wetlands must we keep…?

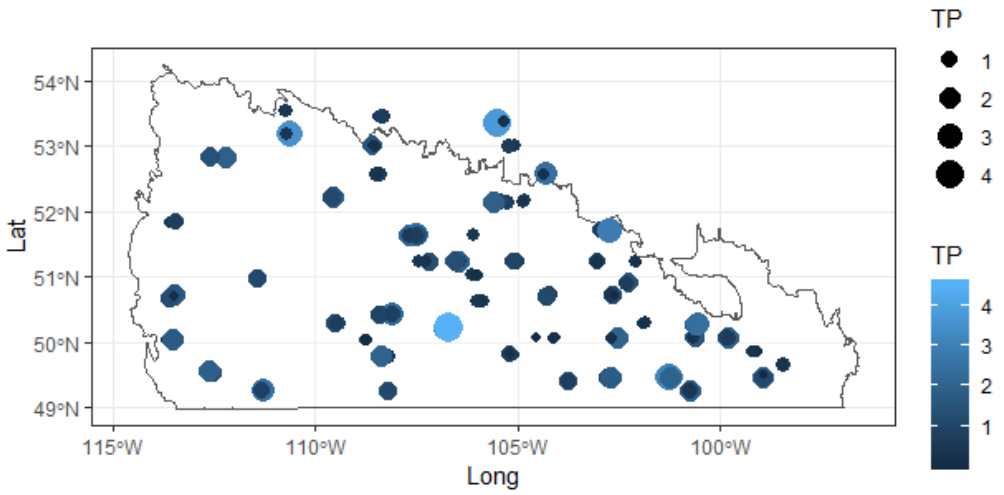
Process measurements



Very fast transformations

Higher nitrogen uptake in less permanent wetlands

Spatial surveys (breadth of conditions)

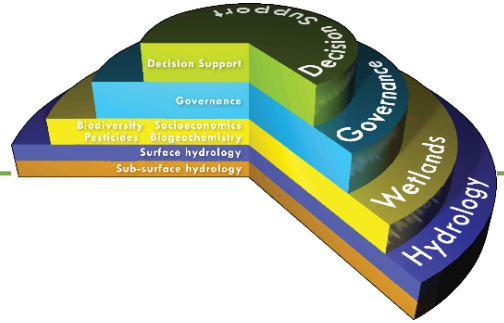


There is high variability among wetlands

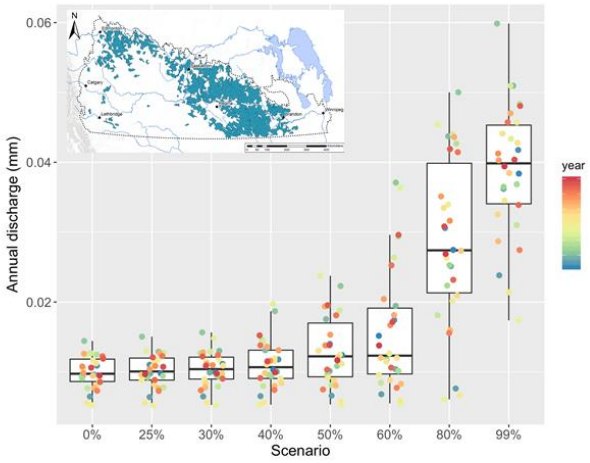
Wetlands are extremely important hotspots of nutrient cycling, and they can be important to nutrient retention

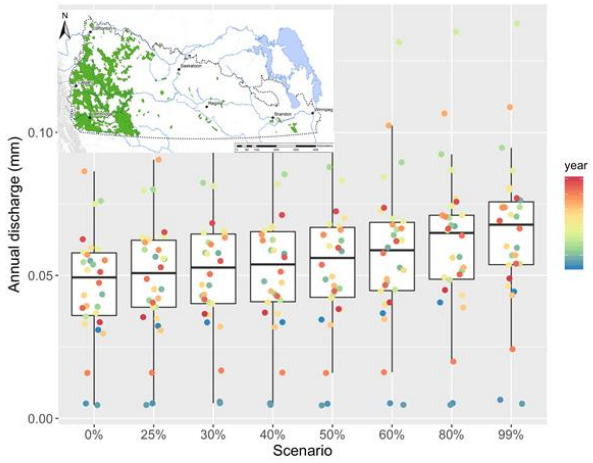
Using process understanding at different scales in development of wetland (pond) model

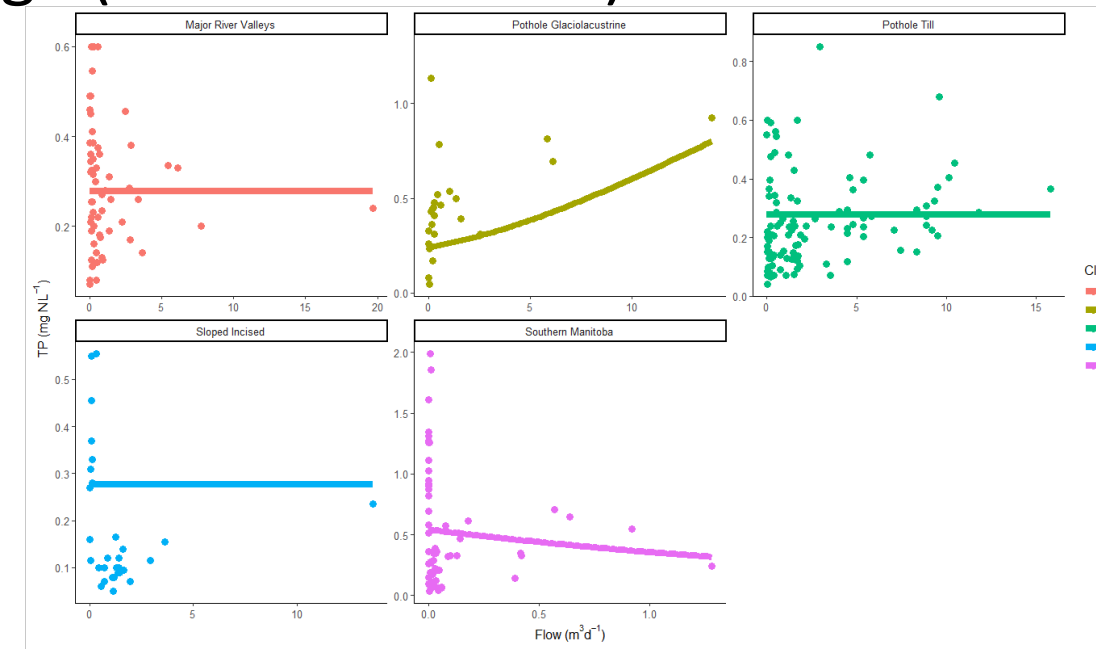
Moving on to integration….



- What wetlands must we keep?
- What are the consequences of drainage (on nutrient load)?



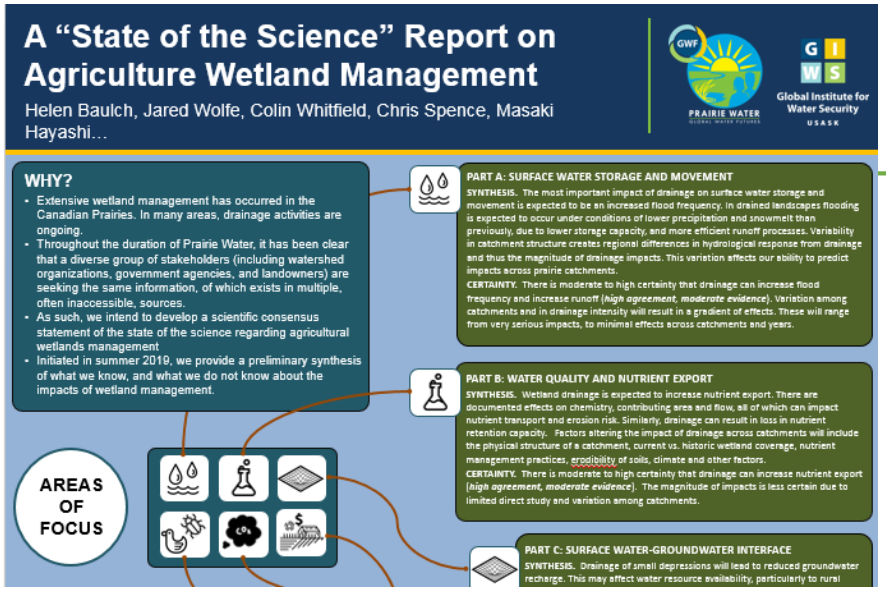


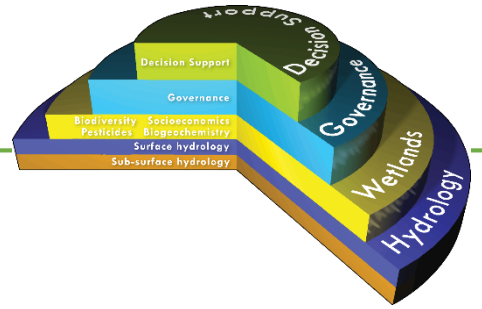


Flow changes will be key factor governing changes in nutrient loads

Changes in nutrients will be ~proportional to flows

In some cases nutrient export may be amplified under higher flow



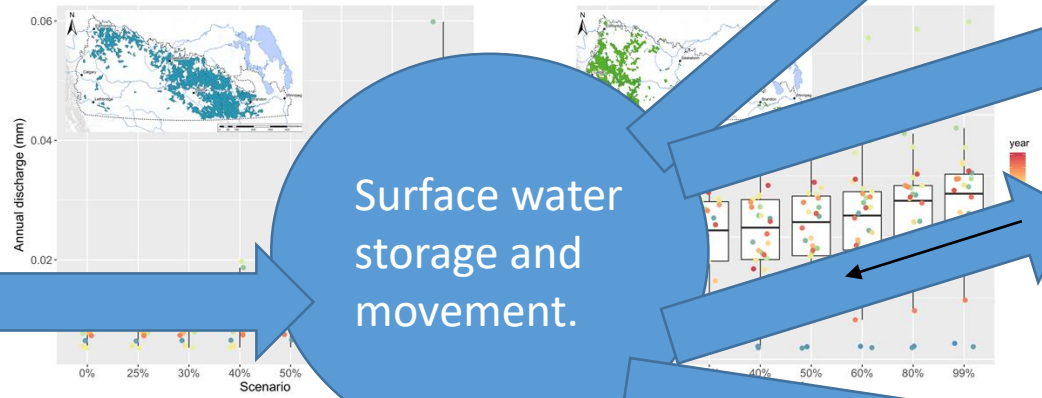


Economics

Water quality

Biodiversity

Economics



Surface water storage and movement.

Surface water-groundwater interaction

Carbon storage & GHGs

Wetland / Waste land

- Prairie drainage governance…
- https://www.youtube.com/watch?v=-ut3x-wGyuQ

Wetlands Crystallization

Data & methods

- Field data from pan-prairie wetland survey
- Proprietary dataset, including pesticide sales and land values, GIS & modelling
- Rate measurements of key processes, spatial modelling & mapping
- Synthesis of water quality monitoring stations
- Model integration to evaluate land use and climate impacts (hydrology to chemistry, economics and biodiversity)

Result

- Herbicide and neonic concentrations found in surveyed wetlands, with observed impact to wetland bugs and birds
- Nutrient concentrations in wetlands are heterogeneous, differing widely across the prairies. Experiments reiterate that wetlands serve important biogeochemical function.
- Established a process to identify the net-present value of a wetland to a producer & support conservation policy informed by landscape heterogeneity.

Uncertainty

- Pesticide and nutrient modelling in the process of calibration
- Difficult to capture space and time variability, and watershed-specific findings would require more detailed analysis
- Social costs of wetland removal to be determined in coming phase.