DRAFT Wet Meadow Hydrology Report

Science Reporting Session – February 2023

Kristen Cognac

Wet meadows

Ephemeral wetlands / grasslands

Shallow GW table

Standing water for part of year

High spatiotemporal variability

Groundwater-fed, high hydraulic connection
Vegetation, river, and GW are tightly linked

[Brinley Buckley et al., 2021]

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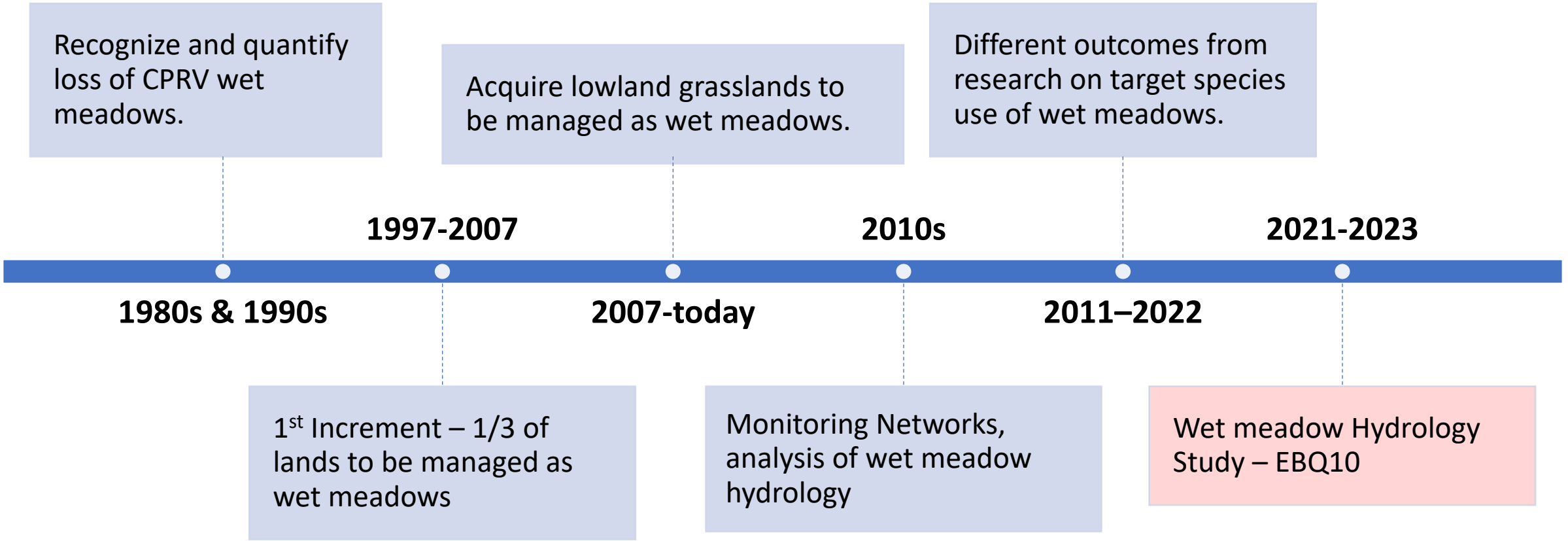
Very brief history of wet meadows



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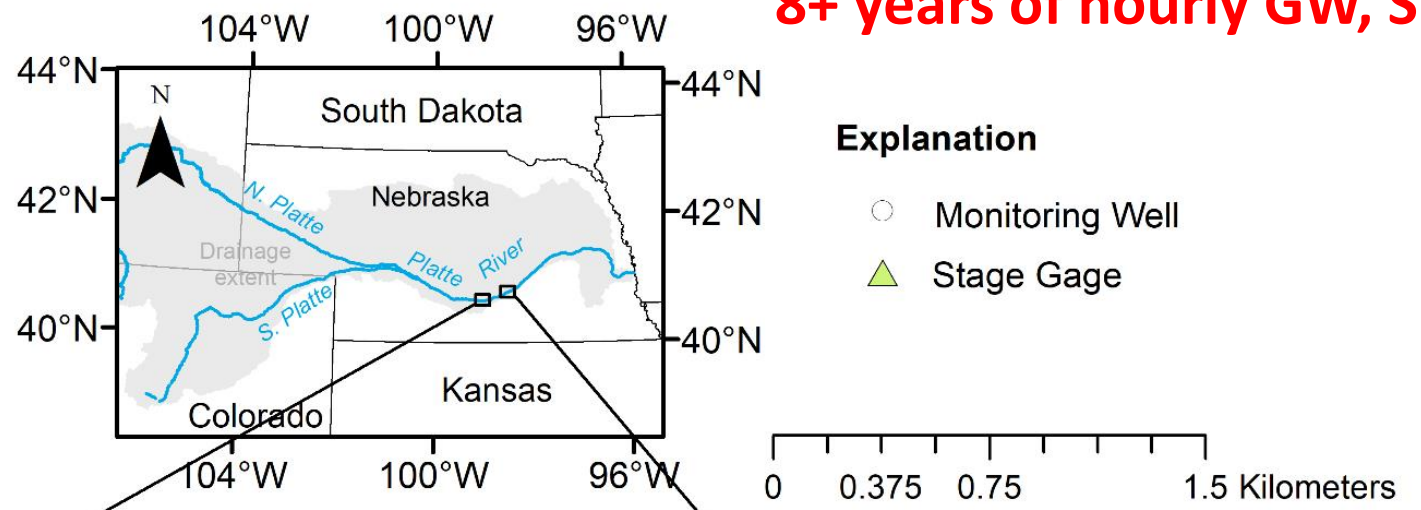
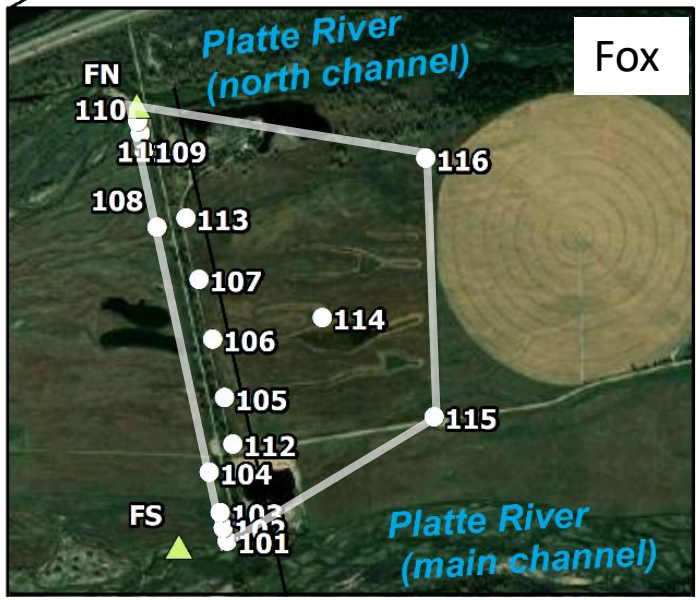
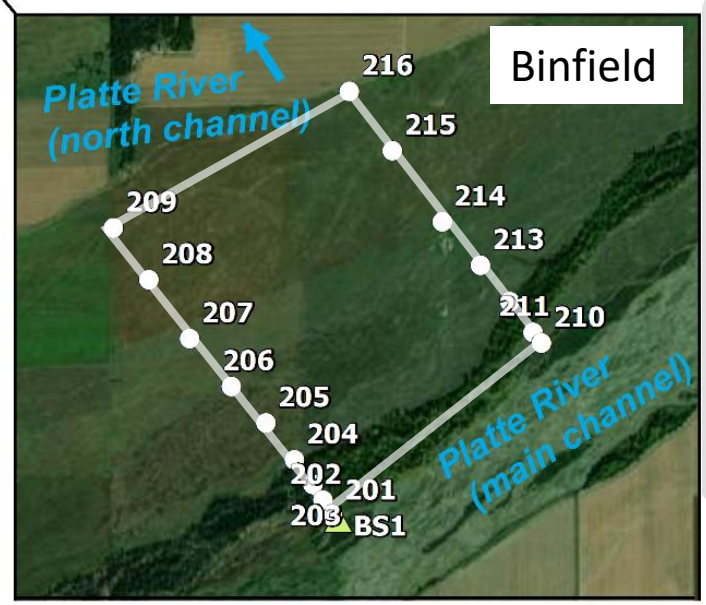
Study Sites

8+ years of hourly GW, SW, and weather data!





Site 1 - Fox (restored)



Site 2 - Binfield (native)

Wet Meadow Hydrologic Study

Objectives

- Improve understanding of wet meadow hydrology
- Quantify wet meadow controls
- Develop tools/methods that inform management
- Use data that was collected 2013-2021

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Wet Meadow Hydrologic Study

4 main parts

- Quantify hydroregime
- Groundwater-vegetation links
- Test management through models
- River-floodplain elevation

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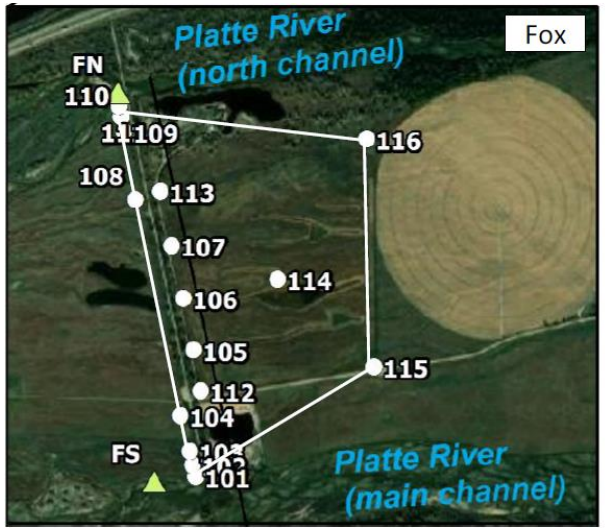
1. Quantify hydroregime

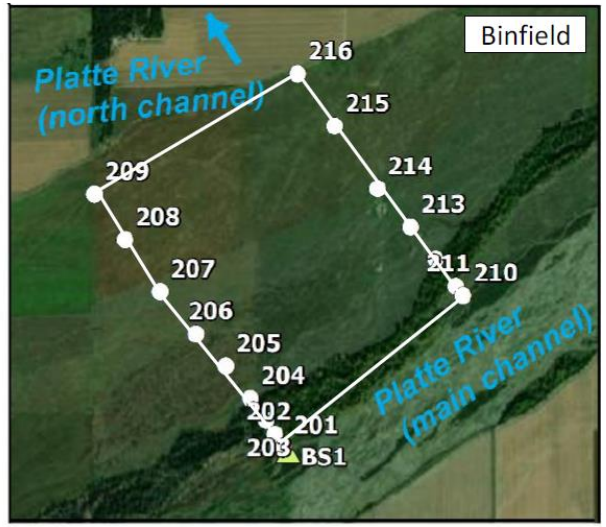
Methods

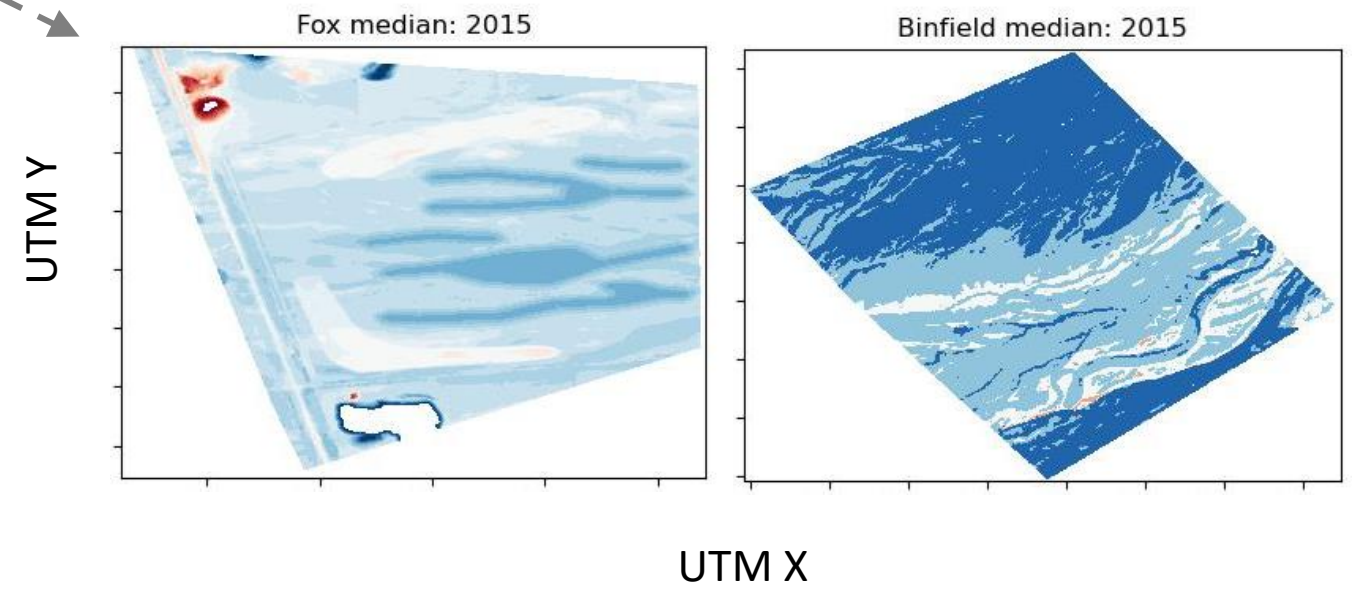
- Statistics to quantify hydroregime
  - Hydroperiod
  - Depth to groundwater (DTGW)

- Point-based at wells
- Area-based for interpolated DTGW

- Spatiotemporal variability
- Compare to other sites







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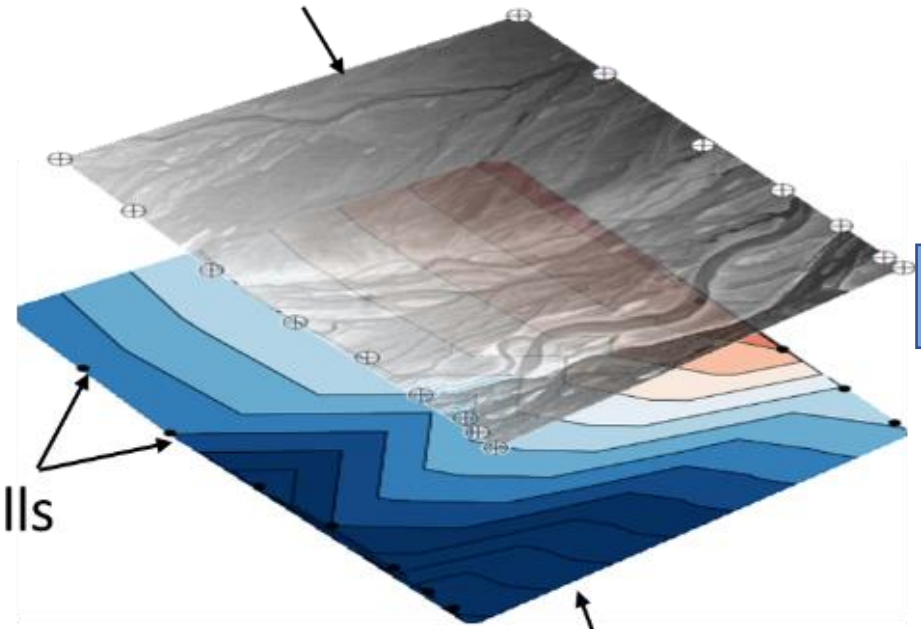
Quantify hydroregime

Lidar Ground Surface Elevation

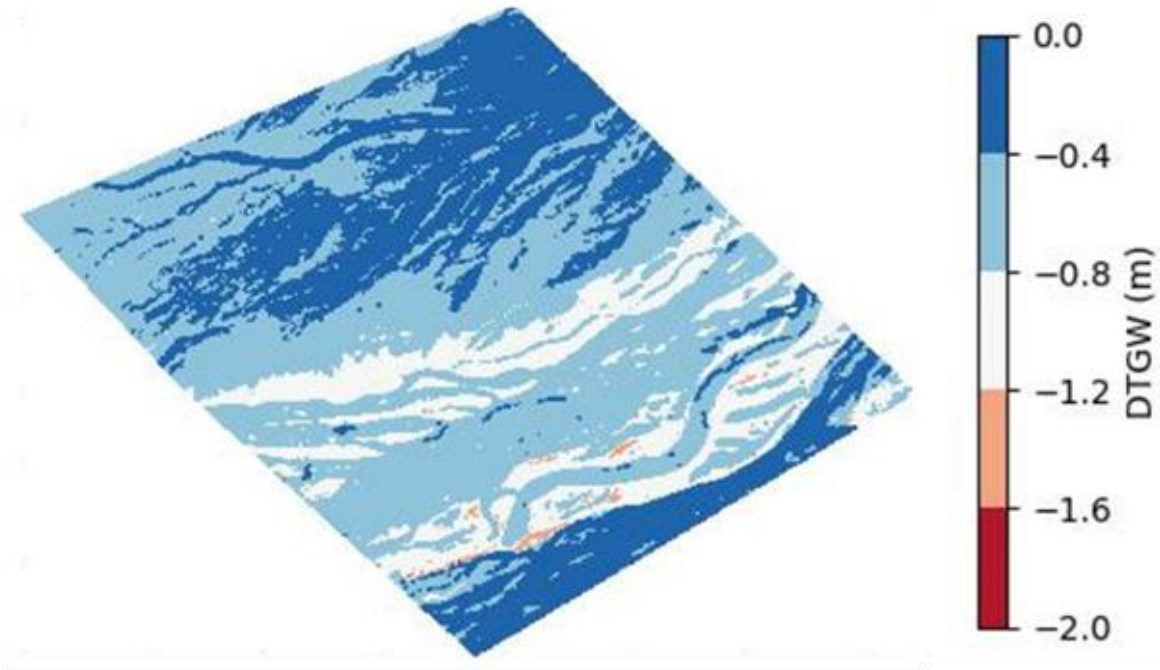


wells

2017 median GW elevation surface

Subtract

2017 median DTGW surface



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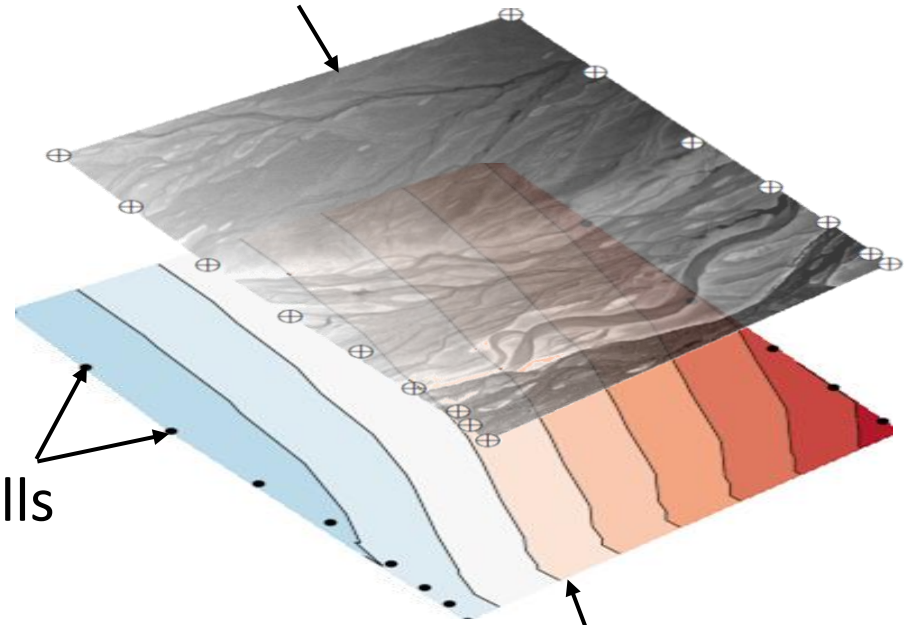
Quantify hydroregime

Lidar Ground Surface Elevation

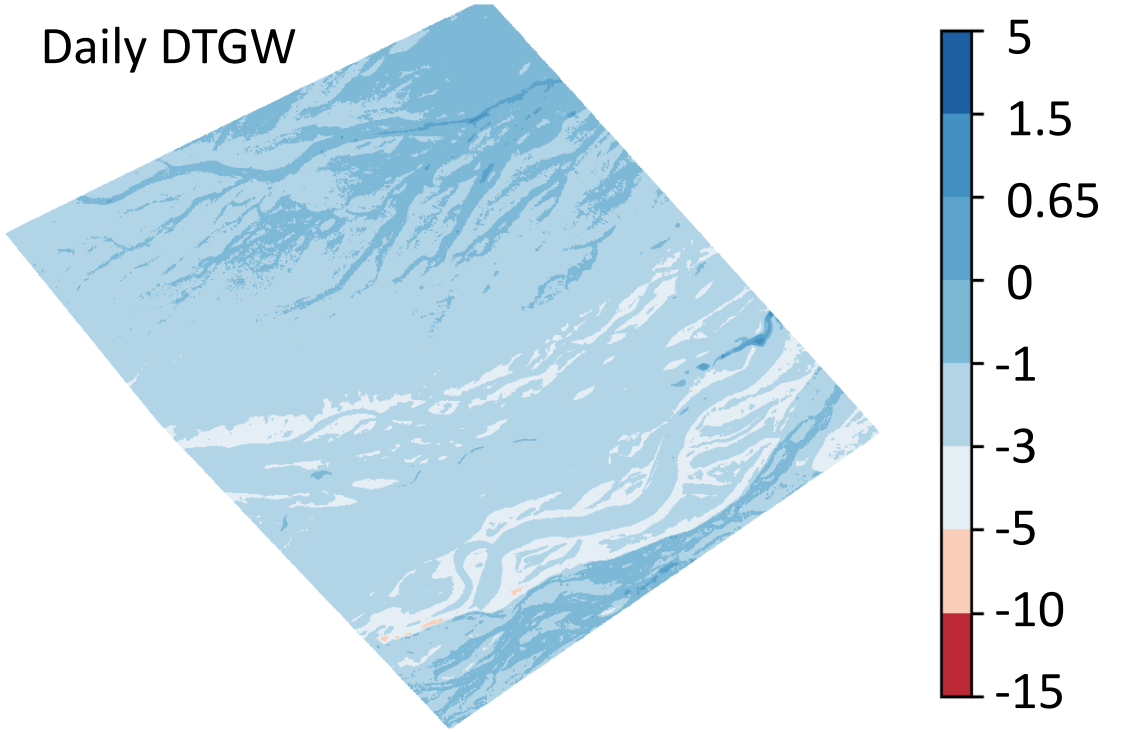


wells

Daily interpolated GW Table from well data

Daily interpolated DTGW

Binfield: March 01, 2015



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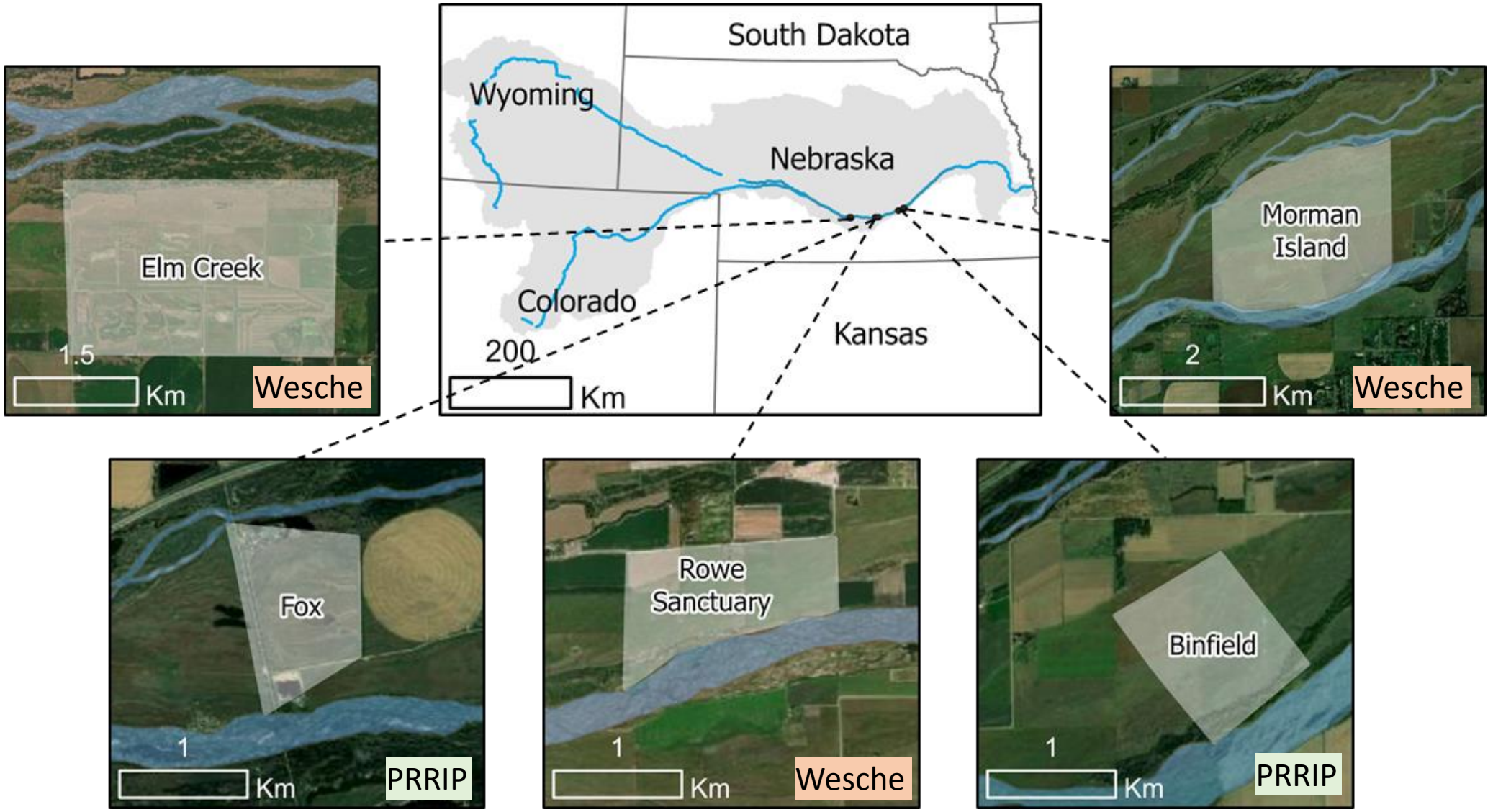
Quantify hydroregime



Compare area % to Wesche et al. (1994)

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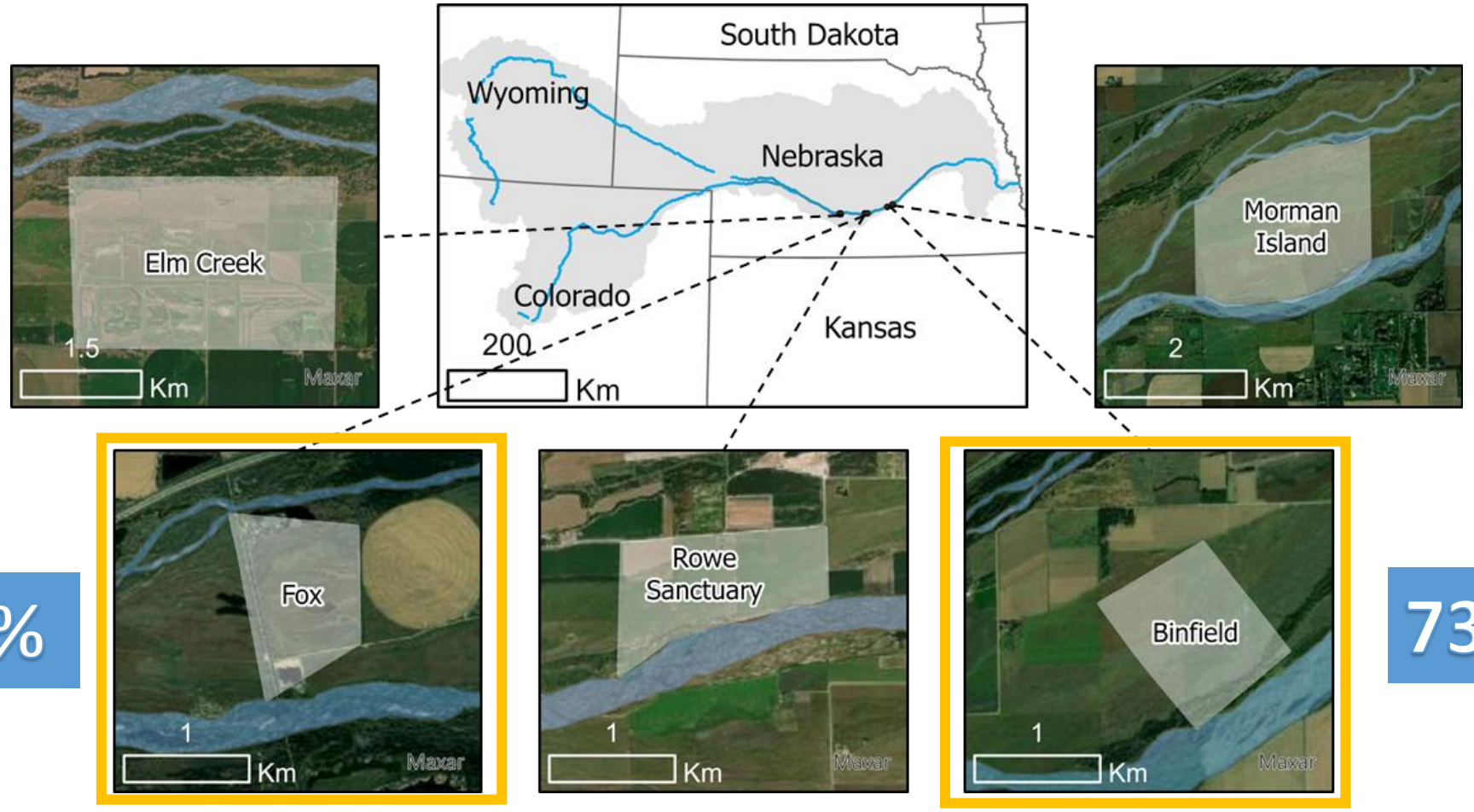
Compare to other sites (Wesche et al., 1994)

Spring median area percent with DTGW < 0.6m



<0.5%

94%

15%

73%

31%

Program Sites

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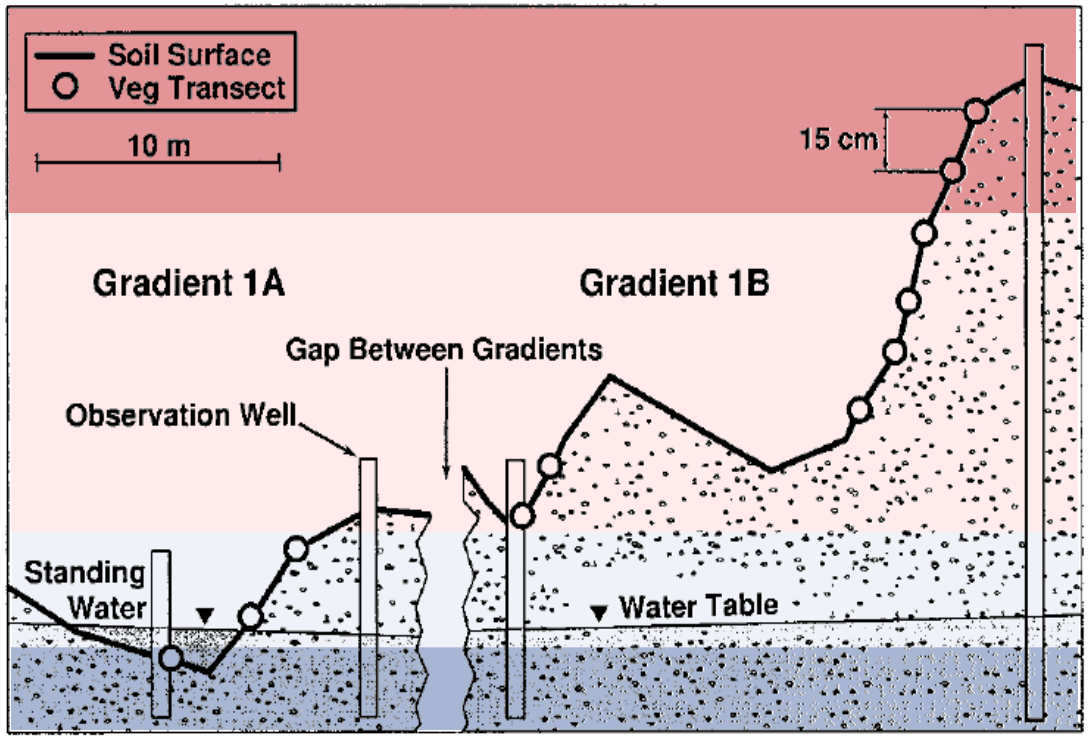
Key takeaways

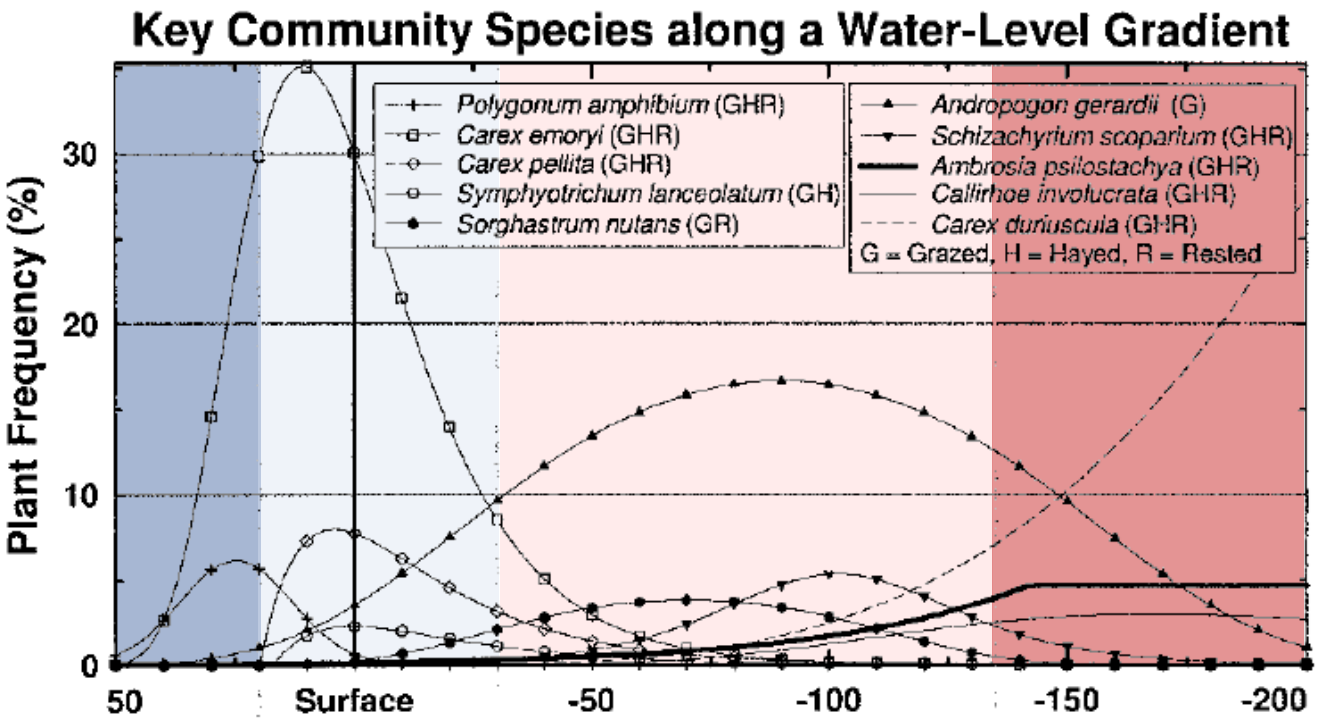
- Hydrology is highly variable within and between sites.
- Fox is drier than Binfield, deeper DTWG, longer hydroperiod due to ponds.
- DTGW data exhibit non-normal distributions (time and space)
- Wettest = Crane Meadows, Driest = Elm Creek, Middle = Fox and Binfield
- Sites become wetter to the east.

Hydroregime Questions

- Is there a better way to summarize temporally varying area-based statistics?
- Are there better methods to characterize spatiotemporal variability?

Groundwater Vegetation Links





Emergent

Mesic Prairie

Sedge Meadow

Dry Ridge

L7th

Growing Season 7-Day Moving Average Maximum Water Level

[Henszey et al., 2004]

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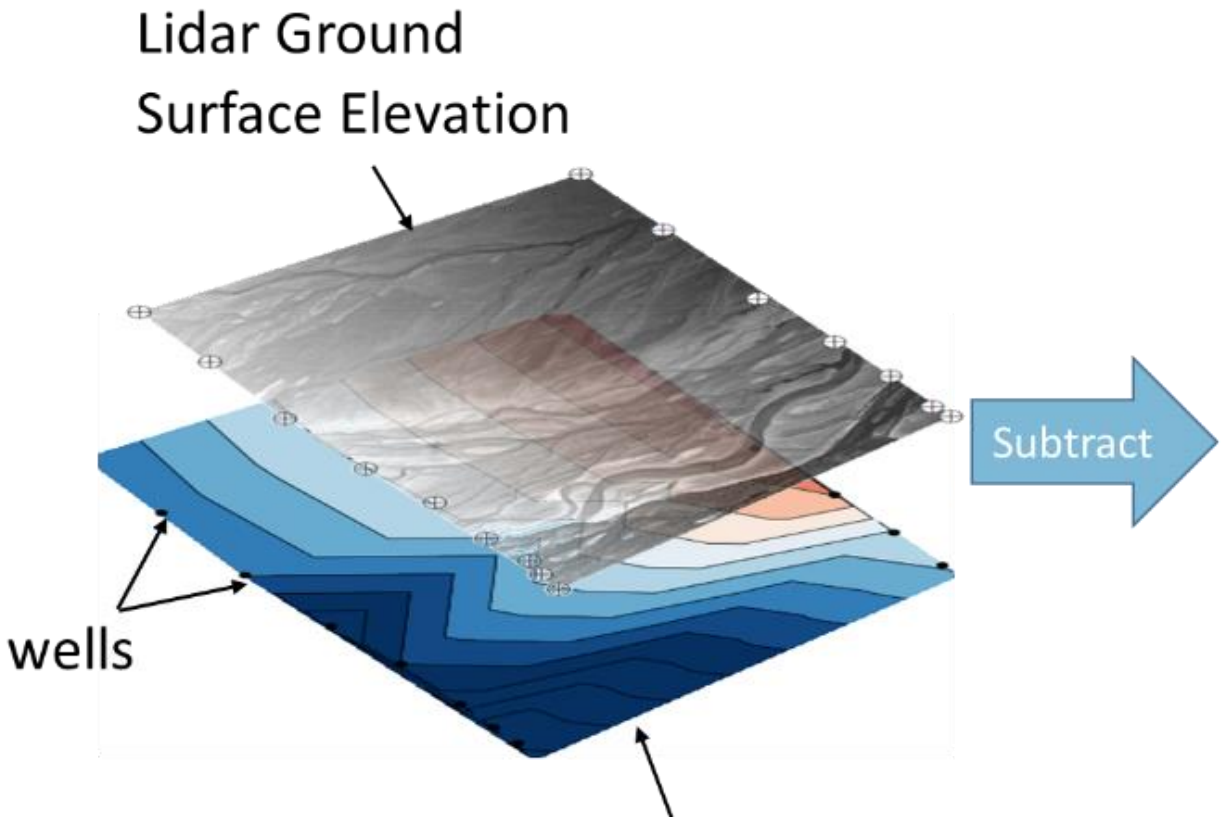
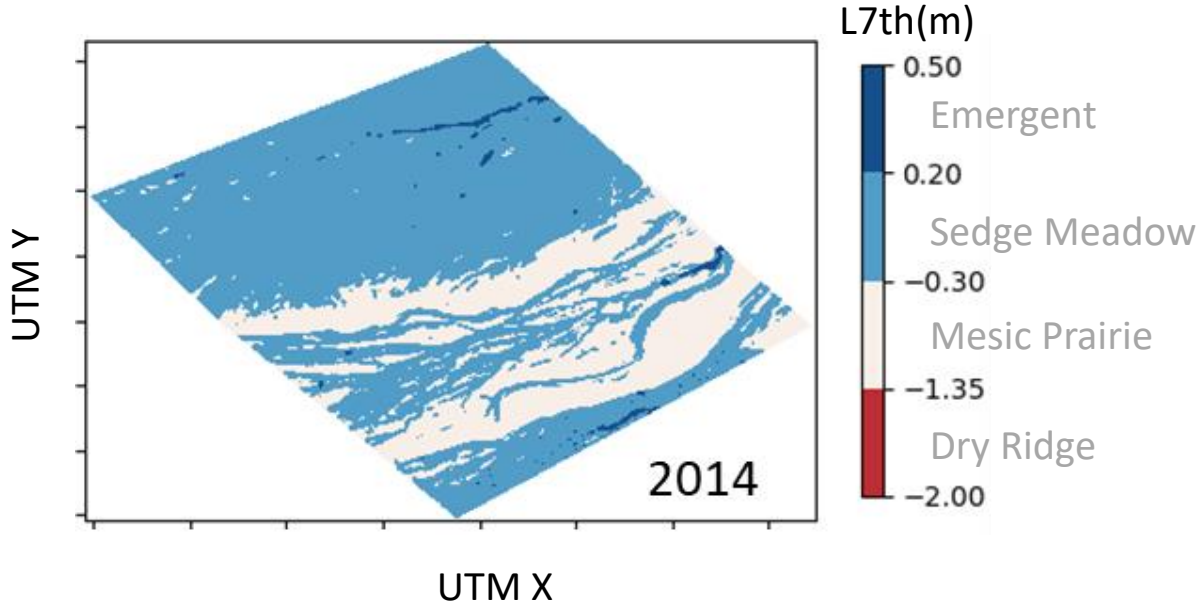
Quantify hydroregime



Maximum 7-day moving average water table

Yearly L7th Surface



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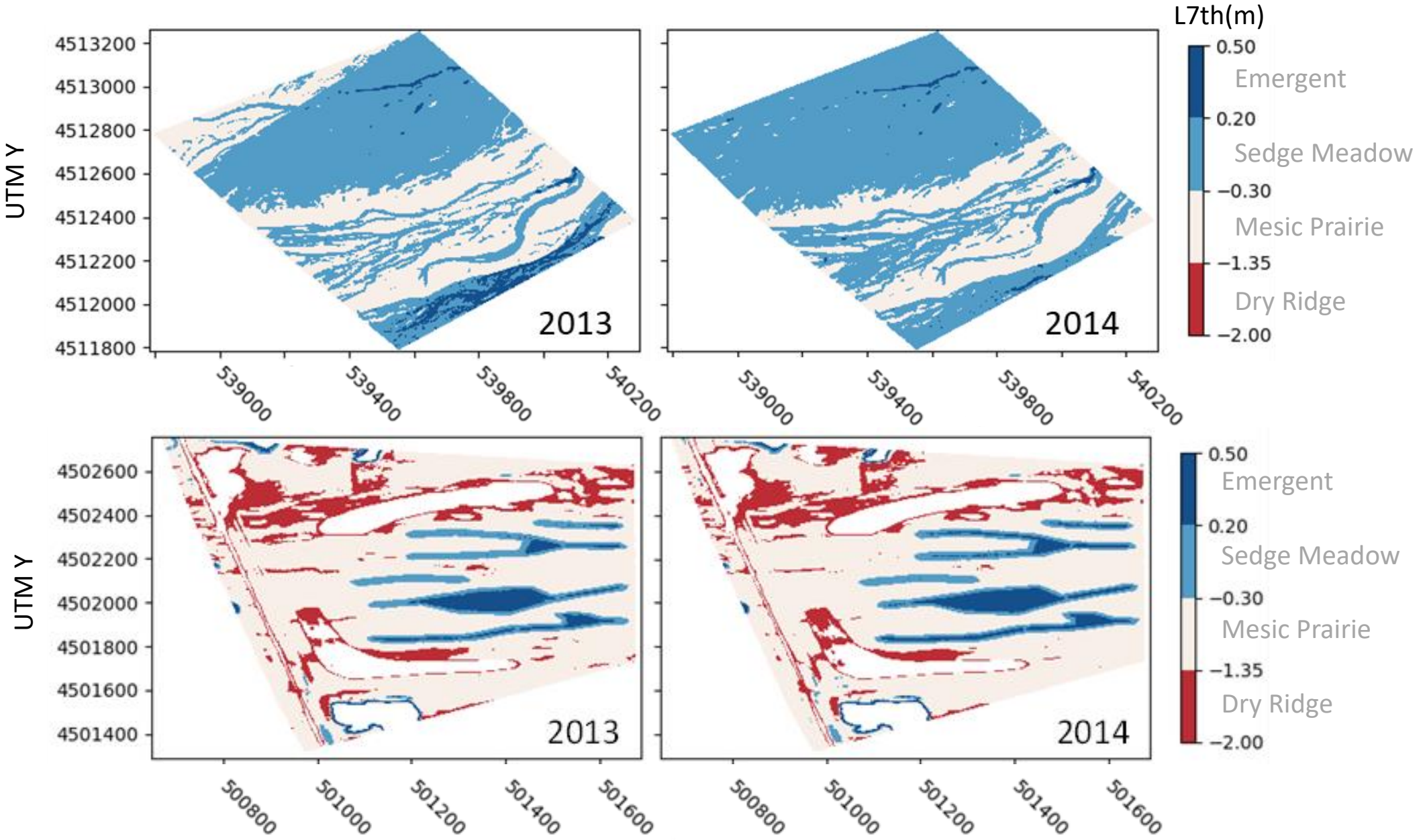
L7th Results

Binfield– Native, wet meadow site



Fox – Restored wet meadow site

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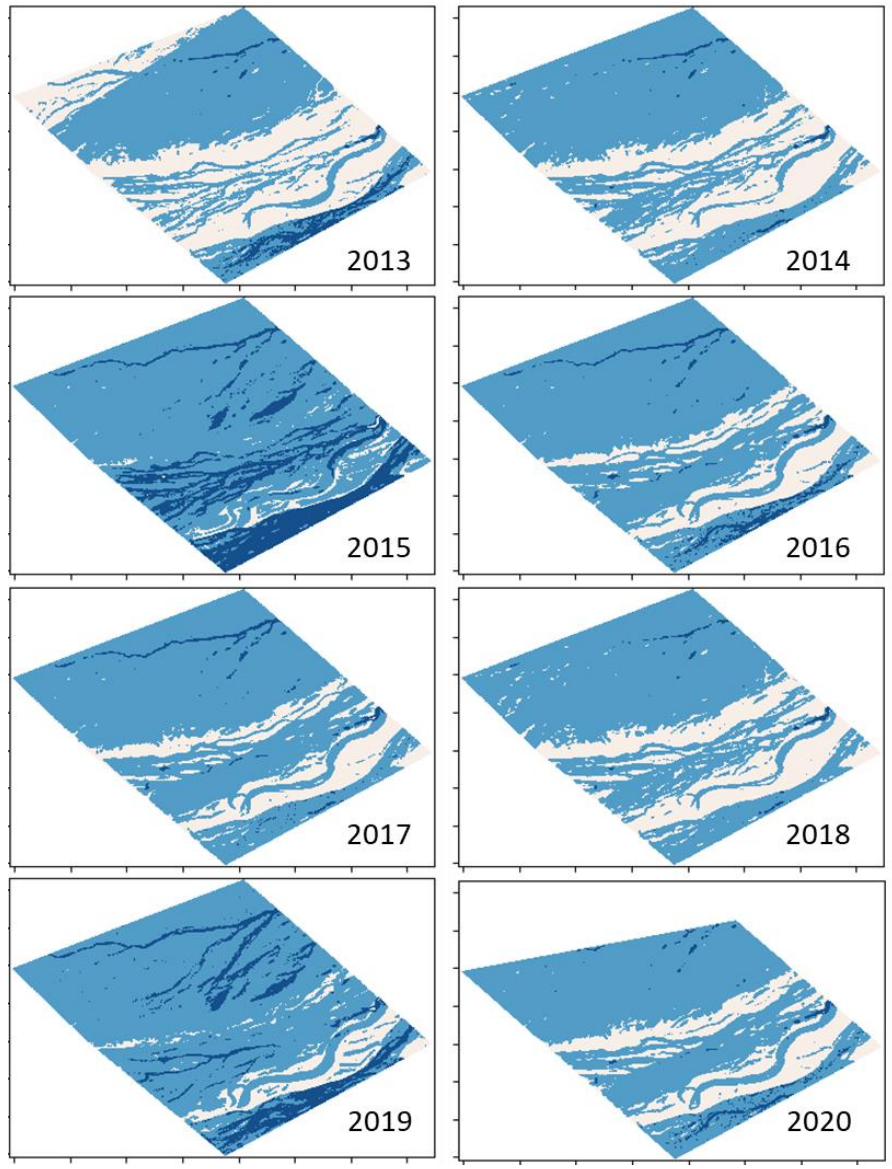
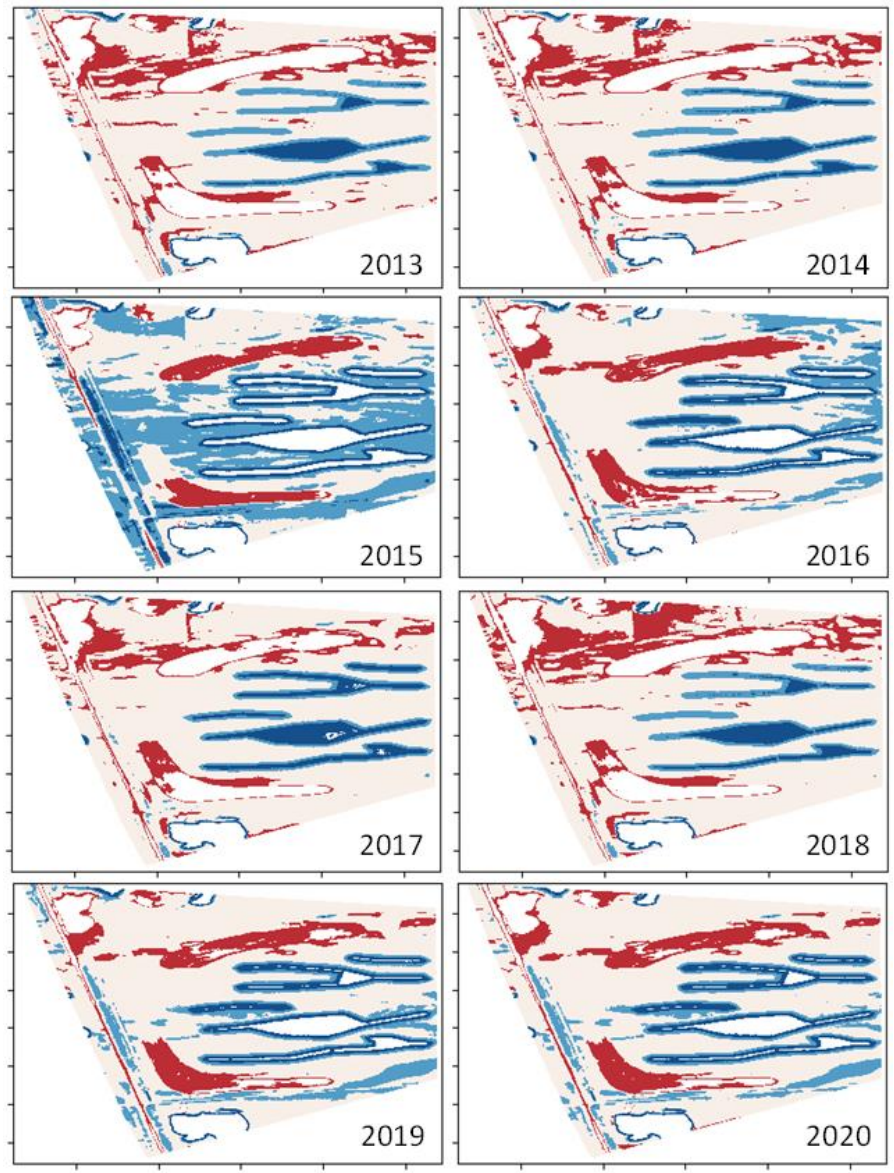
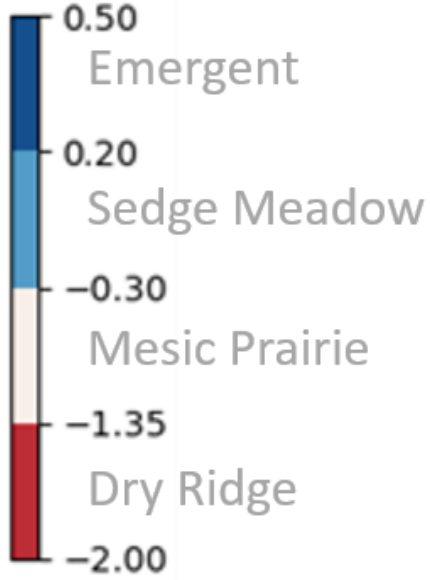
Groundwater Vegetation Links





L7th (m)



UTM Y

UTM X

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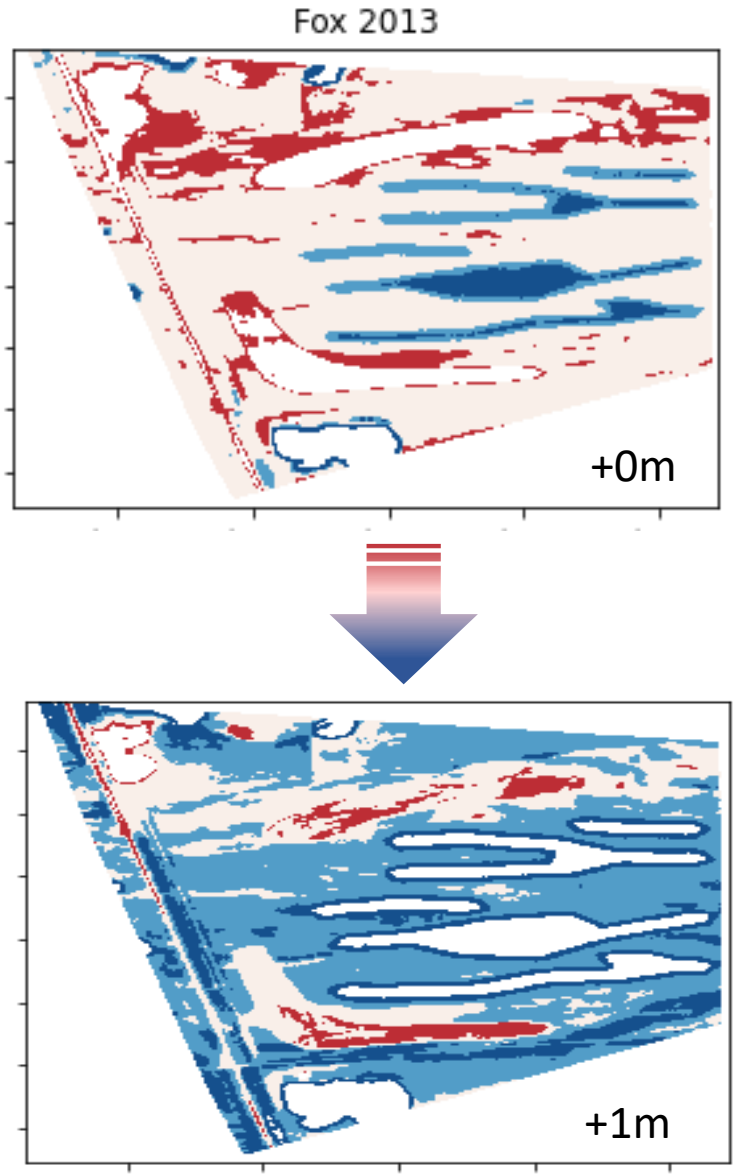
Groundwater Vegetation Links

Required change in L7th to achieve **50% wetland vegetation** at Fox site

Year	ΔL7th (m)
2013	0.89
2014	0.84
2015	0.075
2016	0.41
2017	0.73
2018	0.93
2019	0.42
2020	0.45
AVERAGE	**0.59**



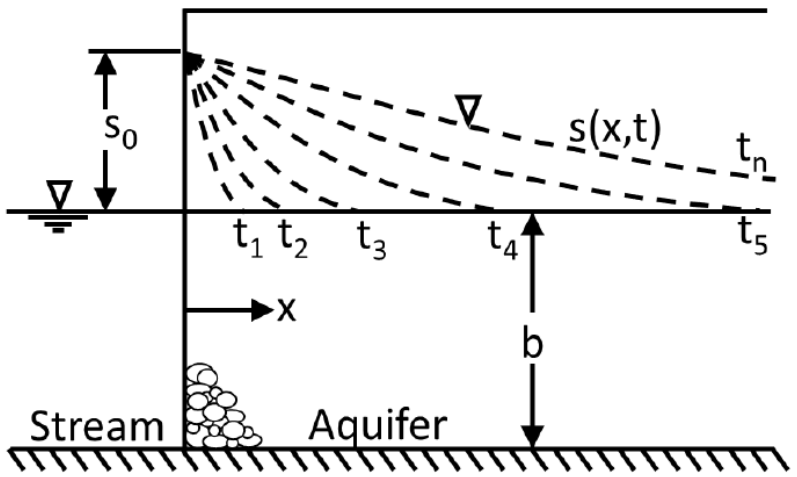
Key takeaways

- Quantified targets for wet meadows based on wetland criteria
- Determined that currently, Binfield hydrology = wetland, Fox = not
- Determine required changes in hydrology

Groundwater-Vegetation Links Questions

- Any improvements/clarity in methodology?
- Do wetland criteria used make sense? i.e., ≥ 50% of site should theoretically support wetland veg.
- Useful for management?

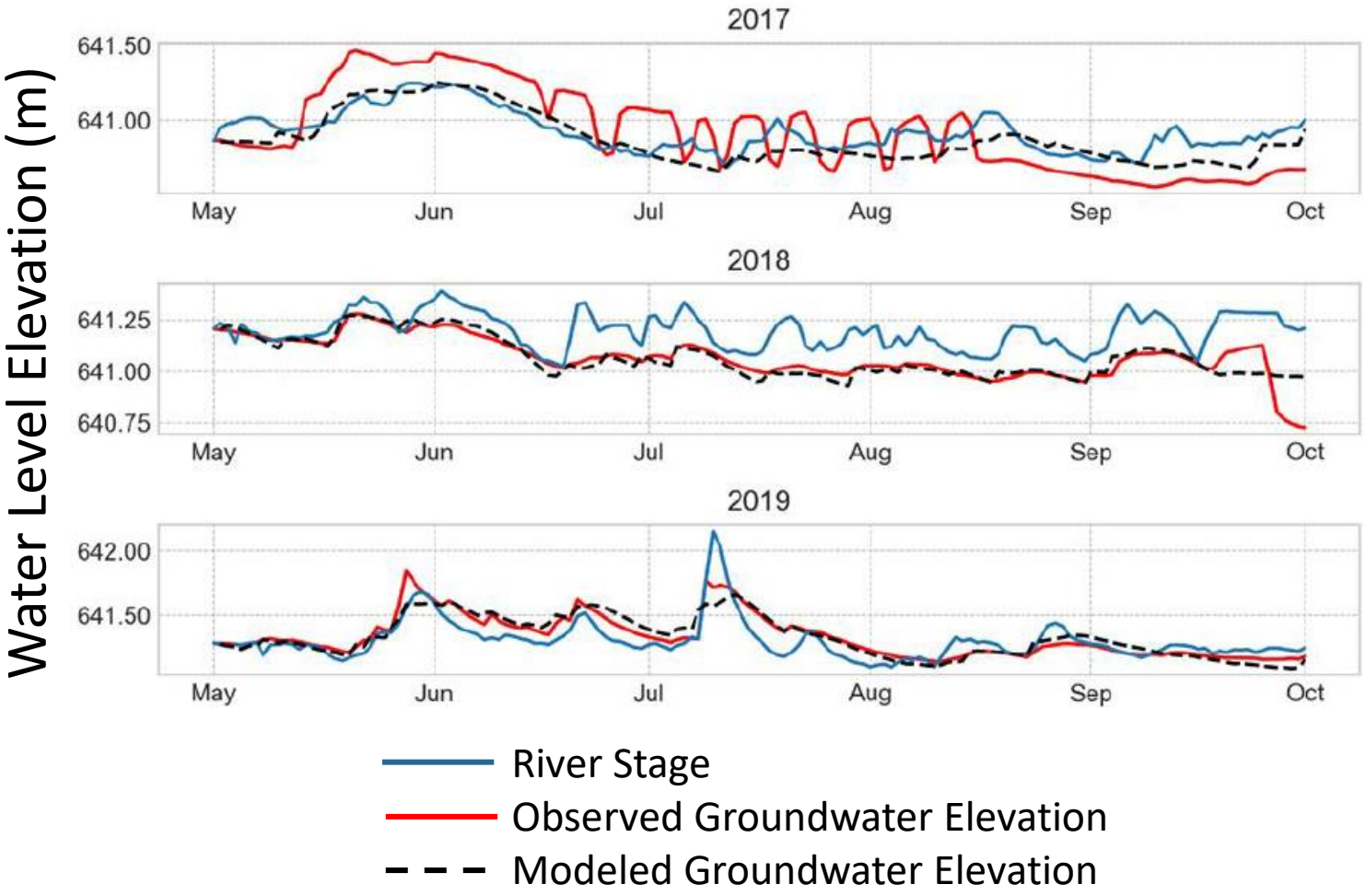
Analytical Model



Inputs: Precipitation, ET, Stage

Outputs: GW Level

Results



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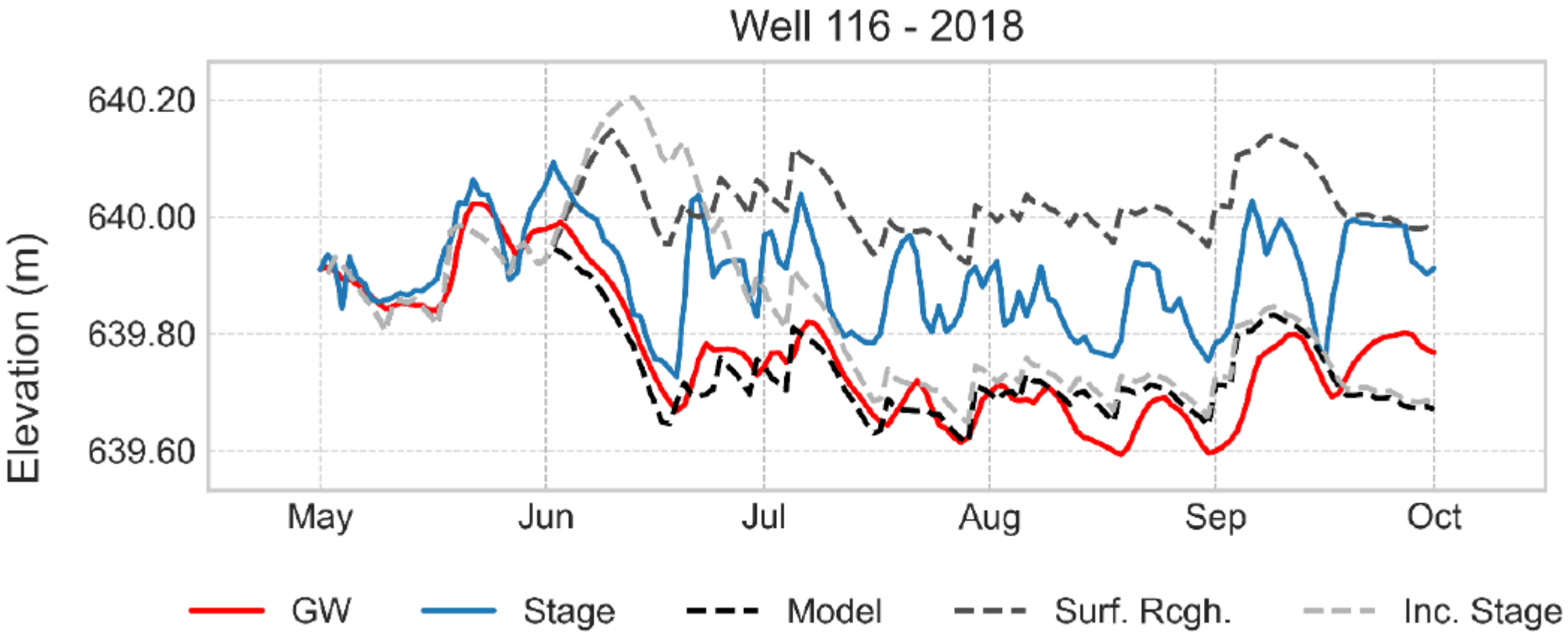
Predictions



Increase stage by 1m (>10,000 cfs)

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Key takeaways

- Simple model that predicts GW level given stage, ET, precipitation
- Model scenarios to make predictions
- Calibrated K and Sy for sites
- Pretty good fit
  - Should quantify (e.g., R^2, error)

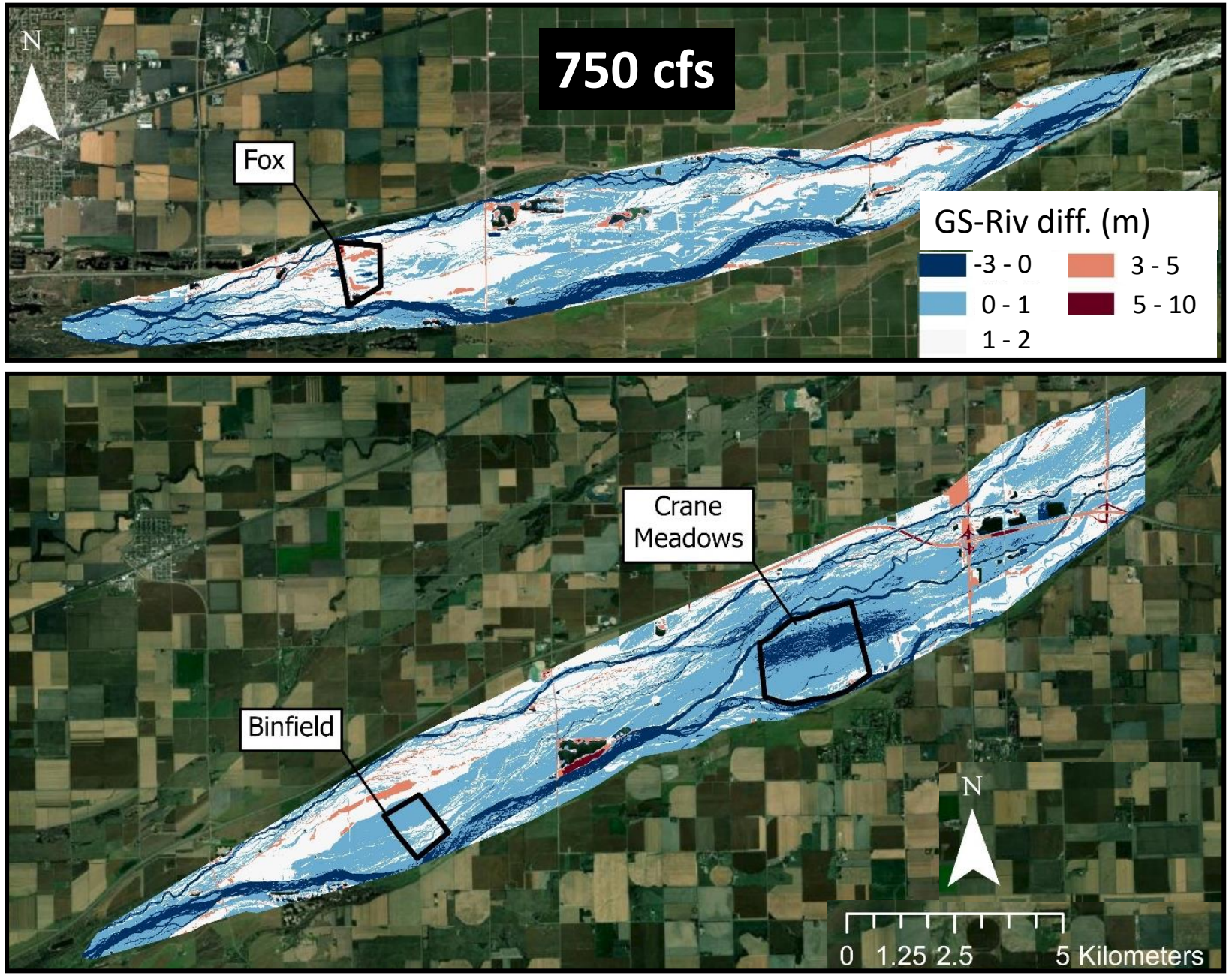
Modeling Questions

- Do calibration methods and range (for K and Sy) make sense?
- Which scenarios should we use model to predict?

River-Ground Surface elevation analysis

Methods

- Extrapolated modeled river surface across vegetated islands
- Difference with bare earth DEM
- Negative = river above ground surface



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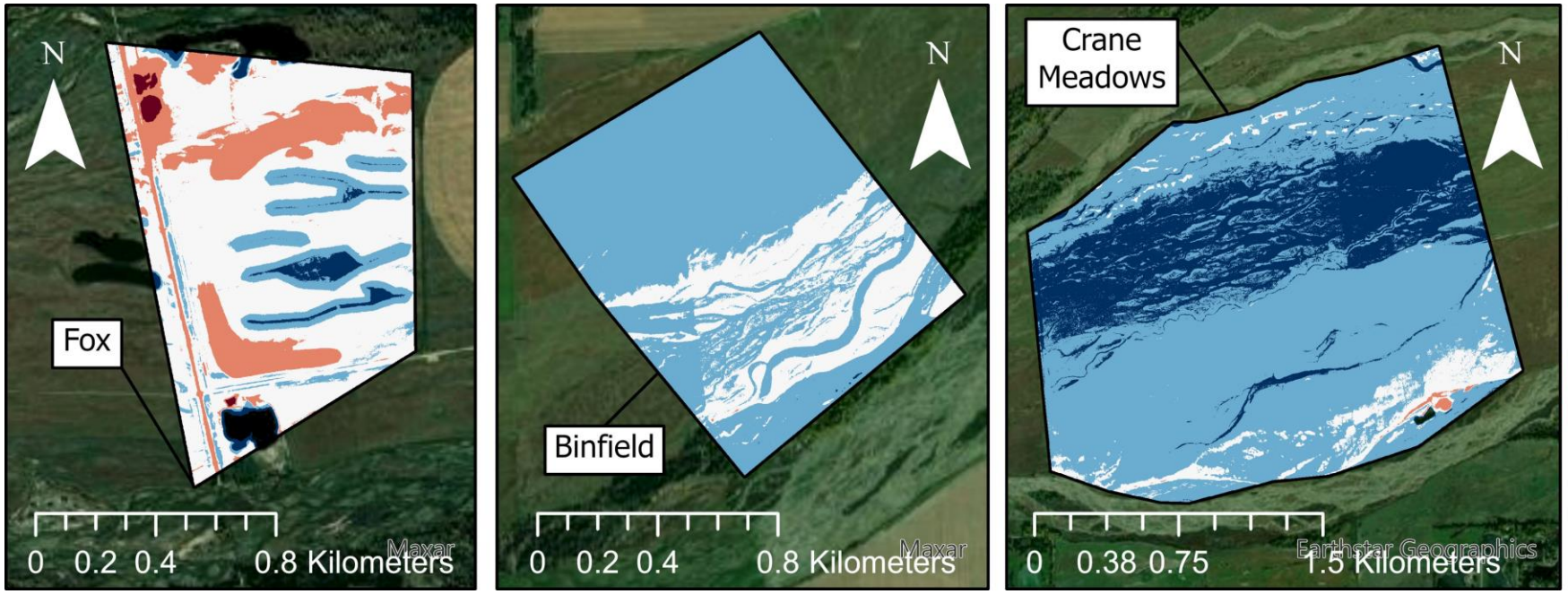
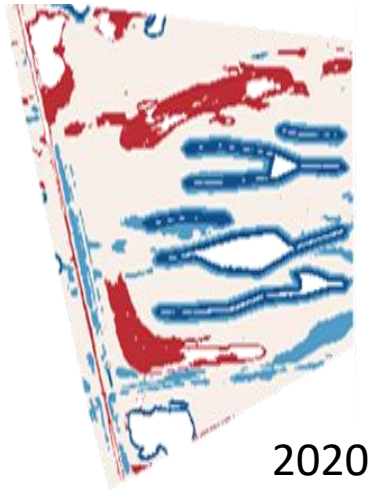
River-Ground Surface elevation analysis

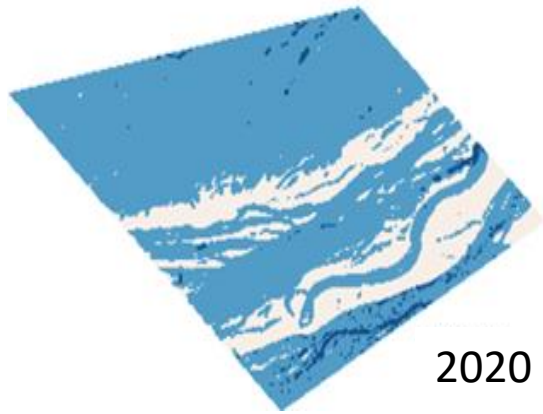
River as Proxy (elevation difference)



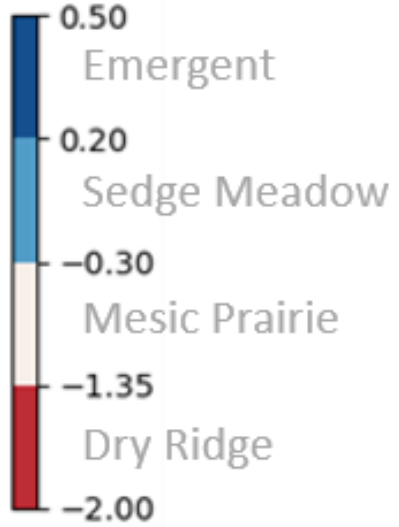
L7th - Vegetation



2020



2020



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Key takeaways

- Developed a method that may be useful for assessing hydrologic conditions at wet meadow sites without intensive data collection.
- Differenced elevation surfaces appear to match patterns in L7th, may be able to relate quantitatively, or at least qualitatively.

River-Ground surface elevation analysis Questions

- Method for quantifying relationship between elevation difference and L7th surfaces? i.e., cell-by-cell regression?
- Alternative method to evaluate river-ground surface relationship?

Scientific motivation

Still unknowns that limit our ability to manage and restore wet meadows.

Hydrology (spatiotemporal variability)

- What are ideal hydrologic conditions at archetypal wet meadows?
- Can we quantify whether hydrology limiting health or restoration success?
- Can we manage sites different with respect to hydrology?

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Discussion / questions