Large-Scale Wetland Mapping in AB Using Open Access Satellite Data and AI

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EO Insights Unit

ABMI

Water Management in AB's Boreal 2025

The ABMI respectfully acknowledges that our work takes place on the territories of Treaties 4, 6, 7, 8, 10 and the Métis homeland, traditional and ancestral lands of First Nations and Métis Peoples, whose histories, languages, and cultures are directly linked to the biodiversity that we monitor. We acknowledge the traditional teachings of the lands that we work on, and that reciprocal, meaningful, and respectful relationships with Indigenous peoples make our work possible. We are deeply grateful for their stewardship of these lands, and we are committed to supporting Indigenous-led monitoring programs, while learning Indigenous ways of knowing, being, and doing.

COMMUNITY BASED
MONITORING
AND ENGAGEMENT

Presentation Outline

1. The ABMI
2. Wetland mapping
3. Enhancing wetland mapping
4. Complimentary case studies
5. Where to access ABMI wetland data

Part 1

The ABMI

ABMI ALBERTA BIODIVERSITY MONITORING INSTITUTE

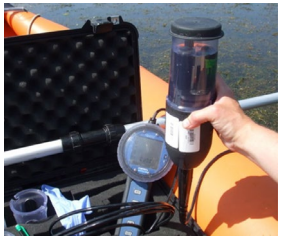
Alberta Biodiversity Monitoring Institute

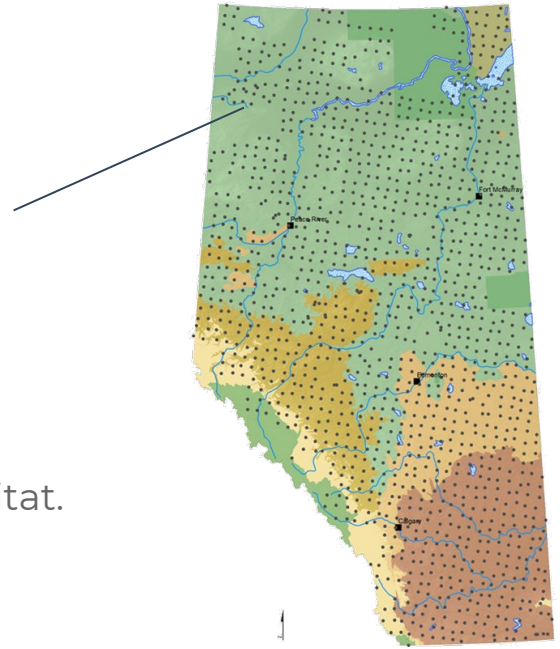
Who are we and what is our goal?

- Established in 2007.
- Arms length, non regulatory, non profit org.
- Vision to advance biodiversity monitoring to inform responsible resource mgmt & land stewardship.
- Mission to track changes in AB wildlife & habitats.
- Ongoing, relevant, scientifically credible info.

Alberta Biodiversity Monitoring Institute

How do we do it?





- Ongoing, systematic ground sampling of species and habitat.
- Map and monitor AB's human footprint & land cover.
- Provide open access data & products.

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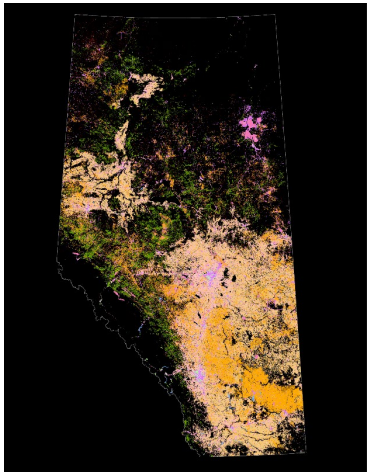
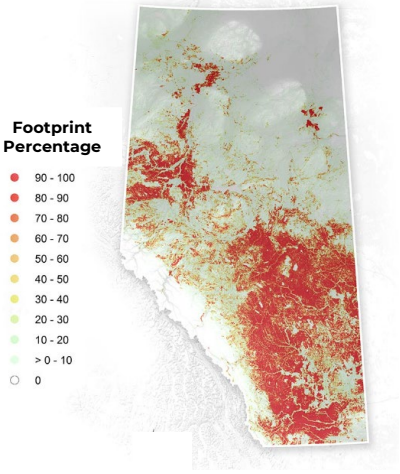
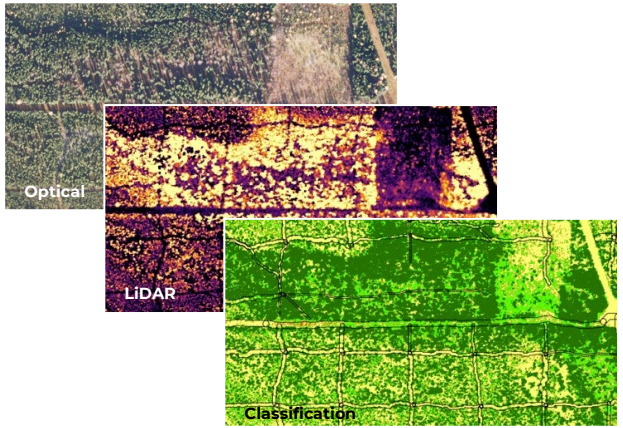
Geospatial Center

- Goal to understand land cover distribution and change.
- Datasets and maps produced from diverse data & technologies.





Human footprint inventory



Vegetation regeneration

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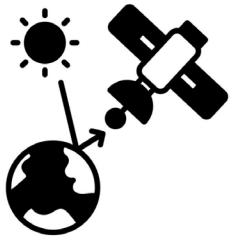
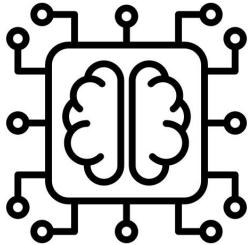
Earth Observations (EO) Insights Unit

- Harness satellite data to better understand AB's changing environment.
- Habitat mapping and monitoring.



Satellite

Remote Sensing



AI &

Machine Learning

GIS &

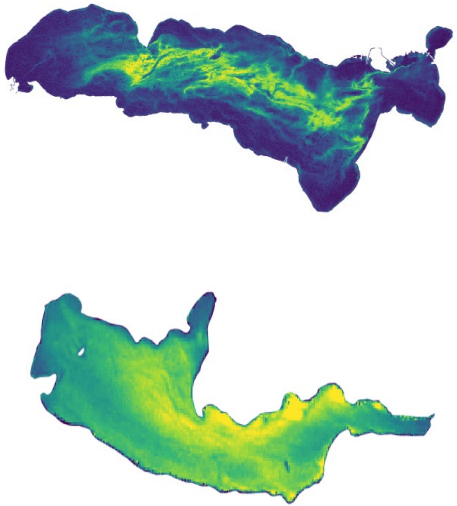
Spatial Data Science

Alberta Biodiversity Monitoring Institute

Earth Observations (EO) Insights Unit

- Harmful algal bloom monitoring with EO.
- Satellite-based chlorophyll-A detection.

Wabamun Lake



Nakamun Lake

Part 2

Wetland Inventory Mapping

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Wetland Ecosystems

Critical habitat

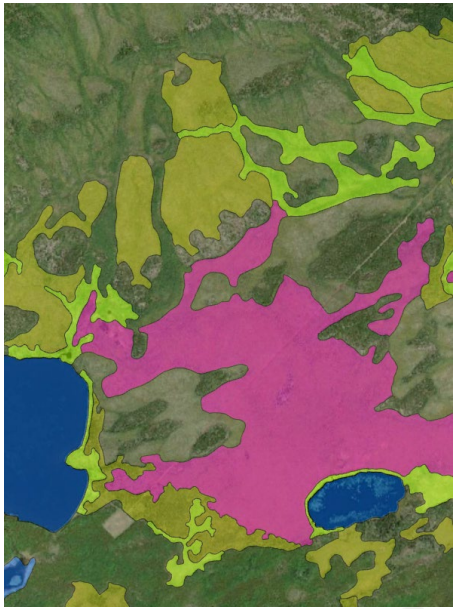
- **Enhance biodiversity** — *habitat for plants and animals*
- **Flood mitigation** — *absorbs excess water*
- **Improve water quality** — *filters pollutants & sediments from run off*
- **Carbon storage** — *helping combat climate change*

Source: National Environmental Treasure

Wetland Inventories

Critical information

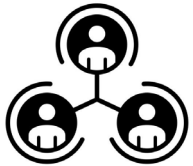
- **Support responsible mgmt** — *knowing what wetlands are where*
- **Assists in wetland restoration** — *identifies degraded wetlands*
- **Locates wetlands for avoidance, mitigation** — *in areas of proposed development*
- **Recognizes rare wetlands** — *maps unique wetland features*
- **Provides state of knowledge** — *status and trends of wetlands*



Wetland Inventories

The importance of knowing where

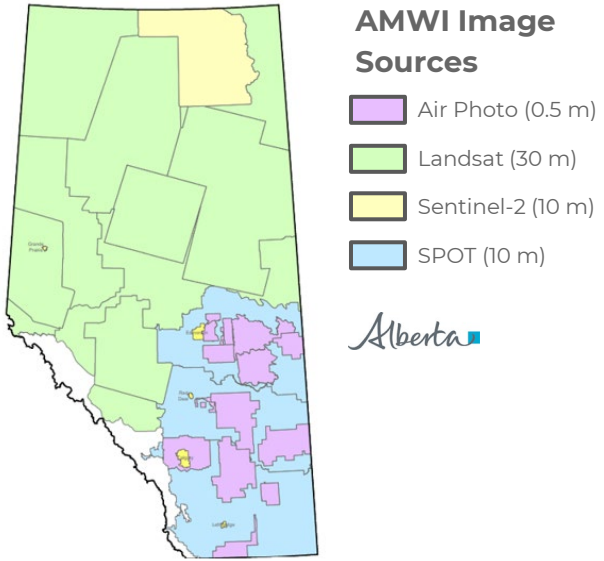
- 2024, ABMI conducted stakeholder survey, identifying wetland knowledge needs.
- Accurate, updated, spatial wetland inventory mapping was among the most sought-after data type.
- Parallel internal survey by GOA-EPA found similar results.



Wetland Mapping in Alberta

Alberta Merged Wetland Inventory (AMWI)

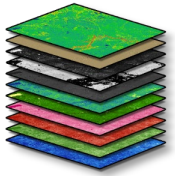
- Dated (1998-2015)
- Limited coverage
- Limited thematic detail
- Variable methods
- Variable inputs
- Variable in quality



Geospatial Tools for Wetland Mapping

Tech trends

- Three big trends are shifting the way geospatial data and technology are applied to large-area wetland inventory mapping and monitoring…



Rapid growth in open-access satellite data

Rise of cloud computing services

Advancements in AI & machine learning

Geospatial Tools for Wetland Mapping

ABMI R&D

- ABMI has been at the forefront of geospatial and AI technology for wetland mapping.

remote sensing MDPI

Article

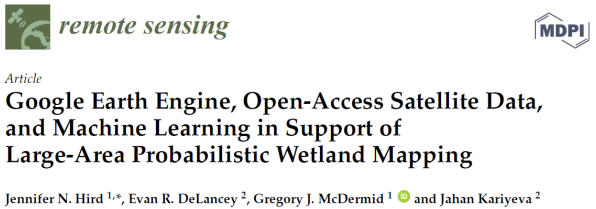
Creating a Detailed Wetland Inventory with Sentinel-2 Time-Series Data and Google Earth Engine in the Prairie Pothole Region of Canada

Evan R. DeLancey [1,2,*], Agatha Czekajlo [1], Lyle Boychuk [3], Fiona Gregory [1], Meisam Amani [4], Brian Brisco [5], Jahan Kariyeva [1] and Jennifer N. Hird [1]

RESEARCH ARTICLE

Large-scale probabilistic identification of boreal peatlands using Google Earth Engine, open-access satellite data, and machine learning

Evan Ross DeLancey [1]*, Jahan Kariyeva [1], Jason T. Bried [1]=, Jennifer N. Hird [2]



remote sensing MDPI

Article

Google Earth Engine, Open-Access Satellite Data, and Machine Learning in Support of Large-Area Probabilistic Wetland Mapping

Jennifer N. Hird [1,*], Evan R. DeLancey [2], Gregory J. McDermid [1] and Jahan Kariyeva [2]

remote sensing MDPI

Article

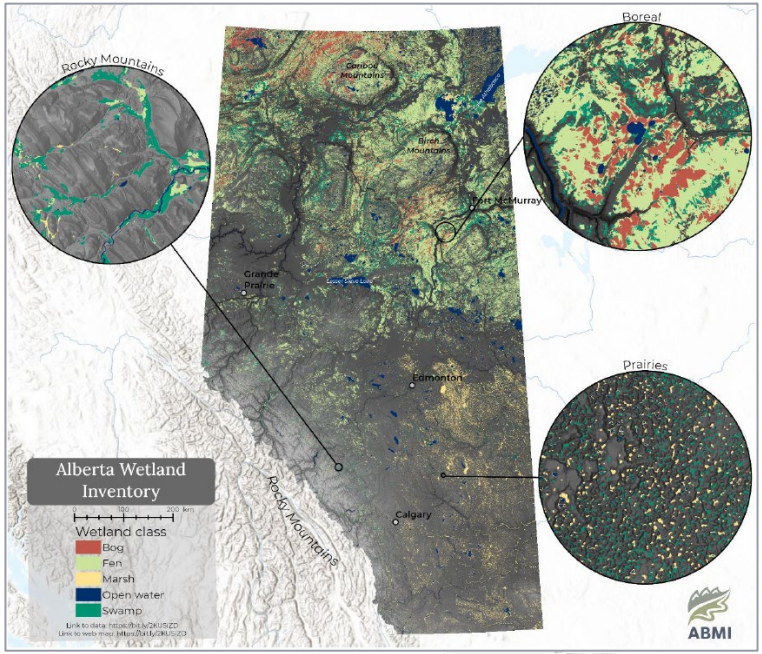
Comparing Deep Learning and Shallow Learning for Large-Scale Wetland Classification in Alberta, Canada

Evan R. DeLancey [1,*], John F. Simms [2], Masoud Mahdianpari [3], Brian Brisco [4], Craig Mahoney [5] and Jahan Kariyeva [1]

ABMI

ABMI's Wetland Inventory

Large Scale Wetland Mapping



- AI-driven
- Released in 2021
- Publicly available
- 5 major wetland classes
  - Water
  - Marsh
  - Fen
  - Bog
  - Swamp

  According to CWCS and AWCS
- 10 m pixel resolution

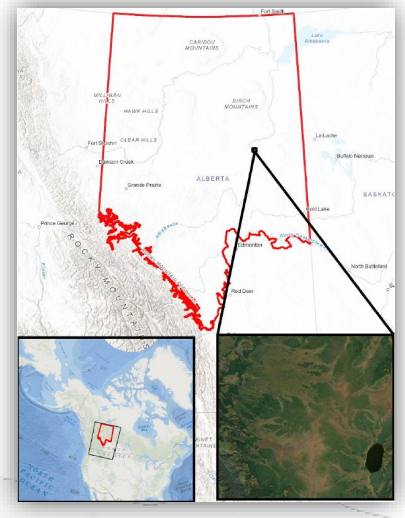
ABMI's Wetland Inventory

Large Scale Wetland Mapping

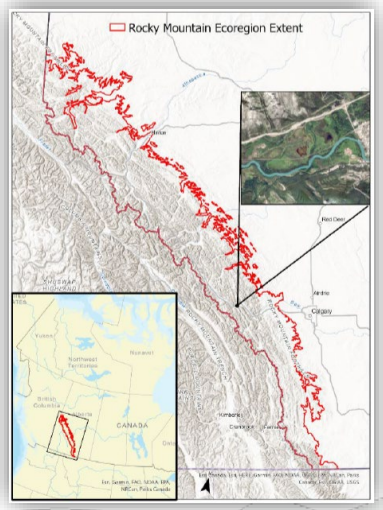
- Completed in three stages, each using Earth Observation, cloud-computing and AI.

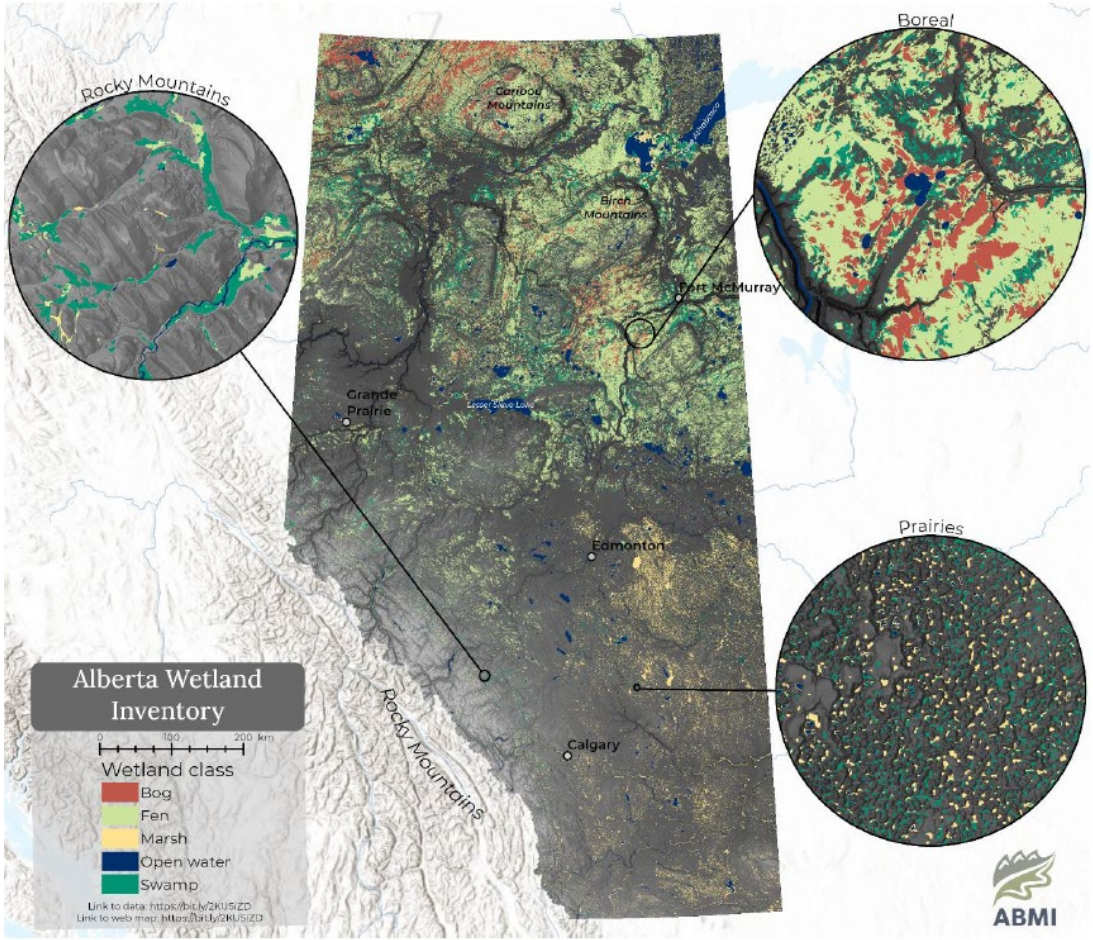
Prairie Pothole Region

Boreal region



Rocky Mountain Region





- > 3m wetland polygons
- 78% is upland
- 4% open water
- 18% wetland
  - 12% fen
  - 3% swamp
  - 2% marsh
  - 2% bog
- Marshes, swamps dominated in Prairies
- Peatlands dominated in the Boreal

ABMI

ABMI's Wetland Inventory

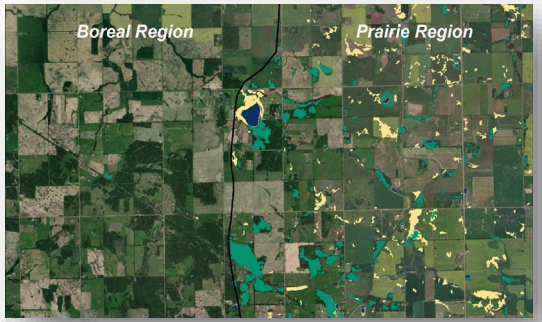
Summary

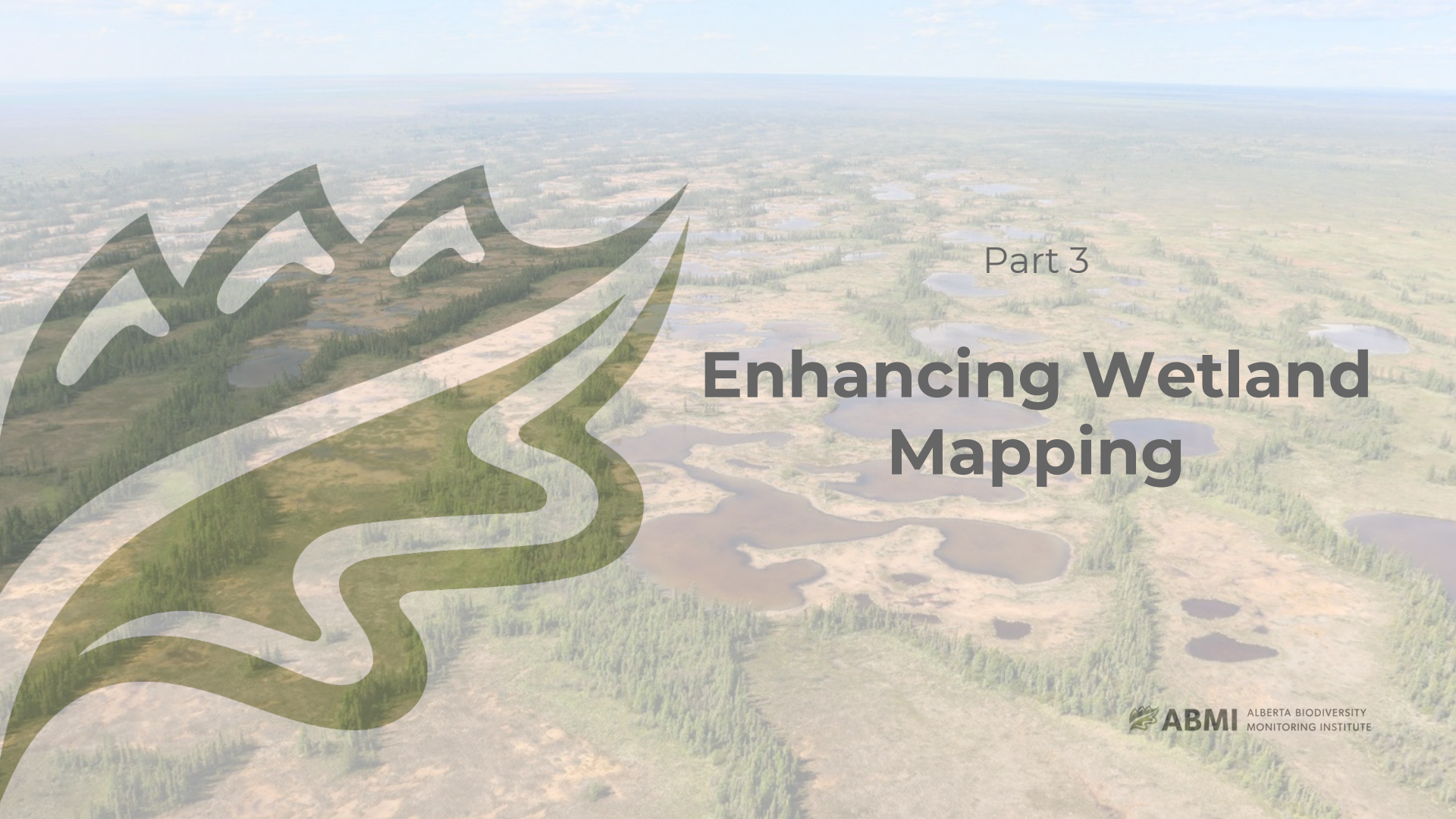
Strengths

- Province-wide coverage
- Thematic consistency
- Temporal consistency
- Reproducible

Limitations

- Variable accuracies
- Seams along regional boundaries
- Thematic depth





Part 3

Enhancing Wetland Mapping

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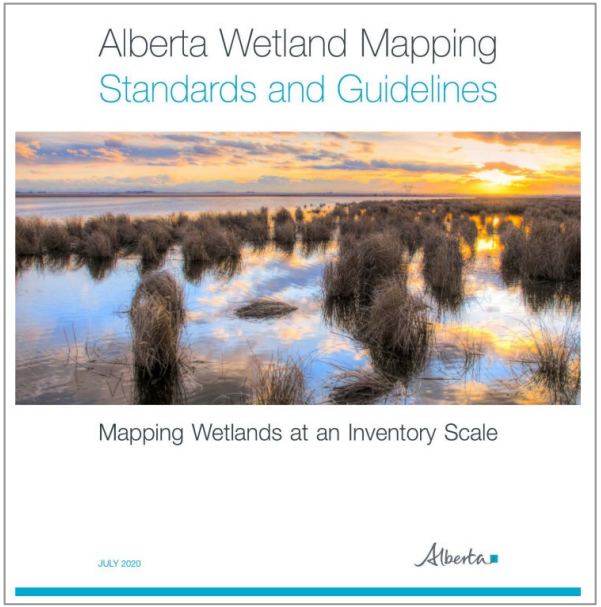
Mapping Guidelines

Inventory Standards

- Min standards & guidelines
- Promote consistency
- Improve data quality
- Support wetland policy, monitoring & planning

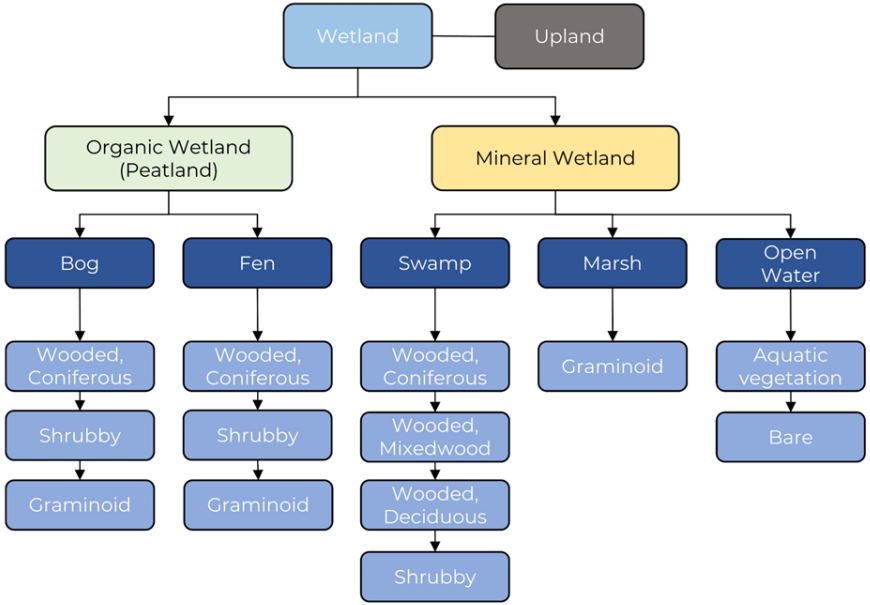
Standards

1. ***Detail***
2. ***Accuracy***
3. ***Minimum feature size***



Mapping Guidelines

Mapping Standards



Wetland / Upland
Min. Accuracy = 90%

'Class' Detail
Min. Accuracy = 80%

'Form' Detail
Min. Accuracy = 70%

Alberta Wetland Classification System

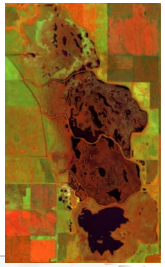
R&D Mapping

AI-driven mapping

- 2023 R&D
- Better training data
- Better model inputs
- Enhanced AI modeling
- Preliminary 64% accuracy

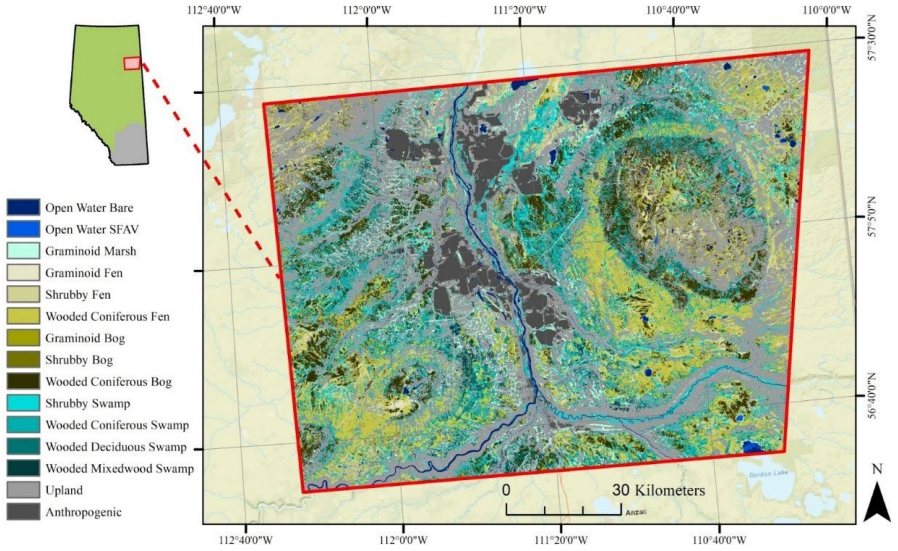
Aerial
True color

Spectral
Infrared



Radar
Microwave

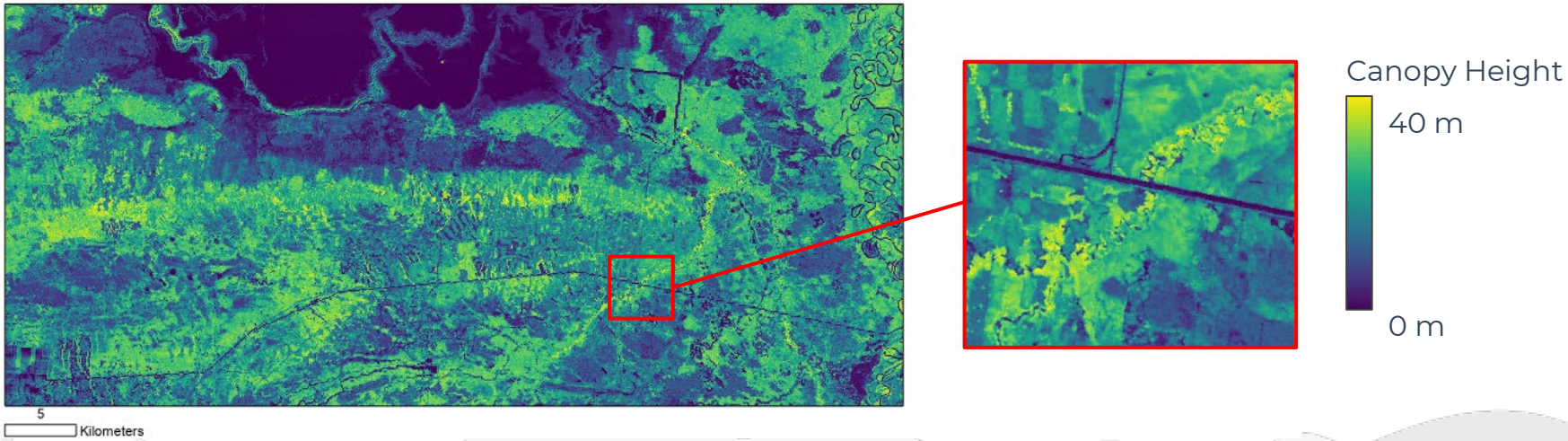
Topography
Hillshade



Looking to the Future

LiDAR Imaging

- Imaging technology that creates 3D maps of the Earth's surface.
- Predicted to improve wetland mapping.
- ABMI Imaging Center collecting LiDAR data.



Part 4

Case Studies Complementing Inventory Work

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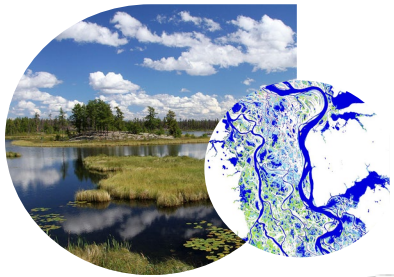
Complementing Inventory Work

Case Studies



1

Groundwater Dependent Ecosystem Mapping — *leveraging wetland inventory data for the mapping of groundwater dependent ecosystems in Alberta's boreal*

2

HydroPatterns Mapping — *enhanced mapping and monitoring of open surface water dynamics*

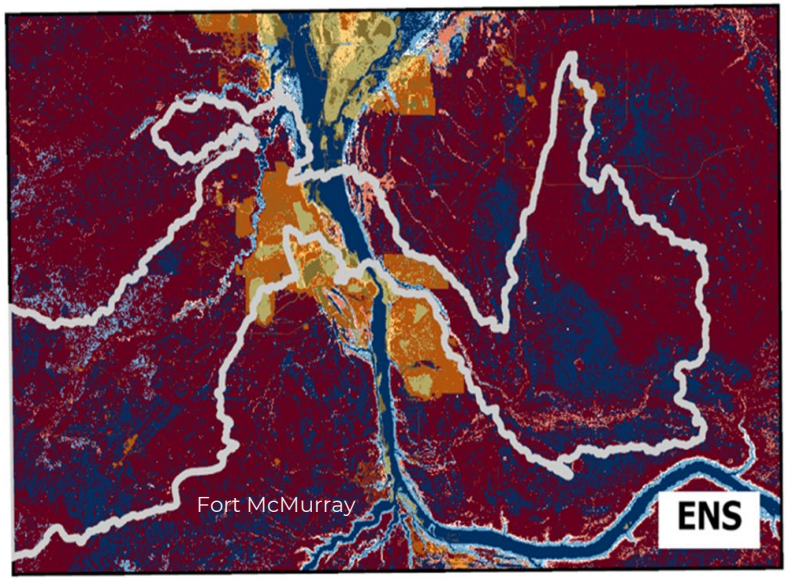
Groundwater Dependent Ecosystem Mapping

Long-term monitoring

InnoTech ALBERTA
A SUBSIDIARY OF ALBERTA INNOVATES

OIL SANDS MONITORING PROGRAM

- **GDE** — *ecosystems that that are maintained by groundwater*
- **Mapping** — *machine learning driven*
- **Model Inputs** — *remote sensing, hydrology, wetland maps*



GDEs are highly responsive to groundwater quantity and quality

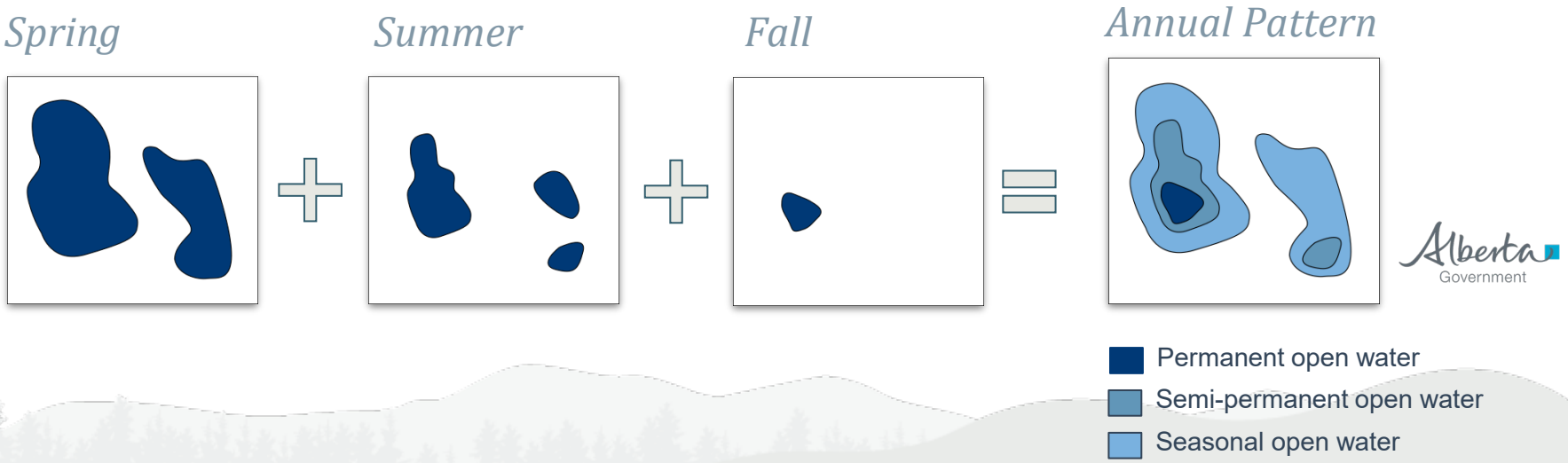
GDE Probability

- Very Low
- Low
- Medium
- High
- Very high

HydroPatterns Mapping

Dynamic monitoring

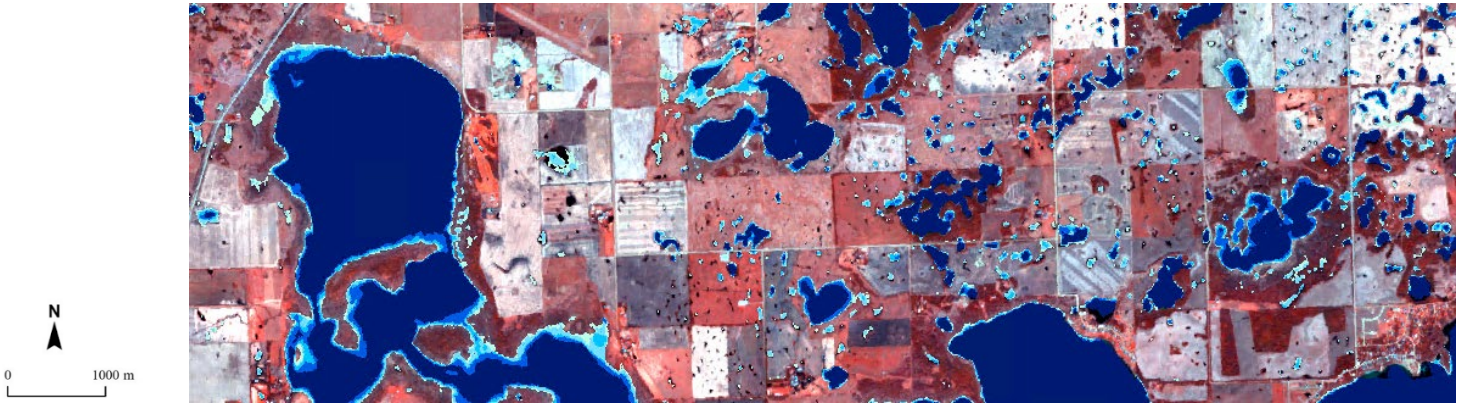
- **HydroPatterns** — capturing open surface water dynamics over time and space
- **High resolution** — 10 m resolution maps produced using cloud computing
- **Importance**— Indicator of climate change, supports wetland characterization



HydroPatterns Mapping

Dynamic monitoring

- Prairie pothole region HydroPatterns map.
- Information critical for wetland characterization.



Alberta Government

ABMI

Part 5

Where to access ABMI data

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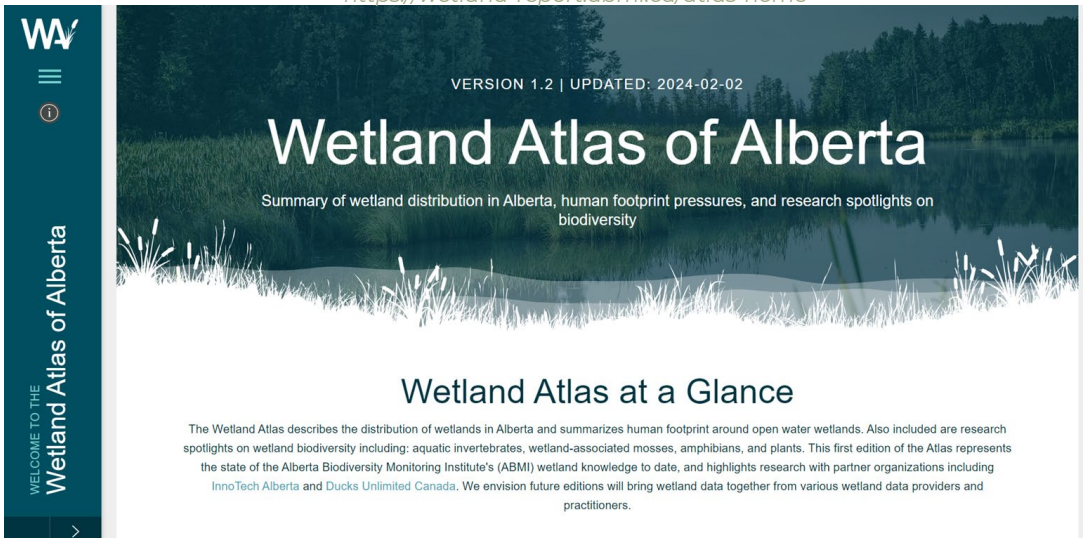
Wetland Atlas

Wetland distribution information

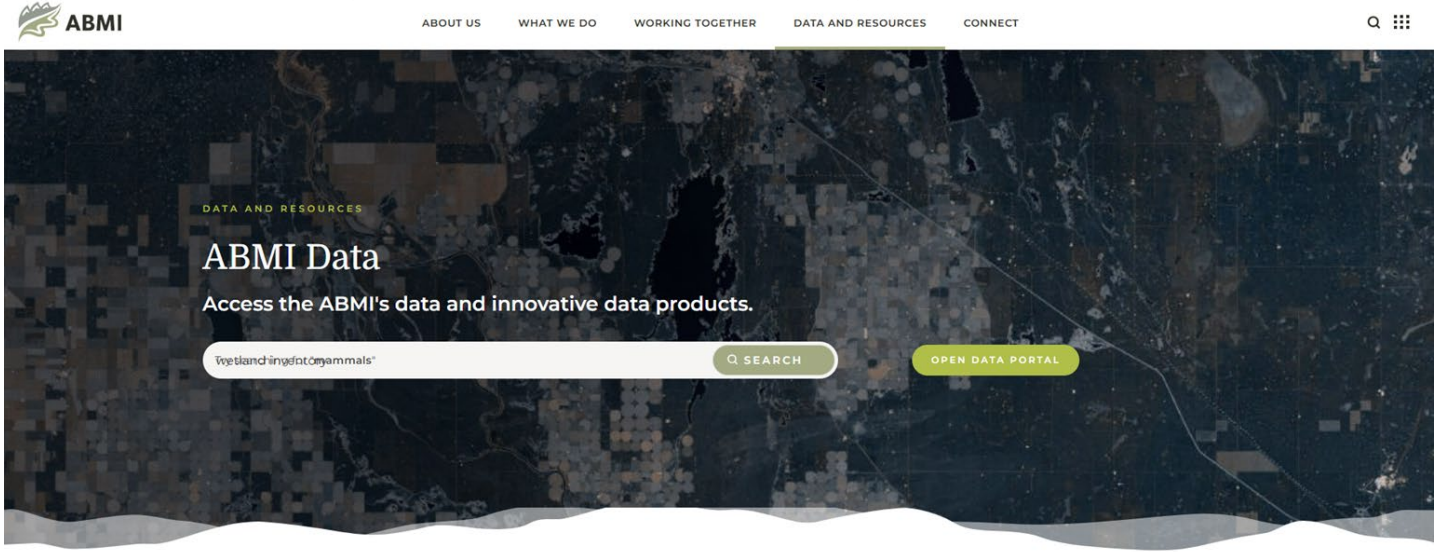
https://wetland-report.abmi.ca/atlas-home



Open Data Portal

Dataset access and download

https://abmi.ca/abmi-home/data-resources/data-portal-main



Summary

ABMI ALBERTA BIODIVERSITY MONITORING INSTITUTE

Presentation Summary

The ABMI

- The ABMI maps and monitors Alberta's landscapes
- The ABMI has extensive data on wetlands
- ABMI's wetland inventory is open access
- ABMI is conducting wetland mapping R&D
- Wetland data can inform other analysis around freshwater ecosystems and resources