

The "Black Lagoon" – Detroit River

A Legacy of Problems

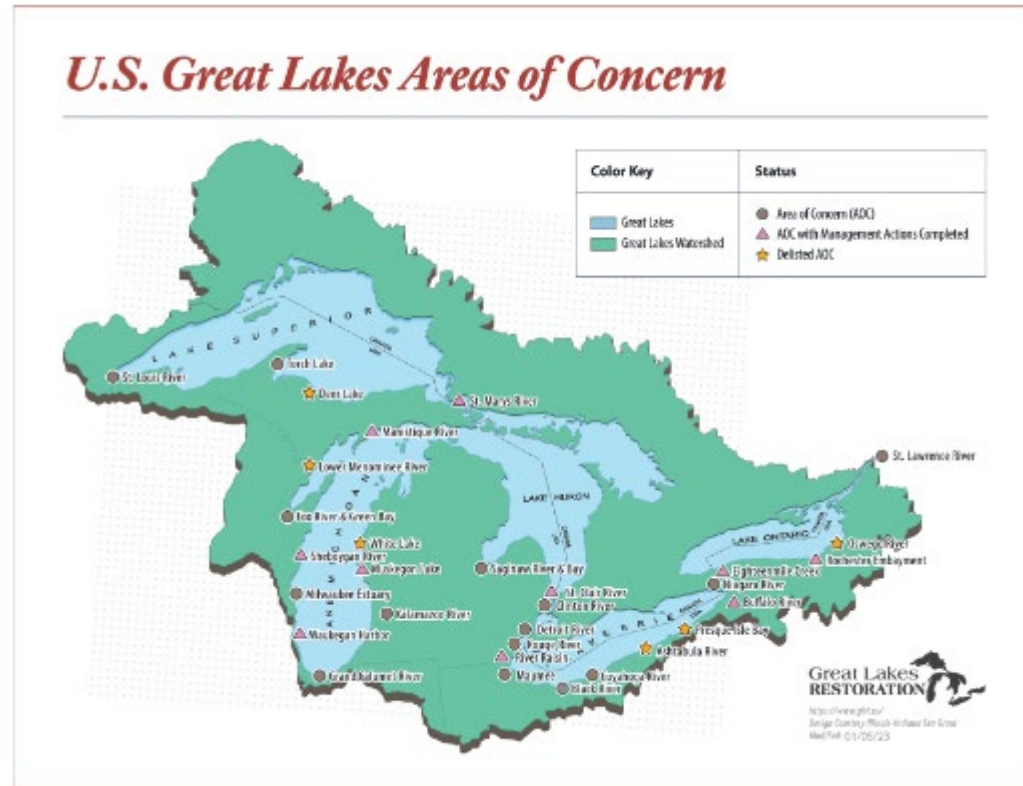


News > News Archive > Largest PCB Cleanup In The World Winding Down

Largest PCB cleanup in the world winding down



43 → US & Canada

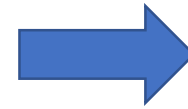


GREATLAKESNOW
POWERED BY DETROIT PBS

NEWS & ISSUES COLUMNS GREAT LAKES NEWS COLLABORATIVE TV SERIES EVENTS EDUCATION DONATE

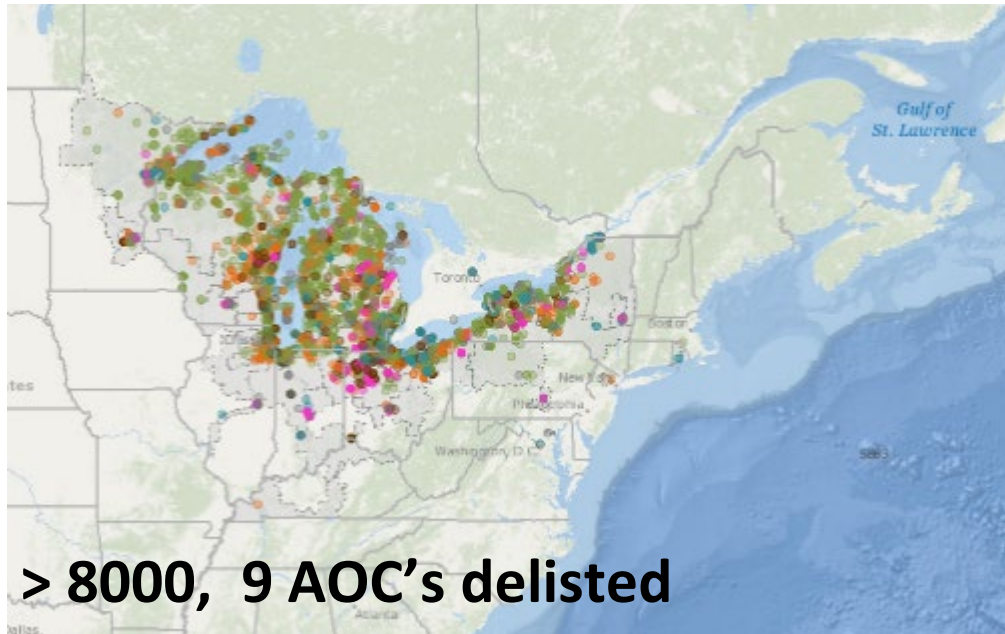
Superfund Sites: New Detroit River site added for threats of PCB, metal, cyanide contamination





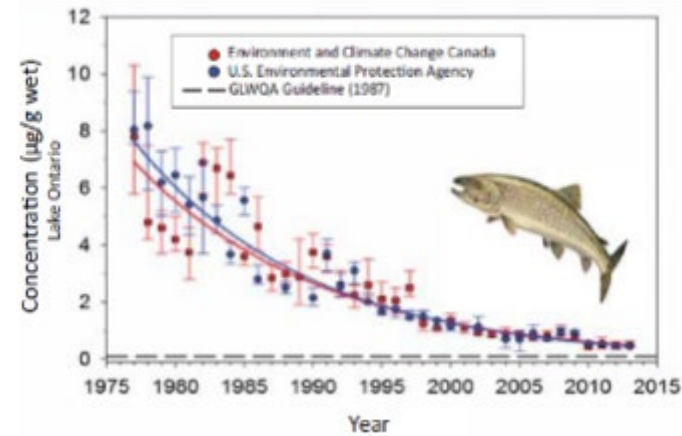
Curing the ills of the past

\$3.8 billion from FY 2010 to FY 2021



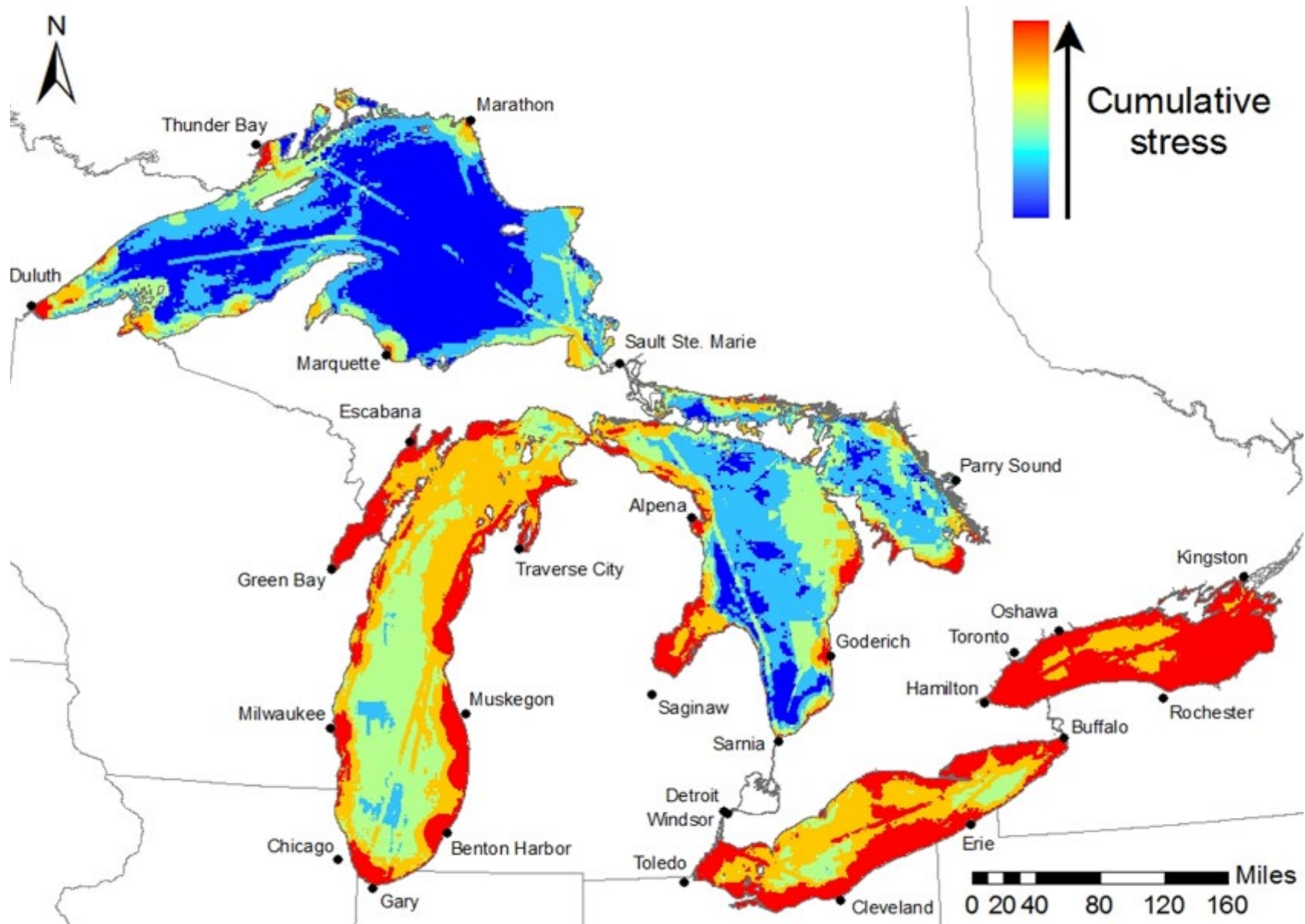
> 8000, 9 AOC's delisted

PCBs in Whole Fish are Decreasing





\$3⁺T economy – 3rd largest



34 cumulative stressors

+ an expanded set of challenges:

- *Habitat alterations*
- *Coastal Development*
- *Fisheries management*
- *Invasive species*
- *NPS runoff*
- *Emerging contaminants*
- *Climate change*

The New York Times

Tap Water Ban for Toledo Residents



City of Toledo
8 hours ago

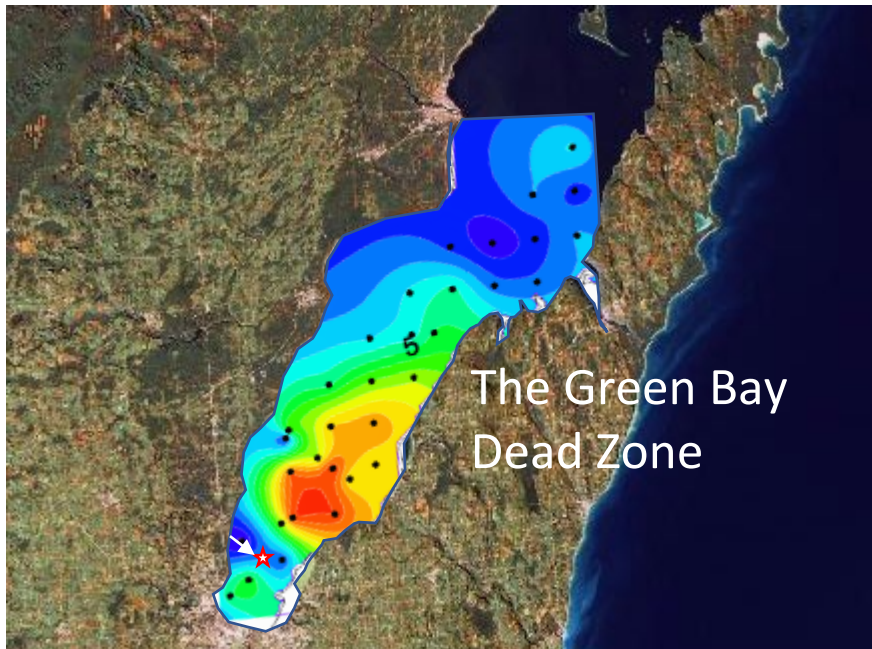
URGENT NOTICE TO RESIDENTS OF TOLEDO & LUCAS COUNTY WHO RECEIVE WATER FROM THE CITY OF TOLEDO

DO NOT DRINK THE WATER
DO NOT BOIL THE WATER

Chemists testing water at Toledo's Collins Park Water Treatment Plant had two sample readings for microcystin in excess of the recommended "DO NOT DRINK" 1 micro-gram per liter standard. This notice applies to ALL customers of Toledo water.

Most important... [See More](#)

• ~ 50 years later



Contents lists available at [ScienceDirect](http://www.sciencedirect.com)

Journal of Great Lakes Research

journal homepage: www.elsevier.com/locate/ijglr

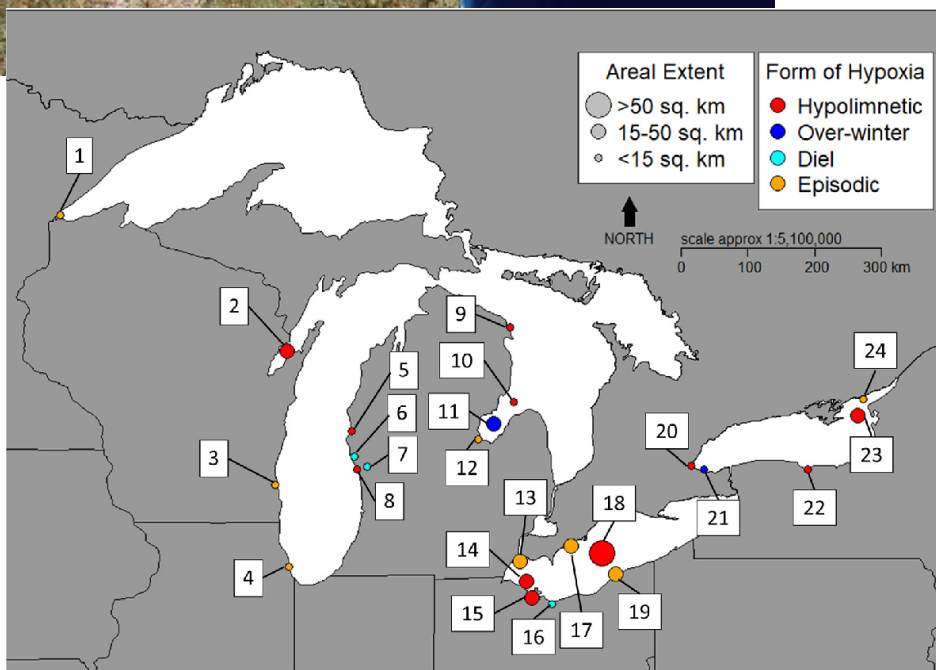


Review

Widespread prevalence of hypoxia and the classification of hypoxic conditions in the Laurentian Great Lakes

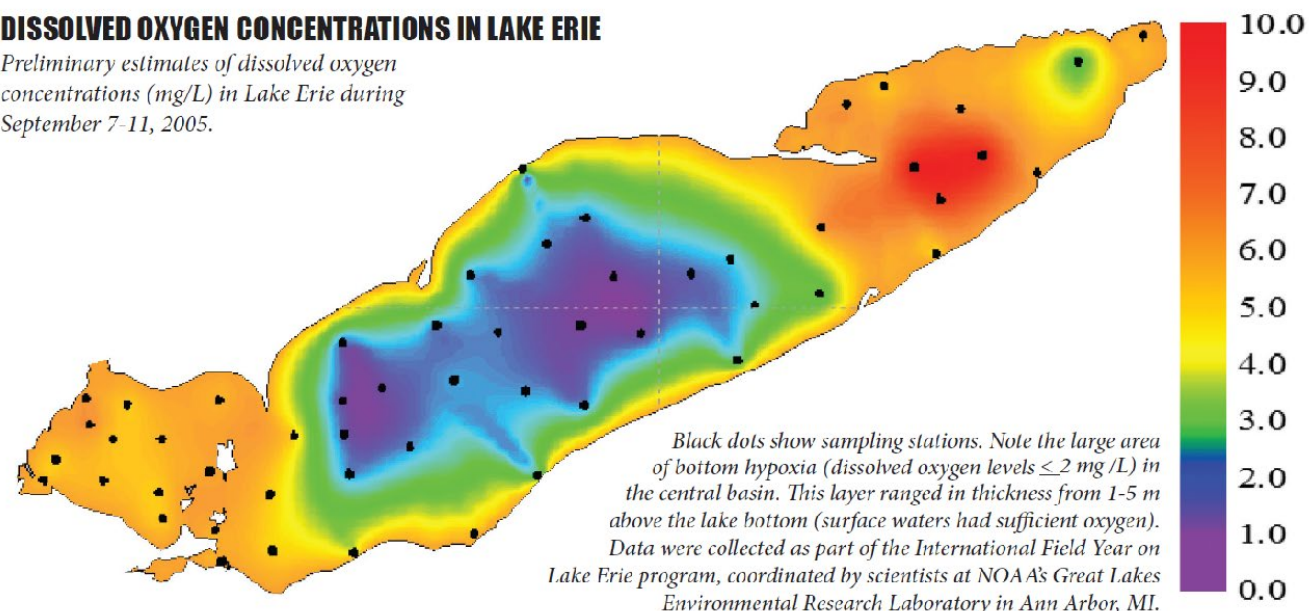


Joshua M. Tellier^{a,*}, Nicholas I. Kalejs^a, Benjamin S. Leonhardt^a, David Cannon^b, Tomas O. Höök^{a,c}, Paris D. Collingsworth^{a,c}



DISSOLVED OXYGEN CONCENTRATIONS IN LAKE ERIE

Preliminary estimates of dissolved oxygen concentrations (mg/L) in Lake Erie during September 7-11, 2005.



Source: IFYLE program, NOAA-GLERL

Invasive species

~ 180 spp



Sea lamprey



alewife



Asian carp



Dreissenid mussels



Spiny water flea



Round goby

Quagga mussels: 950 trillion tiny time bombs in our lakes?

By Jeff Alexander | Muskegon Chronicle
 on April 15, 2011 at 8:00 AM, updated April 15, 2011 at 9:26 AM [Print](#)

A crew of government scientists was measuring water clarity recently in Lake Michigan, several miles offshore of Frankfort, when they saw something none had thought possible.



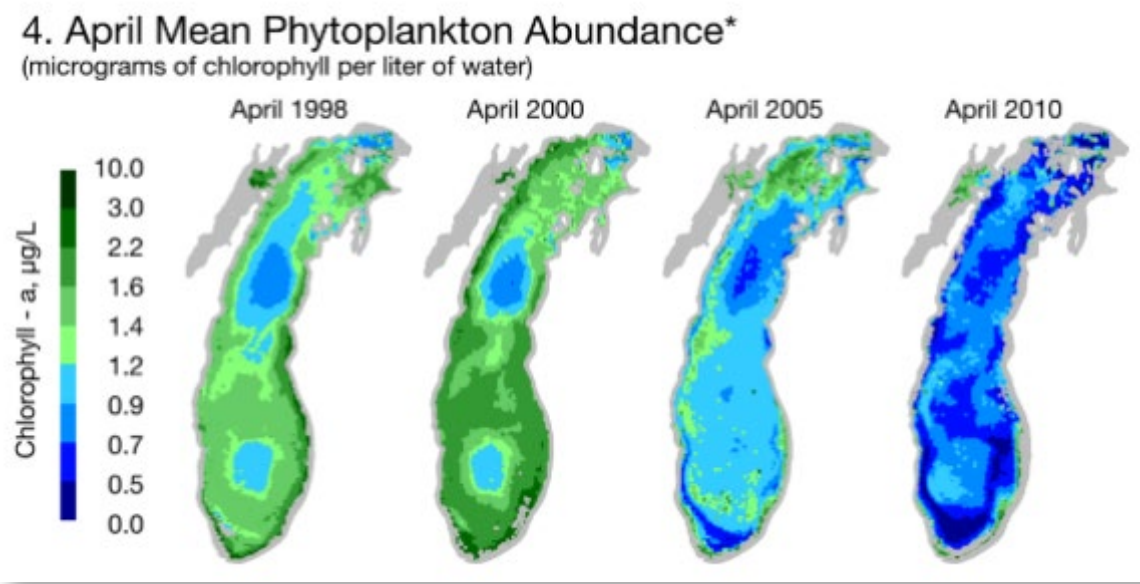
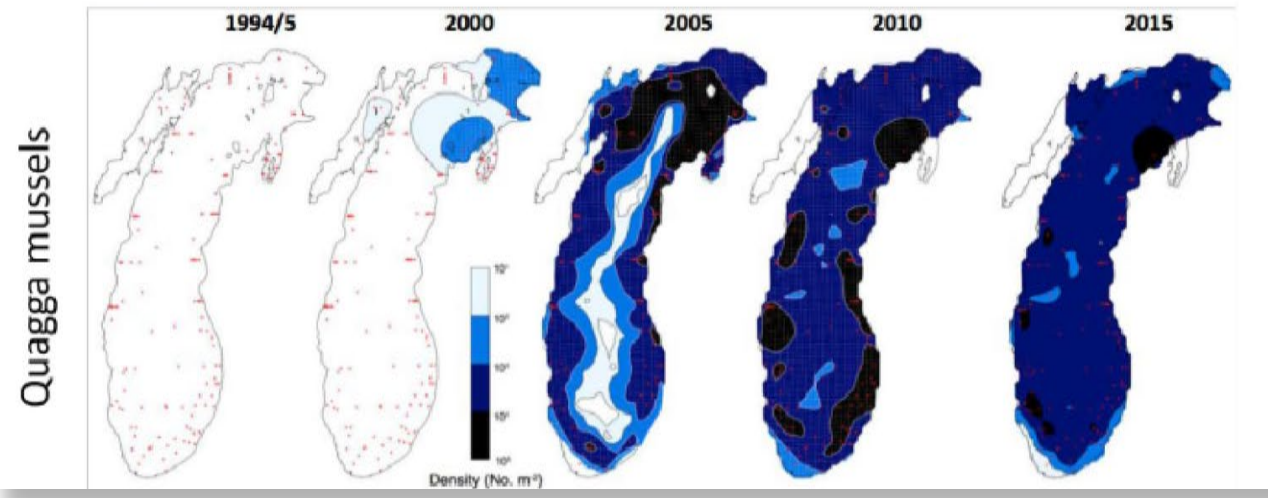
"The water was gin clear ... you could see 90 feet down," said Gary Fahnenstiel, a senior ecologist at the National Oceanic and Atmospheric

Howard Meyerow | The Grand Rapids Press

a **re-engineered** ecosystem ~ 10 yr

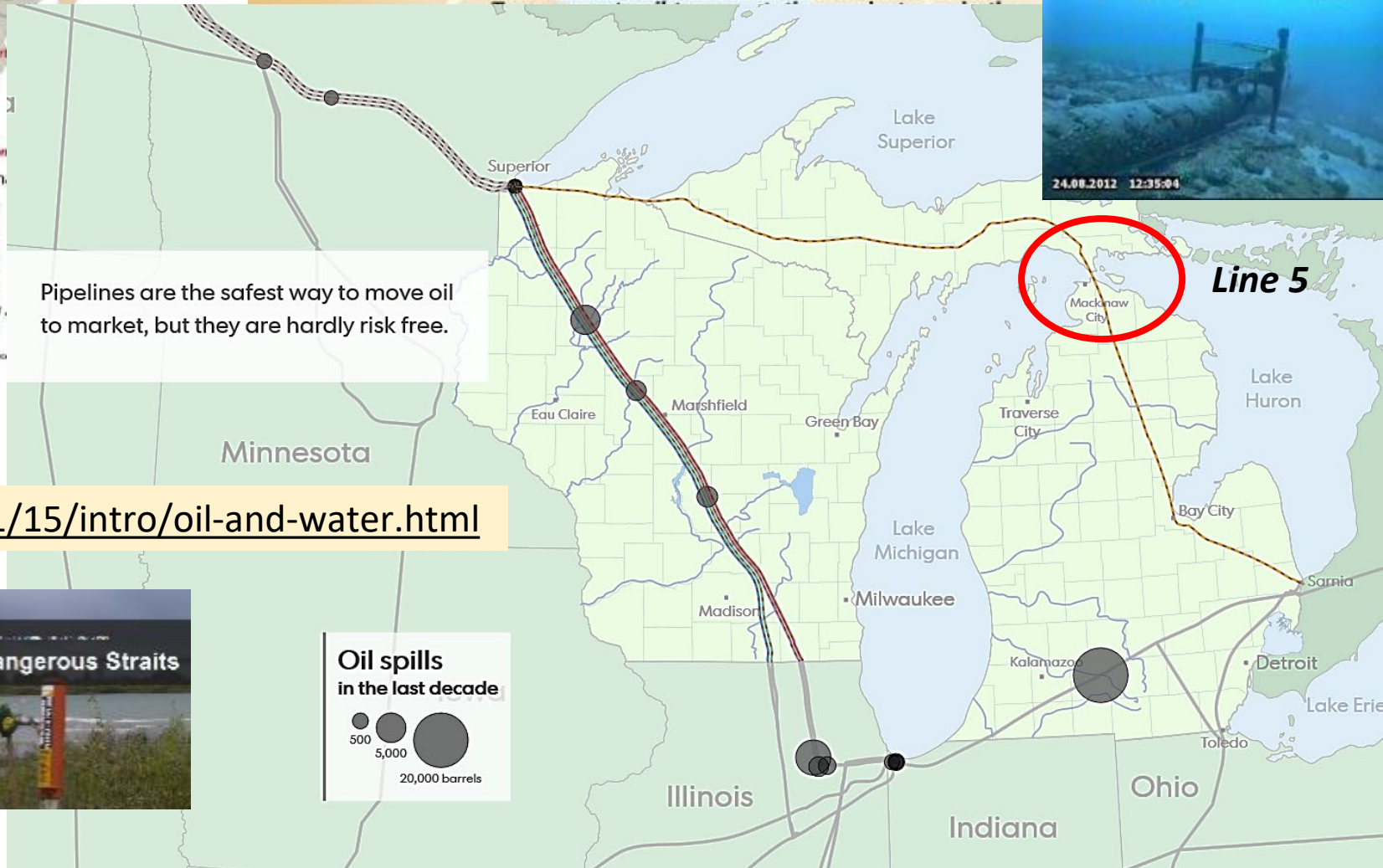
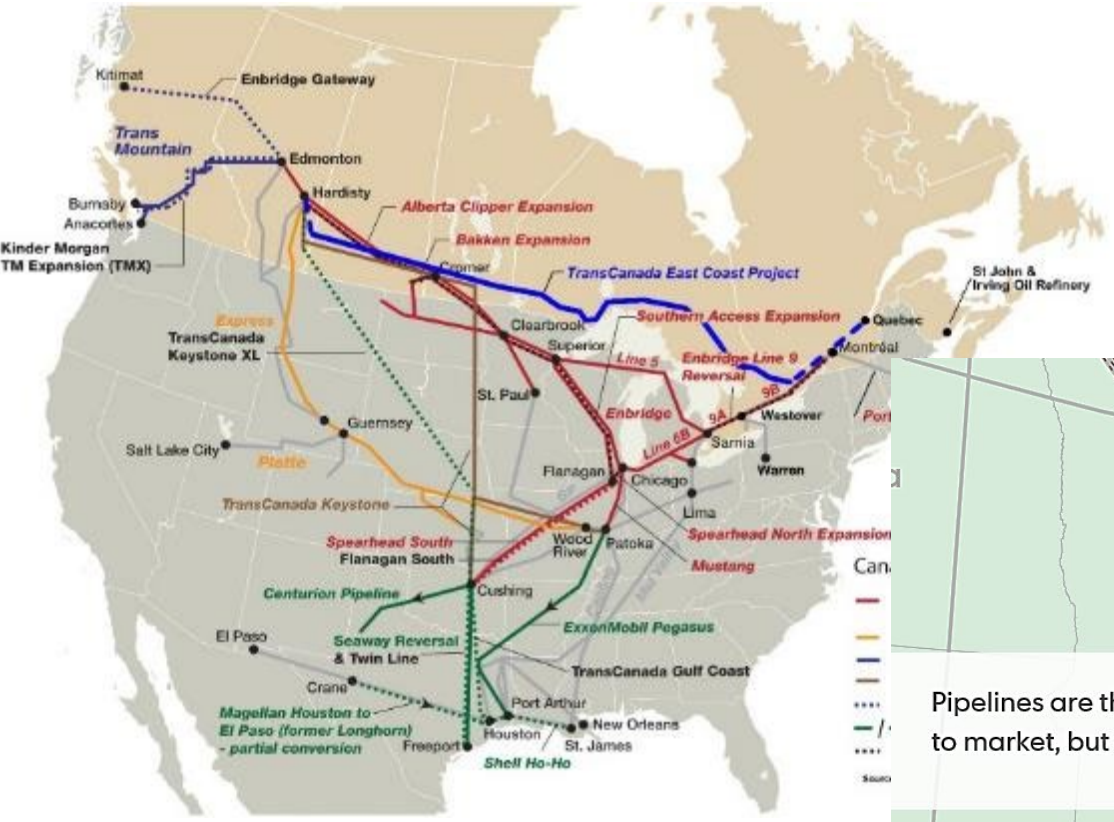
87% decline in phytoplankton biomass
70% decline in phytoplankton primary production

500 million pounds of quagga mussels
 = 4 x weight of all prey fish species



Lake Superior is now the **3rd clearest** in the Great Lakes

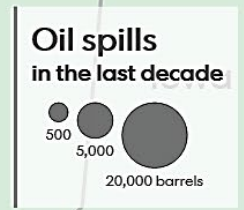
THE OIL INDUSTRY AND THE GREAT LAKES

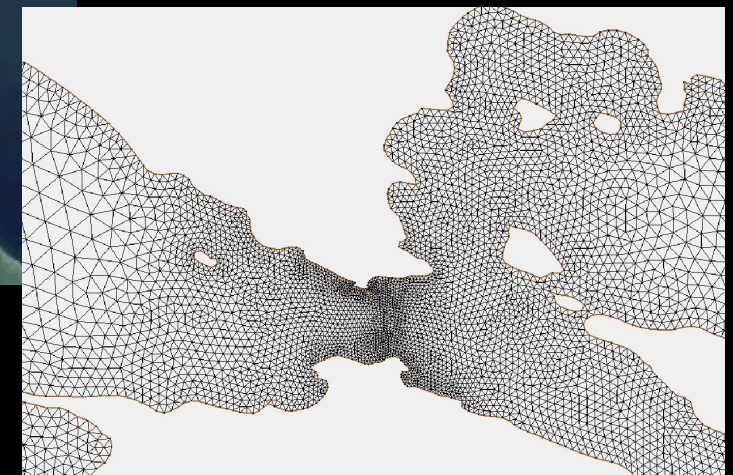
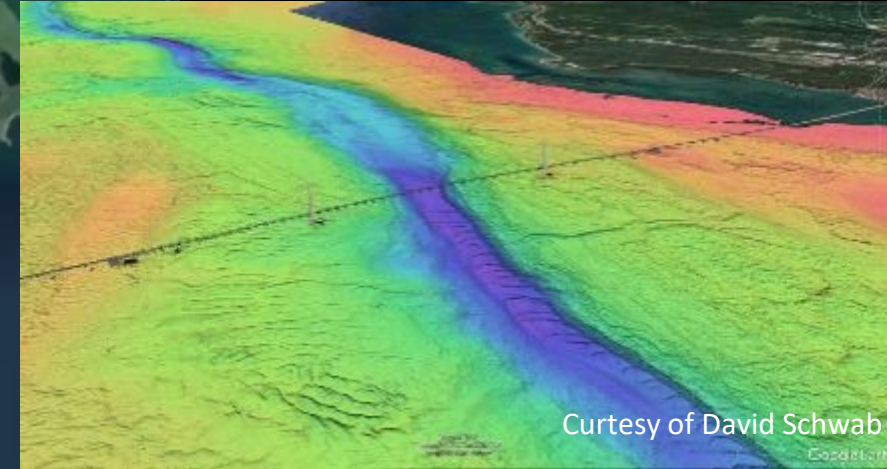


Pipelines are the safest way to move oil to market, but they are hardly risk free.



<https://projects.jsonline.com/news/2017/1/15/intro/oil-and-water.html>



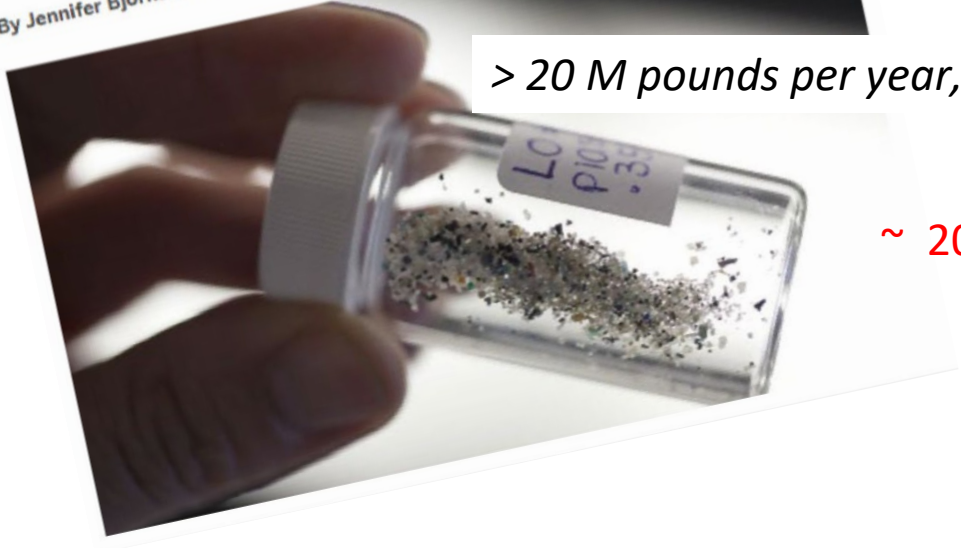


Simulated spill trajectories – St. Mackinac – up to 20 days post spill

DULUTH Great Lakes' latest pollution threat is 'microplastics'

Researchers expand testing on the tiny bits of debris, hoping to gauge potential impact.

By Jennifer Bjorhus Star Tribune | AUGUST 12, 2019 — 12:32PM



> 20 M pounds per year, ~1/2 to Lake Michigan

~ 2050

Emerging contaminants

pharmaceuticals, nanomaterials, pesticides, PFAS, personal care products, microplastics, etc

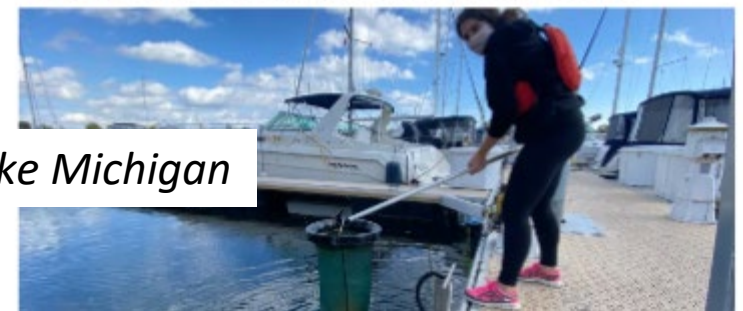
Toronto

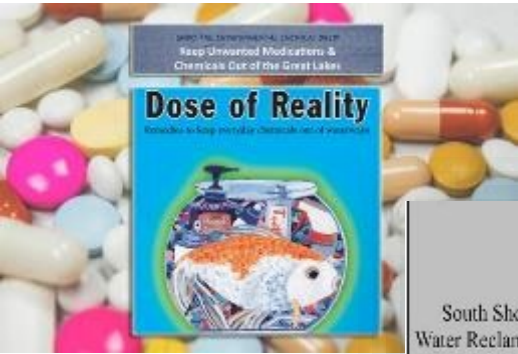
The Great Lakes are awash in plastic. A new project is using trash-trapping technology to get rid of it



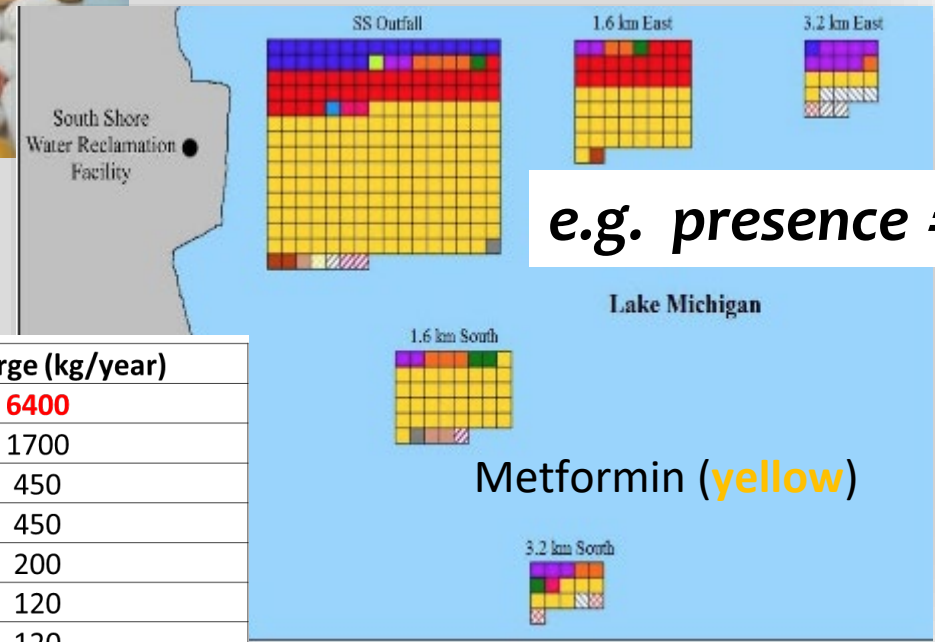
23 marinas will have 'Seabins' installed by end of October, says Great Lakes council

By Kate McMillan - CBC News - Posted: October 1, 2020 1:00 AM EDT - Last Updated: October 1, 2020



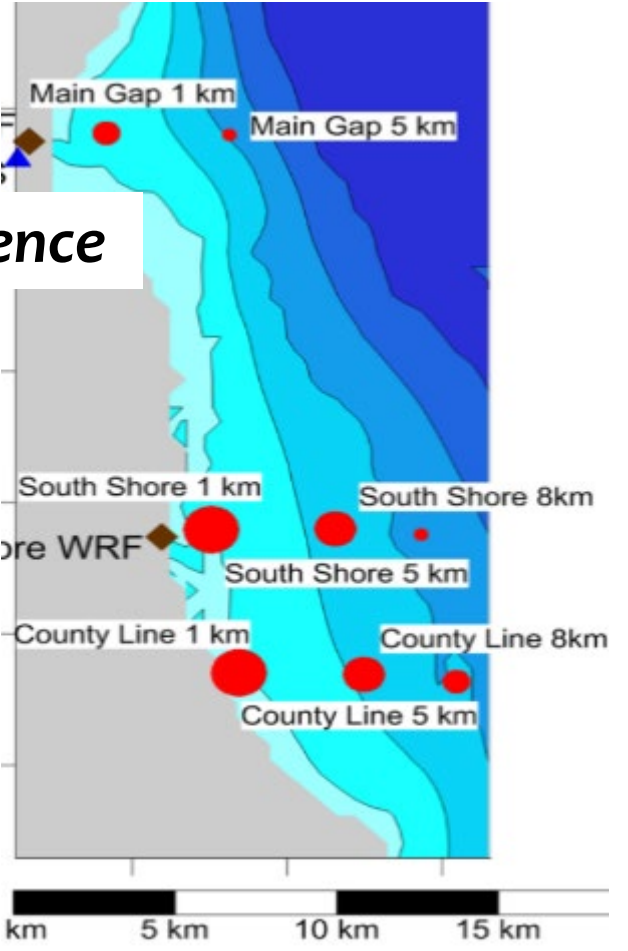


pharmaceuticals



e.g. presence ⇒ input/persistence

	Discharge (kg/year)
Metformin	6400
Caffeine	1700
Acetaminophen	450
Paraxanthine	450
Naproxen	200
Sulfamethoxazole	120
Sulfanilamide	120
Ofloxacin	100
Trimethoprim	90
Triclosan	90
Diltiazem	80
Ampicillin	70



Iodine – 131 ●
Short lived, Radioactive
~ 8 day half life

- 7th most prescribed drug in US
- Highest input of any drug to environment



Overview: Understanding Risks, Impacts, and Responses

Fifth National Climate Assessment



U.S. Global Change Research Program

Climate change

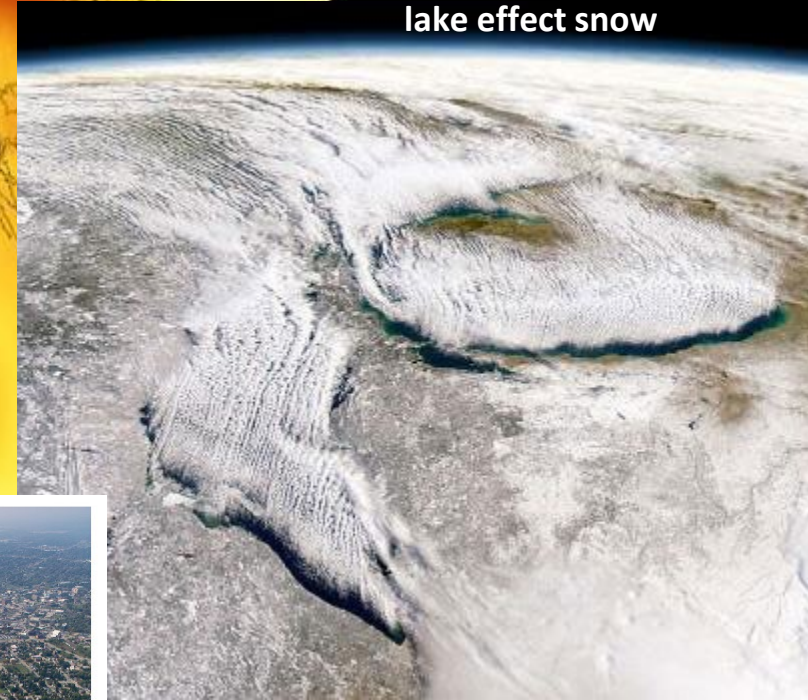
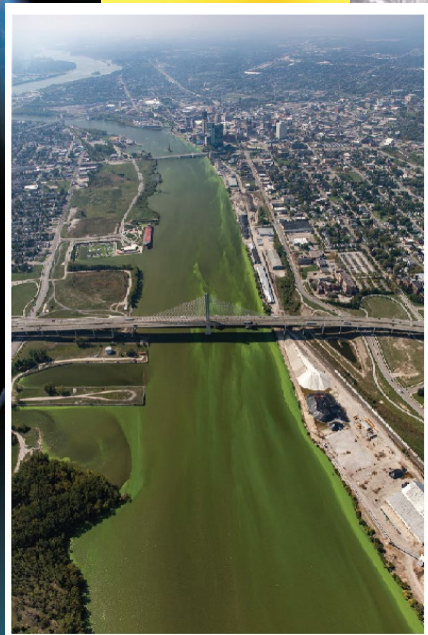
OUR CHANGING PLANET

The U.S. Climate Change Science Program
for Fiscal Years 2004 and 2005



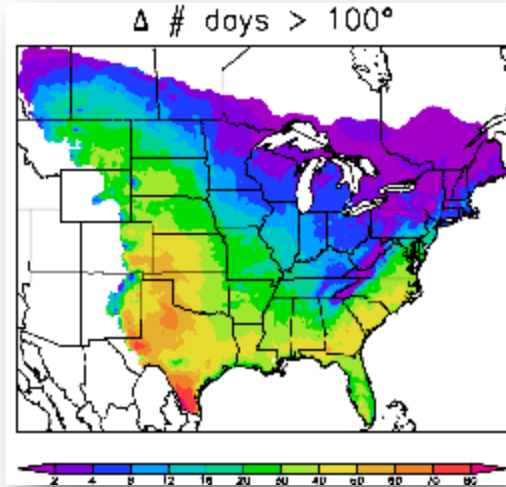
A Report by the
Climate Change Science Program and
the Subcommittee on Global Change Research

A Supplement to the President's Budgets for Fiscal Years 2004 and 2005

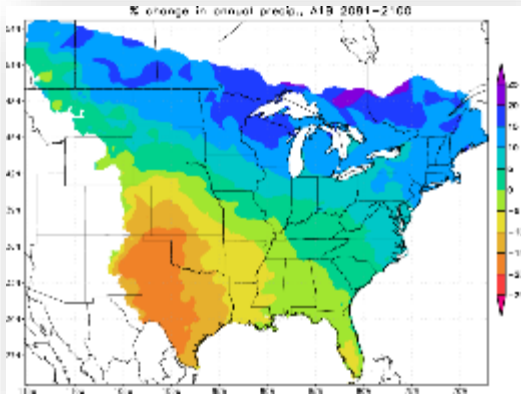


lake effect snow

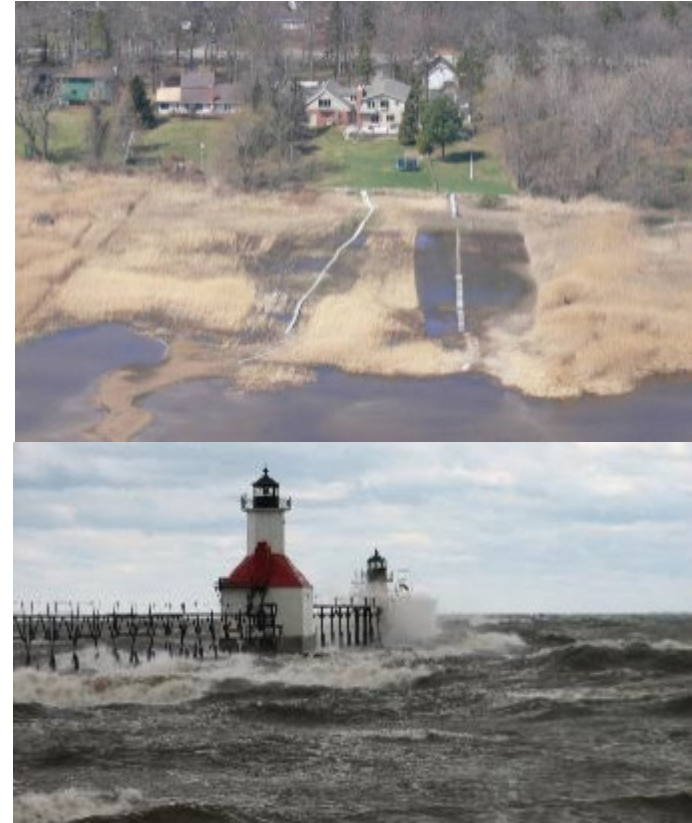
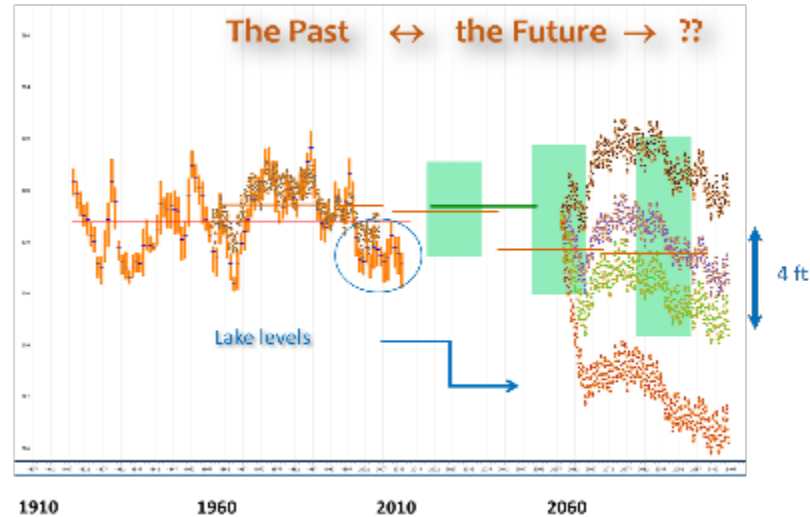
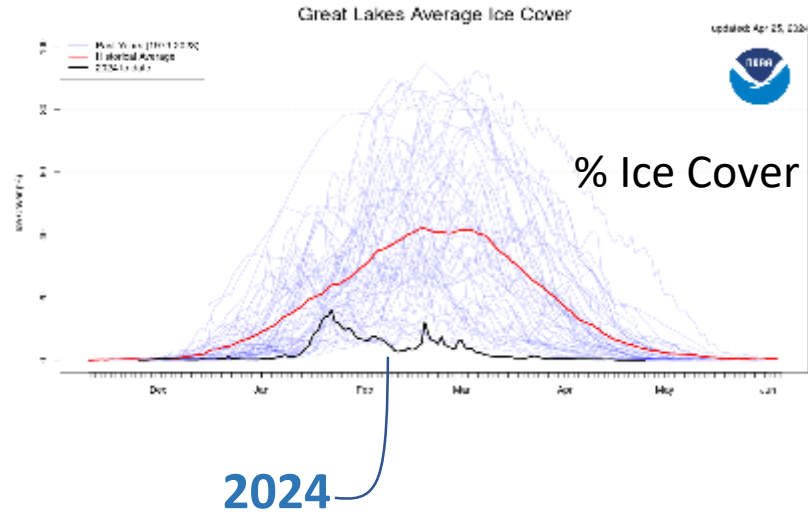
**+ 4-9 F. hotter
by 2090
warmer**



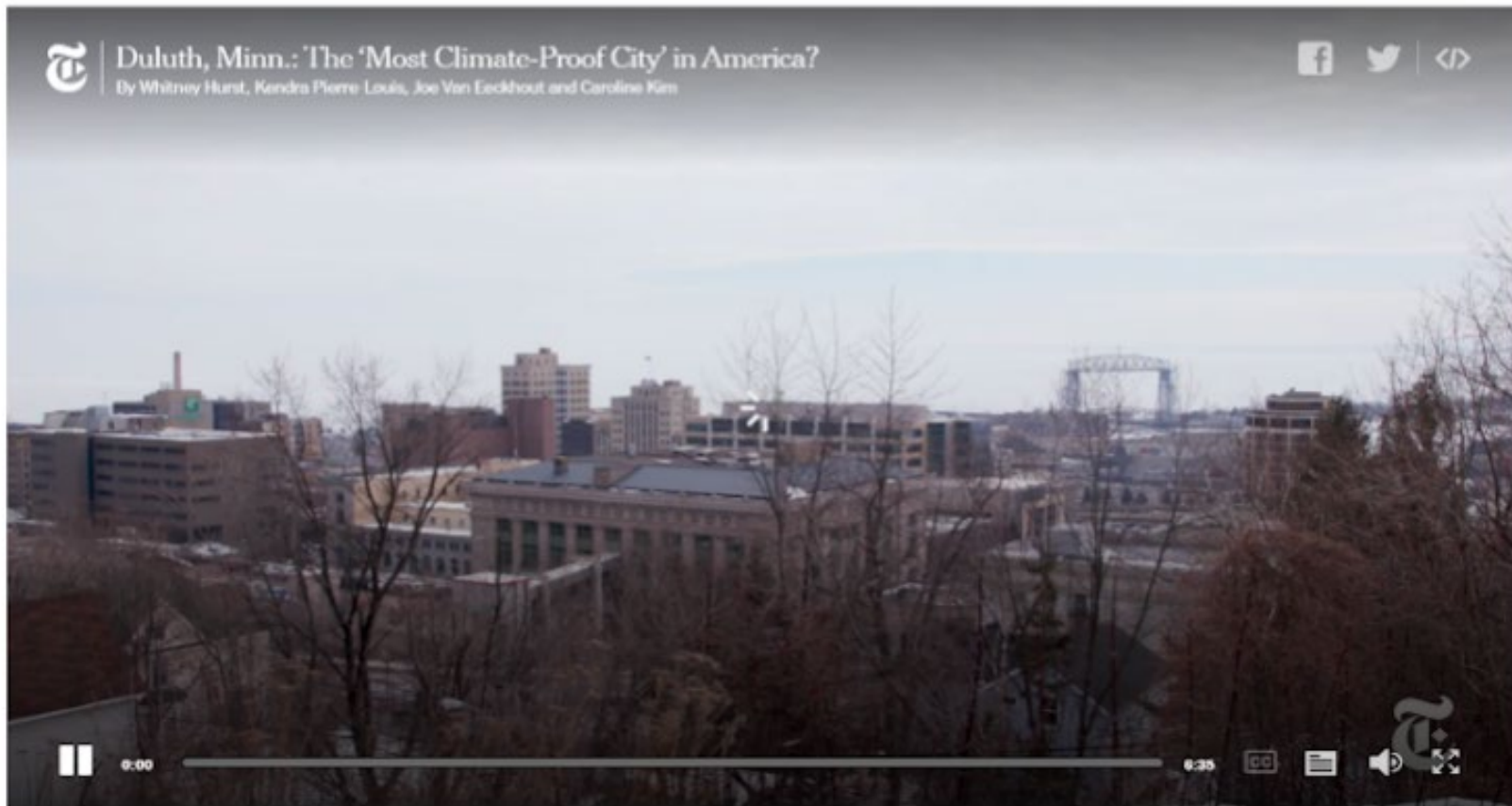
**+ 10-20% ppt
increase
wetter**



→ 50-100% increased freq intense events



Want to Escape Global Warming? These Cities Promise Cool Relief



If extreme weather made your city unlivable, where would you move? Consider Duluth, Minn., a Harvard University climate adaptation expert says. He thinks the city's cold temperatures, abundance of fresh water

Demographics will change

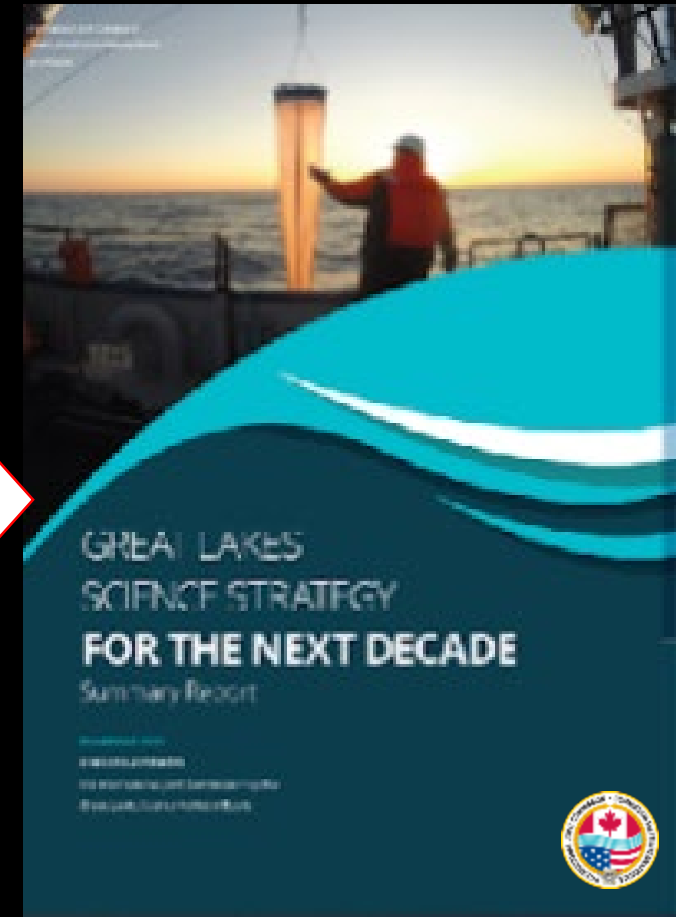
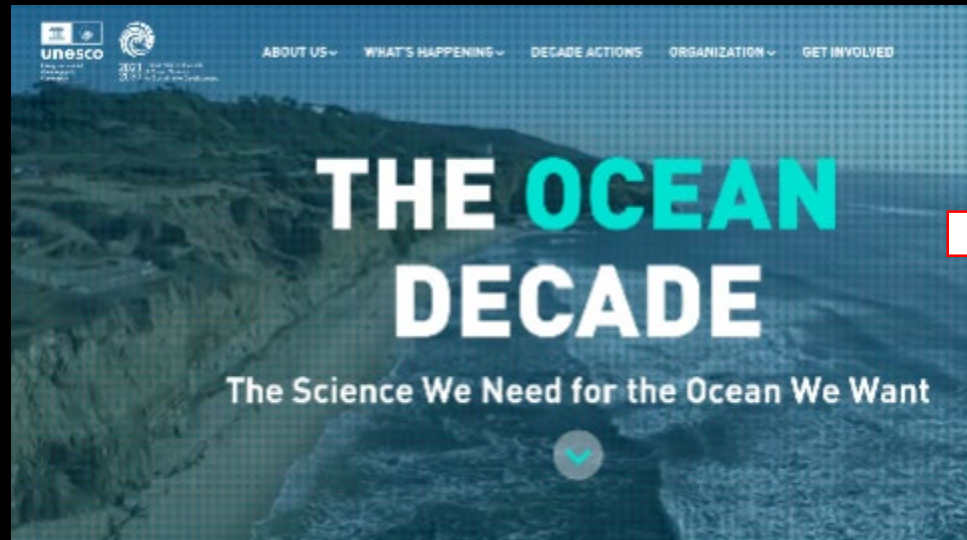
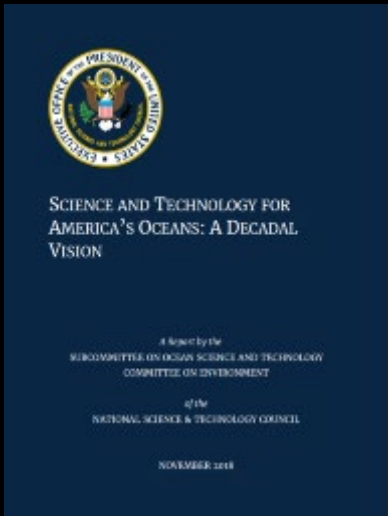
- Climate
 - Freshwater
 - Quality of life
 - Jobs
-
- All dependent upon a healthy GL ecosystem

<https://www.nytimes.com/2019/04/15/climate/climate-migration-duluth.html>



Great Lakes Decadal Science Strategy

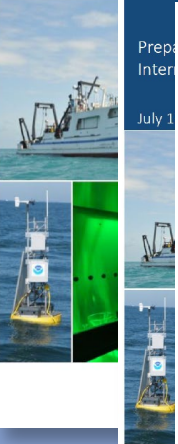
Patterned after ocean plans, linked to regional plans



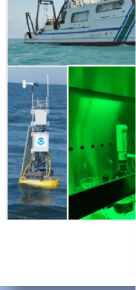
→ **JOIN THE DISCUSSION** ←
An International Decade of Great Lakes Exploration and Research
IAGLR/IJC-SAB Townhall meeting

White Paper
 Development of a Comprehensive Science Plan for a Decadal Scale, Binational Program of Great Lakes Research
 April 20, 2021


Prepared for
IJC Great Lakes Decadal Science Plan Virtual Workshop Proceedings, Appendix C Workshop Notes
 April 8-9 and 15-16, 2021



Great Lakes Science Strategy for the Next Decade
 April 26, 2022
 Prepared for: International Joint Commission



Congressional briefing Jan 2022
Binational Decadal Science Plan for the Great Lakes
 IJC Science Advisory Board




2018-2022

USGS
 science for a changing world

**U.S. Geological Survey Great Lakes Science Forum—
 Summary of Remaining Data and Science Needs and Next Steps**

<https://pubs.usgs.gov/of/2021/1096/ofr20211096.pdf>

Open-File Report 2021-1096

U.S. Department of the Interior
 U.S. Geological Survey

2023-25

INTERNATIONAL JOINT COMMISSION GREAT LAKES SCIENCE ADVISORY BOARD 2022

GREAT LAKES SCIENCE STRATEGY FOR THE NEXT DECADE


Join and support the coalition to develop the **Great Lakes Science Plan**

- ▶ The Great Lakes face unprecedented and accelerating environmental changes that require forward-looking, predictive science to inform the management and stewardship programs essential to the region's economic and social health.
- ▶ The International Joint Commission (IJC) is convening a coalition of partners to prepare a binational, basinwide Great Lakes Science Plan for implementing its 2022 Great Lakes Science Strategy for the Next Decade that outlines six priority areas to target investments of US\$100 million (CAD\$125 million) annually for the next 10 years.
- ▶ The IJC seeks your participation in shaping the forthcoming Science Plan, which will describe science needs, required level of investment and sustainable governance arrangements to reinvigorate Great Lakes science.
- ▶ Contact the IJC Great Lakes Regional Office to get involved: commission@ijc.org

The Great Lakes region is becoming a highly sought-after place to live, work and play, almost entirely because of the presence of nearly 20 percent of the world's available fresh surface water. The Great Lakes ecosystem, while resilient, is surprisingly fragile. The lakes are transforming rapidly in response to climate change, far-reaching land use alterations, and the onslaught of emerging stressors. Now more than ever, the Great Lakes need cutting-edge science and surveillance to anticipate and prevent these threats to protect the wellbeing of the 40 million residents who rely on the lakes for drinking water and the region's US\$6 trillion (CAD\$7.5 trillion) economy.

The framework for these essential science and surveillance needs is outlined in the IJC Great Lakes Science Advisory Board's 2022 *Great Lakes Science Strategy for the Next Decade* report (Science Strategy). To implement the Science Strategy, the IJC's next steps are to create a detailed and actionable basinwide Science Plan. The IJC calls on your participation to help make the Science Plan a reality.

The Science Plan will be a detailed and actionable roadmap to accomplish the six priority areas of the Science Strategy (see back). The IJC is convening coalition to prepare the Science Plan with involvement from governments, Indigenous nation representatives, academia and tribal colleges, nongovernment organizations and others. The Science Plan will position Canada and the United States to achieve the intimately linked goals of a healthy, protected, and sustained regional economy, environment, and high quality of life for basin residents. The future of the Great Lakes, and the generations to come that will depend on them, depends on actions taken today.



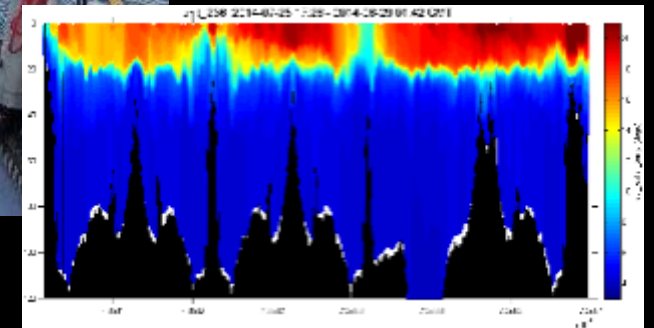
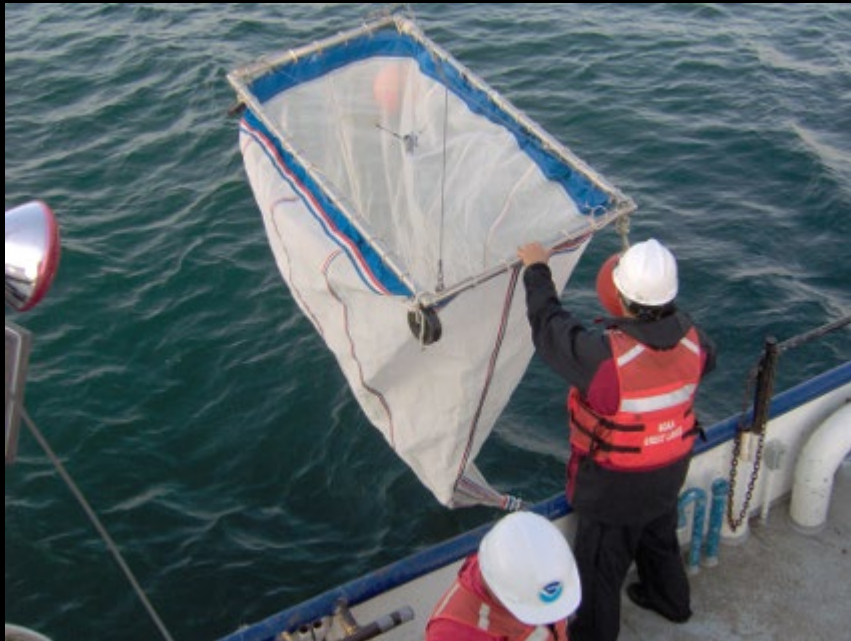
© International Joint Commission. Photo by IJC Great Lakes Science Strategy James Atherton, via Distinct Visual Information Distribution Service

IJC Great Lakes Science Advisory Board
[ICJ.ORG/SAB/GLS-SCIENCE-STRATEGY](http://icj.org/sab/gls-science-strategy)

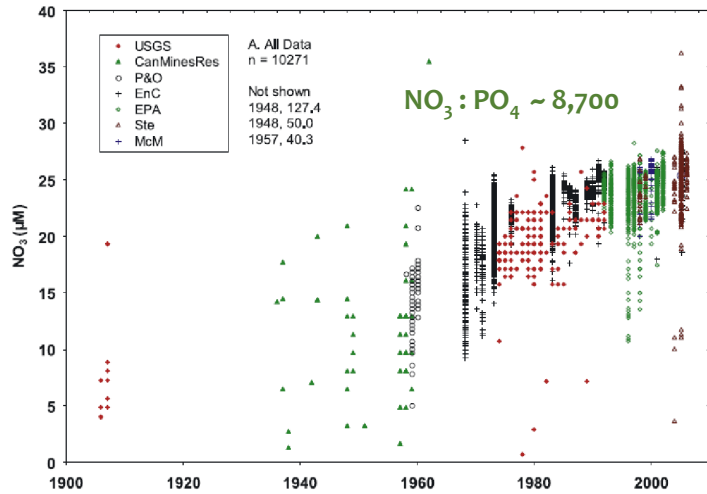
Science Strategy Investment Priorities ~ \$100M/y



1) Basic process research



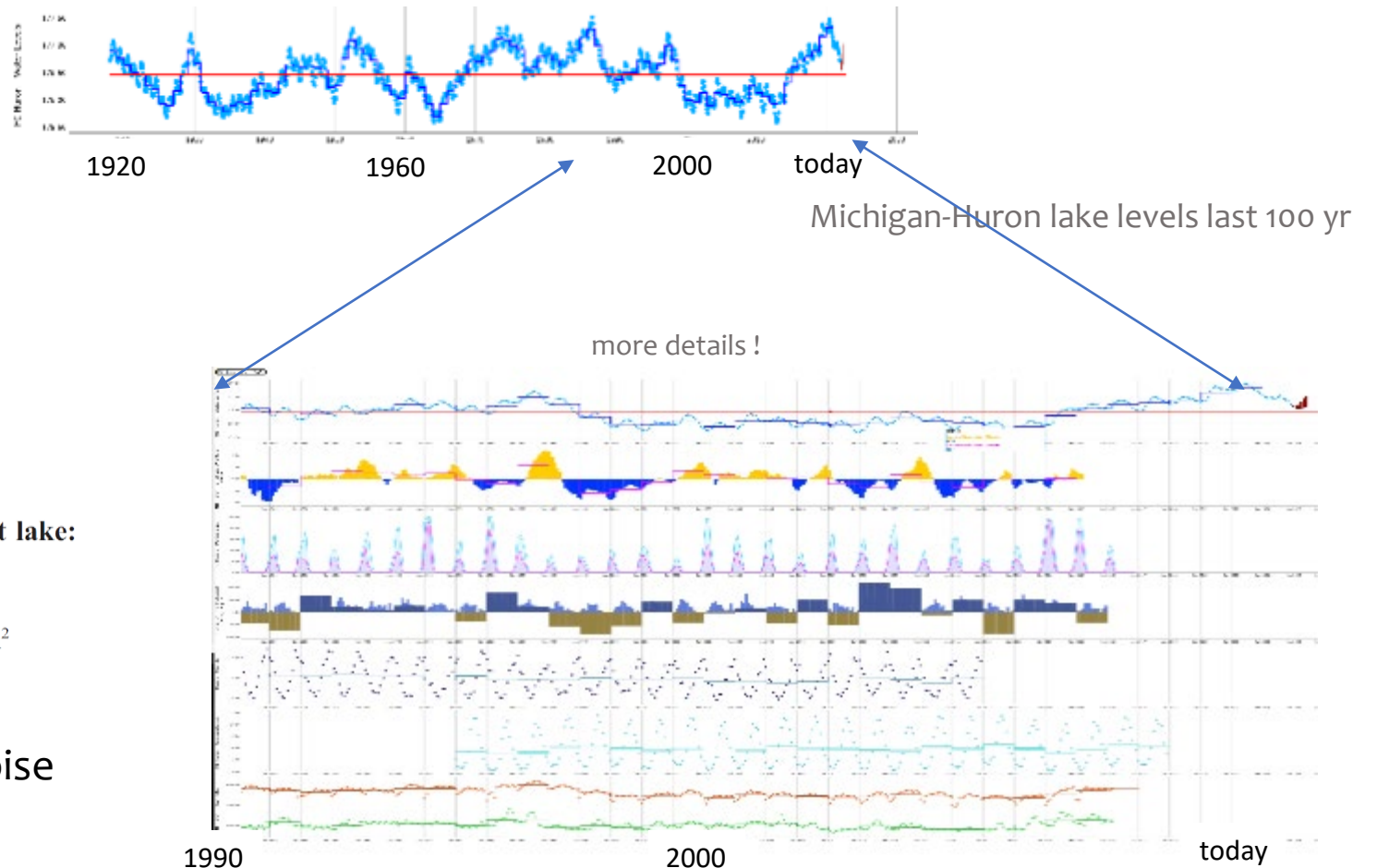
2) Monitoring and long time series measurements



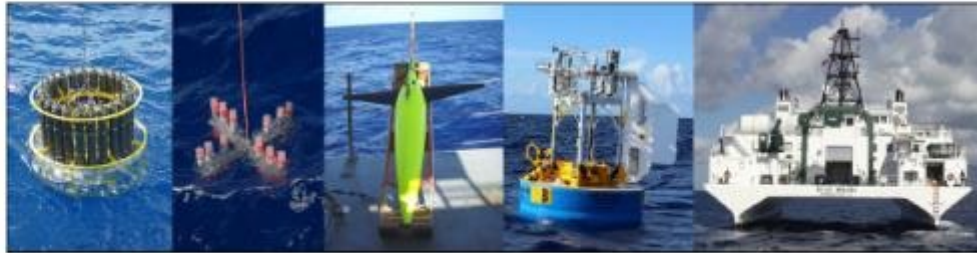
Increasing stoichiometric imbalance in North America's largest lake: Nitrification in Lake Superior

Robert W. Sterner,¹ Eleni Anagnostou,² Sandra Brovold,¹ George S. Bullerjahn,³ Jacques C. Finlay,¹ Sanjeev Kumar,¹ R. Michael L. McKay,³ and Robert M. Sherrell²

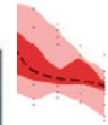
❖ Separating biological variability and noise from long term trends like climate



Hawaii Ocean Time-series (HOT)



Total Wet Mass (g m^{-2})
Hawaii Ocean Time-series - HOT (centr



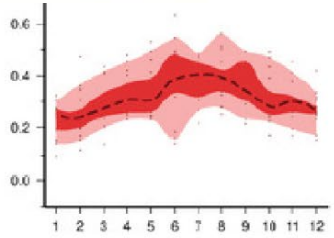
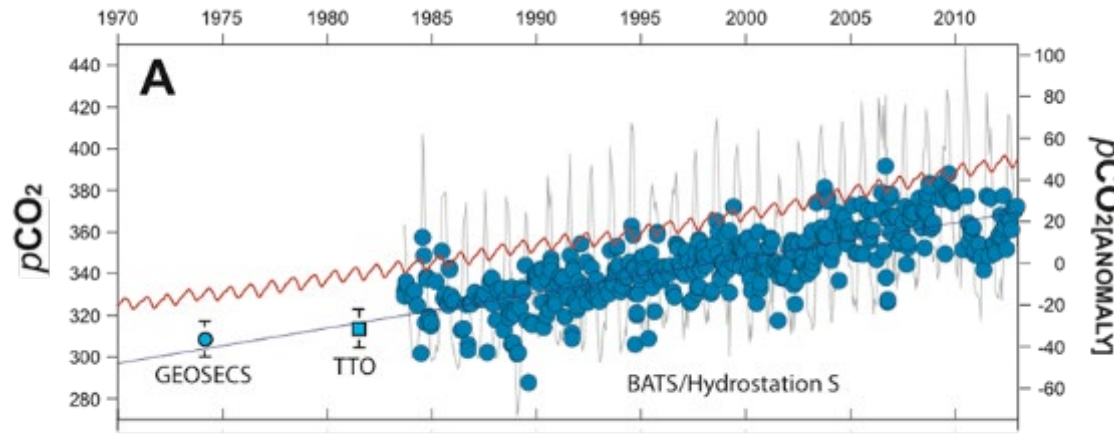
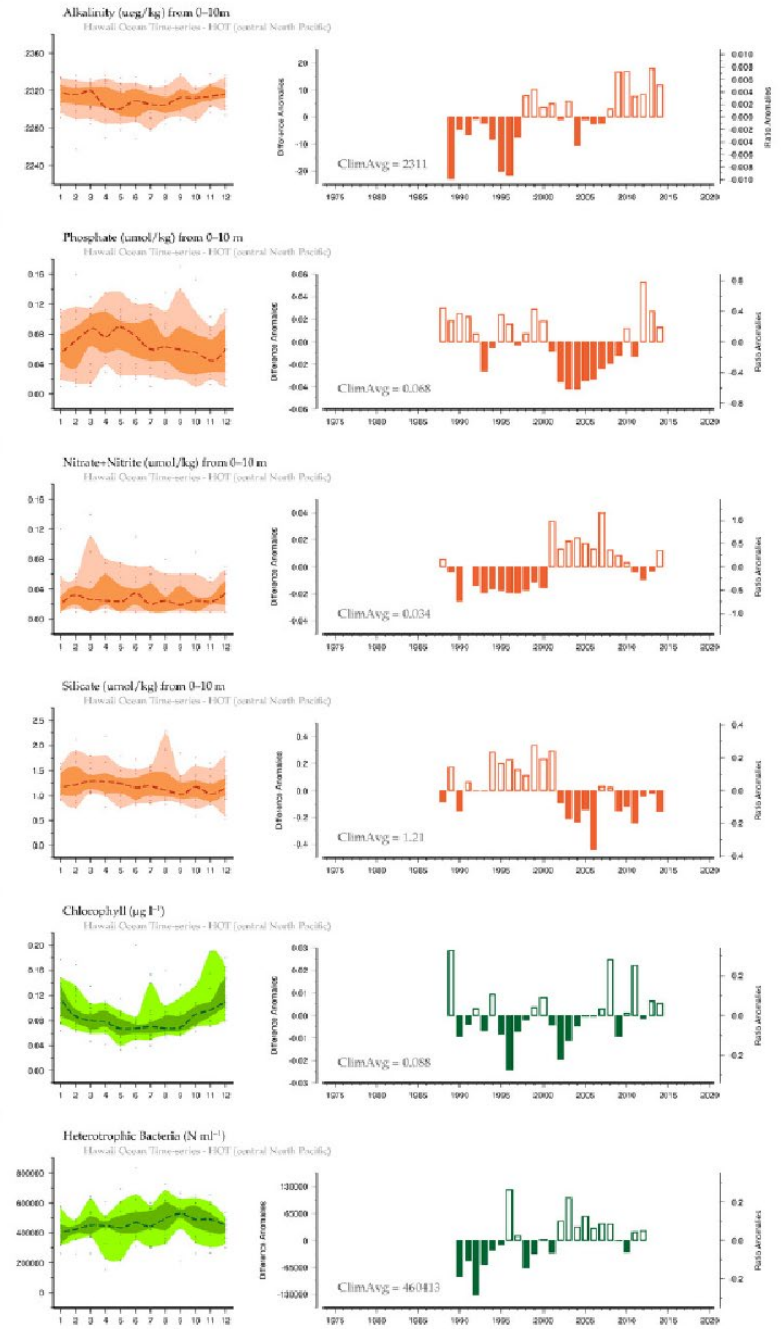
series - HOT (centr

Multi-Vari

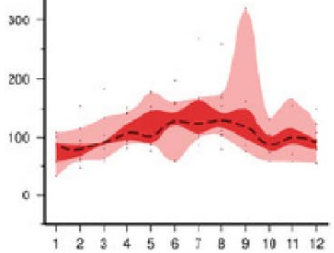
-Checked variables will hav



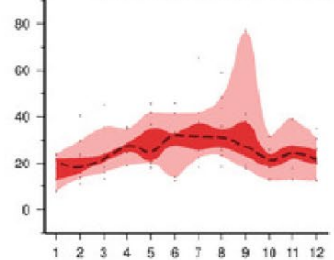
- ✓ Hadley-EN4 Salinity () a
- ✓ ICOADS scalar Winds
- ✓ HadISST Sea Surface T



Total Carbon Mass (mg m^{-2})
Hawaii Ocean Time-series - HOT (centr



Total Zoo Nitrogen (mg m^{-2})
Hawaii Ocean Time-series - HOT (centr



?

FOR SUBSCRIBERS NEWS

Buoys are collecting a wave of data on 'the pulse' of the Great Lakes. But winter remains a mystery.

Caitlin Looby
Milwaukee Journal Sentinel

Published 6:00 a.m. CT Dec. 2, 2022 Updated 11:55 a.m. CT Dec. 2, 2022

Share this story

The 70-year-old Army boat crossed under Milwaukee's Hoan Bridge and glided over the calm, glassy waters as it headed north, hugging the Lake Michigan shoreline.

The crew of the Neeskay, which has been used for more than 50 years by the University of Wisconsin-Milwaukee for Great Lakes research, was on a late-fall ritual: retrieving an 850-pound yellow buoy anchored a little more than a mile off Alwater Beach.

This year, there were 120 buoys floating around the Great Lakes through the warmer months, collecting millions of data points on the weather and water conditions. Three on Lake Michigan are affiliated with the university.



Nathan Schwartz (left) and Jesse Gale (right) help hoist the Great Lakes Observing System buoy onto the Neeskay near Auwater Beach on Nov. 14. Caitlin Looby

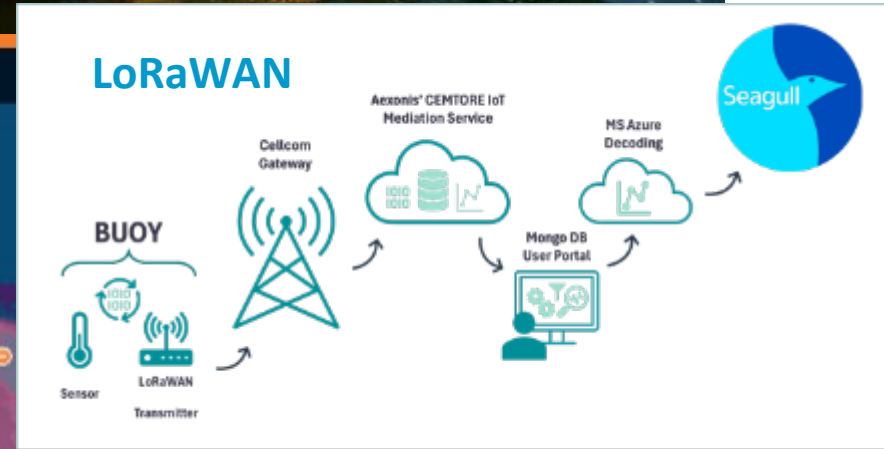
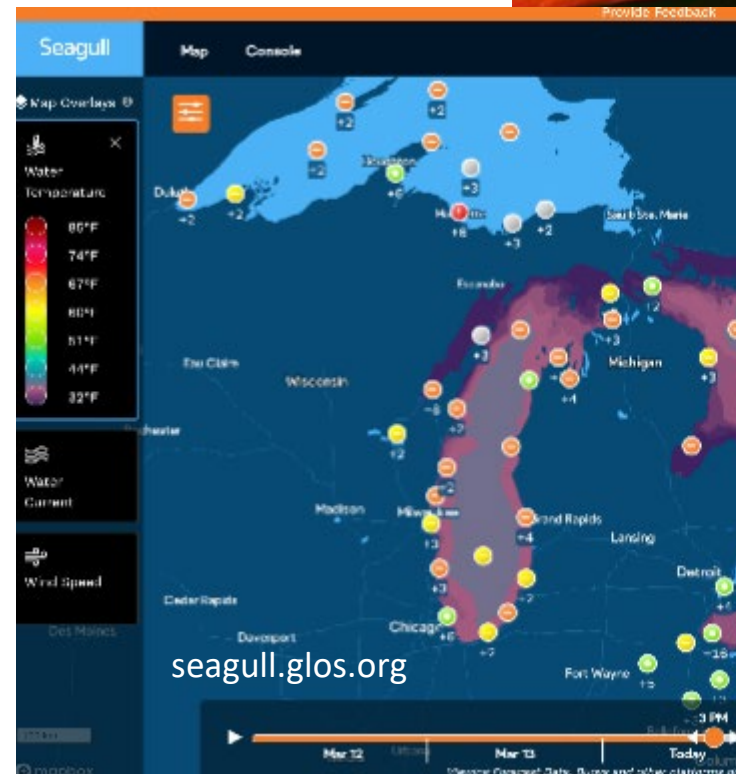


Figure 5) Data pipeline from buoy, through Cellcom gateways, to data management software packages and decoders, and finally onto Seagull for display.



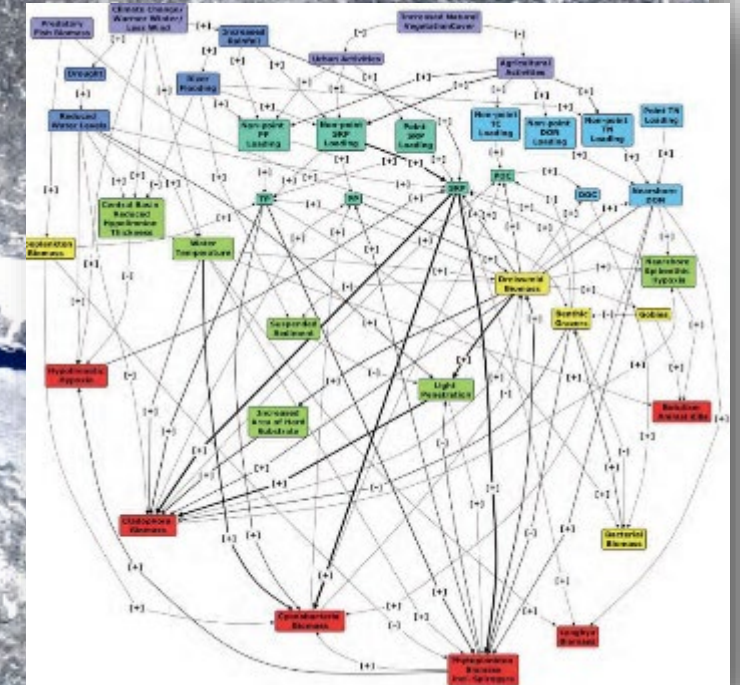
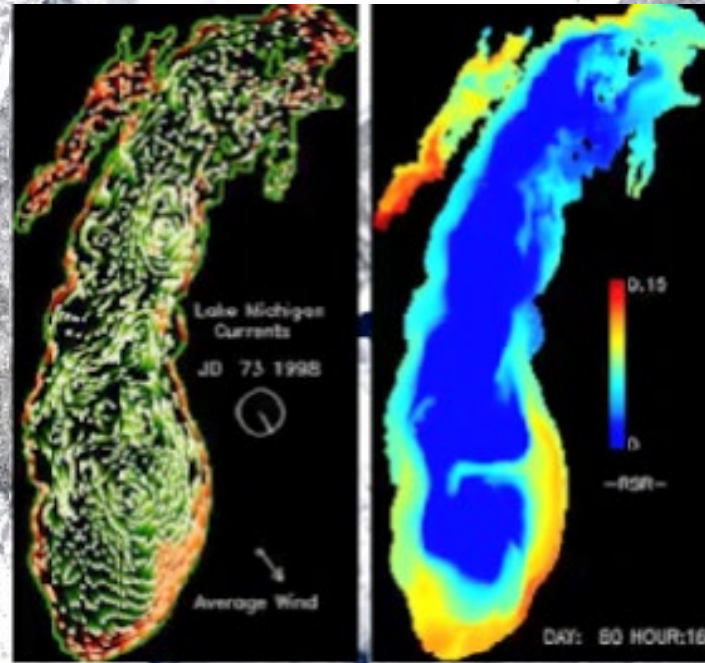
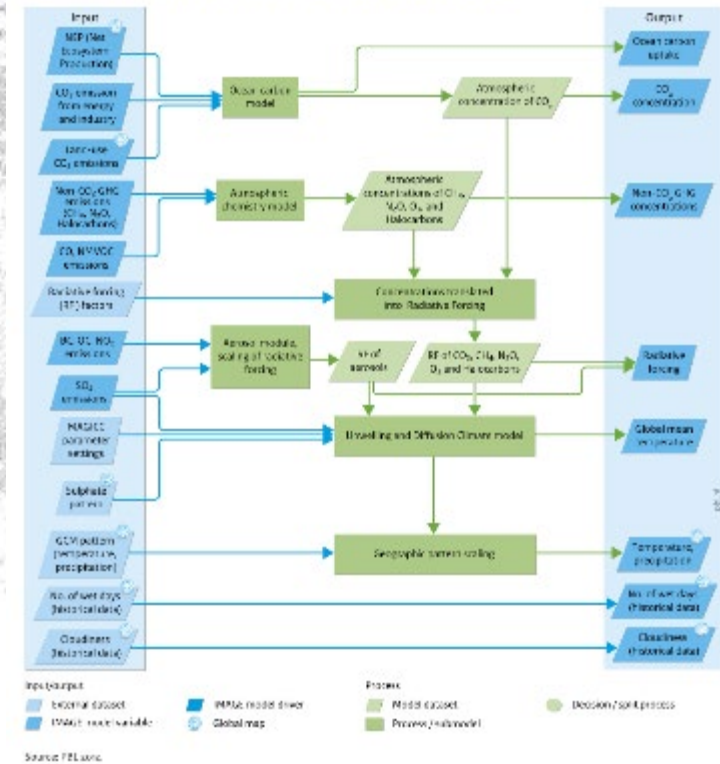
great lakes observing system





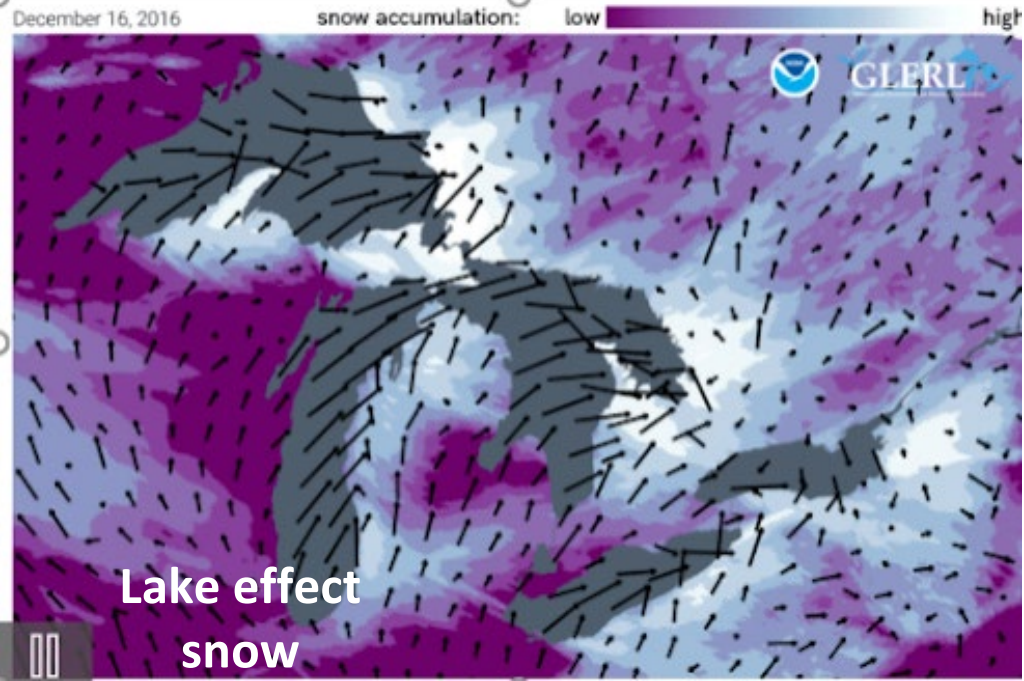
3) Enhanced models and forecasting systems

Atmospheric composition and climate model (based on MAGICC 6.0) in IMAGE 3.0



Models are complex

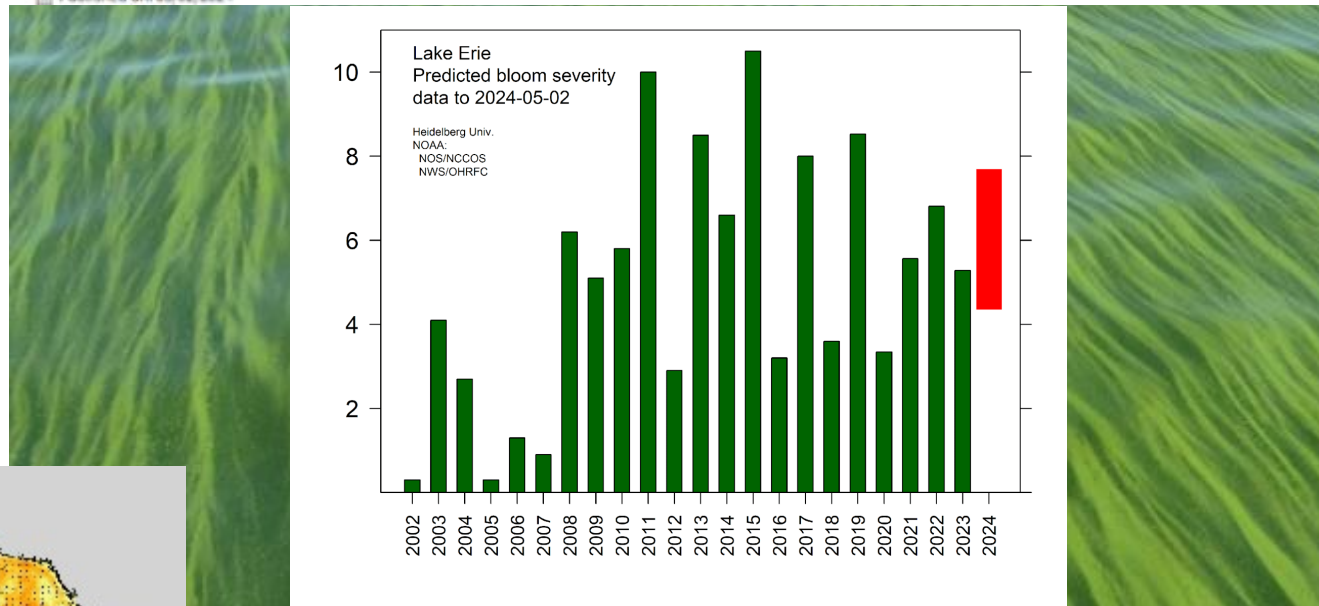




Home > Explore News > NOAA Predicts Moderate to Larger than Moderate Harmful Algal Bloom for Lake Erie this Summer

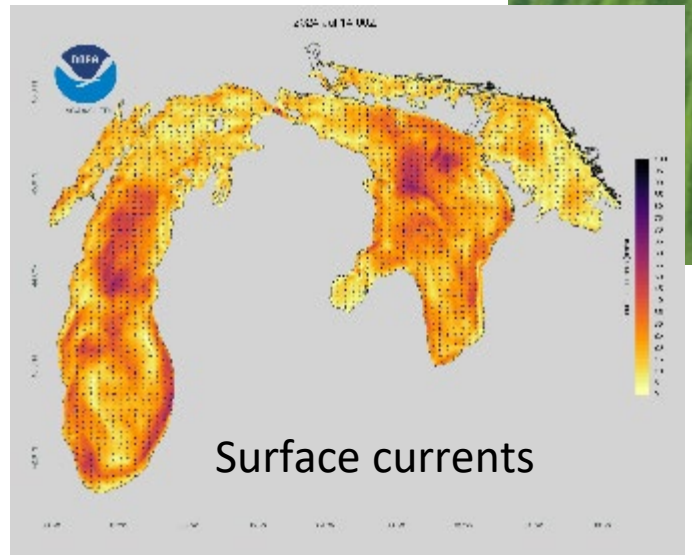
NOAA Predicts Moderate to Larger than Moderate Harmful Algal Bloom for Lake Erie this Summer

Published on: 05/02/2024



https://www.glerl.noaa.gov/pubs/brochures/LakeEffectSnow_Dec2016.gif

Great Lakes Operational Forecasting System



https://nccospublicstor.blob.core.windows.net/hab-data/bulletins/lake-erie/2024/projection_2024_01.pdf

<https://www.glerl.noaa.gov/res/glcfs/ncast.php?lake=mih>



4) Workforce development



Top concern in scientific community

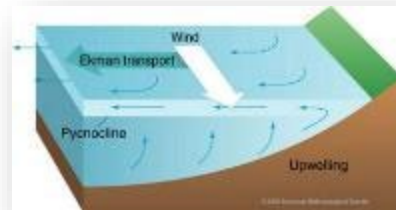


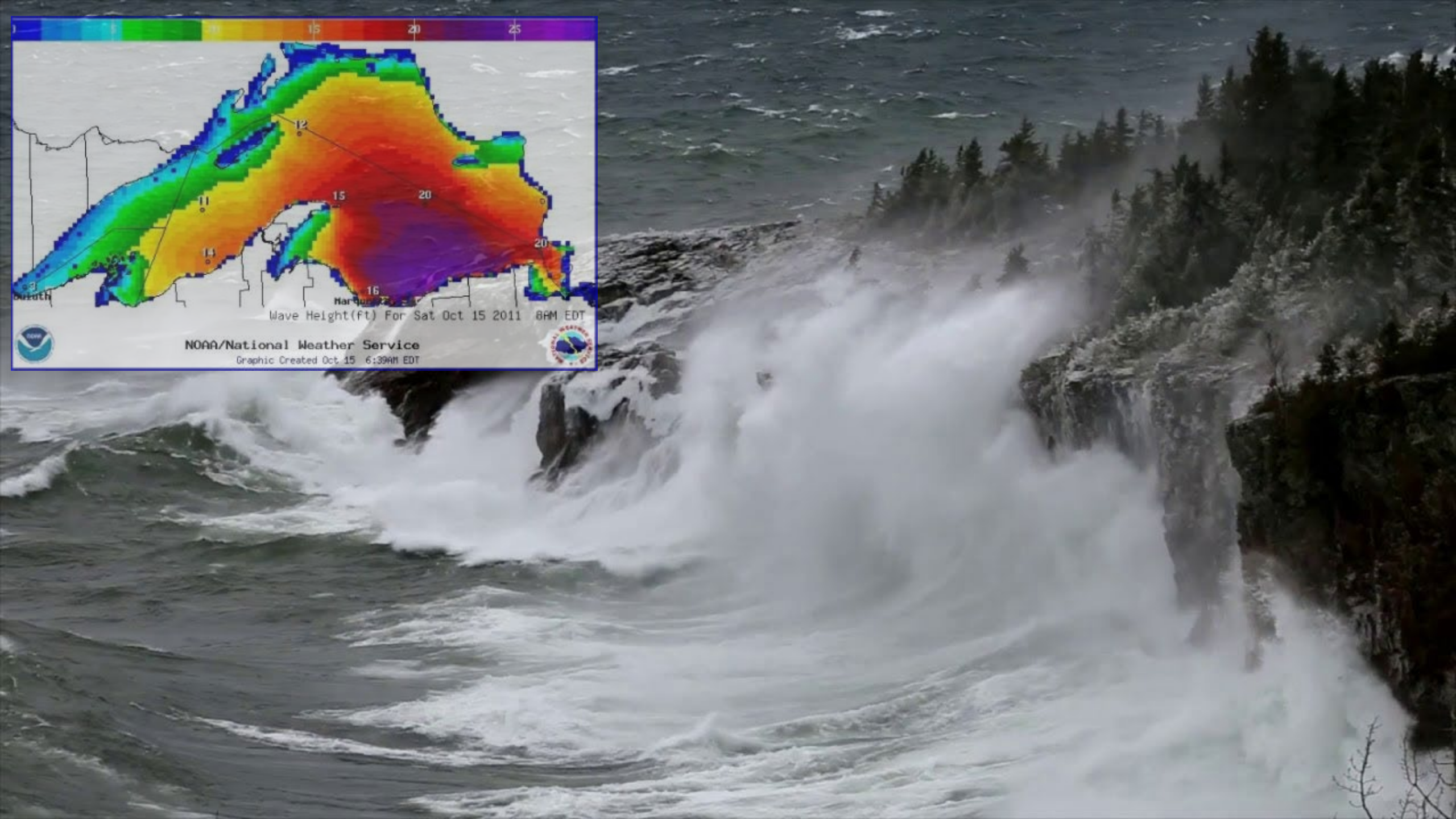
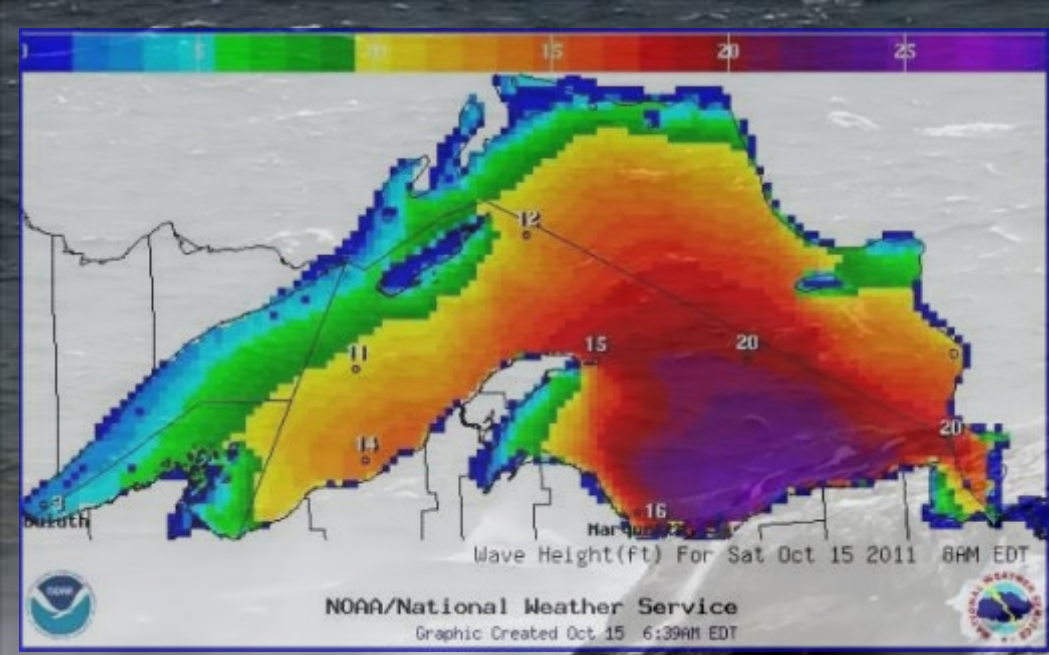
5) Science infrastructure and Centers of Excellence



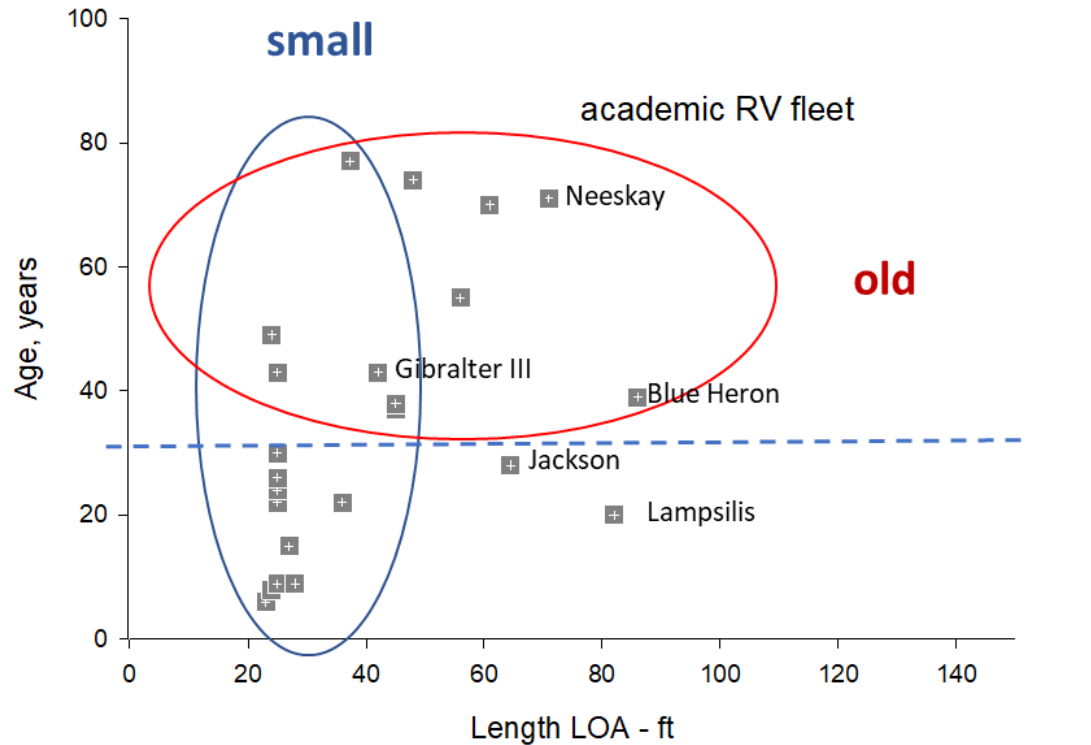
These are not lakes

$$\partial u / \partial t - f_0 v = -g \partial \eta / \partial x$$





GL Assoc Science Ships (GLASS)



- Academic research fleet is small and aging
- No ice-capable vessels
- No year-round operations
- No dynamically positioned

23 University operated
RVs

<https://canamglass.org/>

Winter science = major gap



JGR Biogeosciences

REVIEW ARTICLE

10.1029/2021JG006247















Special Section:

Winter limnology in a changing world

Key Points:

- Winter limnology is a key knowledge gap that limits understanding and management of the Great Lakes and other large, seasonally frozen lakes.

The Changing Face of Winter: Lessons and Questions From the Laurentian Great Lakes

Ted Ozersky¹ , Andrew J. Bramburger², Ashley K. Elgin³ , Henry A. Vanderploeg⁴ , Jia Wang⁴ , Jay A. Austin⁵, Hunter J. Carrick⁶, Louise Chavarie⁷, David C. Depew² , Aaron T. Fisk⁸, Stephanie E. Hampton⁹, Elizabeth K. Hinchey¹⁰, Rebecca L. North¹¹ , Mathew G. Wells¹² , Marguerite A. Xenopoulos¹³ , Maureen L. Coleman¹⁴ , Melissa B. Duhaime¹⁵, Ayumi Fujisaki-Manome¹⁶ , R. Michael McKay¹⁷ , Guy A. Meadows¹⁸ , Mark D. Rowe⁴ , Sapna Sharma¹⁹ , Michael R. Twiss²⁰, and Arthur Zastepa²

5) Science infrastructure and Centers of Excellence

- *Ecosystem Model development, archiving, and operational management*
- *Indigenous and community knowledge, advancement and engagement*
- *Economic and socio-economic data collection and analysis*
- *Numerical modeling, forecasting, AI, and machine learning*
- *Advanced Analytical services – ‘Omics, PFAS, plastics, emerging contaminants*
- *Operational cooperatives - ships, AUV’s, ROVs*
- *Research coordination networks*
- *Communications, outreach, public engagement*
- *Specialized Training centers*
- *Early warning systems and horizon scanning frameworks*

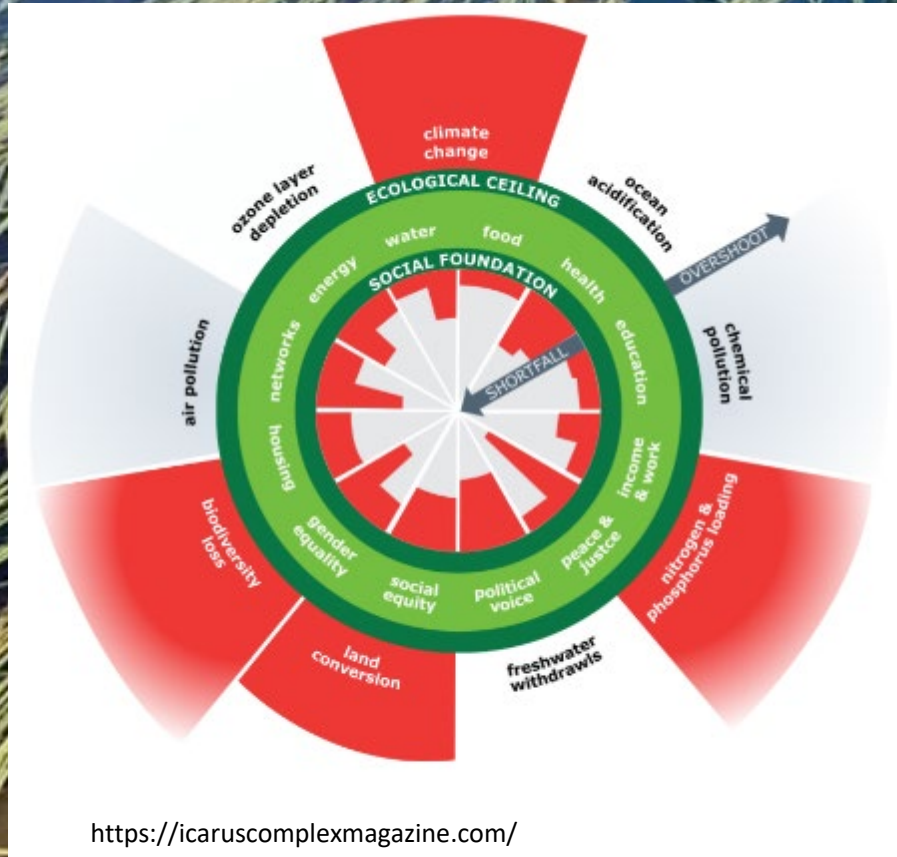
TBD - Activities that require **ongoing, long term commitments** beyond that of the typical 3-5 y research project

The composite image consists of three main parts:

- Top Left:** A news article snippet titled "New Coast Guard center to study impact of oil spills in freshwater" by Tess Ware, dated 11/13/2022. It includes social media sharing icons.
- Top Right:** A diagram of a neural network architecture. It starts with an "INPUT" layer of size $(28 \times 28 \times 1)$. This is followed by a "Conv_2" convolutional layer with 5×5 kernel and padding, resulting in $n1$ channels of size $(24 \times 24 \times n1)$. This is followed by a "Max-Pooling" layer of size (2×2) . Another "Conv_2" convolutional layer with 5×5 kernel and padding results in $n2$ channels of size $(22 \times 22 \times n2)$. This is followed by another "Max-Pooling" layer of size (2×2) . The final layer is a "Fully Connected" layer with $n3$ channels of size $(8 \times 8 \times n3)$. The output is a "Fully Connected" layer with $n4$ channels of size $(8 \times 8 \times n4)$, which is then passed through a "ReLU activation" function to produce an "OUTPUT" layer with 10 nodes (0-9).
- Bottom:** A diagram illustrating various oceanographic data collection methods. On the surface, there are "Moored Buoys", "Ships", "Scientific Quilbas", "Data Centers", and "HF Radars". Below the surface, there are "Argo Profiling Floats", "Surface Drifters", "Tide Gauges", "Giders", "CTD Conusuel", and "Sea Mammals".



6) Inclusion of broad socioeconomic and cultural perspectives



<https://icaruscomplexmagazine.com/>

Climate Change Vulnerability Assessment
Version 1 • April 2018

Integrating Scientific and Traditional Ecological Knowledge

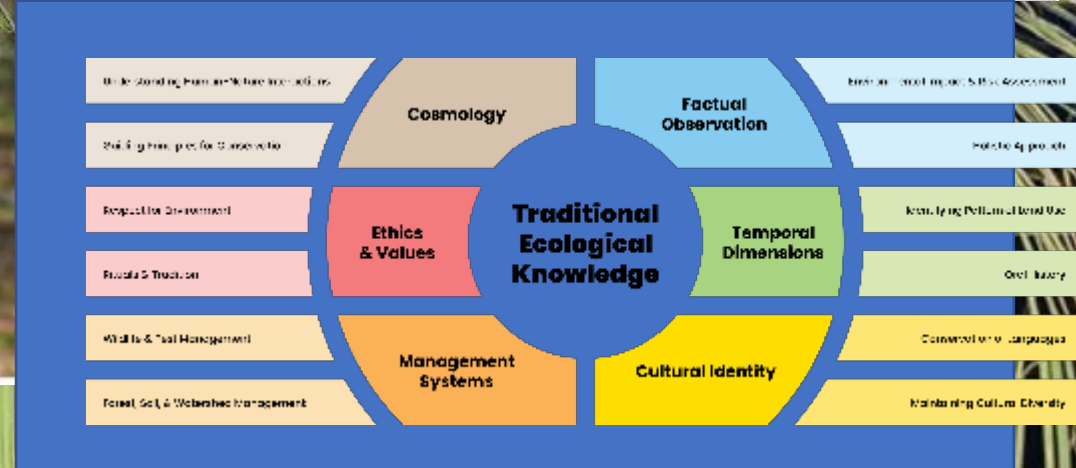
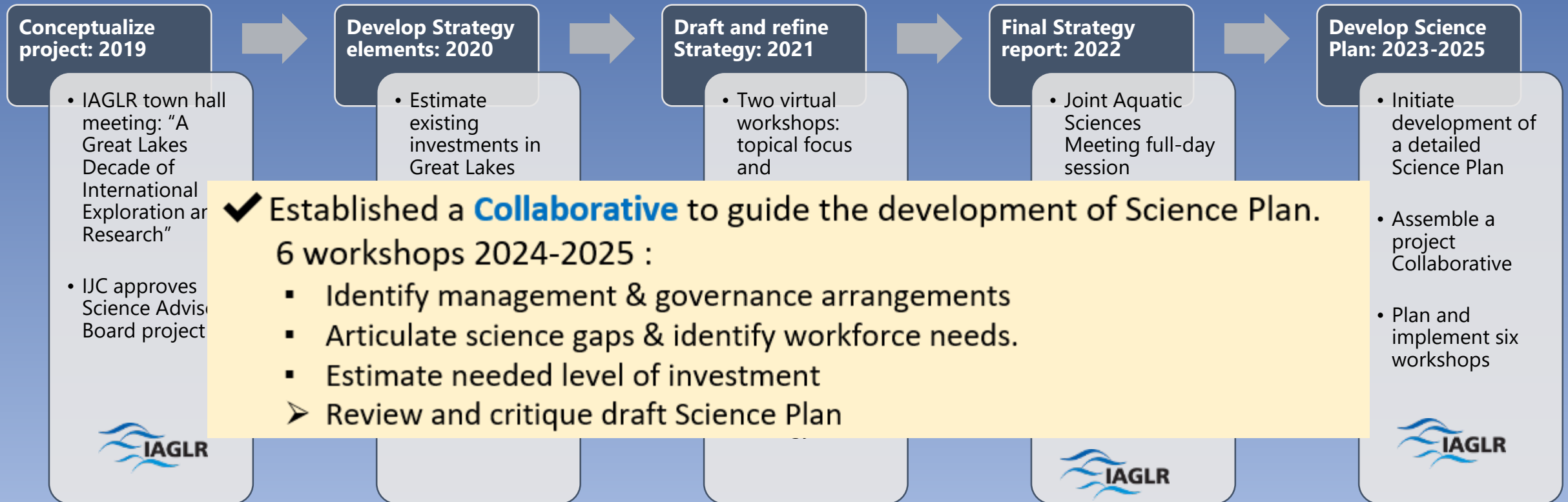


Photo: Fond Du Lac Resource Management Division

From Strategy to Plan

Next step



GL decadal science plan –

Designed to avoid restoration in the first place

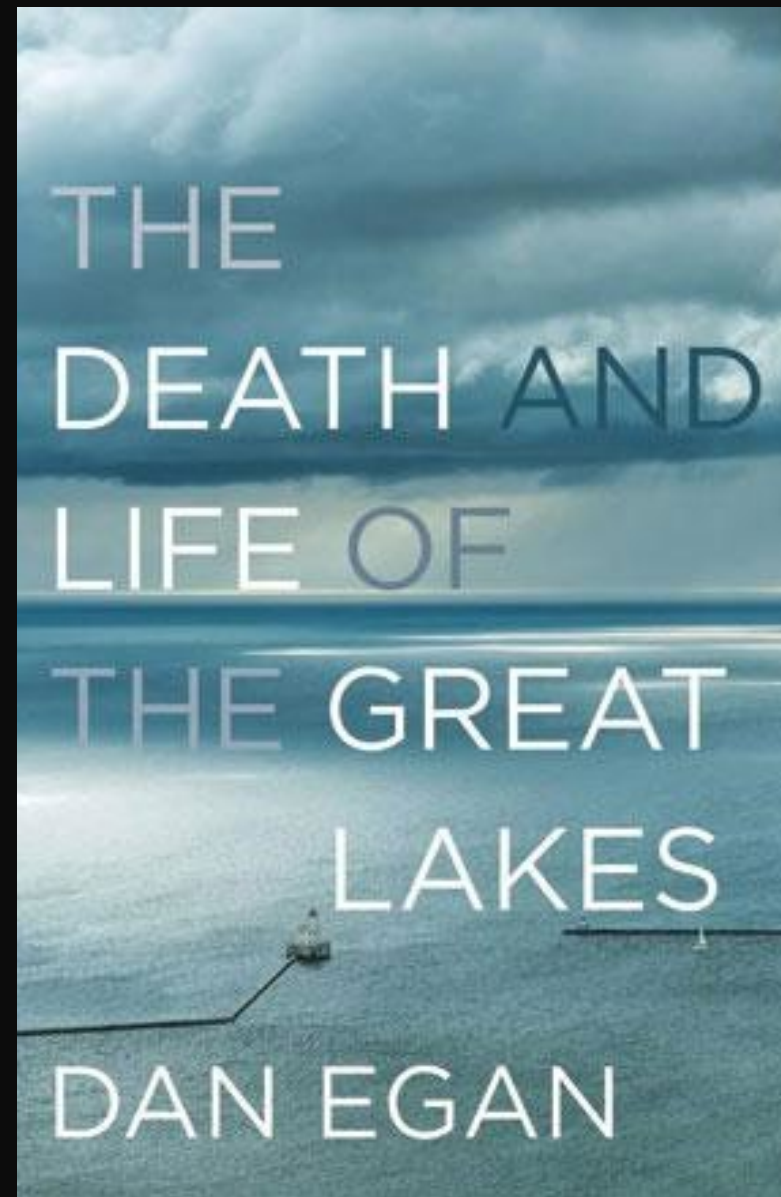
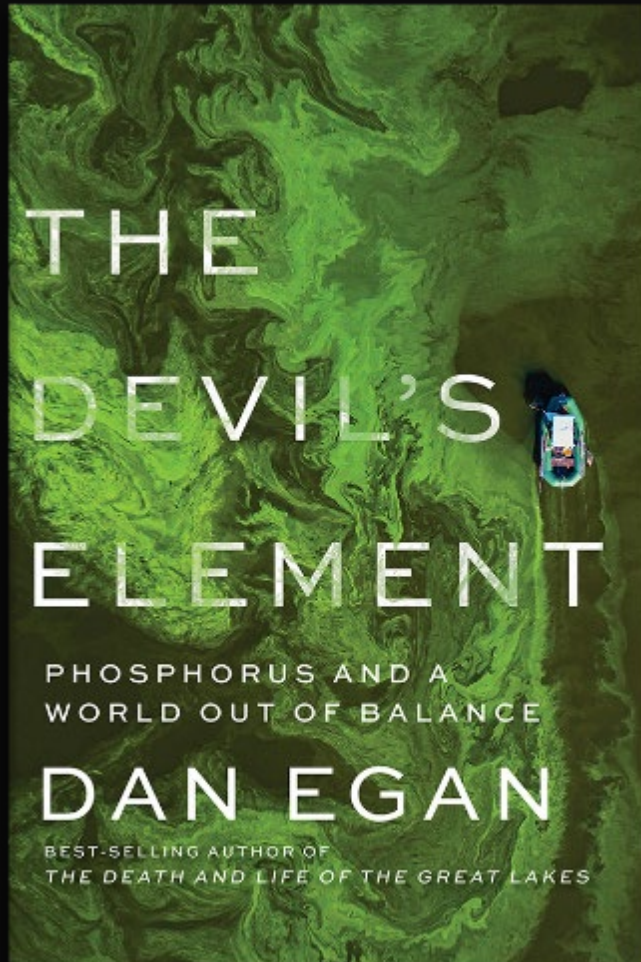
GL decadal science plan –

Designed to avoid restoration in the first place

*If we don't study the mistakes of the future,
we are doomed to repeat them for the first time*

Andrew Janssen, age 17, circa 2017

INFORM POLICY



Brico Senior Policy Fellow in Environmental Journalism



Thank you

J. Val Klump, 7-31-24