Coarse Filter Monitoring: HydroPatterns

Metadata

August, 2025

ABMI ALBERTA BIODIVERSITY MONITORING INSTITUTE

Overview

Summary

The Alberta Biodiversity Monitoring Institute (ABMI) HydroPatterns dataset describes the spatial and temporal dynamics of open surface water, focusing primarily on lentic (standing) water bodies rather than lotic (flowing) water. While similar in concept to hydroperiod, HydroPatterns has a broader focus, encompassing all lentic surface water bodies. The dataset was developed in and covers two study areas in Alberta: one in the boreal region and one in the prairie region. For each study area, the dataset includes a time-series stack of monthly open surface water maps, along with annual, seasonal, and multi-annual average inundation frequency maps covering the growing seasons from May 1 to October 31 for the years 2020-2023.

Description

The ABMI HydroPatterns dataset is available as two raster datasets, each covering a 5,000 km^2 project area in Alberta, and mapping open surface water features as small as 100 m^2 within the 2020-2023 growing seasons. Each data set includes:

i. Monthly open surface water maps (OSWMs) from May to October for each year

ii. Annual inundation frequency maps

iii. Seasonal inundation frequency maps (spring, summer, and fall)

iv. A multi-annual average inundation frequency map

Inundation frequency is defined as the percentage of time each pixel is flooded.

Methods

Mapping open surface water dynamics involved two main steps: (1) monthly detection of open surface water and (2) assessment of dynamics. Open surface water presence was mapped monthly at a 10 m spatial resolution for the growing seasons (May-October) of 2020-2023. Analyses were based on the European Space Agency's Sentinel-2 (S2) imagery, with Sentinel-1 (S1) imagery used to fill gaps caused by clouds and shadows, and topographic variables derived from the GLO-30 Digital Elevation Model (European Space Agency, COPERNICUS, 2019).

Training datasets were generated from the existing Landsat-based Canadian Dynamic Surface Water Maps product (Olthof & Rainville, 2022), with quality control performed using an adaptive spectral-based thresholding approach. Using Google Earth Engine cloud platform, both object-based and pixel-based modeling approaches were evaluated along with several machine learning algorithms to determine the most suitable strategy.

Three validation datasets were used to assess open water map accuracies: one in the boreal study area and two in the prairie study area. In the boreal study area, water and non-water polygons were manually digitized within a 19,000 ha area using the May 2020 Planet Basemap (RGB, 4.77 m resolution) at a 1:7,500 scale, followed by a pixel-based accuracy assessment. In the prairie study area, OSWMs were validated for May 2020 and July 2023. For May 2020, Ducks Unlimited Canada shallow open water and upland polygons interpreted from stereo photos on May 14th 2020 were used for a pixel-based accuracy assessment; polygons smaller than 0.04 ha were excluded. For July 2023, the ABMI Wetland Field Sites, including shallow open water and upland points, were used for a point-based accuracy assessment.

Multiple quality control steps were performed to ensure minimal misclassifications. A 3 × 3 majority filter was applied to each monthly OSWMs to remove isolated spurious pixels. Water false positives in sloping, anthropogenic, and dense vegetation areas were addressed using a slope mask from the GLO-30 DEM (i.e., water pixels with slopes > 8 degrees were removed as water pixels), an anthropogenic mask from the Human Footprint Inventory (Alberta Biodiversity Monitoring Institute and Alberta Human Footprint Monitoring Program, 2023), and a vegetation mask based on the Meta Canopy Height model (i.e., water pixels with > 1 m canopy height were removed as water pixels) (Tolan et al., 2024).

All monthly OSWMs were stacked to form a time-series for each study area. Inundation frequency, or the percentage of time a pixel was open water from 0% (never flooded) to 100% (permanent water), was calculated:

i. Annually (2020 - 2023)

ii. Seasonally

- Spring (May - June)
- Summer (July - August)
- Fall (September - October)

iii. Over the entire study period (2020 - 2023)

Changes in total open surface water extent from month to month were extracted from the stack and visualized in a plot.

Please see the ABMI Coarse Filter Monitoring: HydroPatterns Project Report (ABMI, 2025) for additional methodological details.

Citation

Alberta Biodiversity Monitoring Institute (2025). Coarse Filter Monitoring: HydroPatterns (Version 1.0). Last modified August 20, 2025.

Acknowledgements

We acknowledge Alberta Environment and Protected Areas for providing funding for this work, and Ducks Unlimited Canada for providing us with a valuable dataset for our validation purposes. We thank both organizations for their valuable input and feedback.

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Keywords

open surface water, lentic ecosystems, spatio-temporal dynamics, hydropatterns, cloud-computing, automation, machine learning, hydroperiod

Use Limitations

This dataset was based on freely available open-source data: Sentinel-1 Synthetic Aperture Radar (SAR) data, Sentinel-2 optical data, and the Copernicus DEM GLO-30 topographic variables. This ABMI HydroPatterns dataset may be freely used if cited properly.

Data Product Specifications

Spatial Resolution

10 meters

Processing Environment

Google Earth Engine; R Studio; ESRI ArcGIS Pro 3.2.2

Resource Maintenance

Resource maintenance update frequency: to be determined

Spatial Reference

Projected Coordinate System: NAD 1983 10 TM AEP Forest
Projection: Transverse Mercator
WKID: 3400
Authority: EPSG
Linear Unit: Meter (1.0)

False Easting: 500000.0
False Northing: 0.0
Central Meridian: -115.0
Scale Factor: 0.9992
Latitude of Origin: 0.0
Geographic Coordinate System: NAD 1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D North American 1983
Spheroid: GRS 1980
Semi-major Axis: 6378137.0
Semi-minor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

Lineage

The HydroPatterns dataset was developed using open-source data and processed within freely available computational environments. This dataset represents the second effort by the ABMI at monitoring open surface water fluctuations over time, following the older Hydro Temporal Variability 2014-2017 dataset (DeLancey et al., 2018). The current dataset expands upon the previous effort with updated temporal coverage, higher temporal resolution, and refined methods that are fully automated, scalable, efficient, and reproducible for detecting open surface water dynamics.

HydroPatterns Dataset

The HydroPatterns dataset is a product of multiple layers - a full list of these layers with descriptions and formats is provided in Table 1. Monthly open surface water maps indicate the presence of open surface water (0: no-water, 1: water). Inundation frequency, ranging from 0 (permanently dry) to 100% (permanent water), represents the percent of a given time with open surface water presence at any given location.

Table 1. Description of the HydroPatterns dataset in the boreal and prairie study areas during 2020-2023 growing seasons.

Folder name	Sub-folder name	Description	Format
Boreal_StudyArea	Boreal_Area_Boundary	The boundary of the chosen boreal study area	Shapefile (.shp)
	Monthly_OpenSurfaceWater_Maps	24 resultant monthly open surface water maps (OSWMs), organized by years	Raster (.tif)

		For example, OSWM_2020_May is the open surface water map for May 2020.	
	Annual_Inundation_Frequency	Four yearly/annual inundation frequency maps from 2020 to 2023	Raster (.tif)
	Seasonal_Inundation_Frequency	Three seasonal inundation frequency maps in spring (May-June), summer (July-August), and fall (September-October)	Raster (.tif)
	Average_Inundation_Frequency	One 4-year average inundation frequency map	Raster (.tif)
Prairie_StudyArea	Prairie_Area_Boundary	The boundary of the chosen prairie study area	Shapefile (.shp)
	Monthly_OpenSurfaceWater_Maps	24 resultant monthly open surface water maps (OSWMs), organized by years	Raster (.tif)
	Annual_Inundation_Frequency	Four yearly/annual inundation frequency maps from 2020 to 2023	Raster (.tif)
	Seasonal_Inundation_Frequency	Three seasonal inundation frequency maps in spring (May-June), summer (July-August), and fall (September-October)	Raster (.tif)
	Average_Inundation_Frequency	One 4-year average inundation frequency map	Raster (.tif)

References

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