A Harmonized Arctic-Boreal Lake (HABL) database for studies of carbon form, flux, and processing in northern lakes

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Introduction

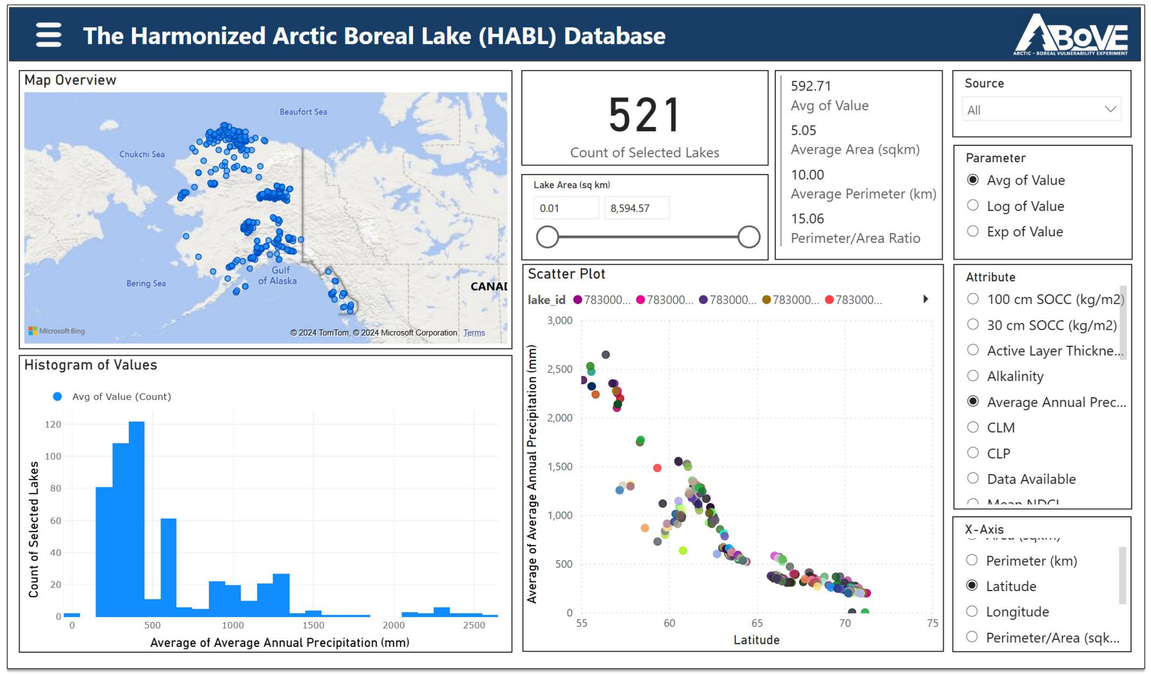
Quantifying spatially and temporally heterogenous variability of Arctic-Boreal lake systems is important for predicting aquatic carbon form, flux, and processing. Here, we introduce the Harmonized Arctic-Boreal Lake database (HABL), an interactive, spatially explicit repository of remote sensing and field measurements of inland water carbon chemistry. The database currently contains in-situ measurements and satellite retrievals for over 2,7000 lakes for the period 1984 – 2025 and will be useful for spatiotemporal lake carbon studies across the ABoVE domain.

Methods

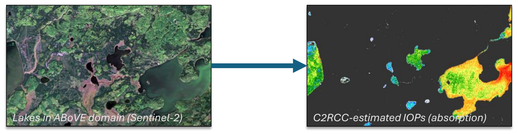
- Compiled in-situ limnological measurements from ~3,000 sites
- Assigned in-situ measurements to the nearest Prior Lake Database (PLD, Wang et al., 2025) lake polygon boundary
- Generated additional lake polygon boundaries for unmatched in-situ measurements using Sentinel-2 data and Google Earth Engine
- Extracted lake catchment boundaries and topological networks from the Harmonized Prior River-Lake Database (HarP, Sikder et al., 2024)
- Calculated >30 lake and lake catchment properties from remote sensing data and land surface models
- Incorporated optical and radar remote sensing measurements of lake water properties
- Integrated all data into a Power-BI based visualization platform for interactive data exploration and analysis

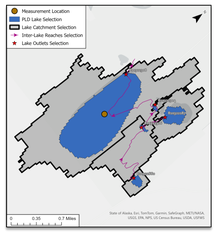
Database Design and Visualization Platform

HABL's Power BI visualization platform enables rapid, interactive analysis of lake and watershed data at user-defined spatial and temporal scales



Satellite platforms (e.g., Sentienl-2, SWOT, Landsat) are used to derive water quality and quantity metrics across all HABL lakes





HarP watershed delineations are used to aggregate land surface data (e.g., land cover, slope, SOCC, active layer thickness) for each waterbody in the HABL

Multiple dashboard pages in the HABL provide custom displays configured for timeseries analyses

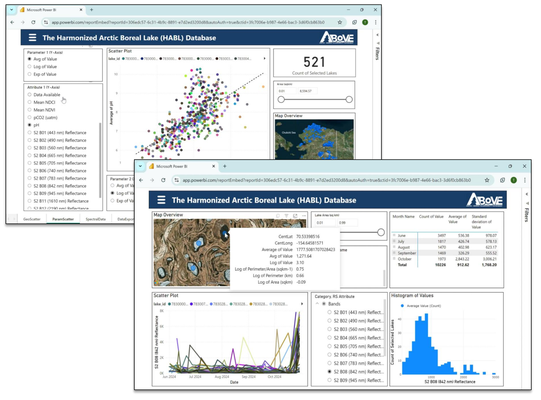
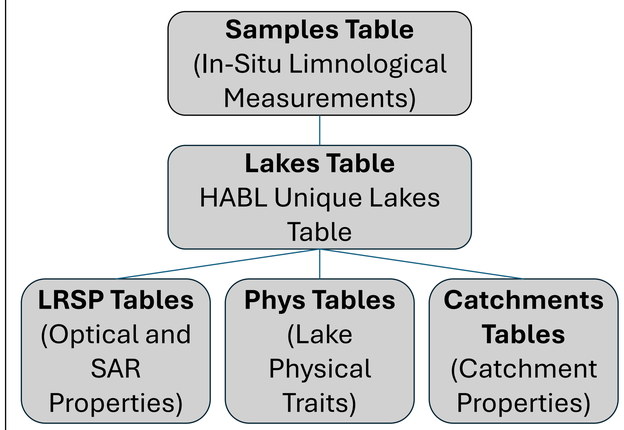


Table Schema

The HABL is a normalized relational database that links in-situ limnological measurements with remotely sensed and modeled lake and watershed metrics.



Key Datasets in HABL - Your Input Requested!

- Limnological measurements (pCO2, DOC, DIC, carbon isotopes, anions, cations)
- Climate model outputs (active layer thickness, soil organic carbon content, monthly and annual mean temperature, precipitation)
- Land surface variables (geology, land cover, slope, lake and river connectivity)
- Remotely sensed variables (reflectance, CDOM, TSS, chlorophyll-a, IOP, aquatic vegetation, water extent, water surface elevation)
- **...? Ideas welcome!**

Data Availability

Currently seeking a host for HABL. Anticipated release Summer 2025.

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