Changes in water levels and linkages to wetland shrub growth over time in Alberta, Canada

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1. **Rationale and Objectives**
2. **Study area and data**
3. **Results**
4. **Take home messages**

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Rationale

- Increased aridity over last 40 years within the Boreal Plains ecozone

- PET > P every 10-12 years: changing climate patterns, greater periodicity of PET>P increase ecosystem sensitivity to drying

- Boreal Plains → oil/gas extraction, forestry; wildfire (partial burning of town & city in past)

- Possible water security issues
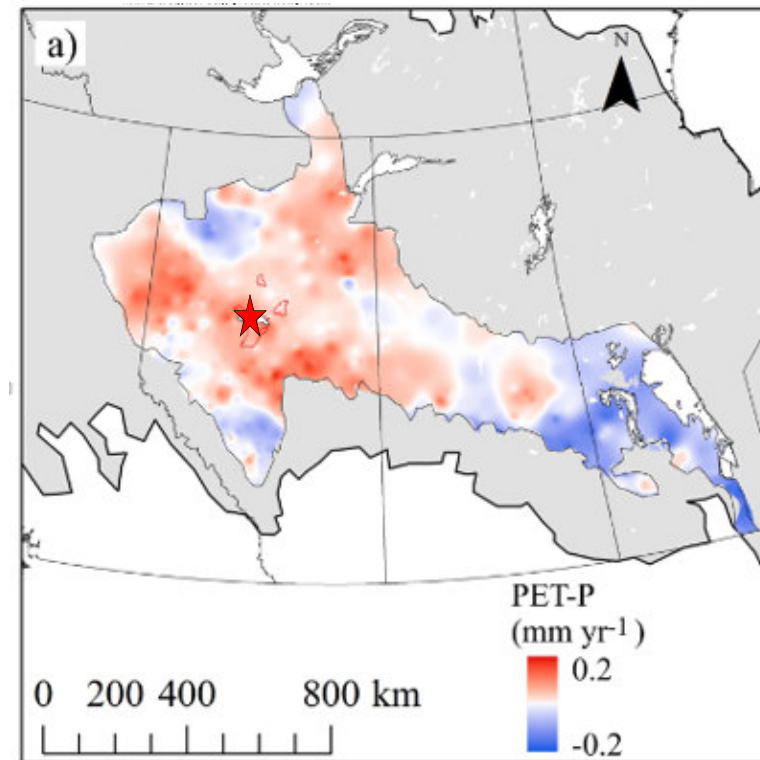
Objectives

1. Quantify spatial variability of shrub growth and loss over the region using multi-temporal LiDAR data (**2002, 2008,** 2011, 2015, **2016**)

2. Links between ground water and temporal change in vegetation growth at 3 pond sites during annual wet-dry regimes
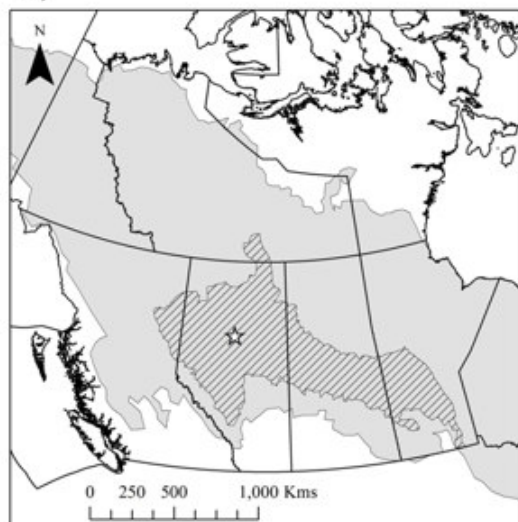

Pond 43 Dry period 2002

Pond 43 Dry period 2002

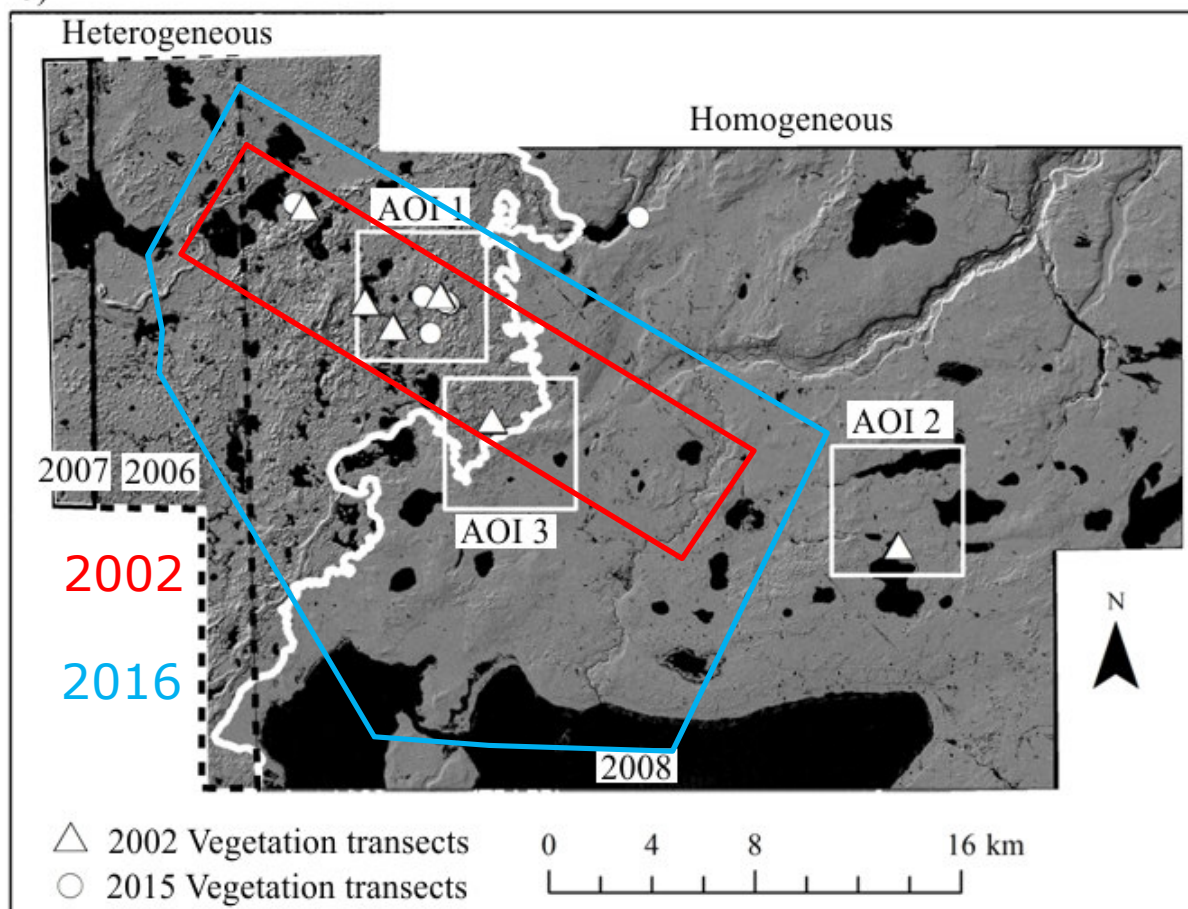Pond 43 Wet period 2008

Study Area and Data Collection

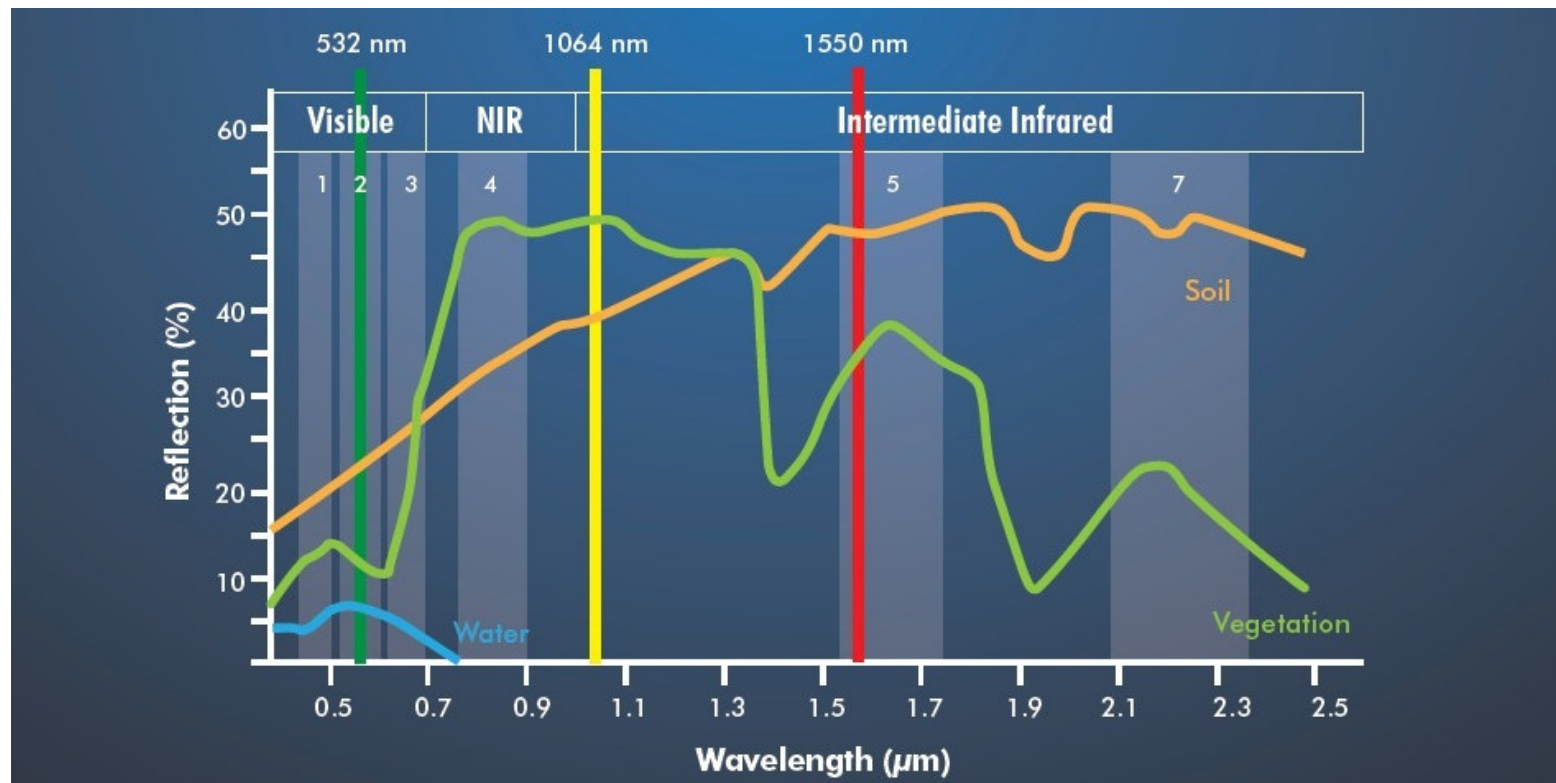University of Lethbridge: Airborne LiDAR data collections: 2002, 2008, 2016 (multi-spectral, bathymetric)

Multi-spectral, Bathymetric LiDAR data overview

2 lasers, 3 wavelength returns = fully 3D multi-spectral + bathymetry (2002, 2008, **2016**) → multi-spectral species, understory characterisation, wildfire
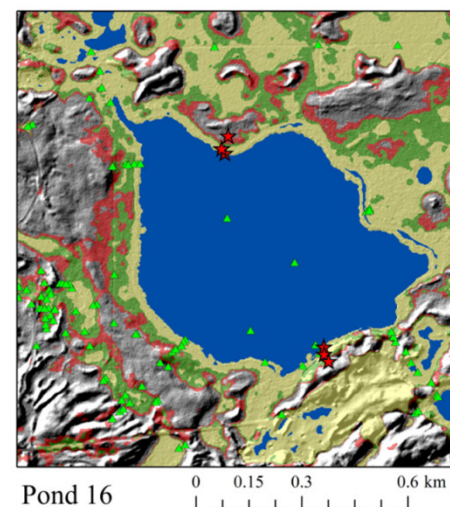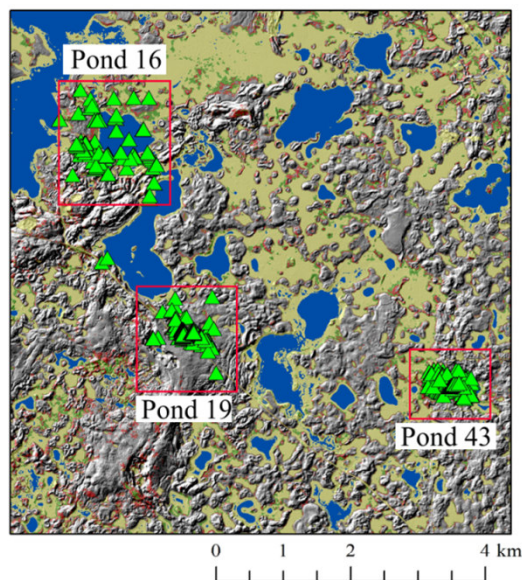

BUT for comparison: Use only 1064 nm

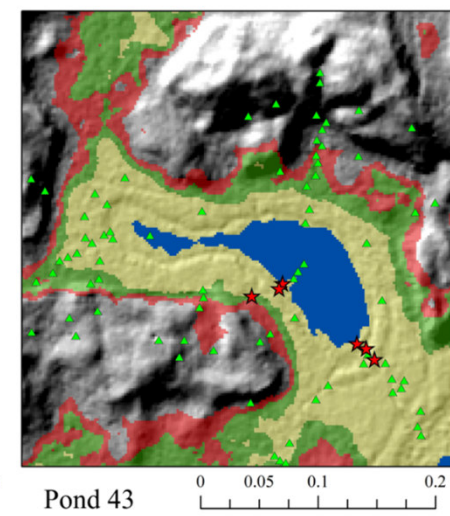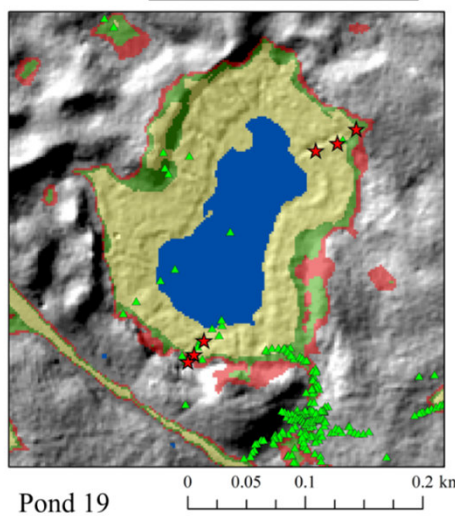# 15 + years of Piezometer Well Transect/Point Data

University of Alberta well data 1999/2000 to present:

Devito et al. (2005)
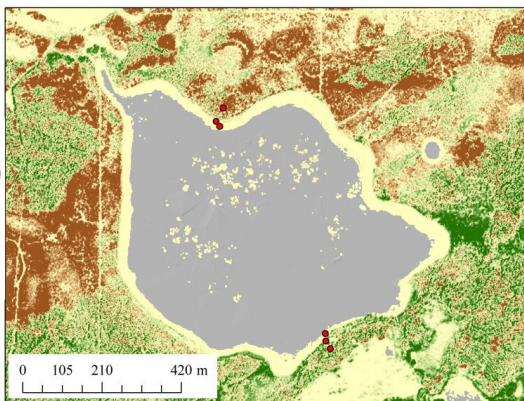Thompson et al. (2015)
Hokanson et al. (2016)

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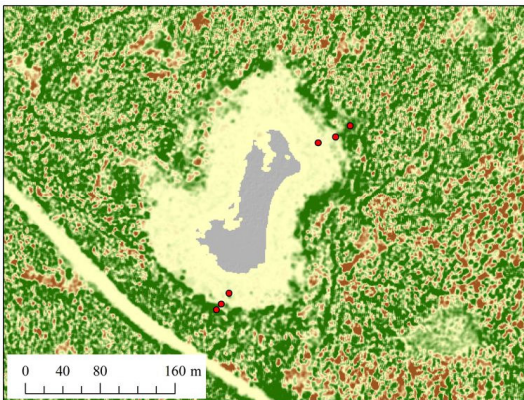
Results: Variability of riparian/wetland change 16-02
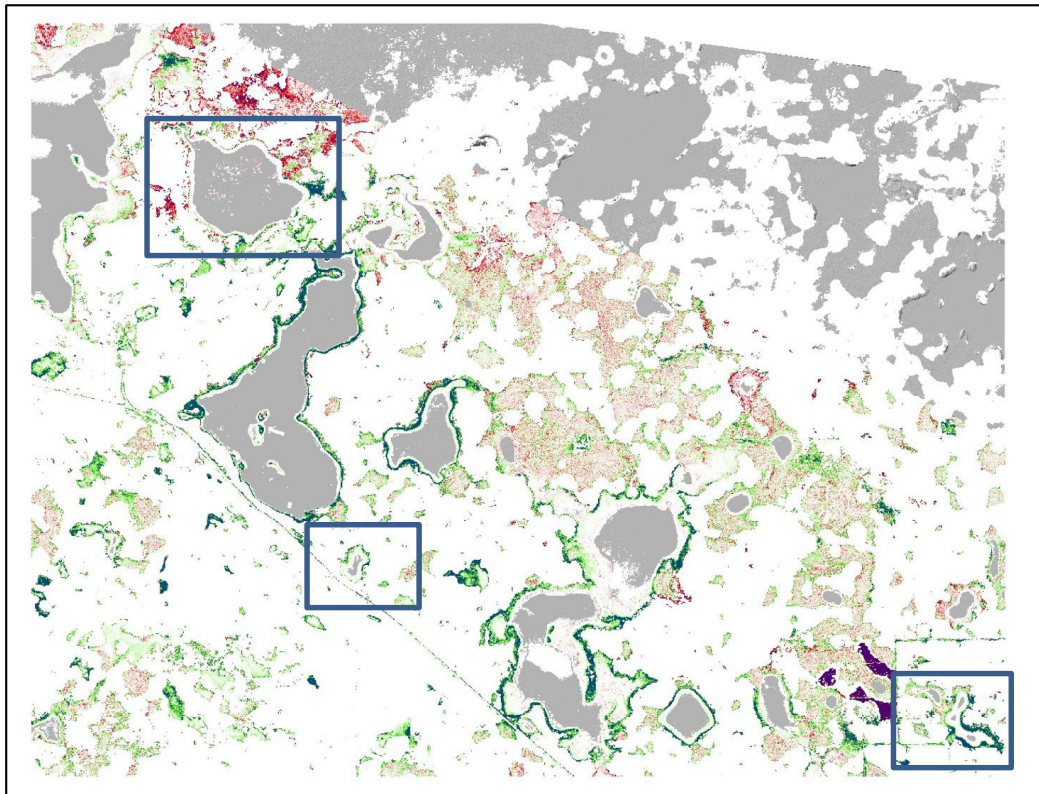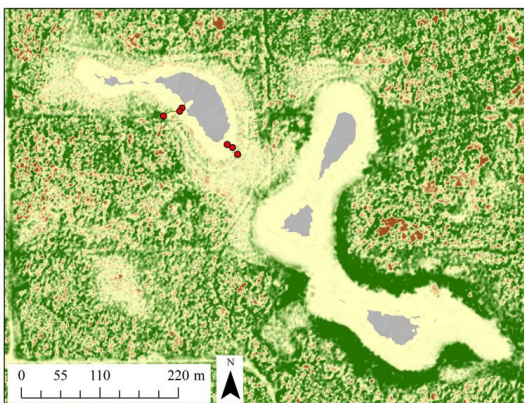
Pond 16

Height change
2016 - 2002 (m)
+5
-5

Pond 19

Pond 43

☐ Upland mixedwood

N

0   600   1,200   2,400 m

Wetland/riparian
Vegetation change

+4m
-4m

Hypothesis:

Drying, changing water levels adjacent to till moraine uplands + high AET from mixedwood forests → Greater shrubification

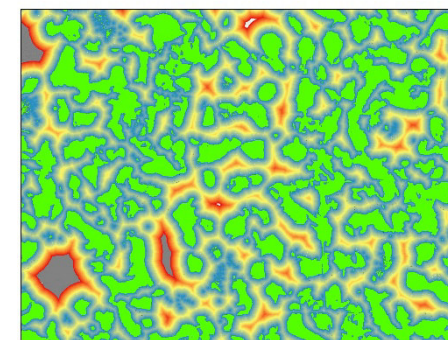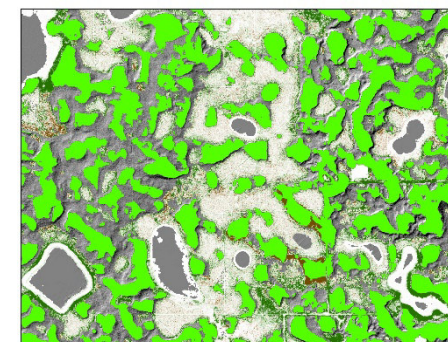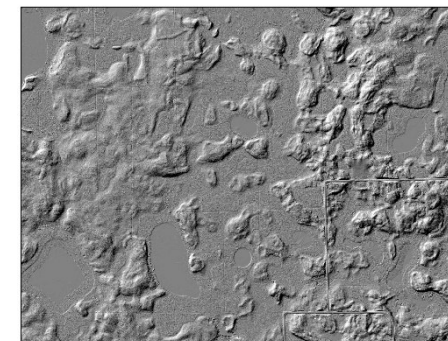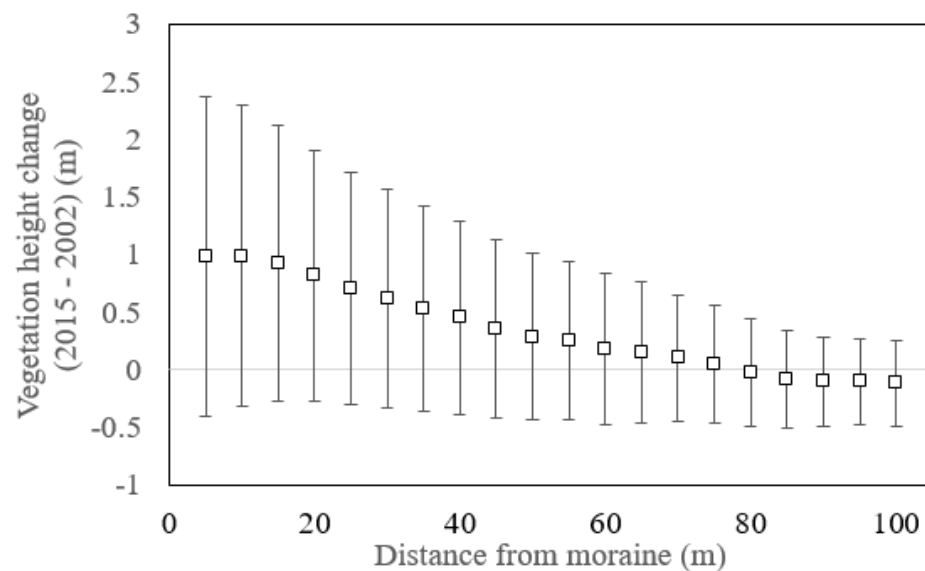Will not be observed within water transporting poor fen land cover types

Results: Veg Changes per land cover type, proximity

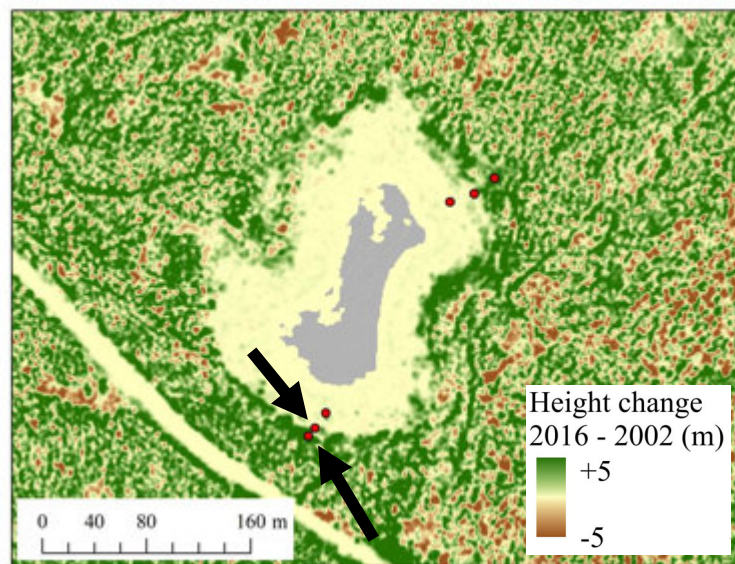Change in vegetation height (13 years) per land cover type:

Land Cover Type	Ave. change (m)	Standard deviation (m)
Upland mixedwood forest	1.97	3.0
Riparian	0.78	2.37
Rich fen	0.60	1.87
Poor fen/bog	0.19	1.31

Results: Vegetation change and water table

Pond 16 veg change 2016 – 2002

Height change 2016 - 2002 (m)
+5
-5

0 40 80 160 m
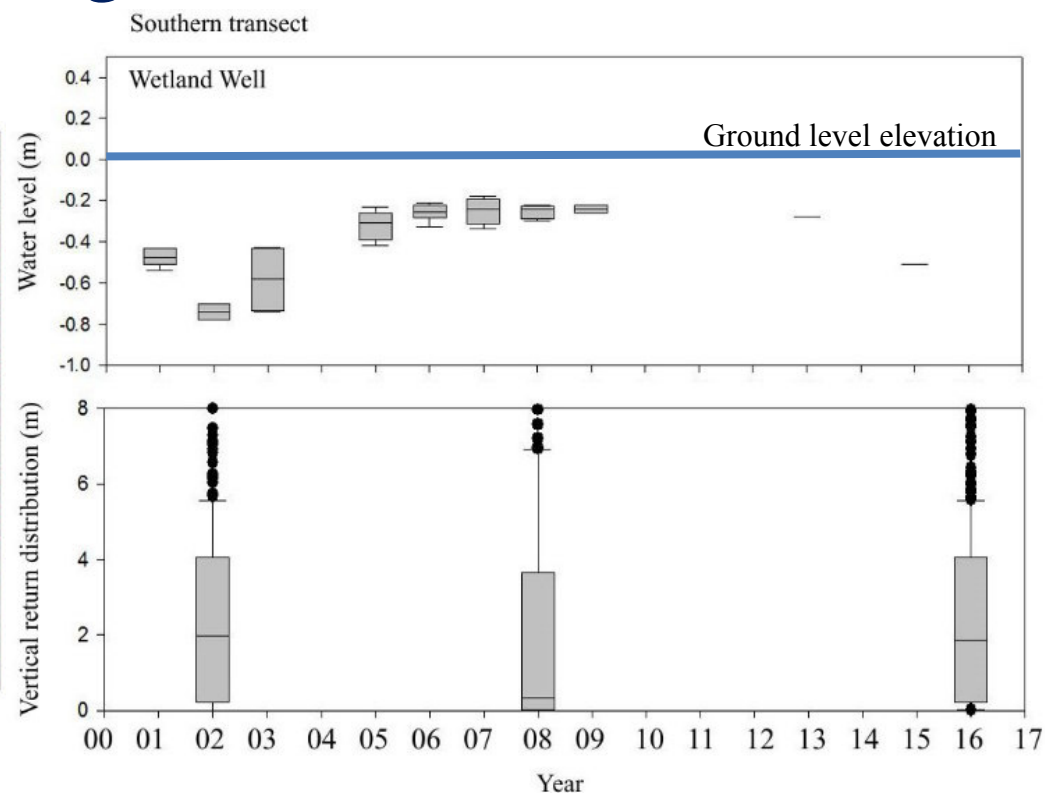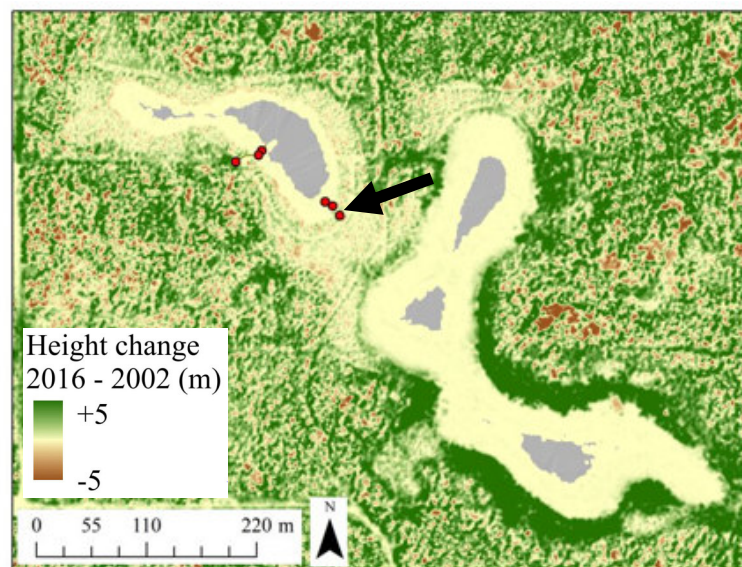
Dry to wet period → shrub initiation by 2008, adjacent to till moraine

Wet to dry period, significant shrubification 2008 - 2016

Southern transect

Wetland well

Water level (m)

Ground level elevation

Dry   Wet period   Dry

Riparian well

Water level (m)

Ground level elevation

Riparian point cloud distribution

LiDAR point cloud surrounding well (5 m radius)

Vertical return distribution (m)

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

Year
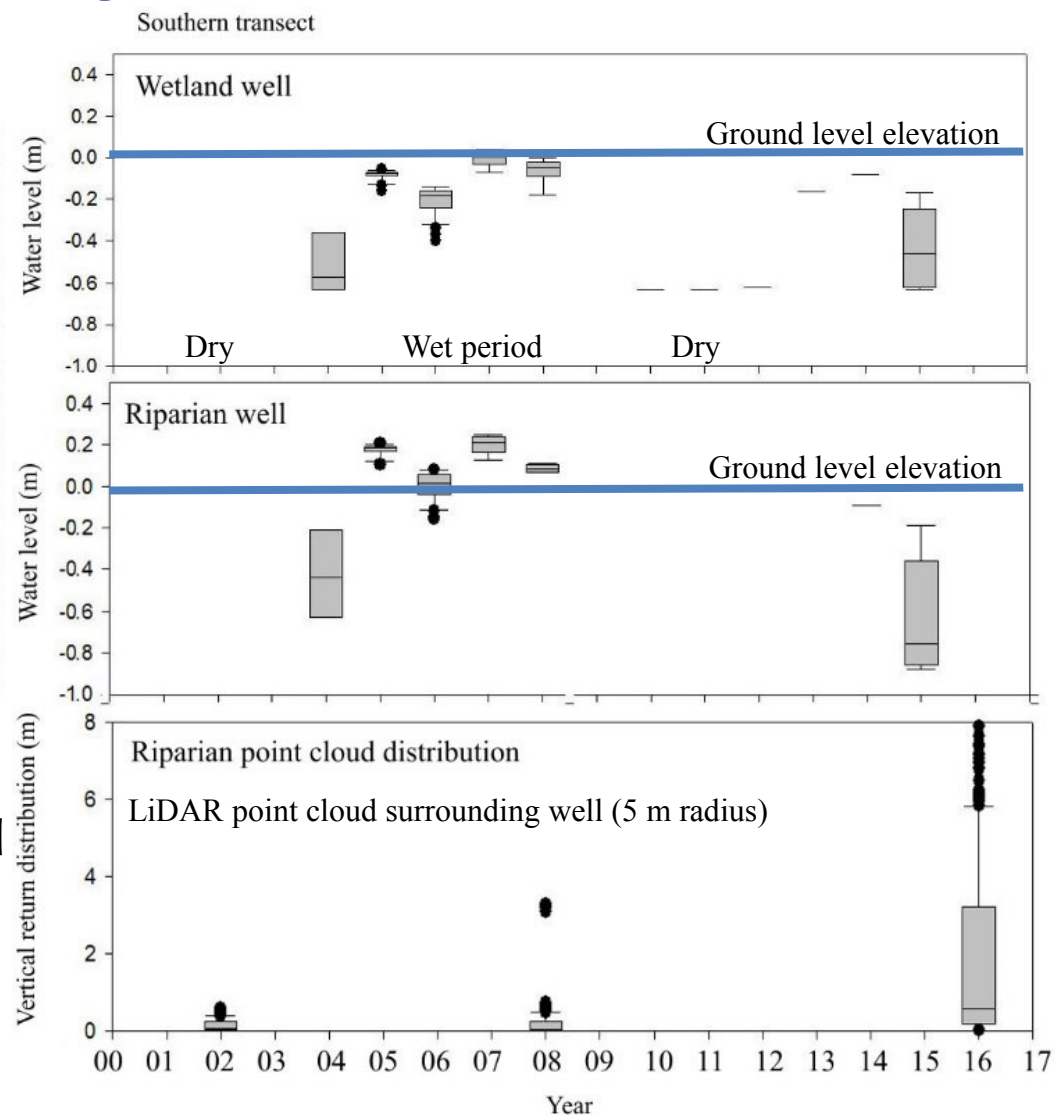
# *Results: Vegetation change and water table*

Pond 43

Low relief (high water table) → no significant shrubification of adjacent wetlands

Take Home Messages:

1. Repeated measures (RM) ANOVA:

All well sites adjacent to or within **wetlands** = no significant difference in vegetation change: 2002, 2008, 2016

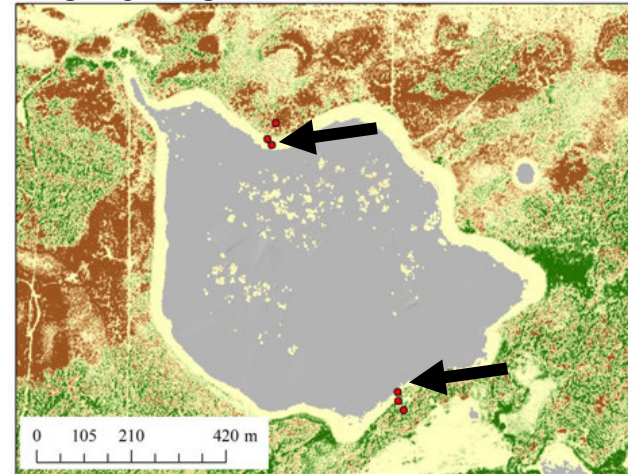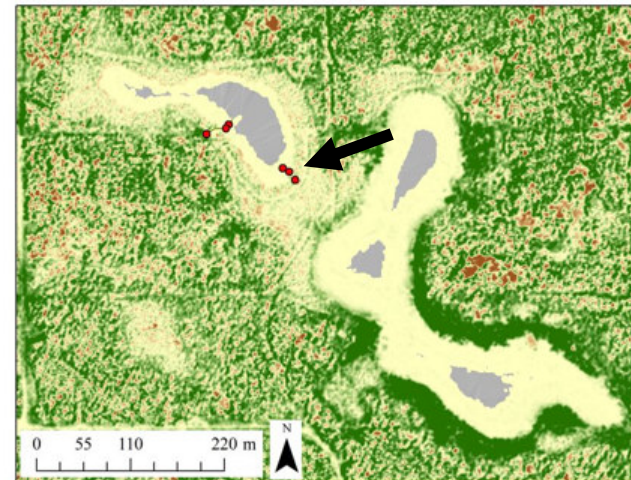(2 of 3 sites, pond 16; 3 of 3 sites, pond 43)

Pond 16
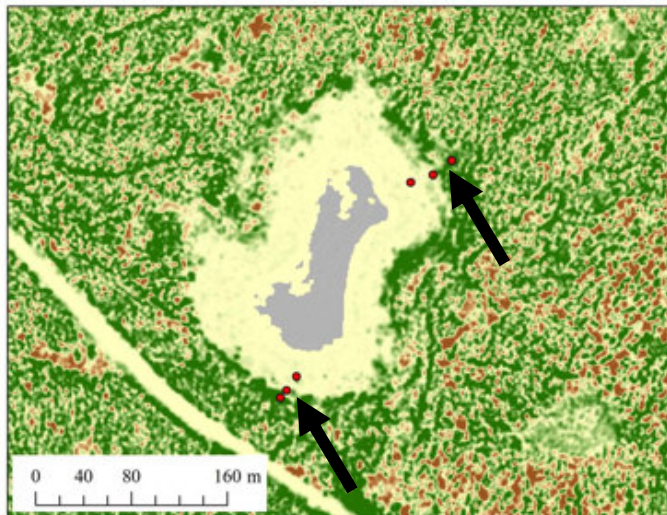

Pond 43

Height change
2016 - 2002 (m)

+5

-5
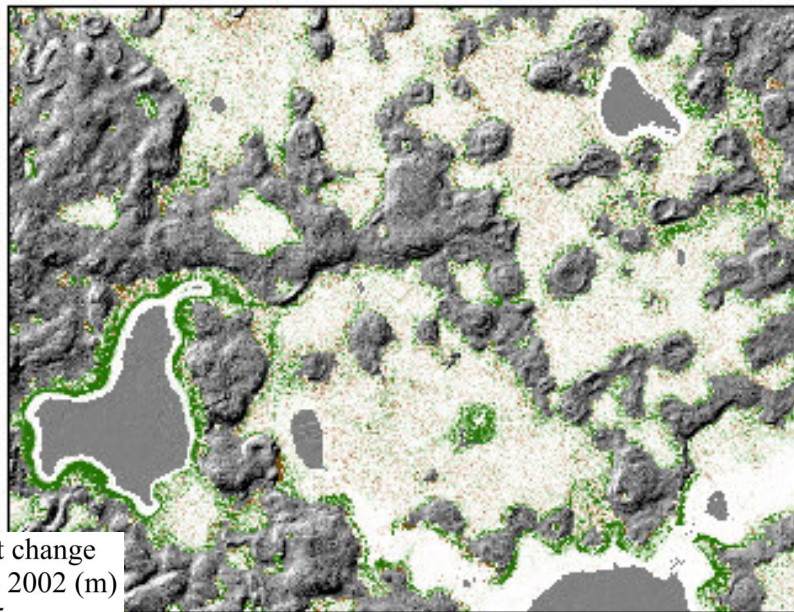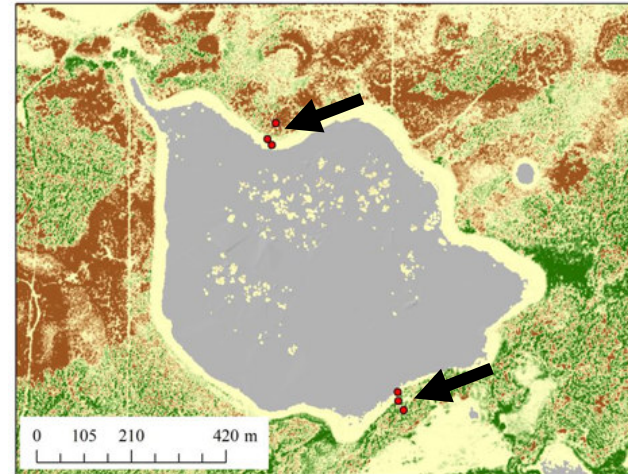
Take Home Messages:

2. Repeated measures (RM) ANOVA:

All well sites within **Riparian adjacent to till moraine** = significant difference ($p \leq 0.01$) in vegetation change: 2002, 2008, 2016

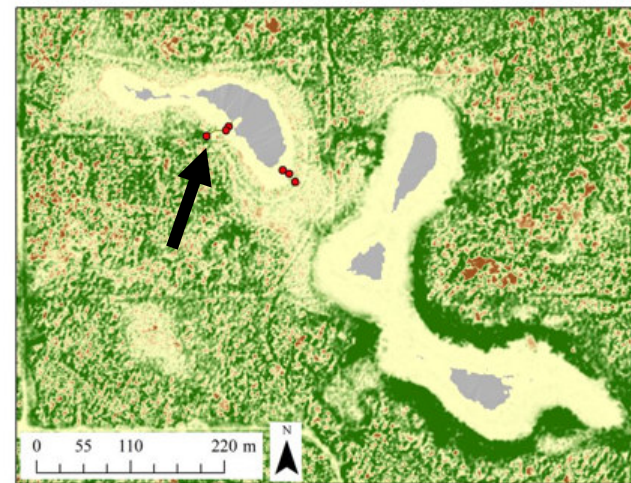(3 of 3 sites, pond 16; 4 of 4 sites at Pond 19; 2 of 2 sites, pond 43)

Pond 16

Pond 43

Pond 19

Height change
2016 - 2002 (m)

+5
-5

Acknowledgements

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