

# Using Remote Sensing to Identify Padded Well Sites in Alberta's Peatlands:

A Case Study of Remote Sensing for Reclamation

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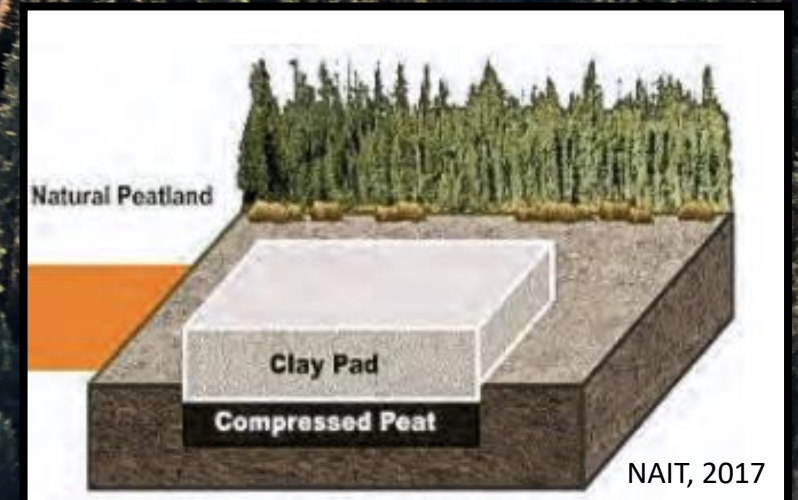
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May 3-5, 2022, Red Deer, Alberta



# What's a padded wellsite?





## Why do we care about padded wellsites?

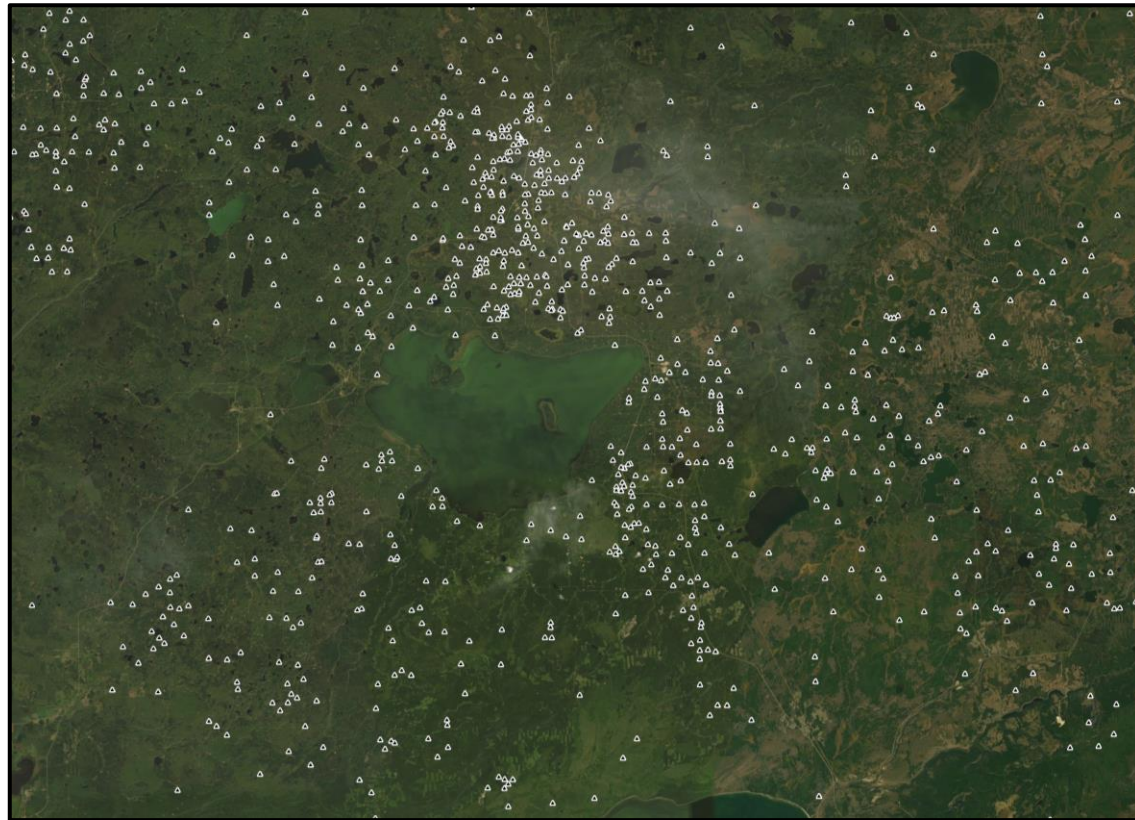
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- Pad creates upland/forested ecosystem island
- Limited research on long-term reclamation success
- Remove the pad, or leave it in place? No clear guidelines!

Upland vegetation  
encroaching

Natural bog vegetation

# Thousands of pads were left in place after site abandonment



# We need an inventory of padded sites

- How many pads are there?
- Where are they located?
- How are these sites distributed across wetland ecosystems?

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How do we answer these questions in a cost-effective manner?

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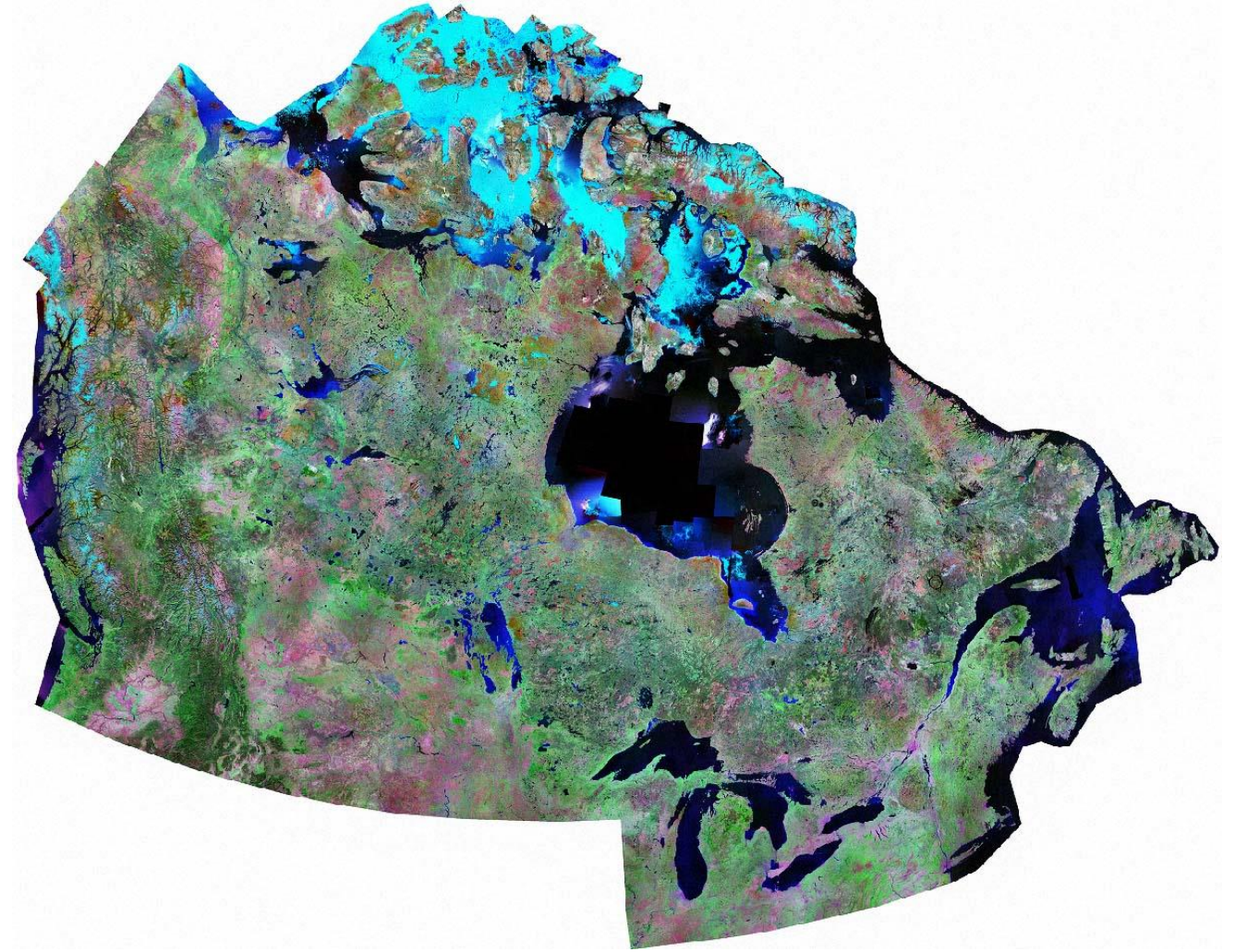
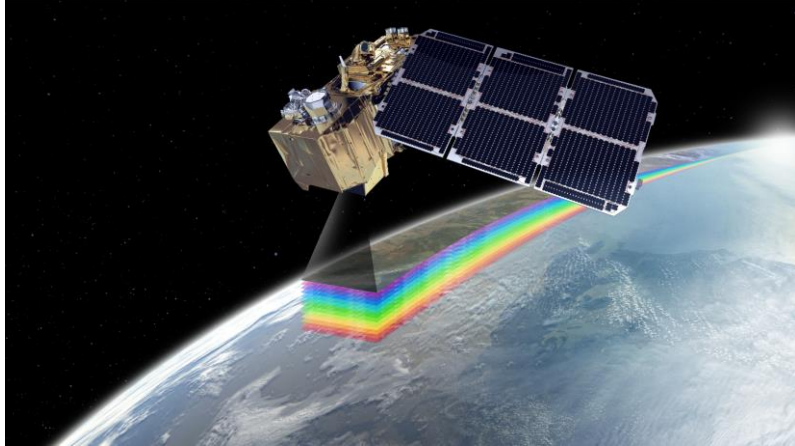
Use **machine learning** modelling  
and **remote sensing** data

# What is remote sensing?



“Remote sensing is the science (and to some extent, art) of acquiring information about the Earth's surface without actually being in contact with it.”

Natural Resources Canada



Natural Resources Canada

# From pigeons



Pigeon photography, 1907

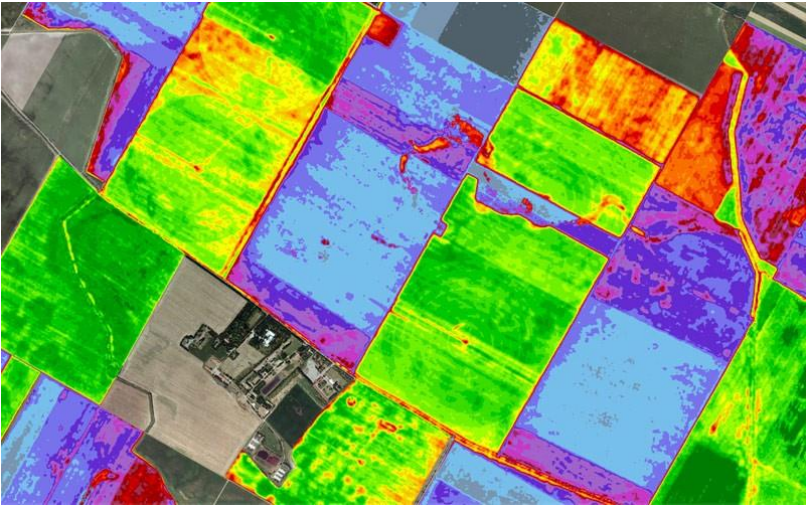
# From pigeons to satellites, airplanes, and drones



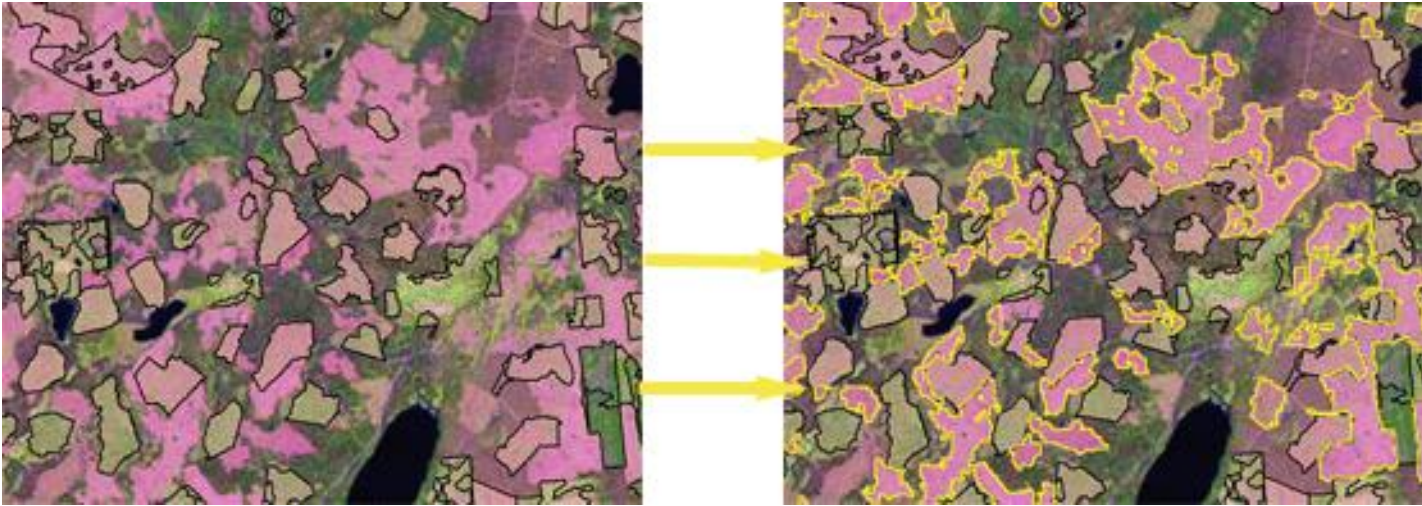
Pigeon photography, 1907



# Remote sensing applications have exploded



**Precision agriculture**



**Tracking deforestation**

# Finding well pads from space

# Characteristics of padded wellsites

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- Raised above the surface (~ 1 m)
- Reduced surface moisture
- Different type of vegetation
- Presence of bare areas more likely



# Characteristics of padded wellsites

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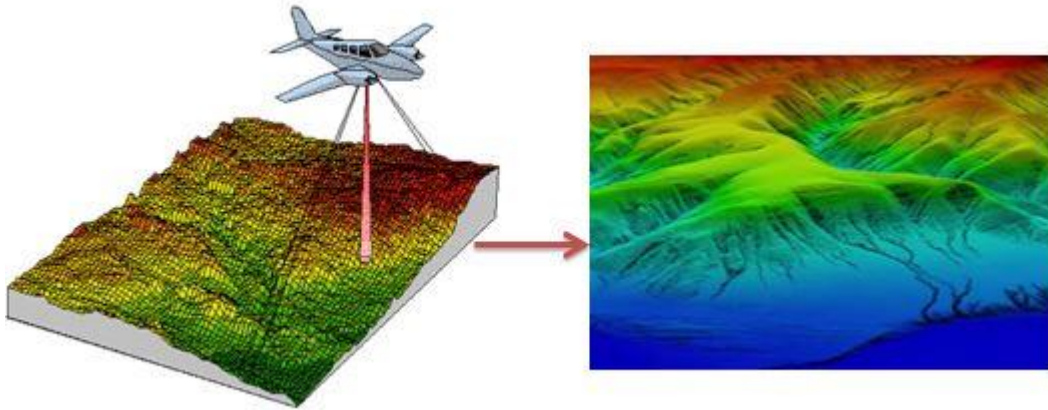
- Raised above the surface (~ 1 m)
- Reduced surface moisture
- Different type of vegetation
- Presence of bare areas more likely

What remote sensing data can we use to measure these characteristics?

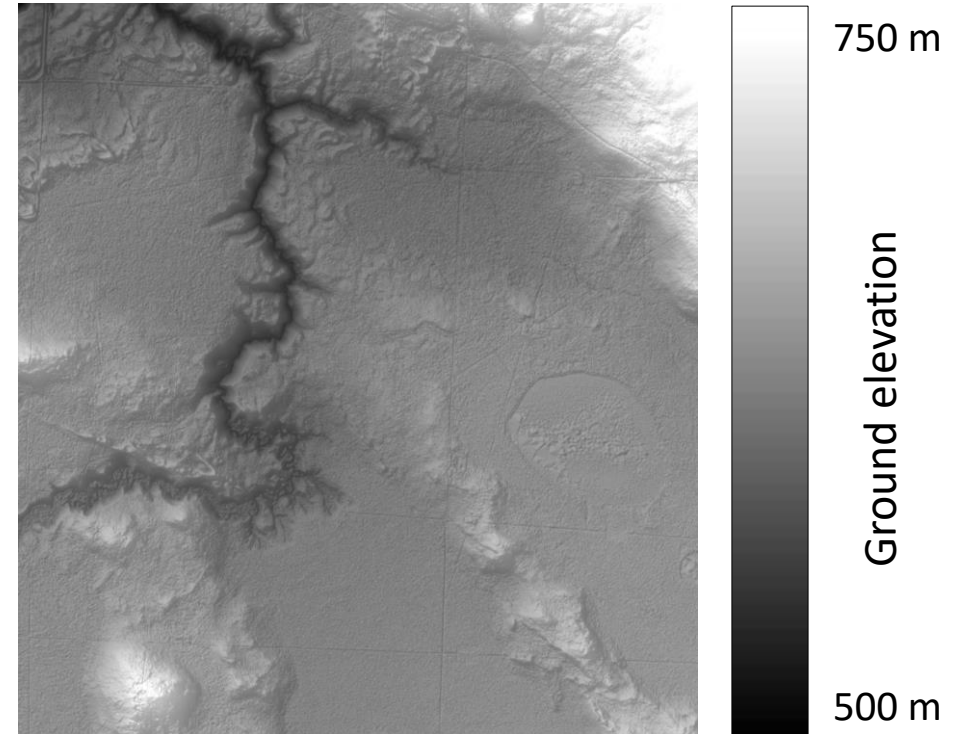


# LiDAR to measure ground elevation

- LiDAR to measure ground elevation
- Provides very accurate mapping of topography
- 1 meter vertical & horizontal resolution (10 000 pixels/site)



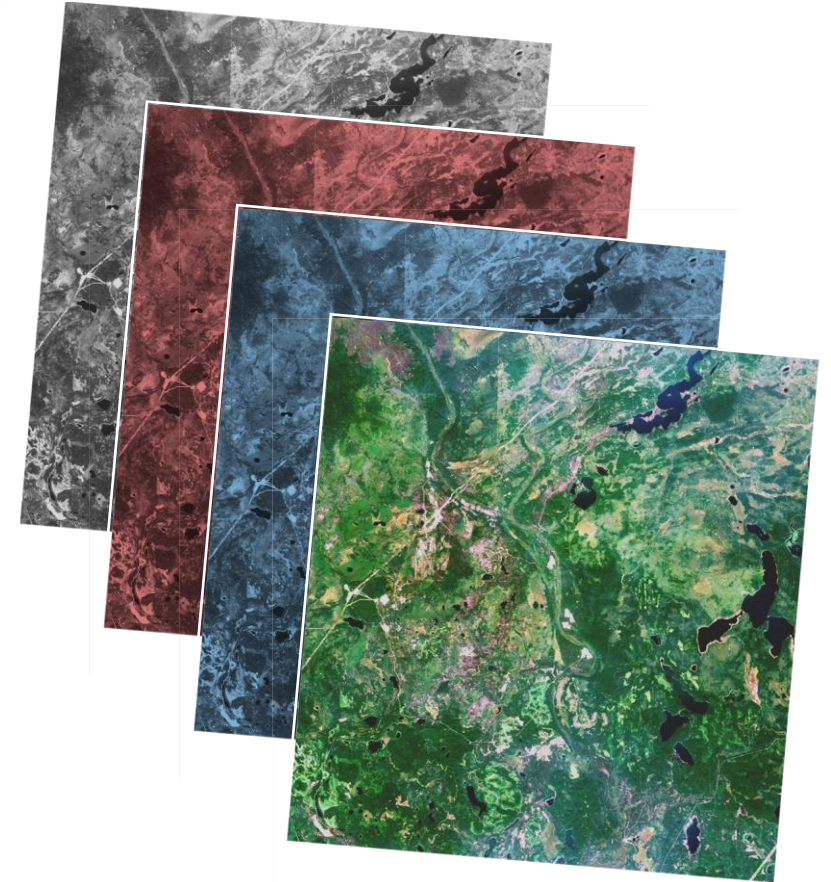
**Bare Earth Digital Elevation Model**





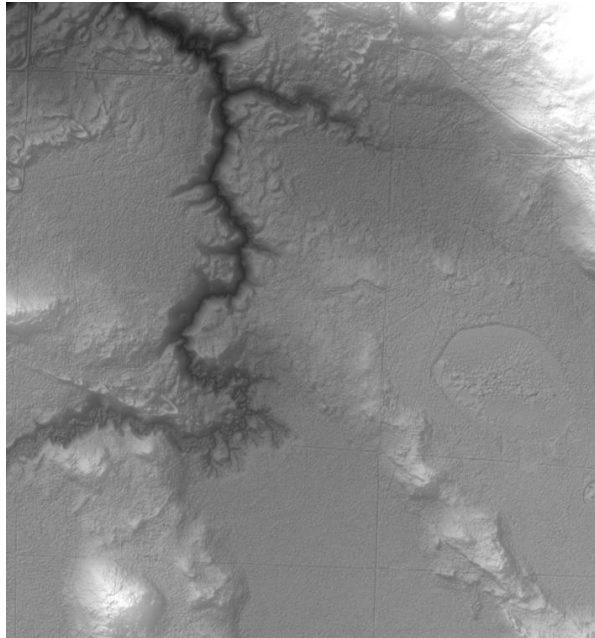
# Optical data to measure vegetation and moisture

- Sentinel-2 satellite mission
- Open access data from ESA
- 10-meter spatial resolution (100 pixels/site)
- High revisit frequency (5 days)
- Multispectral instrument (RGB, Infrared)
- Spring and summer images used to observe various aspects of vegetation and moisture over sites



# How do we use this data to identify padded sites?

**LiDAR data**

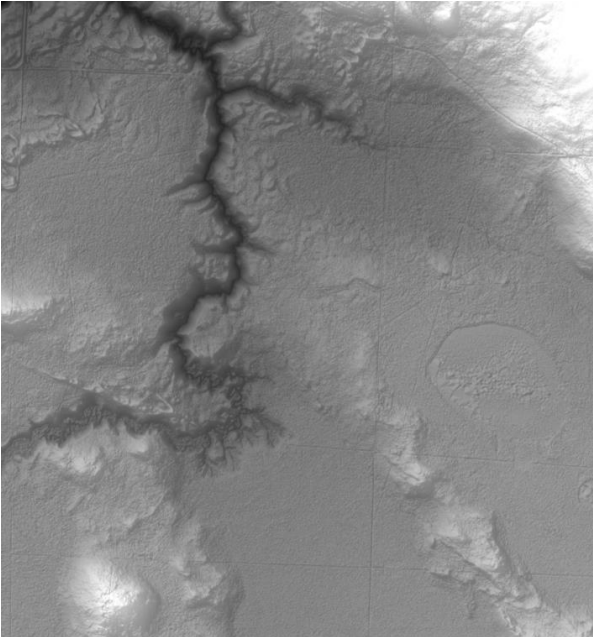


**Sentinel-2 data**

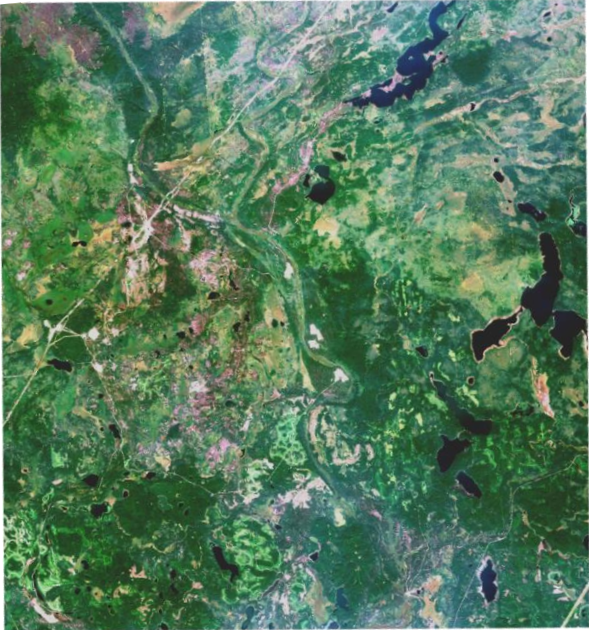


# How do we use this data to identify padded sites?

**LiDAR data**



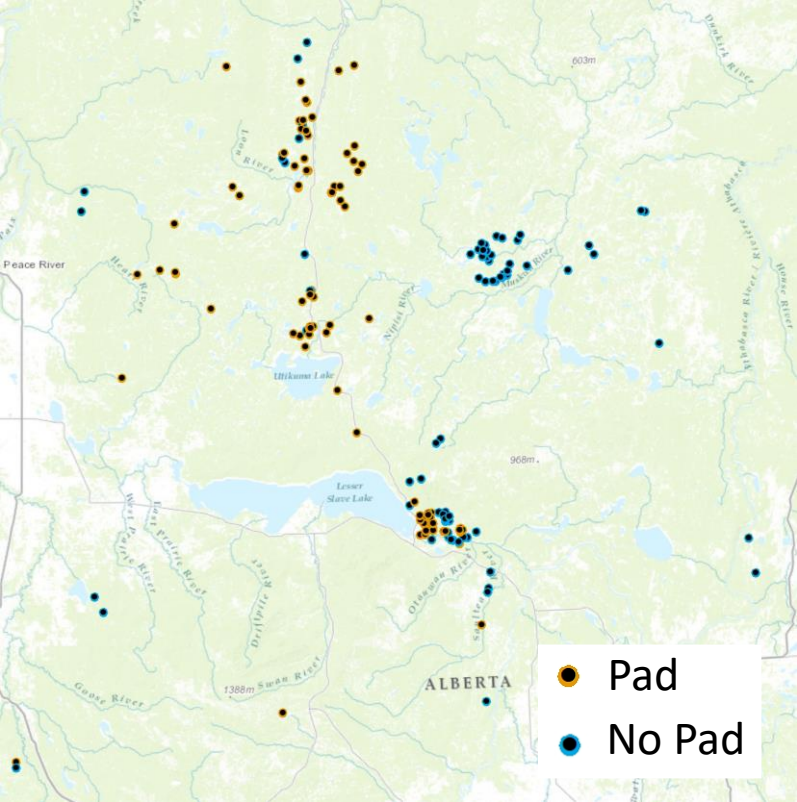
**Sentinel-2 data**



Compare data for padded and unpadded sites

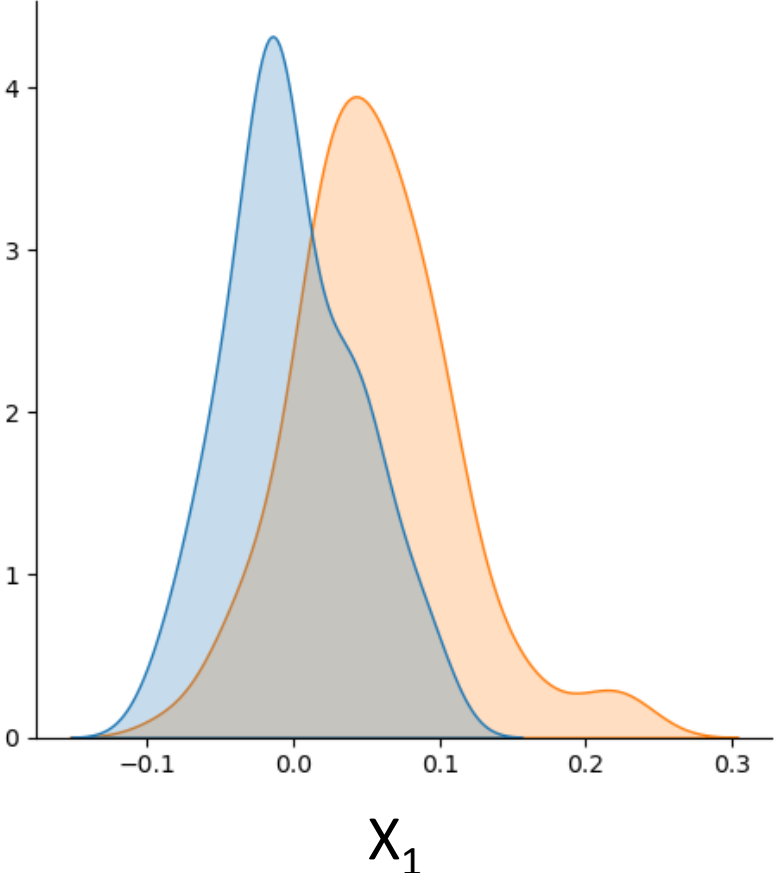
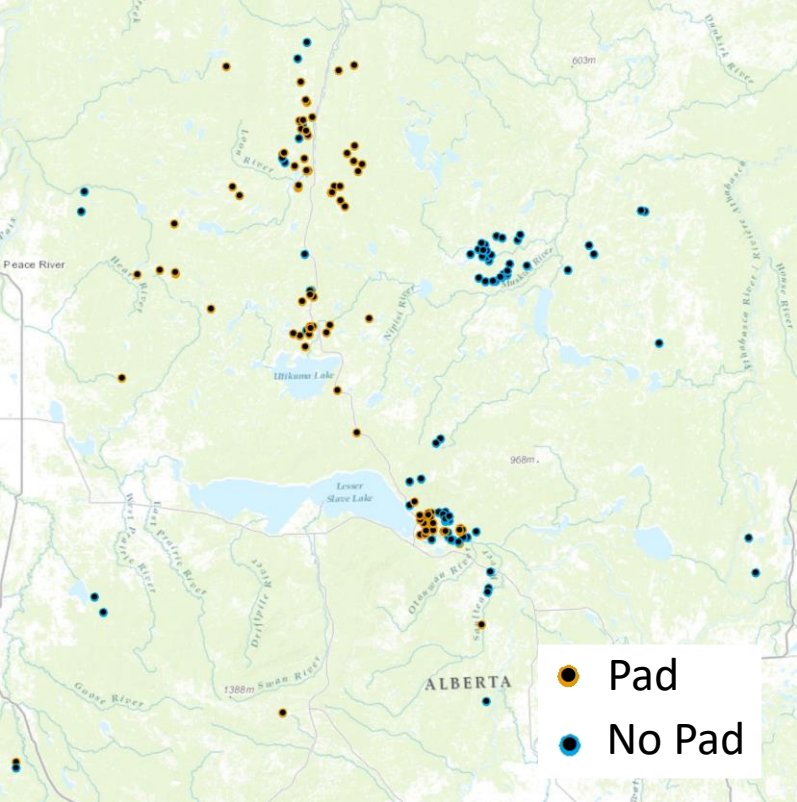
# Padded vs. unpadded sites

Known Wellsites



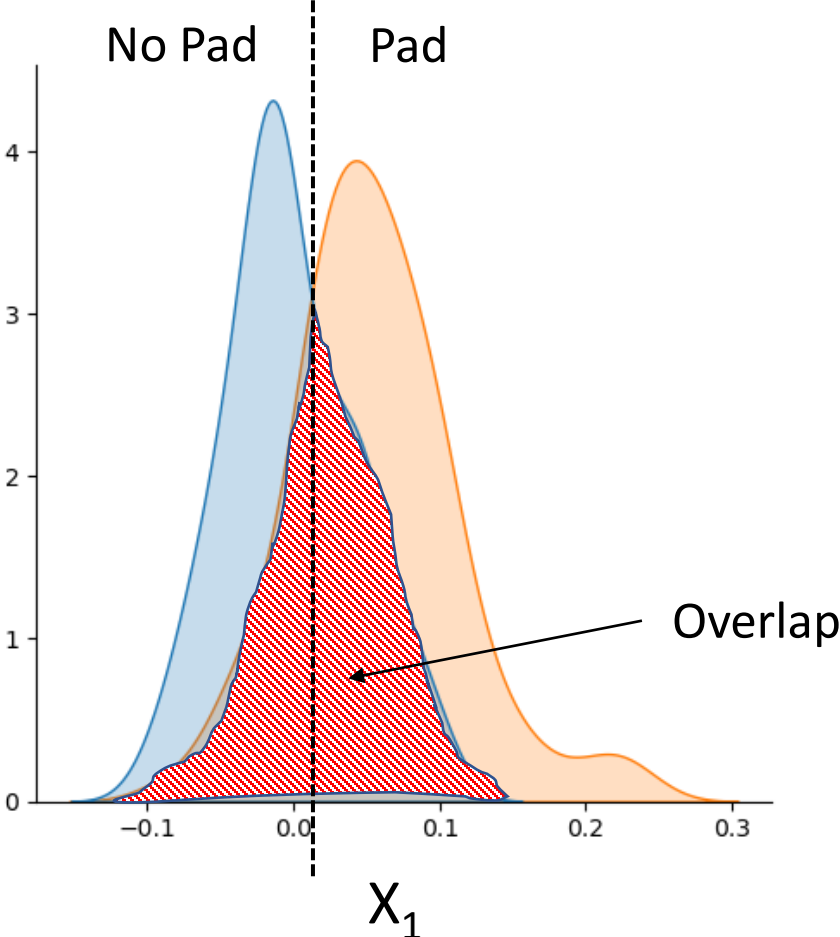
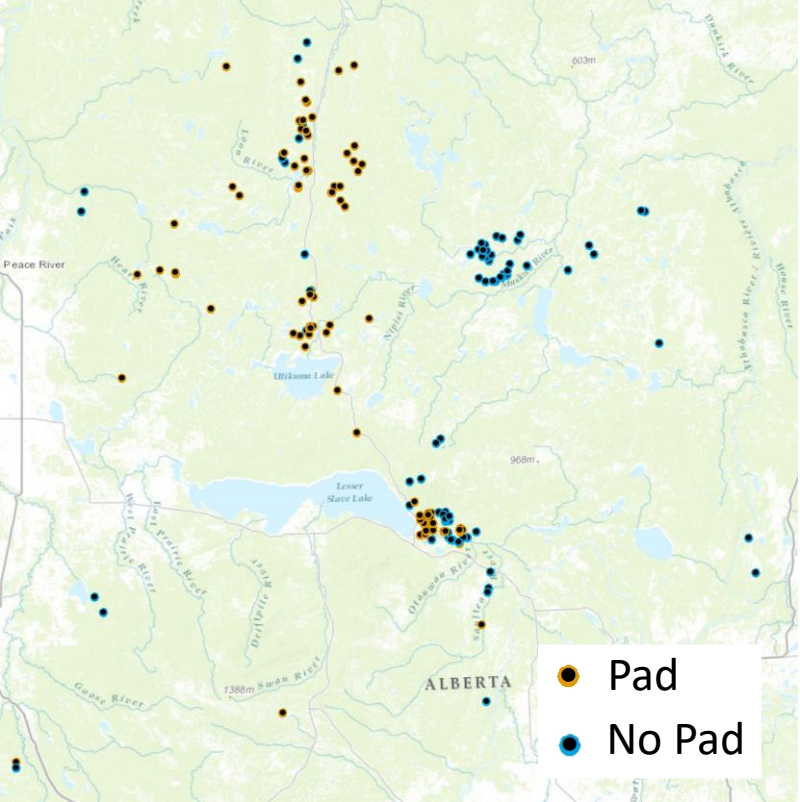
# Padded vs. unpadded sites: One variable

Known Wellsites

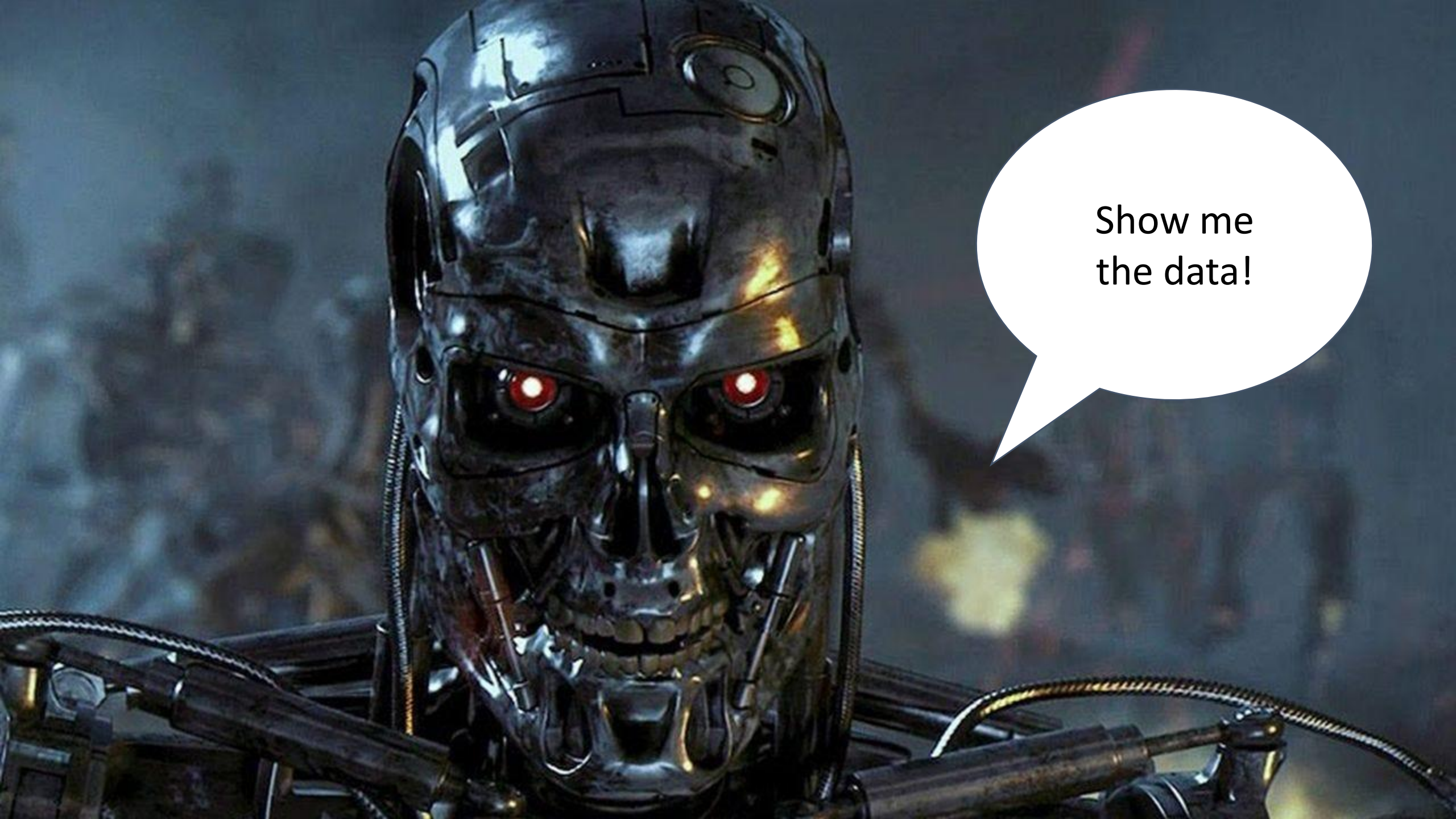


# Padded vs. unpadded sites: One variable

Known Wellsites





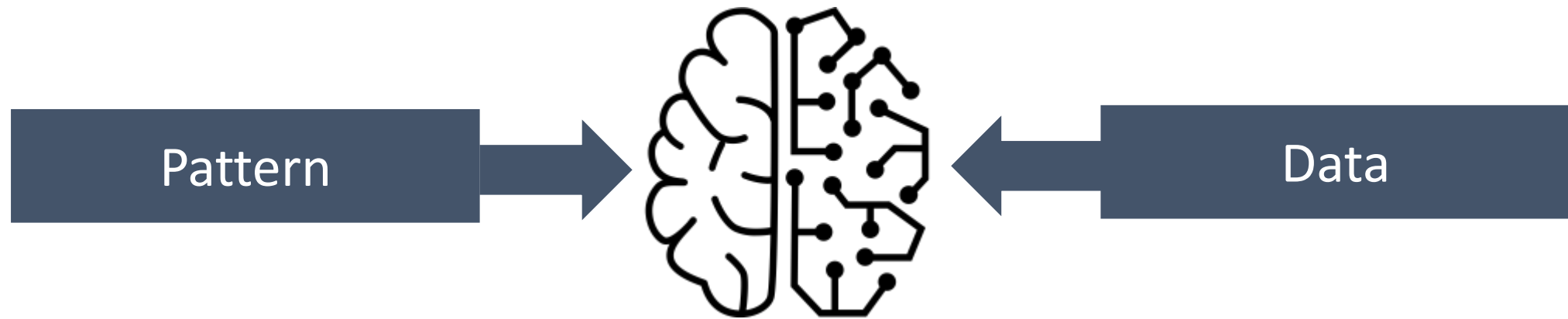


Show me  
the data!



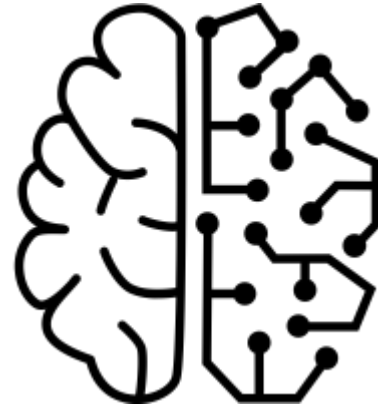
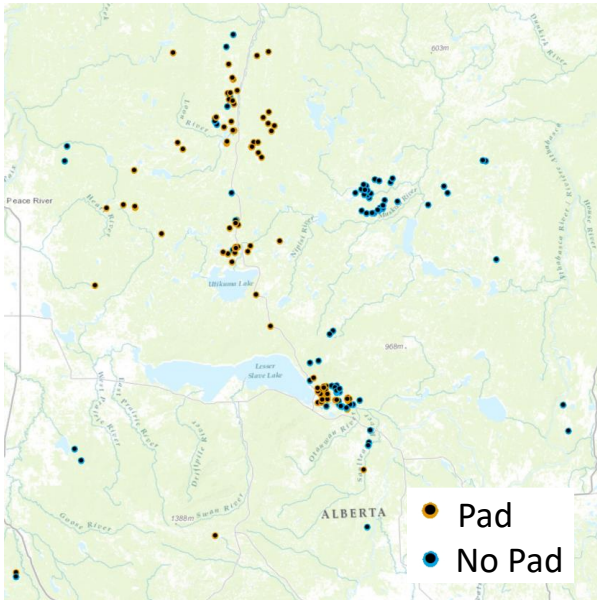
# Machine learning: What is it?

Machine learning is the process of teaching a computer to learn to identify patterns like a human brain using data

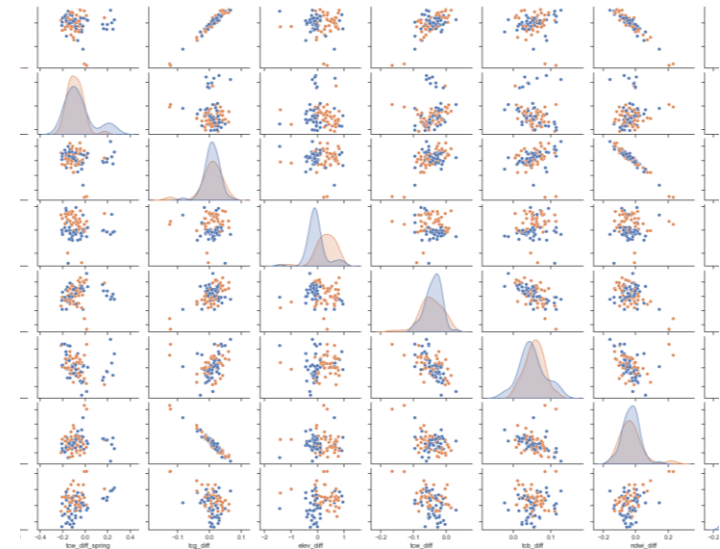


# Teaching a machine to recognize a pad

Pattern



Data



Can we use remote sensing and machine learning to identify pads?

# We need an inventory of padded sites

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# We need an inventory of padded sites

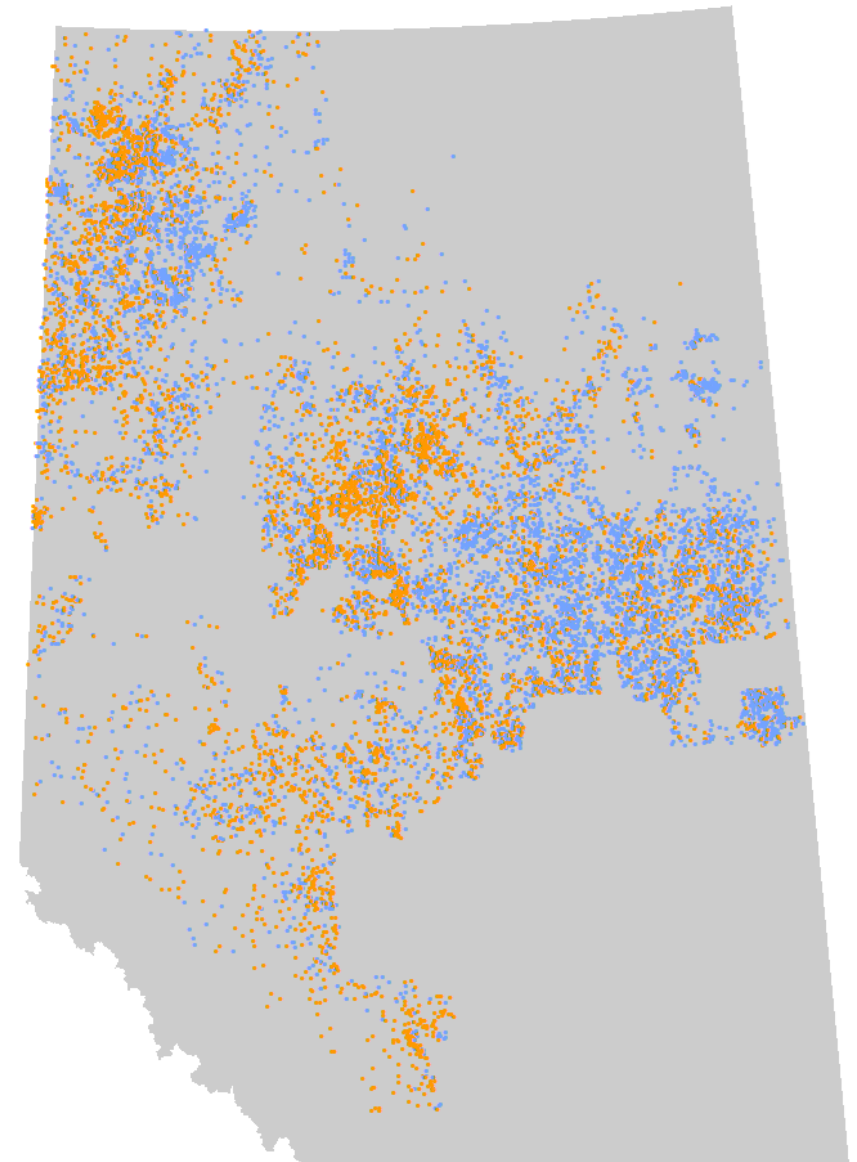
- **How many pads are there?**
- **Where are they located?**
- How are these sites distributed across wetland ecosystems?

# Results

**Padded  
wellsites:  
7,077**

**Unpadded  
wellsites:  
8,006**

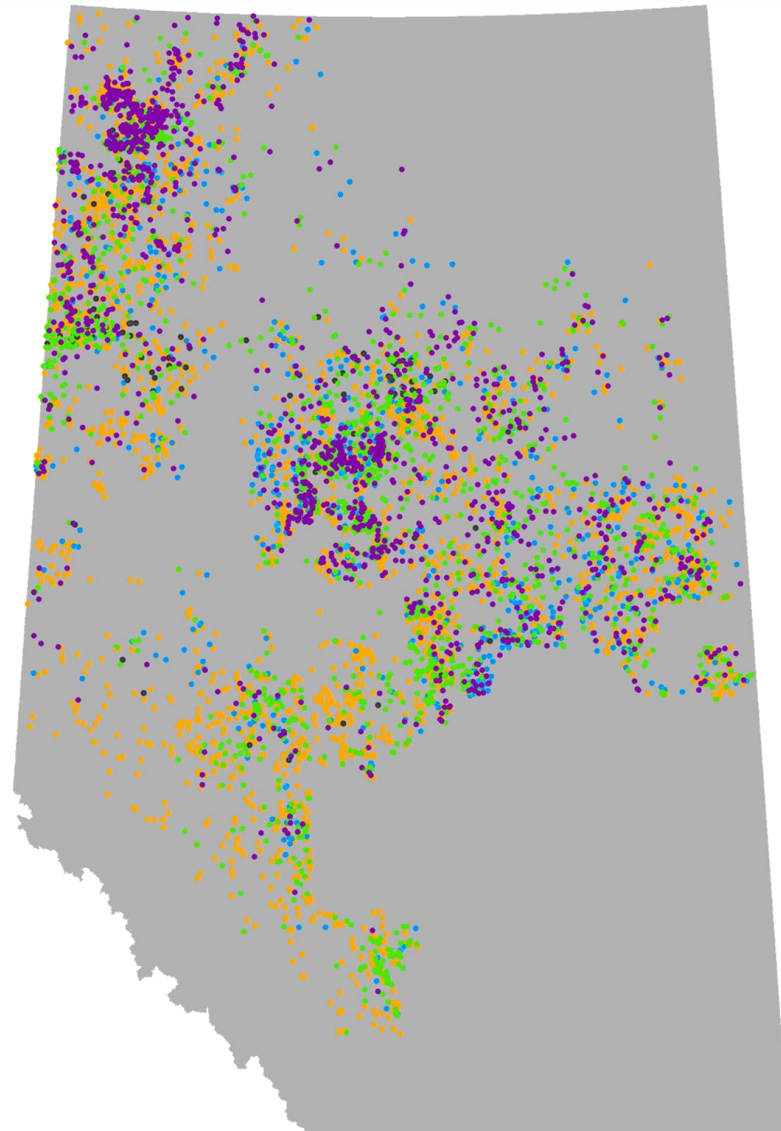
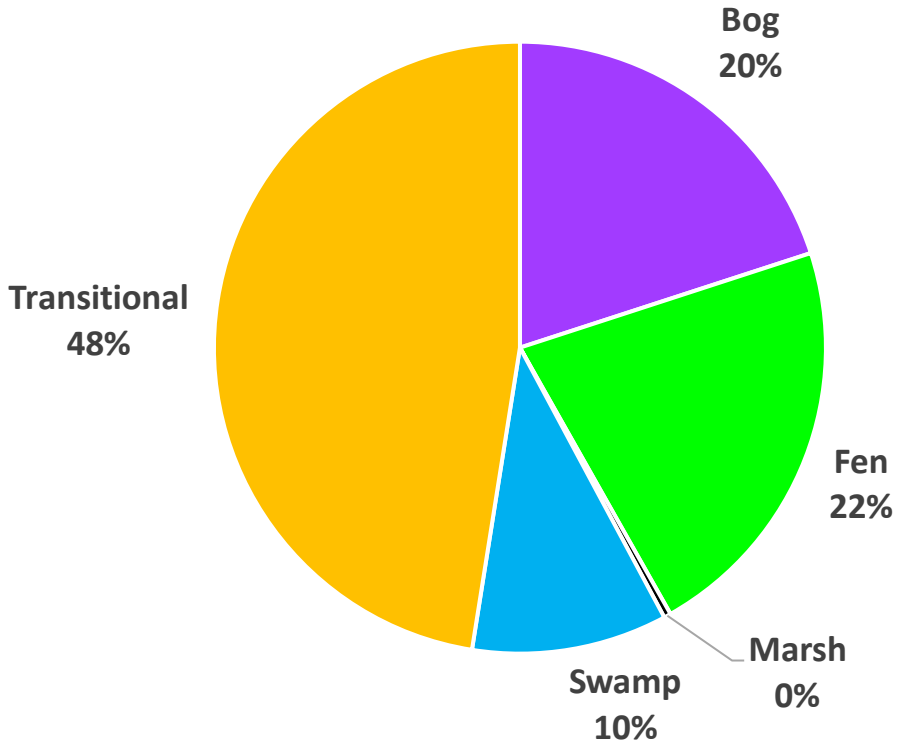
**→ 78% classification accuracy**



# We need an inventory of padded sites

- How many pads are there?
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- **How are these sites distributed across wetland ecosystems?**

# Results





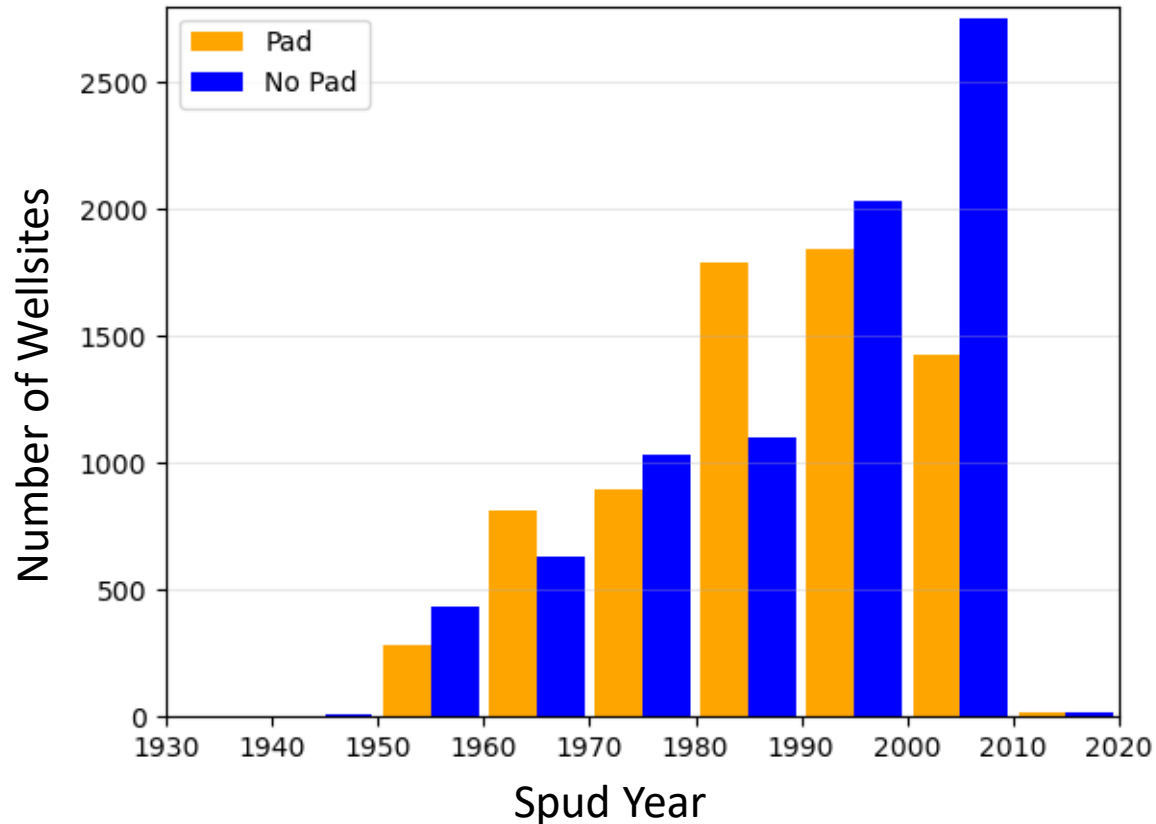
# Future work

Understand the impacts of padded wellsites in peatlands (both on and off-site).



# Future work

Wellsite Classification by Spud (construction) Year



We can look back in time and study the trajectory of recovery.

# What can remote sensing do for reclamation?

- Remote sensing data and imagery collected by satellite and aerial sensors are powerful tools that can help energy companies, reclamation professionals, and regulators
- Examples of applications:
  - Map topography/terrain features
  - Vegetation and land use/ land cover
  - Pre-drilling condition
  - Spill detection

# What can remote sensing do for reclamation?

- Remote sensing can ***enhance*** reclamation methods, ***not replace*** them!
- Example: Identify vegetation species during field survey, then track vegetation trends using remote sensing data
- Reduce expenditure + timeline for reclamation
- Tools exists (from mining, precision agriculture), but not yet widely operationalized in reclamation work
- Active research!

# Acknowledgements



# Thank you!

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