



EOLAKEWATCH: SATELLITE OBSERVATIONS FOR CANADIAN INLAND WATER ALGAL BLOOM MONITORING

Caren Binding

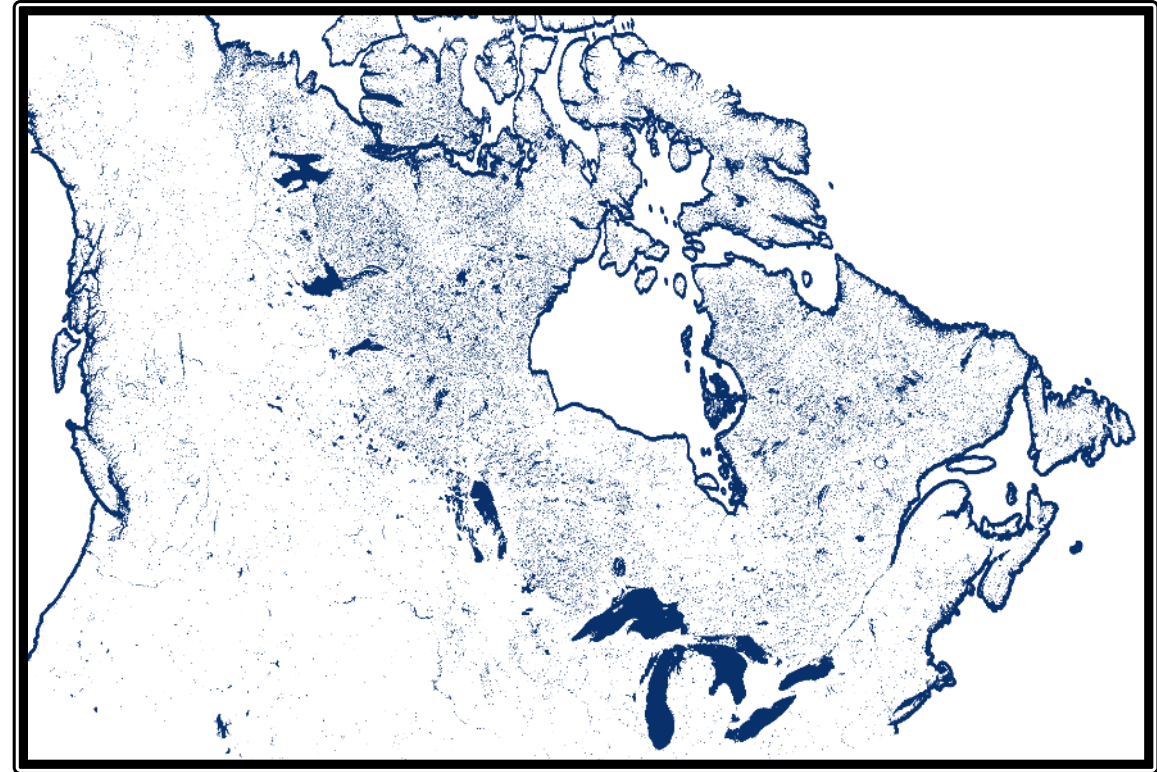
Environment & Climate Change Canada
Canada Centre for Inland Waters, Burlington, ON



Canada 

Background – Water Quality in Canada

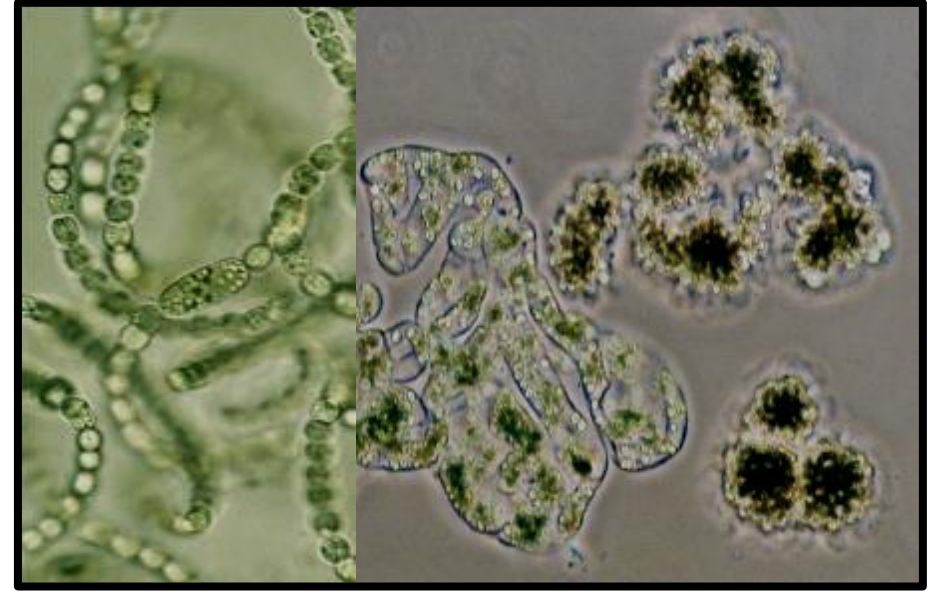
- Vast freshwater resources
 - covering ~8% of Canada's surface area
 - ~879,800 lakes > 0.10 km² *
- Canada's freshwater ecosystems are changing rapidly
 - water quality pressures from land use & climate change
- Costly and logistically challenging to monitor
 - Tiny fraction monitored regularly or systematically
- Joint responsibility for water quality among multiple levels of government
 - Newly formed Canada Water Agency



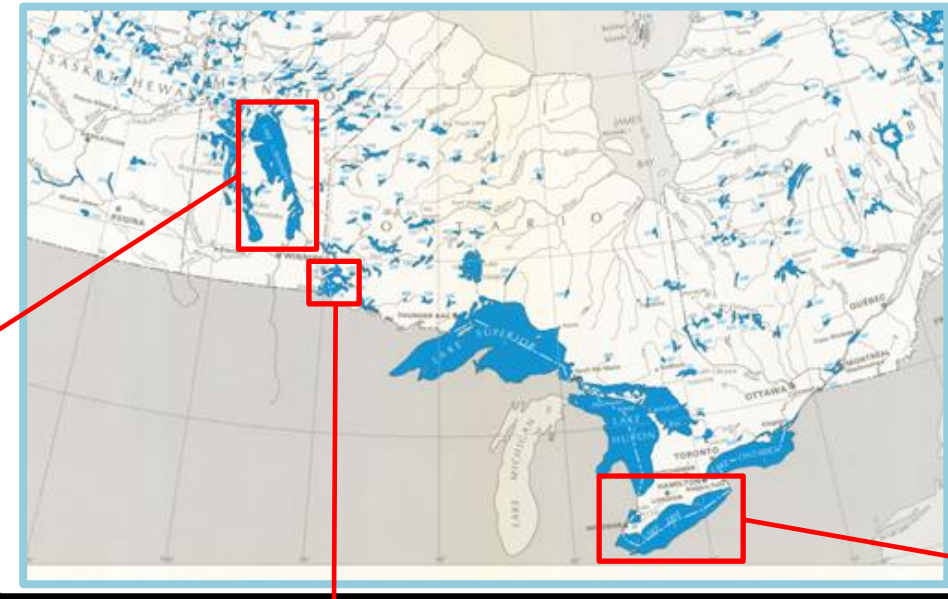
* Messenger et al. HydroLAKES 2016

Harmful & Nuisance Algal Blooms

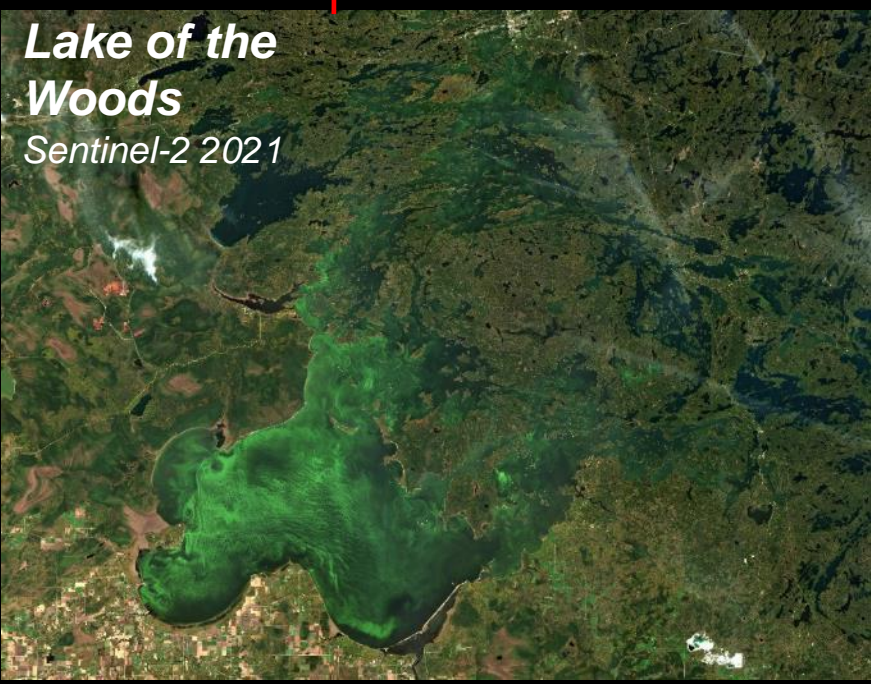
- Excessive growth of algae, cyanobacteria
- High biomass, surface scums, beach fouling
- Toxin producers, taste & odour, hypoxia
- Widespread socio-economic & ecological impacts (tourism, fisheries, public health, industry)



Remote Sensing of Canadian Inland Water HABs



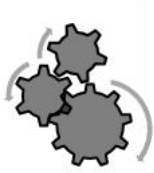
- ECCC research and monitoring to inform policies and action to address eutrophication
- Aquatic optics and remote sensing program for water quality applications



EOLakeWatch

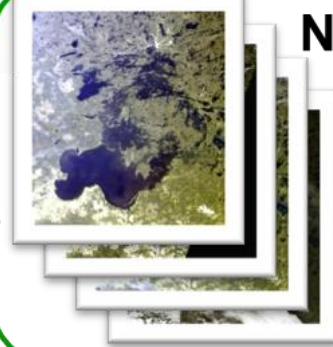
Storage & Processing

Ubuntu
Python
ESA SNAP
QGIS



ECCC HPC

NRT Download



- L1 TOA Radiance
- Copernicus Data Space Ecosystem
- NASA OB.DAAC

Satellite EO Datasets



Sentinel-3 OLCI
(2016-present)



MODIS Aqua
(2012-2015)

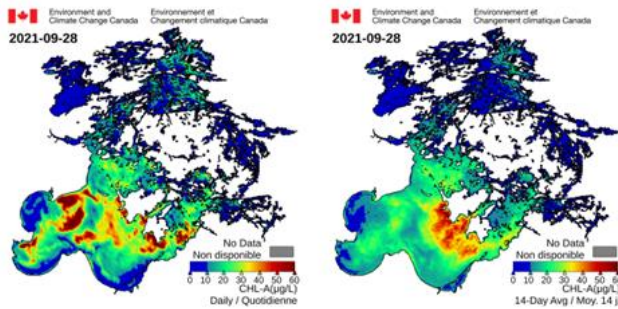


Envisat MERIS
(2002-2011)



Mapped & Data Products

Daily & 14-day Avg Derived Chlorophyll-a

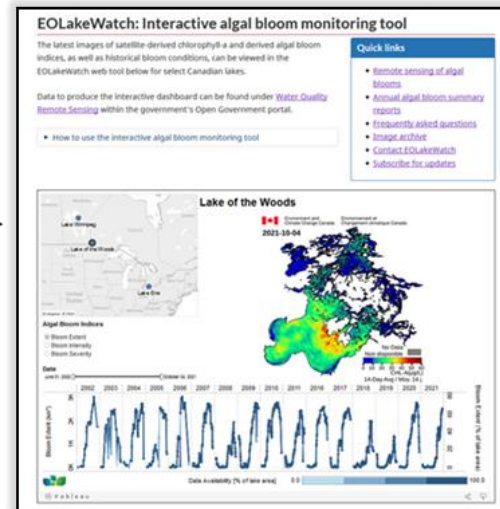


Bloom Indices

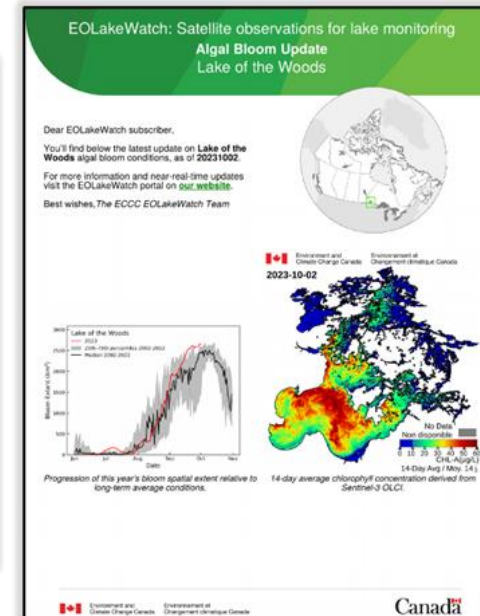
- Bloom Extent
- Bloom Intensity
- Bloom Duration
- Bloom Severity

Product Distribution, Open Data & Reporting

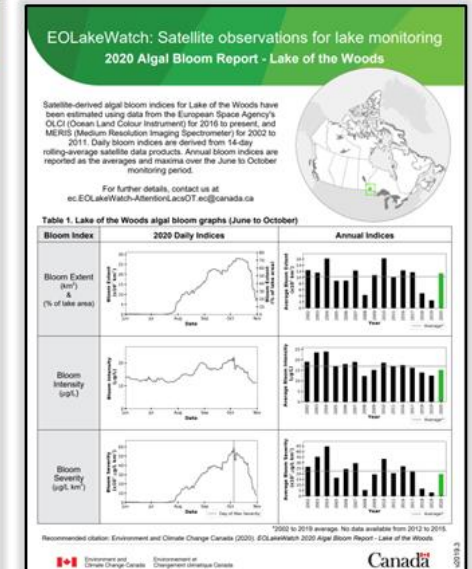
Near-Real-Time Web Portal



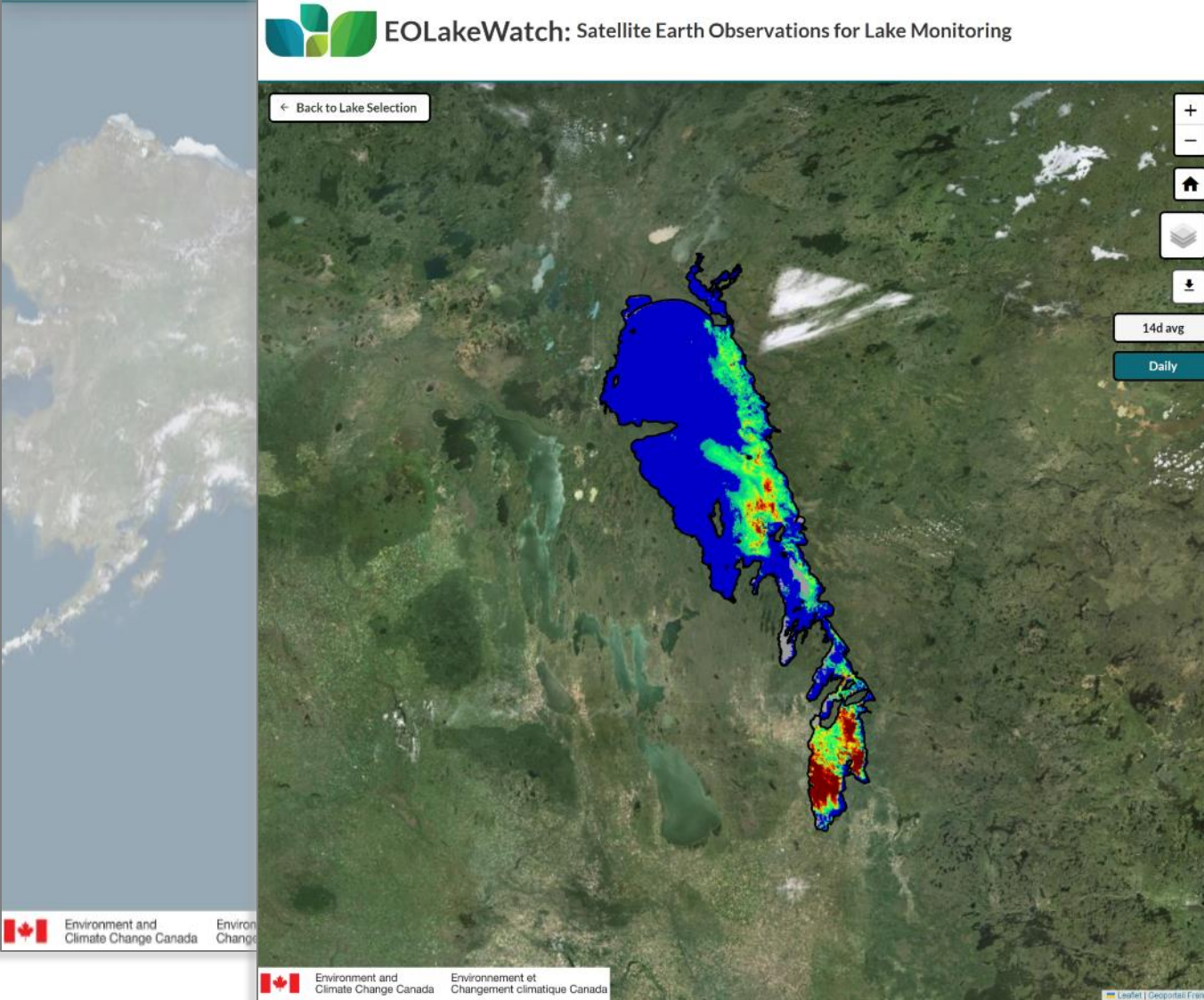
Weekly Bulletins



Annual Reports



EOLakeWatch – Enhanced Web Portal



Lake Winnipeg: Whole Lake

9/26/2023

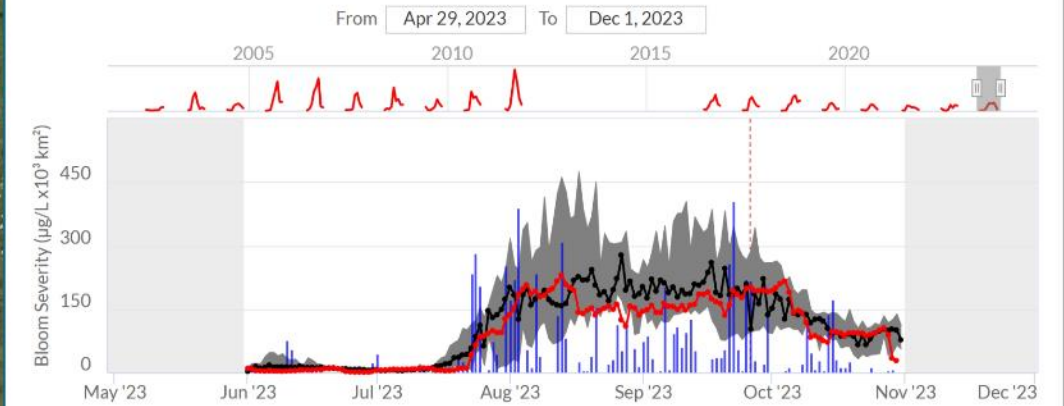
Whole Lake Specific Point

Algal Bloom Indices (Daily)

Bloom Extent (km ²):	7,903
Bloom Extent (% of lake area):	32.18
Bloom Intensity (µg/L):	27.57
Bloom Severity (µg/L km ²):	217,915

Daily Chart

Annual Chart



14-day average Bloom Severity ■ Daily Bloom Severity ■ Median ■ 25th - 75th percentile range ■

Algal Bloom Indices

Extent Intensity Severity

Reporting Frequency

14-day average Daily

2002-2022 Reference Data (14d avg)

Median 25th - 75th percentile range

Export chart

Export data (CSV)

Chlorophyll-a Concentration (µg/L)



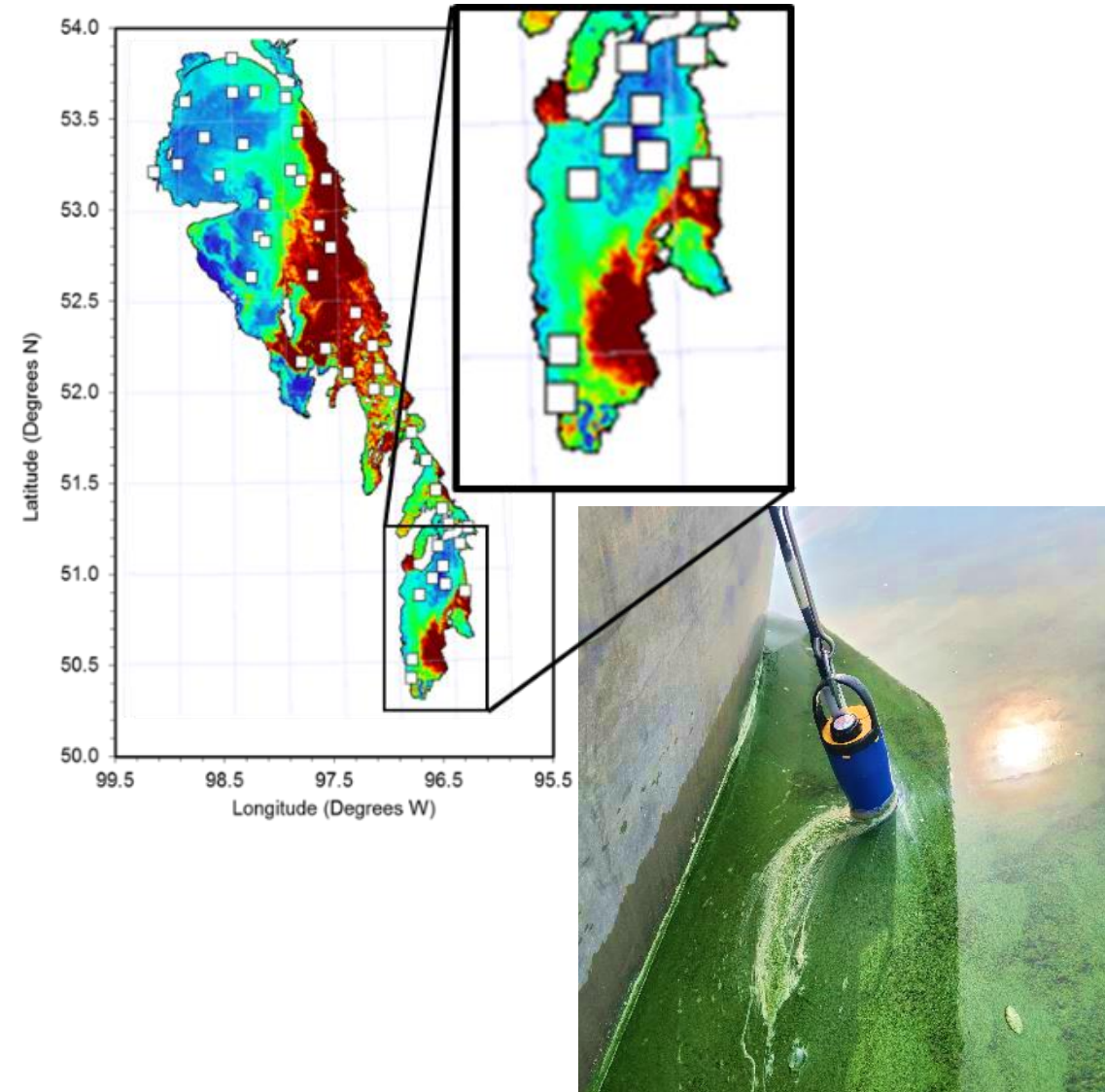
Applications & Societal Benefits

- Wide-ranging stakeholders and end-users



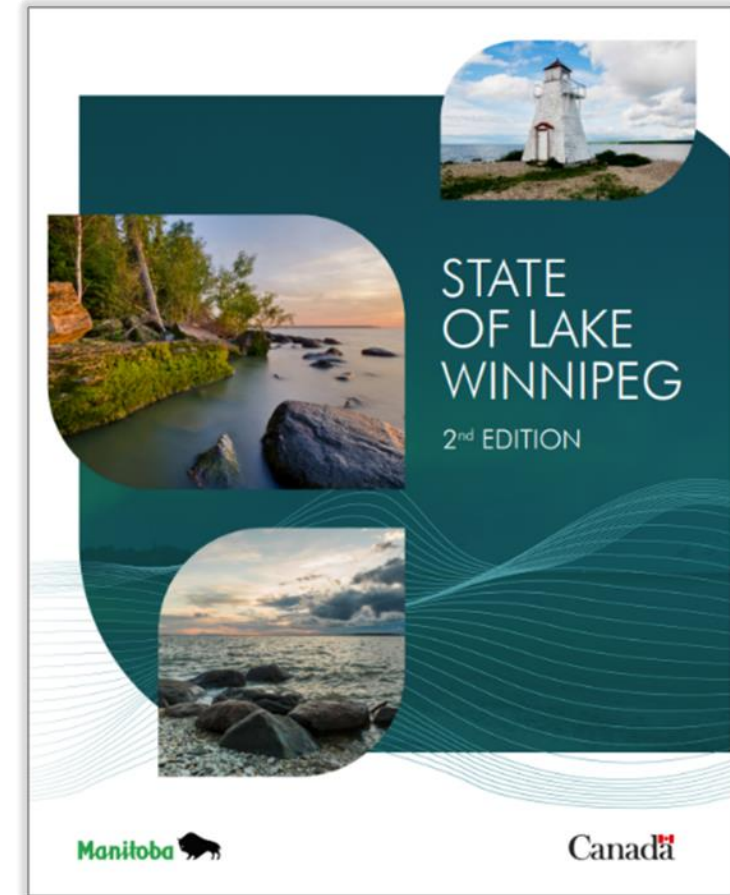
Applications & Societal Benefits

- Wide-ranging stakeholders and end-users
- Prompt bloom alerts, early warning
- Identifying areas of concern
- Optimizing in-lake sampling

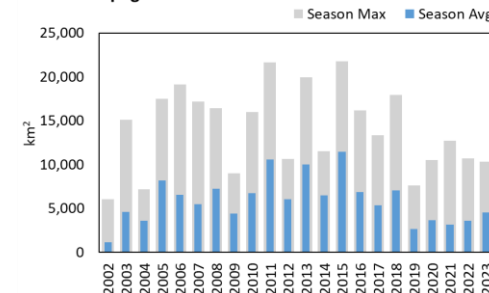


Applications & Societal Benefits

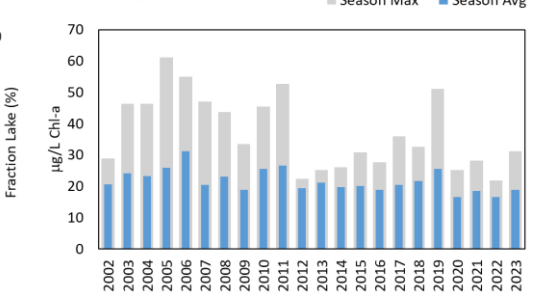
- Wide-ranging stakeholders and end-users
- Prompt bloom alerts, early warning
- Identifying areas of concern
- Optimizing in-lake sampling
- Comprehensive long-term reporting
- Guiding lake management actions
- Monitoring effectiveness of management actions



Lake Winnipeg Bloom Extent

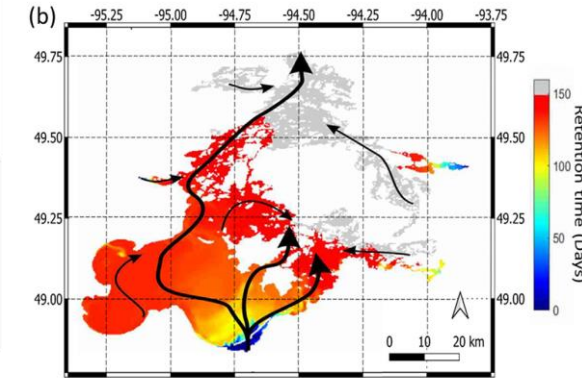
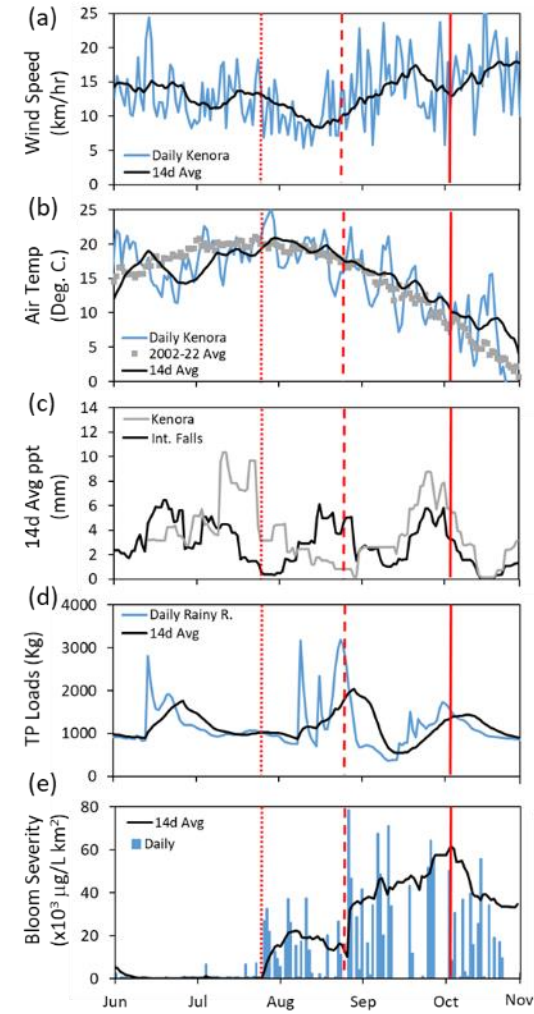


Lake Winnipeg Bloom Intensity

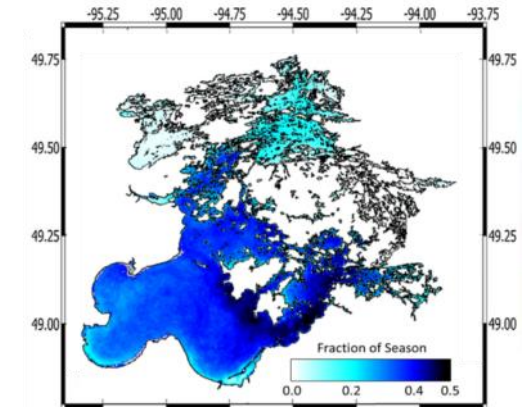


Applications & Societal Benefits

- Wide-ranging stakeholders and end-users
- Prompt bloom alerts, early warning
- Identifying areas of concern
- Optimizing in-lake sampling
- Comprehensive long-term reporting
- Guiding lake management actions
- Monitoring effectiveness of management actions
- Understanding environmental drivers of blooms
- Supporting integrated lake modeling
 - Bloom forecasting
 - Assessing climate change & nutrient management scenarios



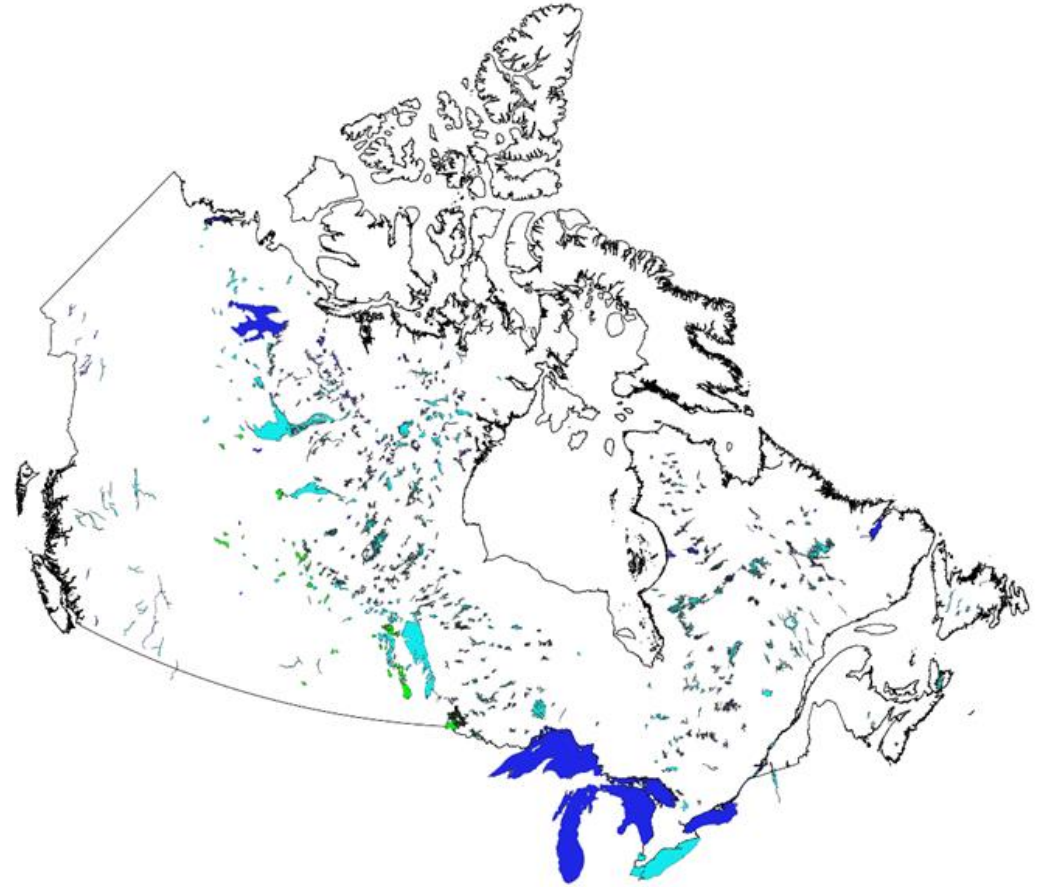
Retention times and water flow directions (Valipour et al. 2023)



Average fraction of the June to October season experiencing blooms over the 2002–2021 period. (Binding et al., 2023)

Applications & Societal Benefits

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- Identifying areas of concern
- Optimizing in-lake sampling
- Comprehensive long-term reporting
- Guiding lake management actions
- Monitoring effectiveness of management actions
- Understanding environmental drivers of blooms
- Supporting integrated lake modeling
 - Bloom forecasting
 - Assessing climate change & nutrient management scenarios
- Nationwide bloom monitoring



Thank you! Any Questions?



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Sentinel-2 MSI
Oct 4 2021