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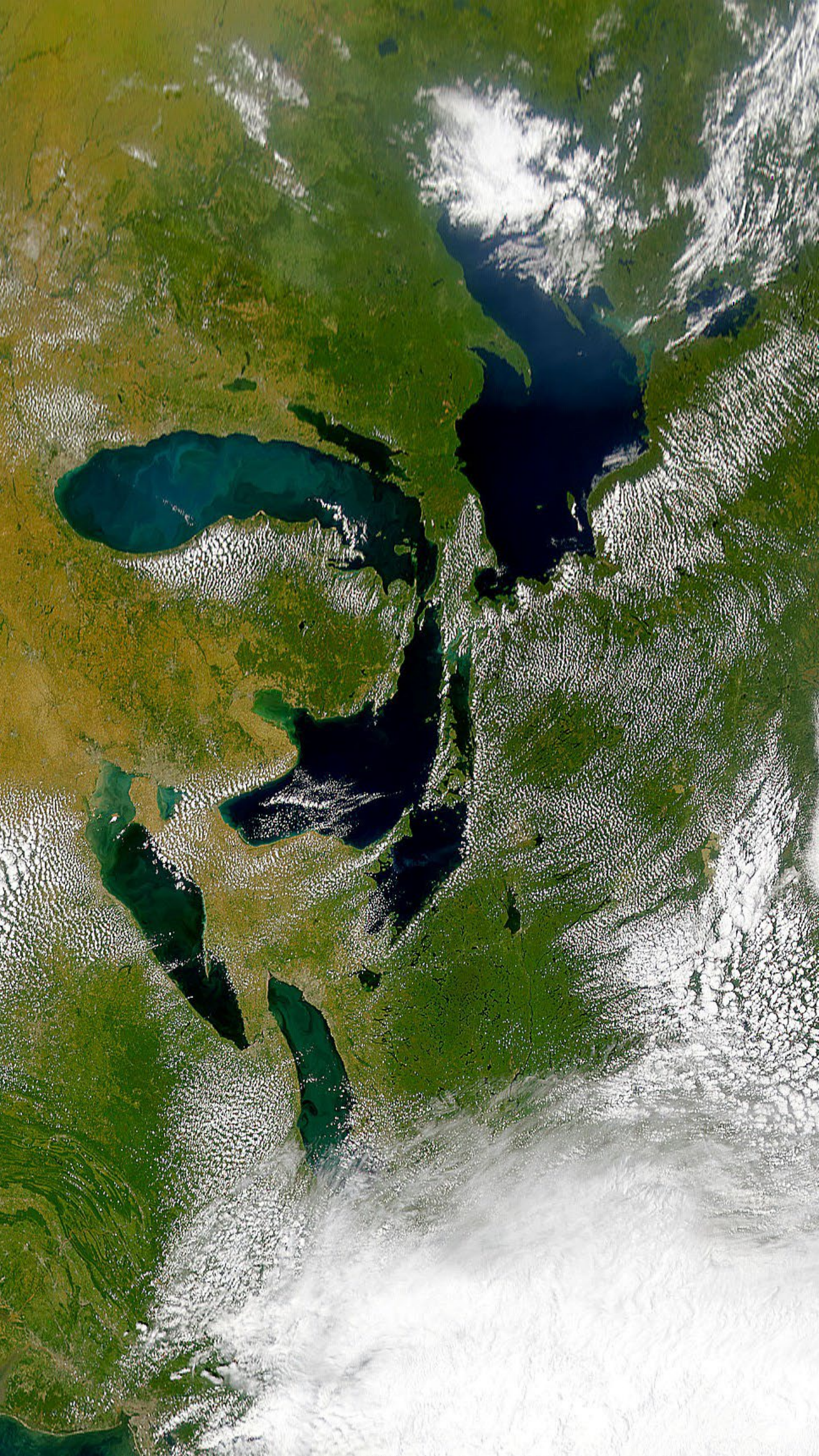
Applying Earth Observatory Data to the Surveillance of Large Lakes Under Shared Governance

Jérôme Marty

Environmental Crimes Workshop 2024

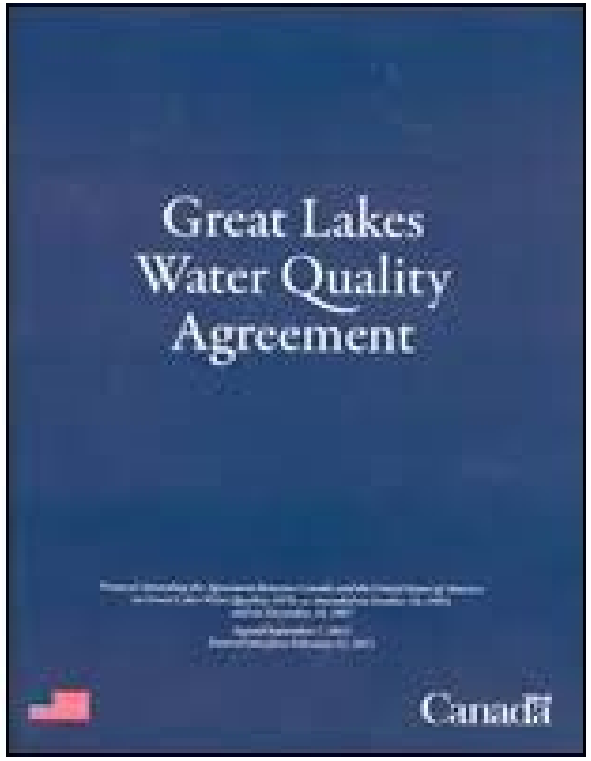
June 11-12, 2024

ESA-ESRIN, Frascati, Italy.

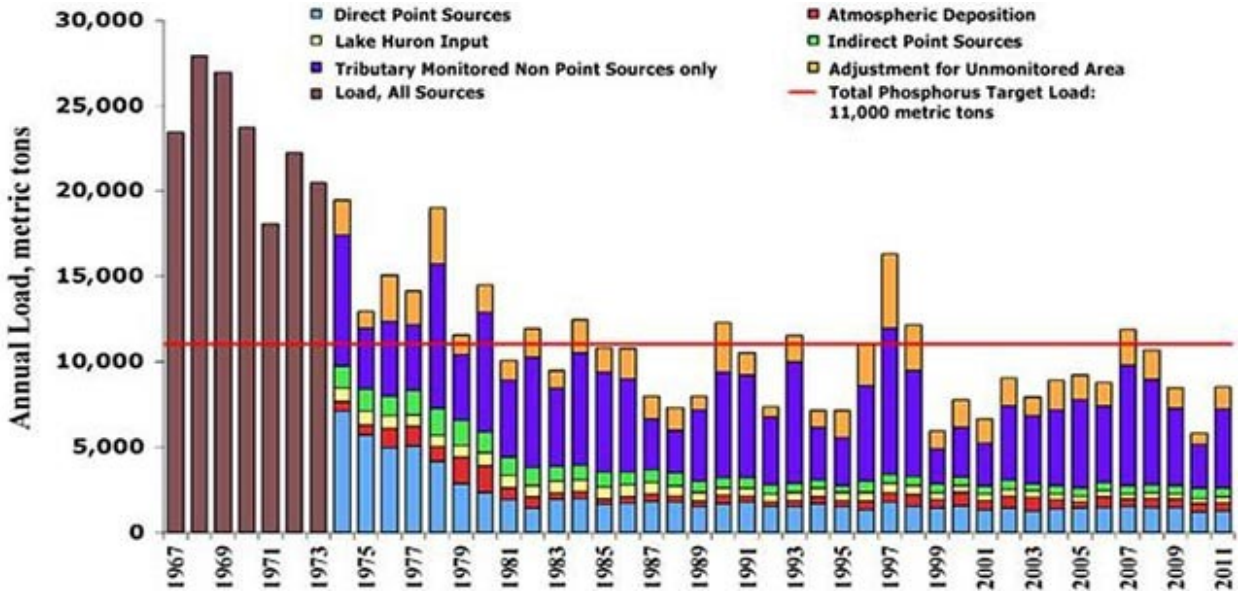


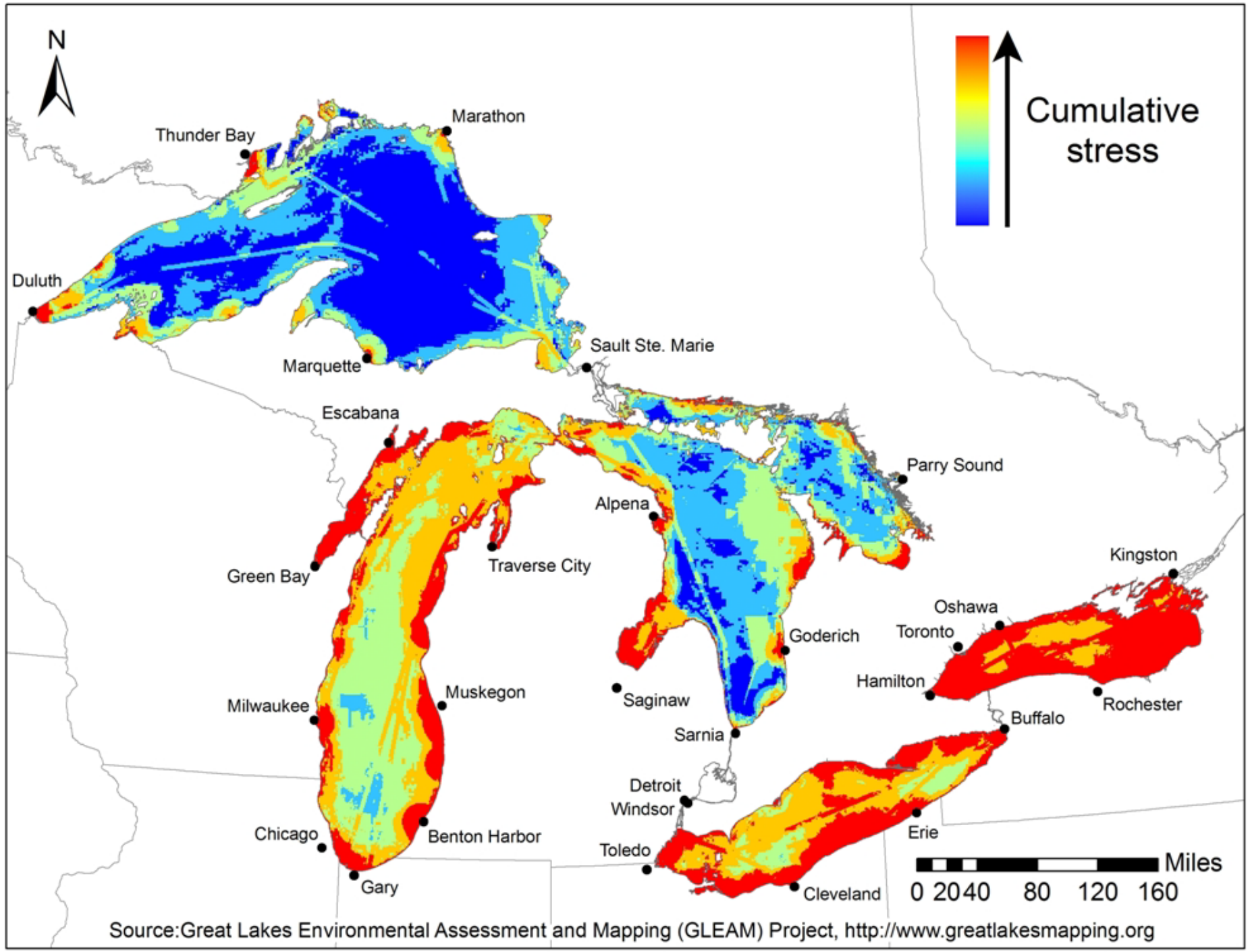
Multi-Jurisdictional Governance

- 2 countries: USA and Canada
- 8 U.S. States
- 2 Canadian Provinces.
- Hundreds of Tribes and First Nations.
- Thousands of local governments.



Science has identified the sources of the problem since the 70’

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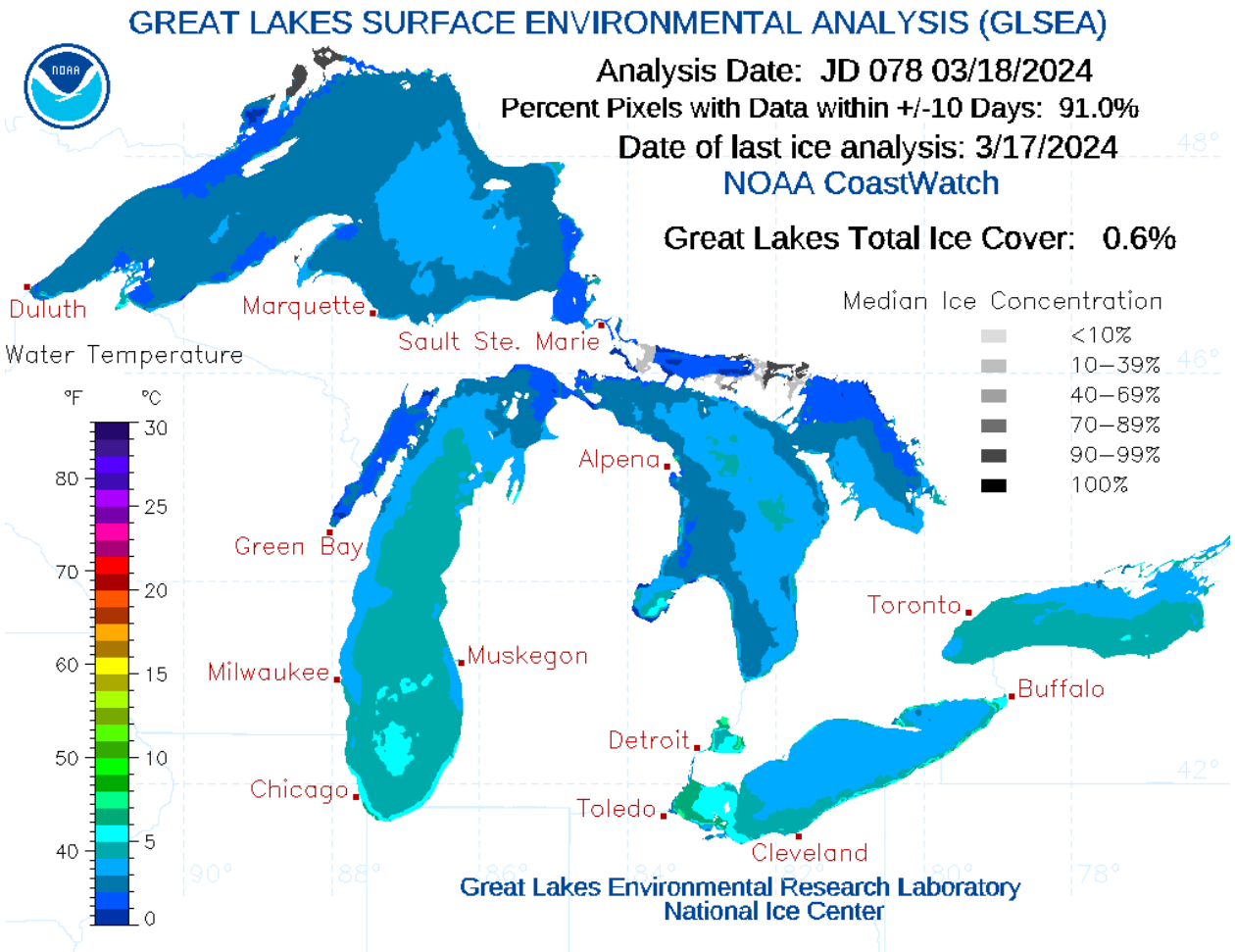
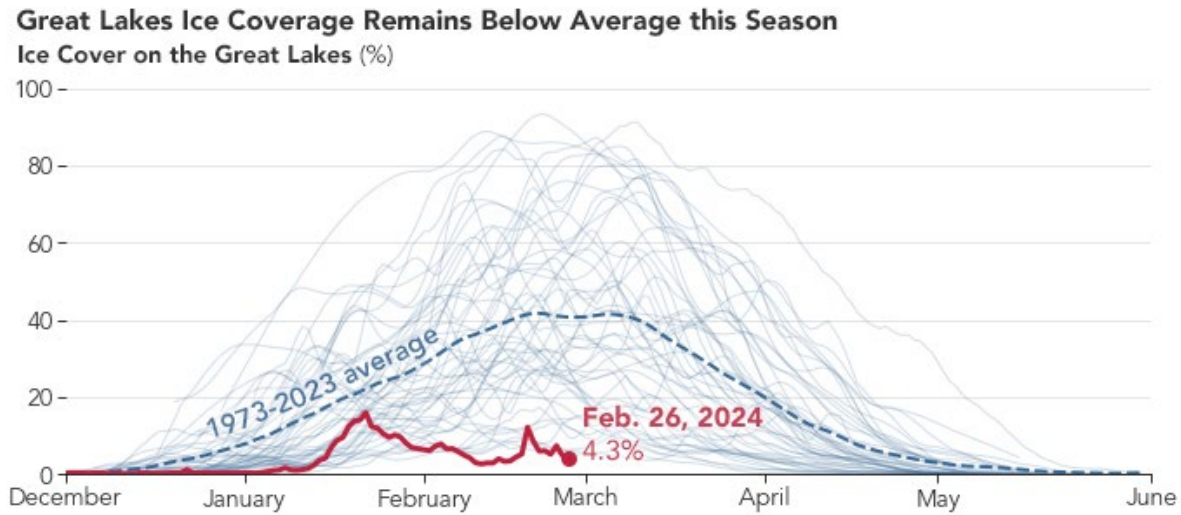
Cumulative stress
Thunder Bay
Marathon
Duluth
Marquette
Sault Ste. Marie
Escabana
Parry Sound
Alpena
Green Bay
Traverse City
Kingston
Oshawa
Toronto
Goderich
Hamilton
Saginaw
Rochester
Muskegon
Milwaukee
Buffalo
Sarnia
Detroit
Windsor
Erie
Chicago
Benton Harbor
Toledo
Gary
Cleveland
Miles
0 20 40 80 120 160
Source:Great Lakes Environmental Assessment and Mapping (GLEAM) Project, http://www.greatlakesmapping.org

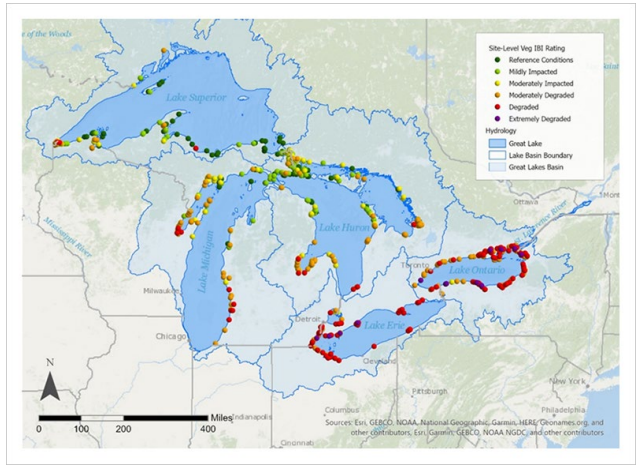
2024 Ice Cover Conditions

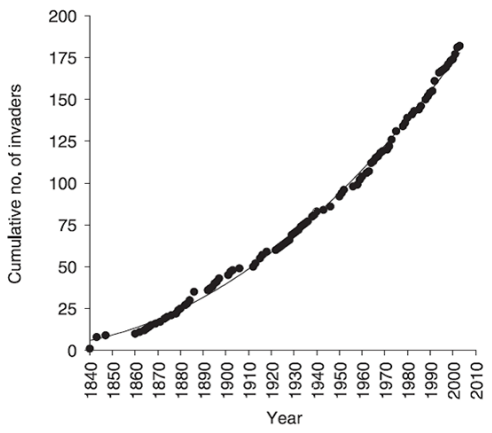




Common environmental crimes affecting the Great Lakes

- Water pollution (industrial discharge, agricultural runoff)
- Illegal fishing and overfishing
- Habitat destruction (wetland loss, coastal development)
- Invasive species introduction
- Waste dumping





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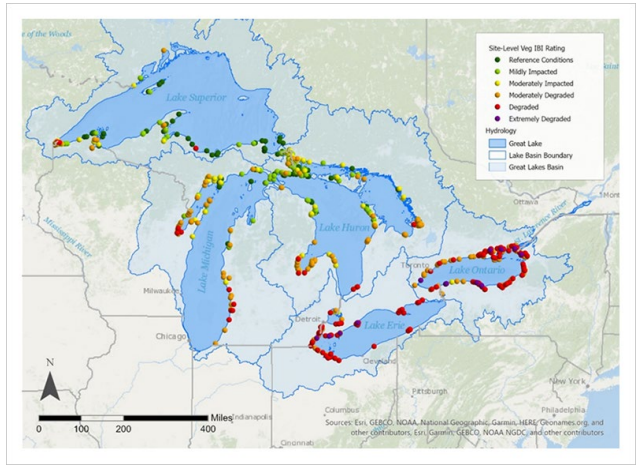
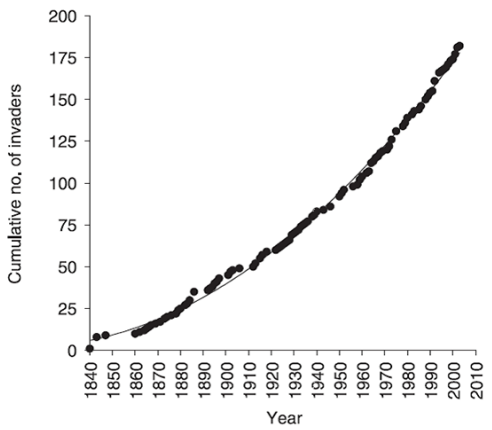




A stew of farm runoff, invasive mussels and big rains poisons Toledo's water, sends lake back to its dark ages

Show caption

Dan Egan Milwaukee Journal Sentinel

Published 11:00 AM EDT Sep. 2, 2021 | **Updated 11:00 AM EDT Sep. 2, 2021**

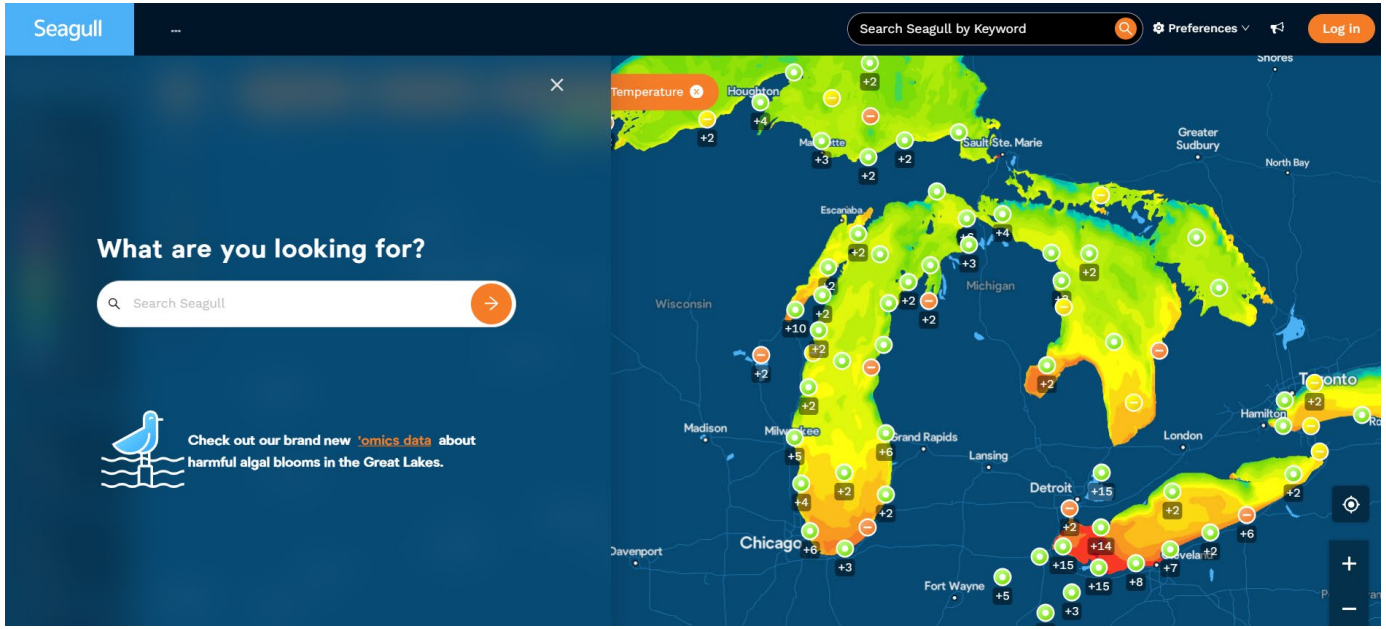
The Need: Harmful Algal Blooms (HABs) Early Warning System with Great Lakes Observatory System (GLOS)

The transmission and transformation of sensor data into information in the *hands* of humans* as fast as possible.

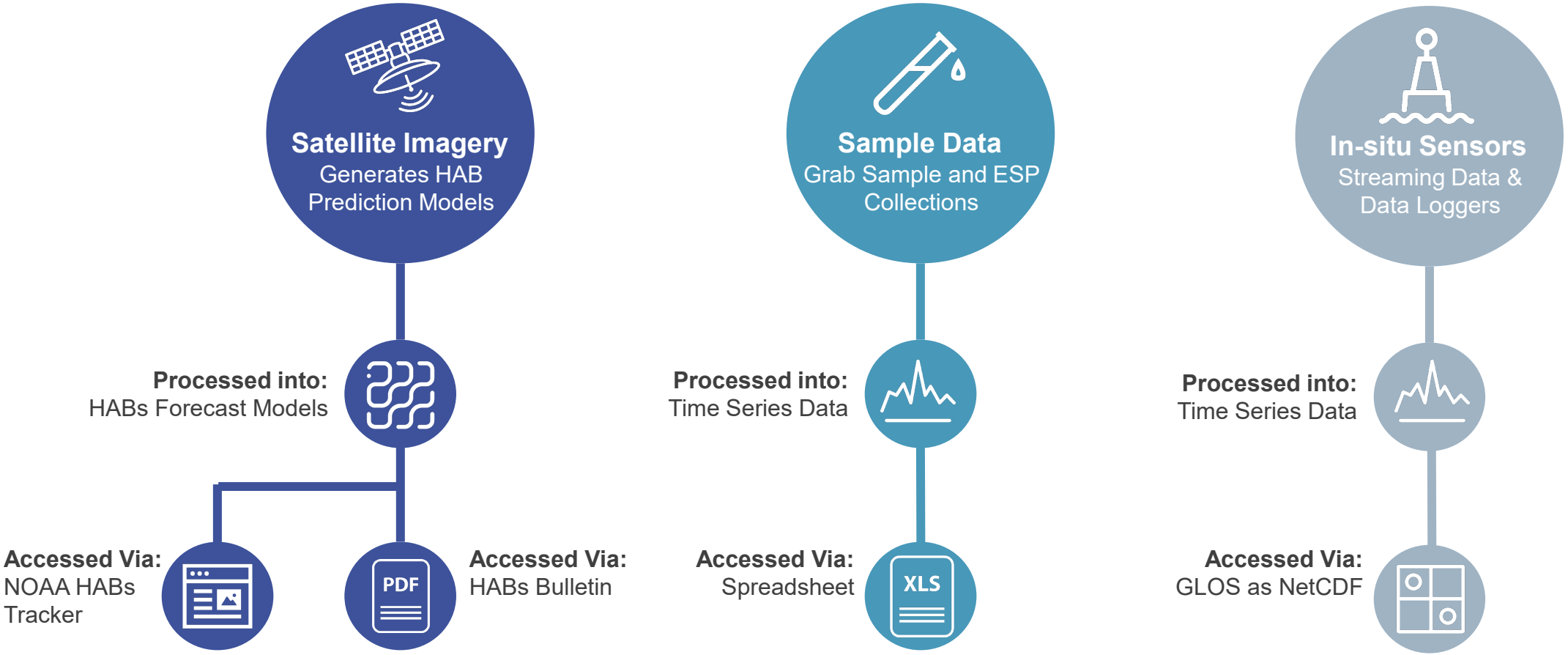
*literally

Harmful Algal Blooms (HABs) Early Warning System

- Managed by both the US (NASA, NOAA, USGS) and Canada (CSA)
- Use of MODIS and Sentinel-3 satellites to monitor water quality
- Combine Satellite Imagery and Remote Sensing Technologies
- Types of data (optical, radar, thermal, multispectral)



Great Lakes HABs Detection Data Today

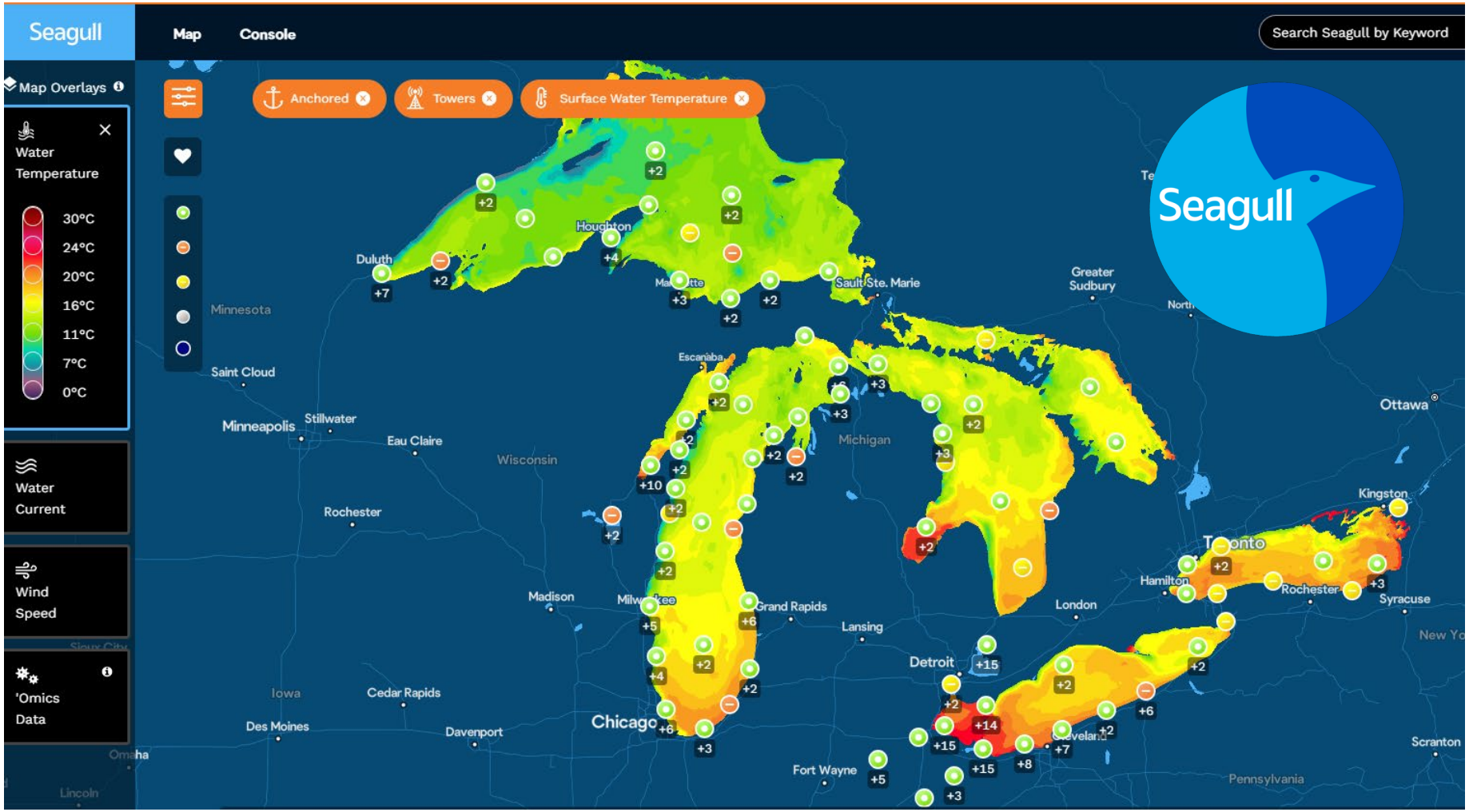


NOAA HABs Models are generated from satellite imagery and complex algorithms. Converted to motion GIFs and static PDF documents, results are **emailed** weekly or accessed via the **NOAA HABS Tracker**.

Sample data is collected and processed in a lab. Results are compiled into spreadsheets and made available online or **emailed**.

Sensor data can be collected in real-time. Data is sent to servers for processing. Results are available on GLOS **on demand**.

Great Lakes HABs Real-time Monitoring for the Public



- 65 Stations with Phycocyanin data
- 85 stations with Chlorophyll data
- 1 station with microcystin toxin data

All publicly available *as long as station is deployed*

Early Warning Systems and Types of Stressors

Slow onset stressors usually take years or decades to establish and influence. Limited tools exist to monitor them.

- Eutrophication, oligotrophication
- Aquatic Invasive Species
- New chemicals, including personal care products and pharmaceuticals
- Changing climate

Rapid onset stressors can be detected through existing Early Detection Systems.

- Drinking Water Monitoring Networks
- Harmful Algal Bloom EWS
- Hypoxia Forecasts
- Aquatic Invasive Species Rapid Response
- Beach swimming advisories

More information: https://www.ijc.org/en/sab/GLEWS-phase-2-webinar-in-june

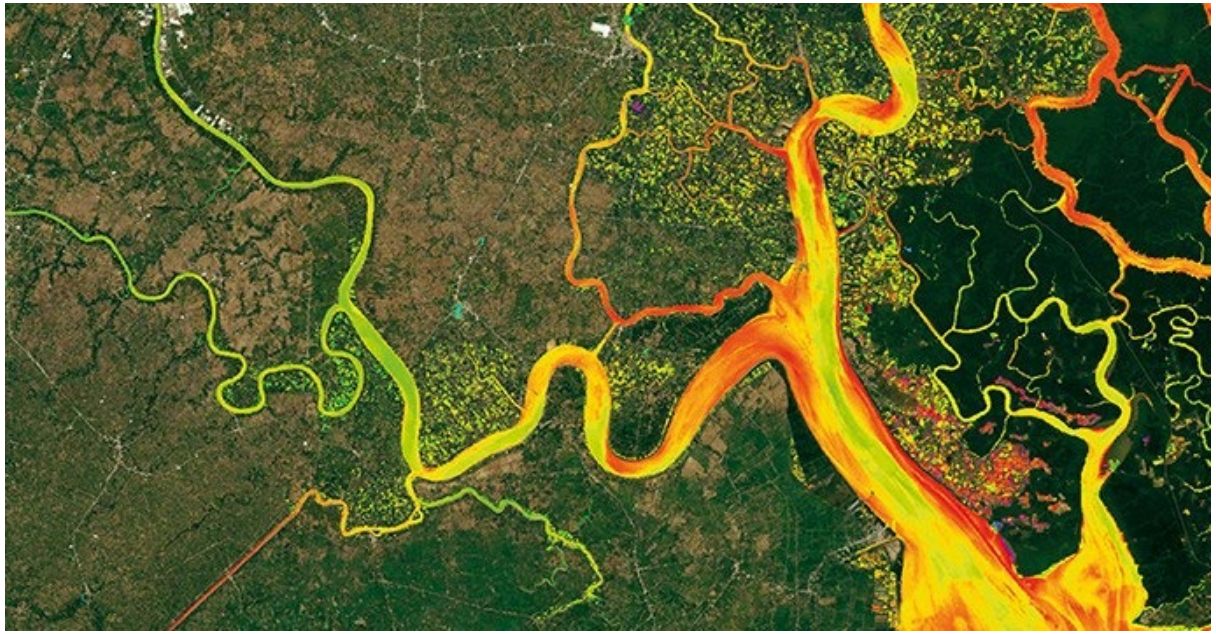
Future work and recommendations

- Importance of continued investment in Earth observation technologies
- Need for international cooperation and data sharing
- Future advancements (e.g., AI and machine learning in data analysis) – cumulative impacts assessments.
- Encouraging public and stakeholder engagement in environmental protection efforts

What opportunities and challenges exist to include Indigenous Knowledge into Earth Observation in support of water quality monitoring ?

Earth Observations provides real time information on water quality for surface and sub-surface waters but do require deploying in situ sensors to calibrate spatial data.

This issue is particularly important in remote areas: how can local communities contribute to collecting such data ?



UN-WATER

More in López Maldonado et al- 2024

Thank you for your attention !

great lakes observing system

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