IAGLR

LAKES Letter

REMOTE SENSING

Emerging technologies

Adapting to protect *manoomin*

High-frequency radar in the Straits

Satellite data help to monitor lake health and coastal changes

Plane- and drone-mounted cameras used to forecast harmful algal blooms

SUMMER 2024, NO. 22

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The future of water quality monitoring is Earth observations from space

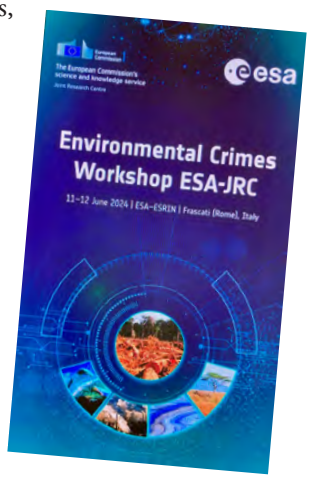
by Jérôme Marty, IAGLR Executive Director

Last June, the European Space Agency (ESA) hosted a workshop on environmental crimes at the ESA Centre for Earth Observation in Frascati, Italy. The event brought together approximately 300 participants, including Earth observation specialists, data users, policymakers, and law enforcement experts. In an oral presentation, I shared the importance of Earth observation (EO) in monitoring stressors on the Great Lakes. Using the Great Lakes Observing System program on harmful algal blooms (HABs) as an example, the presentation highlighted how EO data can contribute to early warning systems.

ESA, with its 22 member states and several associate members, plays a crucial role in global EO efforts. Canada also participates in ESA projects through the Canadian Space Agency and holds a seat on the ESA Council. With an annual budget close to US$8.86 billion (approximately US$11 per European), ESA is the largest provider of EO data worldwide, releasing about 30 terabytes of data daily. One of ESA's most renowned programs is the Copernicus initiative, which delivers environmental data through the Sentinel satellite constellation.

EO offers a tool for tracking environmental crimes, which are a relatively new and evolving concept, with a global impact estimated to range between US$70 billion to US$213 billion annually. These crimes have been linked to the Geneva Convention, particularly Article 55(1), which calls for the protection of nature from widespread, long-term, and severe damages. A few years ago, several organizations and countries proposed adding *ecocide* (the intentional or unintentional actions that cause environmental harm, such as pollution and habitat destruction) as the fifth crime under the jurisdiction of the International Criminal Court.

EO data can be instrumental in tracking long-term and widespread environmental damage. It can also help determine environmental conditions before a crime, aiding in the assessment of the extent of the damage. In freshwater, reflectance data can be used to infer turbidity and support trophic state index assessments. In Ireland, models have been developed to detect *E. coli* in areas impacted by urban wastewater pollution. In the Great Lakes region, EO data are used to track vessel activity (e.g., speed and oil spills), monitor fishing activities, and assess the impacts of stressors like HABs. However, EO data remain underutilized in legal proceedings, as they are not always recognized as valid evidence in court. Therefore, there is a growing need to raise awareness about the value of geospatial intelligence within the legal system.



One of the themes discussed during the workshop was the ownership and access to EO data, especially concerning sensitive sites and areas. As EO technologies become increasingly precise—Sentinel-2, for example, offers a resolution of 10 meters—AI processing further enhances mapping, creating cloud-free, natural color images of the entire globe. However, not everyone may have consented to be included in these products, raising critical concerns about data sovereignty, particularly among Indigenous communities who are often excluded from EO research projects.

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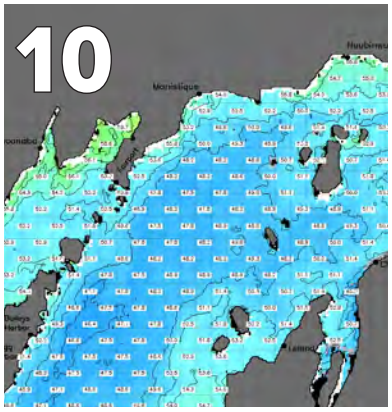
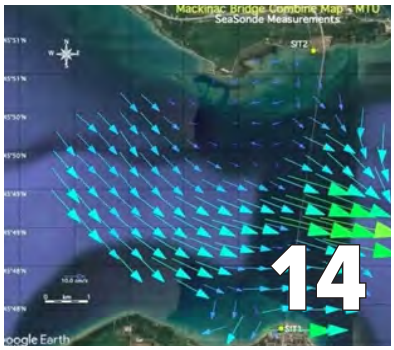




On the Cover

Great Lakes CoastWatch hosts satellite products such as this true-color image from NOAA-20's Visible Infrared Imaging Radiometer Suite sensor (VIIRS NOAA-20) taken February 24, 2024. True color images look similar to a photograph of the Earth and lakes from a space-borne satellite perspective.

IAGLR 2025
JUNE 2-6 | MILWAUKEE
Creating Great Lakes Resilience

IAGLR 2025 Call for Sessions

We invite you to propose a scientific session for IAGLR's 68th Annual Conference on Great Lakes Research, which will bring together natural and social scientists, environmental engineers, practitioners, decision makers, community members, and others to highlight current and future scientific needs and advances to promote resilience of the world's large lakes.

The conference will be held June 2–6, 2025, in Milwaukee, Wisconsin, as a hybrid event. Session chairs should be prepared to facilitate a session that welcomes both in-person and virtual oral presentations and audience participation.

Deadline: Friday, September 20

Let us help put you in the spotlight!

Gain visibility and show your support for large lake research through these IAGLR 2025 opportunities:

Sponsor the conference

Exhibit at the conference

Fund a specific event or item

Place an ad in the Program Book

Become a Great Lakes Benefactor—Enjoy sponsor and exhibitor benefits and more!

iaglr.org/iaglr2025

ASSOCIATION NEWS

IAGLR 2024 survey results

We invited 788 conference attendees to share their thoughts about the event in a follow-up survey. Of the 30% who responded, a majority were white (71%), women (55%), and from the United States (54%). Over half were from academic institutions (56%), while 15% were from nonprofit organizations, and 13% from federal government. Most presented research (71%), and about 8% attended virtually. It was the first IAGLR conference for 42% of the respondents, and 31% indicated they were mid career. Other highlights include the following:

- 89% rated the conference as "excellent" or "good"
- 97% indicated the conference was beneficial to their career
- 87% agreed they gained knowledge in their area of expertise and 90% indicated they gained knowledge outside their expertise
- 91% indicated they felt welcome and 89% agreed the conference helped them feel part of the Great Lakes community
- 85% said we should continue to offer a midweek break. This was the first year we offered field trips and workshops on Wednesday afternoon. 86 respondents did one of these events, while others used this time to catch up on work, network, explore on their own, or participate in other meetings.

Get support to attend IAGLR 2025 conference

In addition to various registration discounts, including for scholarship recipients (see last page), did you know IAGLR offers the following support? The conference is scheduled for June 2–6, 2025, in Milwaukee, Wisconsin.

- **IDEA+ Workshop Award** provides support for someone to host a workshop at the conference. The award aims to broaden participation in IAGLR by welcoming and involving people from historically marginalized communities. **Apply by Nov. 1.**
- **International Travel Award** supports a master's or Ph.D. student or post-doctoral fellow from countries outside of Canada or the United States to present at the conference. **Apply by Feb. 10.**
- **Student Travel Awards** provide funds to IAGLR student members to help with travel costs. Apply when you register for the conference. Make sure to sign up for your 2025 membership before then.

Webinar recording available

If you missed the livestream, please visit our YouTube to watch the recording of this recent webinar featuring Indigenous speakers from around the globe who present examples of Indigenous Peoples' observations, understandings, and ways of managing the natural environment, with a focus on components of the hydrological cycle. The webinar was organized by GEO Indigenous Alliance and GEO AquaWatch, with support from CSIRO's AquaWatch Australia, IAGLR, and the World Water Quality Alliance.

IAGLR committee chairs set for upcoming year

The following members will serve as chairs of IAGLR's committees. Thank you to all for your leadership and service. Paris Collingsworth and Neil Rooney, Awards Committee; Calvin Hitch and Noel Urban, Conference Committee; Donna Kashian and Jérôme Marty; Finance Committee; Alex Duncan and René Shahmohamadloo, IDEA+ Committee; Alfred Achieng and Ronald Semyalo, International Committee; Calvin Hitch, Membership Committee; Suzanne Gray and Sabina Rakhimbekova, Nominations Committee; and Jim Bence, Publications Committee.

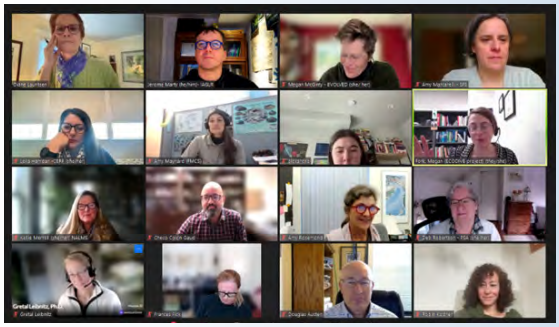
Interested in JGLR print copies?

Occasionally, IAGLR members or libraries approach us to see if we know of anyone interested in obtaining a set of hard-copy issues of the *Journal of Great Lakes Research*. We'd like to start a list of people who are interested in either donating or receiving a set. If that is you, please reach out to Wendy Foster at wendy@iaglr.org. Although we will not coordinate arrangements, we will help you start the conversation by exchanging contact information.

Staying active in aquatic science society network

IAGLR continues to play a role within the Consortium of Aquatic Science Societies (CASS). This global network comprising 10 aquatic science societies is known to IAGLR members primarily for its Joint Aquatic Sciences Meeting (JASM), last held in 2022 in Grand Rapids, Michigan. Beyond this conference, CASS is active through several committees, which include IAGLR board and staff members.

Policy statements, including those from CASS, are available on the IAGLR Policy page.



Recent CASS highlights

MOU: The signing of an MOU by all CASS members to commit to the next JASM in 2028. This conference is expected to attract approximately 4,500 participants and is likely to be the largest aquatic conference ever. The next step is to find a location for this event.

Open Access: The publication of a joint statement to the White House Office of Science and Technology Policy regarding public access policies for federally funded research results and data (Nelson Memo). In this statement, CASS highlights the value of open access publishing while raising concerns about the implementation of such policies, which could have unintended consequences for nonprofit societies and their publications.

Bookkeeping: IAGLR has volunteered to manage CASS's books. CASS members are expected to contribute an annual fee to support specific activities (e.g., a booth at the SACNAS conference). Moving forward, IAGLR will collect and manage these annual contributions and report back to the CASS executive committee annually.

Early career science communication fellowship accepting applications

Scientists Promoting Policy, Access, Research, and Knowledge (SP²ARK) is a new six-month science communication training program organized by the Consortium of Aquatic Science Societies (CASS). It aims to build a diverse network of skilled science communicators among early career aquatic scientists.

SP²ARK is accepting three early career members from each of the CASS societies for a total of 30 participants in the first year. IAGLR members are eligible! The program defines "early career" as graduate students and postdocs or equivalent.

Trainings will be offered online from November 2024 through June 2025. Topics include audience connections, the narrative framework, challenging conversations, policy, media, and environmental justice.

Applications due October 1

IAGLR, ASLO receive minigrant for "conferencing better"

We are pleased to announce that IAGLR and the Association for the Sciences of Limnology and Oceanography have received a $3,500 minigrant from ACCESS+ for the project "Conferencing better: A collaborative approach to inclusive aquatic science conferences."

The facilitated project is intended to produce a set of guiding principles and a shared code of conduct for conducting inclusive conferences, including the Joint Aquatic Sciences Meeting organized by the Consortium of Aquatic Science Societies. Pictured below at the award ceremony are Paris Collingsworth, IAGLR vice president; Paula McIntyre, IAGLR communication director and strategy advisor, and Shani Dellimore Barrax of Aurora Change Agency LLC who will help facilitate the work.

CALL FOR AWARD NOMINATIONS

PROFESSIONAL AWARDS

Deadline: February 1

Did you know that only IAGLR members are eligible to nominate people for our three professional awards? It's your chance to recognize outstanding contributions in the large lake community. We encourage you to nominate someone this year.

Lifetime Achievement Award
honors individuals who have made important and continued contributions to the field of large lake research over a period of 20 years or more

Large Lake Champion Award
honors individuals whose work has made significant contributions to sharing the social, economic, and ecological understanding of large lakes of the world

John R. (Jack) Vallentyne Award
honors an individual or team who has made important and sustained efforts to inform and educate the public and policymakers on large lakes issues, thereby raising awareness and support for large lake protection and restoration

IAGLR members, we need you to nominate!

JOURNAL AWARDS

Deadline: January 15

All are invited to nominate a notable paper from the *Journal of Great Lakes Research*, vol. 50 (2024).

Three awards are given to the author(s) of peer-reviewed papers in the current volume of the journal judged to be "most notable." Nominations are considered for one of the following awards depending on the career status of their lead author.

Chandler-Misener Award
recognizes the top-ranked paper published during the previous calendar year

JGLR/Elsevier Early Career Scientist Award
recognizes the top-ranked paper whose lead author was within five years of graduation from their terminal degree at the time of acceptance

JGLR/Elsevier Student Award
recognizes the top-ranked paper whose lead author was a student at the time of acceptance

We encourage nominations of people from diverse identities, perspectives, and experiences.

iaglr.org/awards-scholarships

MEMBER NEWS

KUDOS

Congratulations to the following IAGLR members!

SUZANNE GRAY for starting a new position as associate professor of biology at the University of Prince Edward Island. She's looking forward to filling her new lab with local fish and eager students.

SCOTT KOENIGBAUER (Purdue University) for completing his Ph.D. His research focused on the dimensions of reproductive diversity in Great Lakes fishes. He was a 2023 recipient of IAGLR's Norman S. Baldwin Fishery Science Scholarship.

MATT SIMCIK (University of Minnesota, School of Public Health) for being named a new associate editor of the *Journal of Great Lakes Research*. Simcik is an environmental chemist with degrees from Michigan State University (B.S. in Chemistry), (M.S. Civil Engineering), and Rutgers University (Ph.D. in Environmental Science). His research focuses on the fate and transport of organic contaminants.

Many in the IAGLR community know **LIZHU WANG** not only in his role as IAGLR treasurer, but also from his long career in the Great Lakes, most recently as senior science advisor at the International Joint Commission Great Lakes Regional Office. Wang retired from the IJC in July, leaving an indelible legacy of thoughtful and diplomatic leadership. The IJC Great Lakes Regional Office staff thanks Wang for his decades of service and camaraderie. Wang has been a member of IAGLR since 2013 and is currently serving his last year as the association's treasurer.

LES WARREN (Purdue University) for his new position as aquatic ecology and buoy specialist for Illinois-Indiana Sea Grant and the Department of Forestry and Natural Resources at Purdue.

Student presentation award winners

We're pleased two announce the recipients of our awards for outstanding students presentations at the 67th Annual Conference on Great Lakes Research, held in May 2024, in Windsor, Ontario. Congratulations!

IAGLR Outstanding Student Paper Award

JULIA OBUYA, Kenya Marine and Fisheries Research Institute, "Socioeconomic consequences of cyanobacteria harmful algal blooms in small-scale fishing communities of Winam Gulf, Lake Victoria"

LUKE MCGILL, Purdue University, "Acoustic tracking of largemouth bass in a busy, steel-walled urban waterway" *(Runner up)*

IAGLR Outstanding Student Poster Award

MITCH KEHNE, Michigan Technological University, "Assessing the nutritional quality and fate of Saginaw Bay Dreissenid mussel veligers"

ANDREW BUMPS, University of Dayton, "Round goby male reproductive tactics: connections to environmental factors and impacts on behavior" *(Runner up)*

Welcome new members

The following members joined IAGLR between May and July 2024.

Odai Al Balasmeh
Elizabeth Anderson
Kat Cameron
Rosen Chang
Brian Cumming
Eric Diesing
Yasasi Fernando
Alyssa Frazao
Angus Galloway
Paul Gledhill
Jordan Gurneau
Rachel Hackett
Robert Kagali
Alexander Kain
Kenneth Lee
Junzhi Liu
Mallory Llewellyn
Paul MacKeigan
Lawrence Makasa
Tabitha McKechnie
Danielle Montocchio
Akunne Okoli
Margaret Owensby
Thomas Reid
Collin Roland
Ali Saber
Lamees Shah
Mike Shriberg
Stephen Sumary
Andre Guy Tranqui Temgoua
Chuyan Zhao

HELP STEER THE SHIP

Run for the IAGLR Board of Directors

Nominations due Friday, October 18

We're seeking candidates for the following positions. Terms start in June 2025.

Treasurer
(4-year term)

U.S. Regular Member
(3-year term)

Canadian Regular Member
(3-year term)

Canadian Student Member
(2-year term)

Here's what some outgoing board members had to say about their experience:

"*Chi-miigwetch* (big thank you) to the IAGLR Board of Directors and the membership for making my tenure truly special and inspiring. I have served two terms as the Canadian student board member during my time as both a master's and Ph.D. student. Through these experiences, I was able to connect with Great Lakes scientists and advocates across North America and the world. These connections have flourished and impacted my trajectory as an early Great Lakes scientist, leading to collaboration, new areas of inquiry, job opportunities, and perhaps most important of all, friendship and comaraderie. Through my tenure I was able to participate in a number of committees including the IDEA+ and Awards committees, helping to guide IAGLR and ensure it is a welcoming place for people from all backgrounds. It has been a distinct pleasure to be a part of some of these initiatives and see their intentions come to fruition.

In particular, I am most proud of IAGLR for taking serious steps towards acknowledging and engaging with the Indigenous fisheries and practitioners from across many Great Lakes, something rarely seen at this level in the current academic society landscape. The real impact of this work has been felt throughout the Laurentian Great Lakes as Indigenous participation has hit record numbers and Indigenous-focused programming has helped to bring cultural awareness and partnership across a number of venues.

By serving on the board and participating in IAGLR activities, I have grown as an individual and developed essential skills to prepare me for a future working in the Great Lakes. I feel a deep sense of belonging in this community and would champion IAGLR without reservation. I plan to continue to be an active and engaged member well beyond my service as a board member."

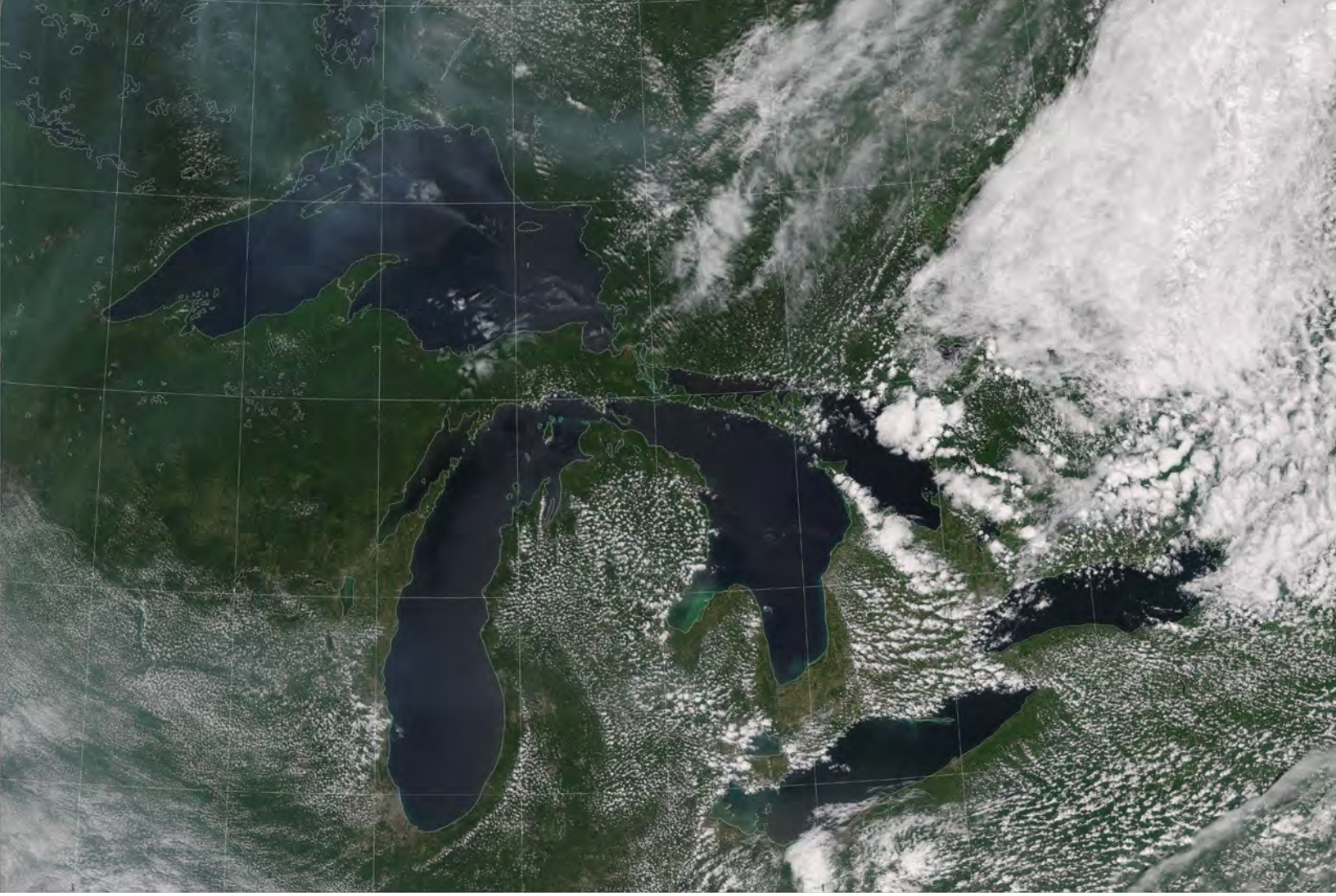
Alex Duncan
Student Board Member

"It has been a great experience to serve as the treasurer of IAGLR for the past three years. It is a great honor to work with such a talented and dedicated board of directors and staff in making strategic decisions for the association, as well as planning, coordinating, and managing the association's activities.

In this role, I have not only helped IAGLR's operation and decision making, but also have grown my knowledge on how the association is operated financially, got to know colleagues with diverse knowledge in association operations, and built my professional connections."

Lizhu Wang
Treasurer

View the Call for Nominations



The NOAA Visible Infrared Imaging Radiometer Suite satellite images the Great Lakes on a daily, and sometimes twice daily, basis. This is called a true-color image, typically what your eye would see of the Great Lakes from space. This image was acquired on July 25, 2024, and, together with the cover image captured last February, shows the contrast between the winter and summer months. These data are hosted on NOAA's Great Lakes CoastWatch node and are free to users.

Emerging technologies for remote sensing of the Great Lakes

by ANDREA VANDER WOUDE

Remote sensing offers an unprecedented perspective of our Great Lakes. Whether from a buoy, drone, plane, or satellite far above in space, the information available to us from remote sensing affords us the opportunity to track and monitor the health of the Great Lakes. These types of remote observations include the extent of harmful algal blooms, the dispersion of extreme lake surface temperatures, ice coverage, and oil spill response efforts among other actions that are hard to capture otherwise.

NOAA's Great Lakes Environmental Research Laboratory (GLERL) is a leader in innovative research using multiple remote sensing platforms that individuals, communities, resource managers, and decision-makers use every day. One example is GLERL's Great Lakes CoastWatch, which hosts a repository of satellite data and in the near future will add information derived from aircraft and drones. These data, photos, and visualizations are free, and new satellite products are being added regularly.

Some of the most widely used data and informational graphics include true-color imagery, which looks like a photograph that one would typically take from a camera, but with the broad perspective of each lake on cloud-free days (see images on cover and preceding page). GLERL also delivers satellite imagery that can see through the clouds when prevalent cloudy days roll through the Great Lakes region. This imagery is referred to as synthetic aperture radar (SAR). Other products are in development that will add important new information to the SAR imagery, such as lake winds and environmental pollutants called surfactants that disrupt surface tension of the lake surface.

One of the most popular data sets visualized on the CoastWatch site includes maps of refined sea surface temperature that delineate fronts of different water masses and their location (pictured at bottom right). This is a significant update that is in addition to the sea/lake surface temperature contour maps that anglers and other recreational users have been using for decades to plan their voyages with contour maps that are currently mapped by port region for all of the Great Lakes (top right).

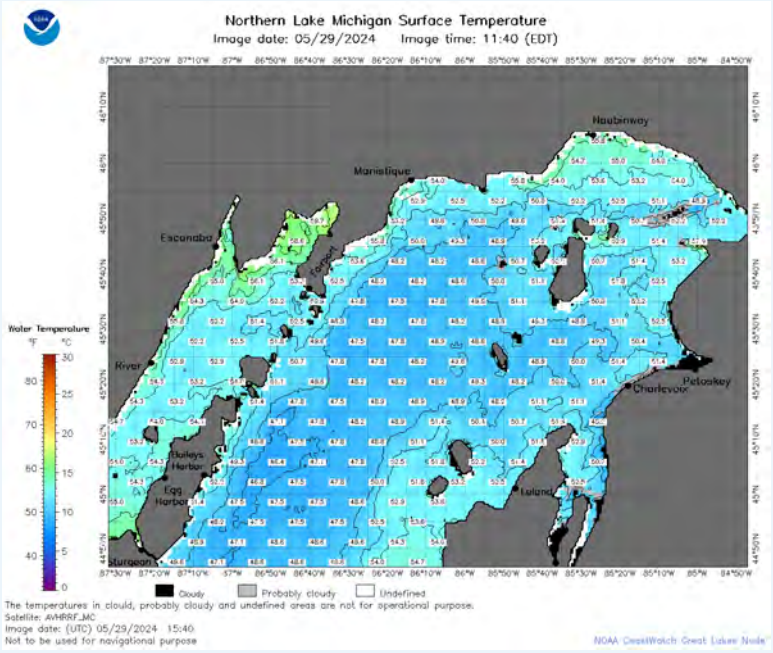
CoastWatch is continually working with stakeholders in the region as part of NOAA's mission to develop technology to improve science, service, and stewardship, to ensure that we are fulfilling users' needs in the Great Lakes for a wide range of recreational, commercial, and academic applications.

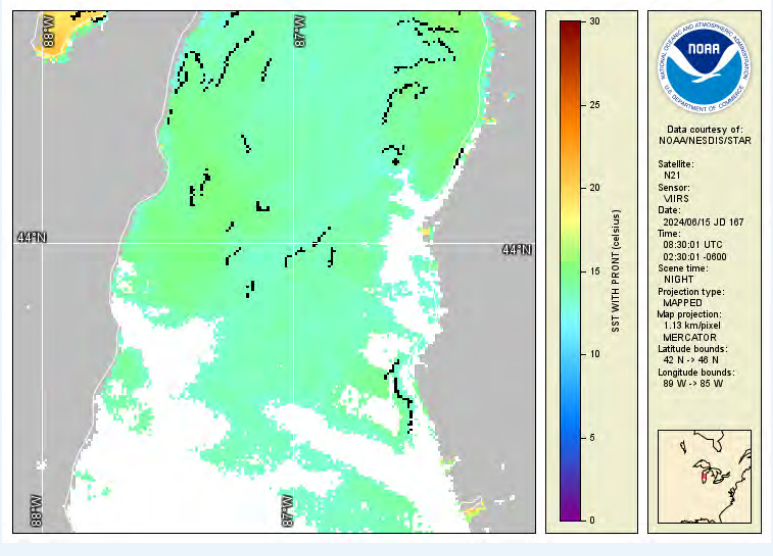
Andrea Vander Woude is chief of the Integrated Physical and Ecological Modeling and Forecasting Branch and Great Lakes CoastWatch node manager at NOAA, Great Lakes Environmental Research Laboratory.

Remote sensing and lake temperatures

Satellites measure lake surface temperatures, and the Great Lakes CoastWatch node at NOAA provides contoured temperature data for all of the major ports in the Great Lakes, like the image of northern Lake Michigan shown in the first image below.

The CoastWatch node is also moving toward offering a product that shows *thermal fronts*, where different water masses meet that have drastically different temperatures. In the bottom image of Lake Michigan's central region, these fronts are shown by the thick black lines with the colors representing the temperature of the water.





A research *jiimaan:* Adapting to protect *manoomin*

by JEFF FENG, MICHAEL WAASEGIIZHIG PRICE, JOSIAH HESTER & KIMBERLY MARION SUISEEYA

The *wiigwaasi jiimaan*—birch bark canoe—was once the predominant mode of transportation across the Great Lakes and today carries forward the culture and heritage of the Ojibwe. Traveling from their original homelands on the eastern shores of North America, the Ojibwe used the wiigwaasi jiiman to migrate to the Great Lakes region they now call home.

The jiimaan's legacy of adapting with migration lives on through the STRONG Manoomin Collective. Partnering with several Ojibwe tribal nations, including Bad River, Lac du Flambeau, and Lac Courte Oreille, our team seeks to protect *manoomin* (wild rice) and achieve greater climate resilience throughout the Great Lakes by constructing a metaphorical wiigwaasi jiimaan. Generations ago, Ojibwe came to these lands in search of the "food that grows on water," manoomin, which has sustained them spiritually and physically since. Now under constant threat from climate change, pipelines, and poor non-tribal management, manoomin needs help.

To work toward a future where manoomin is healthier and more plentiful, we are building a research-based wiigwaasi jiimaan. Consider its physical construction: all materials are different and have unique qualities, but if one was missing, the canoe could not be constructed. *Giizhig* (cedar) is the frame of the canoe: lightweight but durable and bends easily when green. *Wiigwaasi-wanagek* (birch bark) constructs the outer hull of the canoe. The bark is insect- and weather-resistant when applied properly. The grain of the bark is horizontal, which runs perpendicular to the structure of the canoe; this characteristic adds strength to the hull. *Wadabiiyaab* (spruce root) binds the birch bark to the cedar frame. Incredibly strong, spruce root grows in straight strands just underneath the soil. When dried, the roots contract, tightening the binding. *Bigiw* (spruce pitch) seals the cracks and seams in the bark hull to make the canoe watertight and functional. Each material contributes, and when combined, is greater than the sum of its parts.

Our team works across four themes. First, the **sensing theme**—using advanced algorithms, onsite environmental sensors, and observations from the air and space—represents the giizhig (cedar) of our wiigwaasi jiimaan. Uploading and analyzing environmental data about manoomin in

Pictured above, custom buoy sensor developed by the collective, deployed in Manoomin lakes and streams that sense water level, temperature, and potentially boat wake to assist tribal scientific offices with co-management of manoomin waters.


Left: Collective team members, including article authors, presenting at the U.S. Indigenous Data Sovereignty & Governance Summit. Middle: Buoy sensor near a manoomin bed, transmitting data for use in guiding natural resource management and protection strategies. Right: Collective team members and employees of the Great Lakes Indian Fish and Wildlife Commission siting and deploying sensors.

real time, this cyberinfrastructure is the frame of our research canoe by signaling to tribal leaders what waters manoomin treads. Second, concerned about the fragmented institutions that threaten manoomin management, the **governance theme** represents the wiigwaasi-wanagek (birch bark). Analyzing the institutional and policy landscape, governance research gives the canoe direction. The wiigwaasi-wanagek corrects the jiimaan when the waters (policies) are stormy. Third, the **environmental theme** combines Indigenous Knowledge with the computing capabilities of the cyberinfrastructure as an implementation of two-eyed seeing. This theme serves as the wadabiiyaab (spruce root); it binds together knowledge systems that ensure manoomin's resilience. Fourth, engaging tribal members and guaranteeing that the research expands to many end-users, the **education theme** centers capacity building. It seals all themes together, and with its functionality, serves as our bigiw (spruce pitch).

Our research-based wiigwaasi jiimaan operates in practice by feeding insights and data from each theme into the others. Governance research, for instance, informs all the other themes by specifically interpreting and analyzing data to be usable.

For example, the sensors–the frame of our canoe—are the starting point for our data. They can collect and interpret data on the spot, flagging trends of concern. Take wake surfing. Some research show that wake surfing and boating cause turbidity that threatens the relatives that Ojibwe tribes steward. Moreover, driven by tribal leaders and knowledge that boat wakes and turbidity are a danger, the sensors can be programmed to flag these trends to spur decision-making to protect manoomin.

Governance research steps in by developing and testing resilience indicators—measures and scales for knowing when ecosystems (physical and social) are resilient. A potential indicator of resilience in this case is the number of bans on potentially harmful boating practices across the tribes that we work with. Because the Wisconsin Department of Natural Resources and the Wisconsin legislature have not enacted any statewide policies, regulation of wake boarding is ad hoc. Still, a tribe we work with—Lac du Flambeau—recently banned wake boating in the exterior waters of its reservation and cited threats to manoomin as one of the reasons. Governance researchers can track if other tribal nations enact bans, and in turn, can direct the sensors in lakes and waters where bans are enacted to provide the data case about the effectiveness of wake boat bans and manoomin health. With the backing of this scientific data, tribal leaders have a stronger foundation to shape agency and state policies.

Constructing and directing our research-based wiigwaasi jiimaan is ongoing. But it captures the importance of weaving Indigenous Knowledge and western science. Tribal knowledge holders direct our inquiry, with scientific knowledge providing further credibility to collect valuable policy-relevant data. Operating across themes makes it possible for teams to be greater than the sum of their parts and provide the evidence to inform resource management across the Great Lakes. We may not know all that the future entails, but our wiigwaasi jiimaan is durable and lightweight enough to adapt.

Jeff Feng is a post doctoral scholar in the Department of Political Science at Northwestern University. Michael Waasegiizhig Price is a Traditional Ecological Knowledge specialist at the Great Lakes Indian Fish and Wildlife Commission, Josiah Hester is an adjunct associate professor of computer engineering at Northwestern University, and Kimberly Marion Suiseeya is an associate professor in the Department of Political Science and the Environmental Policy and Culture program at Northwestern University.

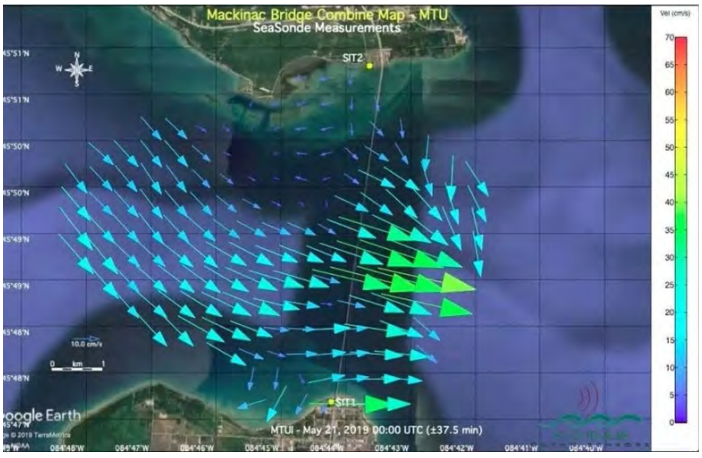
High-frequency radar antenna located at Bridgeview Park in St. Ignace, Michigan, overlooking the Straits of Mackinac.

Improving safety in the Straits of Mackinac with high-frequency radar

by TIMOTHY HAVENS

Nestled between Michigan's Upper and Lower Peninsulas, the Straits of Mackinac have long been a vital passageway for maritime traffic, connecting lakes Michigan and Huron. They serve as a crucial junction for shipping routes that link the Great Lakes to the Atlantic Ocean via the Saint Lawrence Seaway. Stunning natural beauty and regional historical significance attract countless tourists to Mackinac and Bois Blanc islands. This busy maritime corridor presents navigational challenges, including strong currents, rapidly changing weather conditions, and the narrowness of the Straits. The Straits are also home to the Mackinac Bridge—the longest suspension bridge in the Western Hemisphere—and Enbridge's Line 5 pipeline, a submerged natural gas and crude oil pipeline just west of the bridge. Coupled with this significant infrastructure, the potential risk of accidents increases. Moreover, the Straits' ecological sensitivity, due to their proximity to numerous freshwater ecosystems, adds another layer of complexity to their management. To enhance maritime safety and environmental monitoring, high-frequency radar (HFR) technology has become a game changer for this critical waterway.

Originally developed for military applications, HFR found a new and crucial role in maritime safety and environmental monitoring. HFR works by emitting radio waves that travel across the water's surface. When these radio waves encounter surface waves on the water, they are reflected back to the radar, which then analyzes the data to provide real-time information about the speed and direction of the water's surface currents. While HFRs have been in widespread use in coastal ocean regions for more than 40 years—with over 150 systems deployed on the United States coasts—the first demonstration of this technology on freshwater did not occur until 1999 in southern Lake Michigan. Following this successful test, Lorelle Meadows and Guy Meadows of Michigan Technological University performed other feasibility tests and then, in 2020, installed the first permanent system on freshwater in the Straits.



Surface currents from HF radar in the Straits of Mackinac, measured on May 21, 2019. Arrows indicate direction and speed of the surface current.

One of the primary benefits of HFR in the Straits is the invaluable, real-time, high-resolution data on surface currents it provides. Ships navigating through the Straits can adjust their routes based on the current patterns, reducing the risk of accidents caused by unexpected strong currents. This helps tankers and cargo ships, which require precise navigation to avoid collisions and grounding.

The freshwater ecosystems in and around the Straits support diverse wildlife and are vital for the region's fishing industry. HFR technology plays a crucial role in protecting these ecosystems by providing data to help monitor and mitigate environmental impacts. Researchers could use HFR data to study the dispersion of pollutants in the water. Understanding how contaminants spread can inform cleanup efforts and prevent further environmental damage. This is particularly relevant with the presence of the Enbridge Line 5 pipeline in the Straits. In the event of a leak, HFR data could help track the spill and optimize clean-up efforts to minimize the impact on the surrounding environment.

Additionally, HFR technology supports the work of the U.S. Coast Guard and other emergency responders. In the event of a maritime incident, such as a ship grounding or chemical spill, real-time data on surface currents helps responders predict the spill's movement or locate distressed vessels more quickly and accurately. This capability significantly enhances search and rescue operations and environmental response efforts.

The data generated by HFR in the Straits is invaluable for scientific research, providing insights into coastal processes, climate change, and ecosystem dynamics. It has fostered collaboration among various stakeholders, including government agencies, academic institutions, and private organizations. Researchers use HFR data to study the complex hydrodynamics of the Straits. Their findings contribute to a deeper understanding of how natural and human-induced changes affect the Great Lakes system. This research, in turn, informs policy decisions and conservation efforts aimed at preserving the health of the Great Lakes for future generations.

As technology advances, HFR's capabilities are expected to further improve. Future developments may include enhanced spatial resolution, longer range, and the integration of artificial intelligence. This could provide even more detailed and comprehensive data. Moreover, the success of HFR technology in the Straits could serve as a model for other critical freshwater systems worldwide and inspire similar initiatives in other freshwater bodies facing comparable safety and environmental challenges. Michigan Tech, in collaboration with the Great Lakes Observing System, will begin construction of a new HFR east of the Mackinac Bridge in 2025.

High-frequency radar antenna located outside Fort Michilimackinac in Mackinac City, Michigan.

The introduction of HFR in the Straits of Mackinac represents a significant leap forward in maritime safety and environmental stewardship. By providing publicly available real-time data on surface currents, HFR technology helps mariners navigate safely, supports efficient emergency response, and aids in the protection of sensitive ecosystems. As we look to the future, continued investment in and development of this technology will ensure that the Straits of Mackinac remain a safe and vibrant passageway, balancing the needs of commerce, recreation, and environmental conservation.

More information on the Straits HF radar, including real-time data, can be found online.

Timothy Havens is director of the Great Lakes Research Center and director of the Institute of Computing and Cybersystems at Michigan Technological University in Houghton, Michigan.

RESEARCH BRIEFS

Plane-mounted hyperspectral cameras help forecast Great Lakes harmful algal blooms

Under a Great Lakes Restoration Initiative project, NOAA's Great Lakes Environmental Research Laboratory (GLERL) has been funded to evaluate water quality and ecosystem health. Led by Steve Ruberg, this work investigates harmful algal blooms (HABs) and uses remote sensing platforms with multi-year observations from an aircraft with a hyperspectral camera affixed in the aft of the plane. For almost a decade, the aircraft has been flying weekly to biweekly over the Great Lakes during the harmful algal bloom season, and the imagery is quickly processed to quantify harmful algal bloom levels for stakeholders in the region that monitor drinking water intakes in the lake (e.g., Lake Erie).

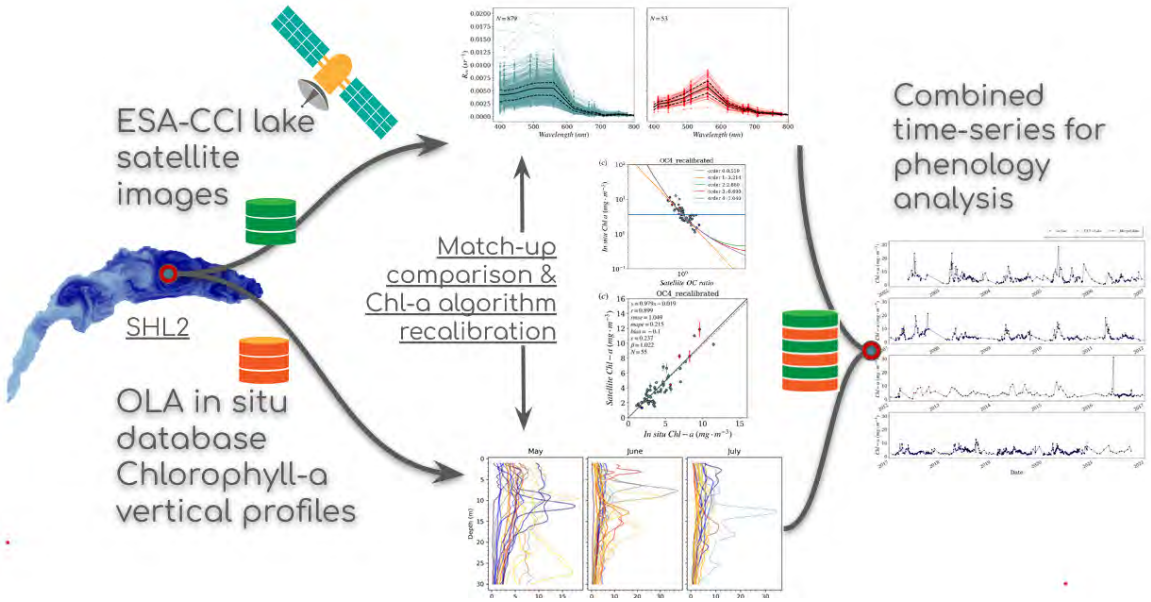
This aircraft platform capability has transitioned, under the leadership of Lauren Marshall, to putting the same hyperspectral camera on a drone to fly the very nearshore areas where HABs persist and people are more likely to interact with HABs. This effort is part of a funded project under NOAA's Prevention, Control, and Mitigation of HABs program led by Reagan Errera. The aim of the project is to combine uncrewed surface vehicles (USV) that measure bloom toxin concentrations in near-real time with the airborne drone directing the USV where to sample next. These are two examples of NOAA GLERL's dedication to delivering science to service to the Great Lakes region.

By Andrea Vander Woude, chief of the Integrated Physical and Ecological Modeling and Forecasting Branch and Great Lakes CoastWatch node manager at NOAA, Great Lakes Environmental Research Laboratory.

Taken during August 19, 2019, flight to assist in improvements to the NOAA Harmful Algal Bloom forecast. This airborne campaign is ongoing in conjunction with NOAA weekly Lake Erie monitoring and biweekly sampling in Saginaw Bay. The flyovers are done in collaboration with researchers at NASA Glenn that have been flying their own airborne imaging sensor. Credit: Zachary Haslick, Aerial Associates Photography Inc, www.skypics.com

Investigation on Lake Geneva

Assessing satellite data for monitoring phytoplankton abundance and phenology in deep lakes



Summary of strategies for comparing different datasets of Chl-a concentrations for the analysis of phytoplankton phenology.

Monitoring the water quality of Lake Geneva necessitates quantifying phytoplankton abundance, particularly through chlorophyll-a (Chl-a) concentration measurements (Chang et al., 2022). Optical satellite imagery facilitates regular mapping of Chl-a concentration on a lakewide scale. The European Space Agency Climate Change Initiative (ESA-CCI) provides global Chl-a concentrations using medium-resolution satellite data. This study evaluated the accuracy of ESA-CCI optical products in depicting the seasonal dynamics and phenology of phytoplankton in Lake Geneva. By integrating in situ data sets, it aims to establish a comprehensive long-term time series of Chl-a concentrations, essential for lake management and understanding environmental changes. These datasets were assessed through match-up comparisons.

The satellite data used in this study are derived from the CCI-lake processing chain, applied to the Medium Resolution Imaging Spectrometer and two Ocean and Land Colour Instrument satellite missions (Carrea et al., 2023). The in-situ data were collected as part of the environmental monitoring coordinated by the French and Swiss commission for the protection of Lake Geneva water, available through the OLA database (Rimet et al., 2020). To evaluate long-term phytoplankton variability, data from sampling station SHL2, used for Water Framework Directive monitoring and located on the deepest part of the lake (pictured at left in image above) were focused on.

Since the underlying algorithms do not consider the vertical distribution of phytoplankton, a specific analysis was conducted to evaluate potential biases in remote sensing estimation and their impact on observed phenological trends. Various data averaging approaches were applied to reconstruct Chl-a estimates from remote sensing algorithms. A strong correlation (R-value >0.89) and acceptable discrepancies (rmse~1.4 mg/m^3) were observed for the ESA-CCI data. This facilitated the recalibration of ESA-CCI data for Lake Geneva. Ultimately, merging satellite and in situ data produced a consistent time series for long-term analysis of phytoplankton phenology and its interannual variability since 2002. This combination enhanced the temporal resolution of the time series, enabling a more precise identification of specific spring events characterizing phytoplankton phenology.

By Mona Bonnier, Orlane Anneville, Université Savoie Mont Blanc; R. Iestyn Woolway, Bangor University; Stephen Thackeray, UK Centre for Ecology & Hydrology; Guillaume Morin, Magellium; Nathalie Reynaud, Frédéric Soulignac, and Thierry Tormos, INRAE, Aix Marseille Université, and Tristan Harmel, Magellium. To learn more, see Bonnier et al., 2024.

High-resolution satellite images provide insight into Great Lakes' coastal changes after historical water level Increase

From left, Two Creeks, Wisconsin, author conducting real-time kinematic (RTK) survey at Ogden Dunes, Indiana, and Warren Dunes, Michigan. RTK surveys are used to correct for common errors in satellite navigation systems.

The Great Lakes are known for their significant water level fluctuations. From 2013 to 2020, Lake Michigan-Huron experienced a remarkable two-meter rise in water levels, setting records for both the lowest and highest water levels ever measured in just seven years. This rapid and large increase led to substantial coastal erosion, shoreline retreat, habitat changes, and even damage to infrastructure. However, quantifying and tracking these changes has been challenging due to the extensive length of the Great Lakes shorelines and the logistical difficulty in tracking their movements.

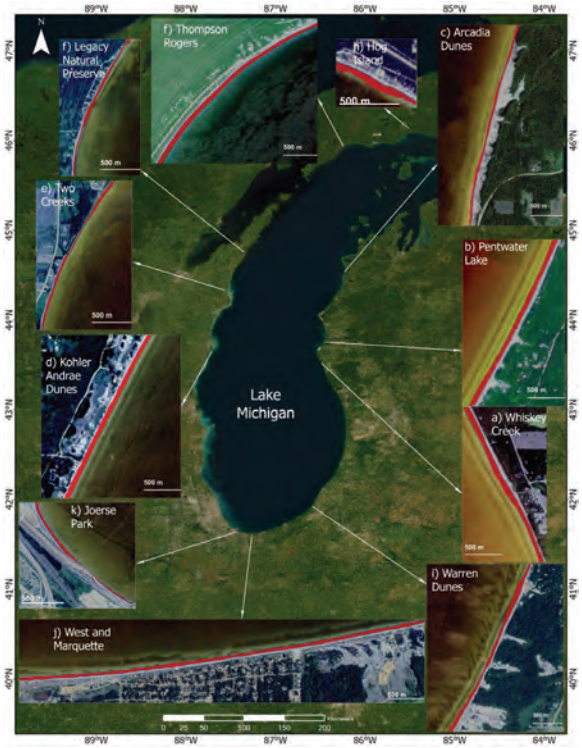
To address this issue, we developed an automated tool to monitor shoreline changes using high-resolution multispectral satellite images. The tool was validated using in-situ surveys. This approach allows us to accurately track shoreline movements over time across any part of the Great Lakes (Abdelhady et. al., 2022). The method relies on imagery from commercial satellites such as PlanetScope, which provide daily multispectral imagery at three–five meter resolution, which is ideal coverage for tracking Great Lakes shoreline positions. This tool is now available for coastal researchers across the Great Lakes.

We applied this shoreline detection tool to 11 natural beaches around Lake Michigan for the water level increase period of 2013 to 2020. Our findings revealed that shorelines retreated between 20 and 62 meters on average (see image below). These differences were primarily due to variations in wave activity and beach shape, highlighting how different factors can influence erosion at Great Lakes beaches despite the same water level increase (Abdelhady et al., 2024).

The shoreline change observations inspired the development of the Great Lakes Shoreline Model. This model uses water level data, wave data, and beach information to predict expected shoreline changes. Importantly, the model explicitly includes the effect of water level changes, which drive shoreline changes in the Great Lakes but have been thus far omitted from ocean shoreline models. We calibrated the model with the shoreline change data obtained from the satellite images, and the calibrated model was able to simulate observed shoreline changes accurately (Abdelhady and Troy, 2023).

Currently, we are expanding this work to other Great Lakes to assess their coastal changes and to compare the similarities and differences in the lakes' responses to water level fluctuations. While the lake levels are currently back to normal, coastal communities need to be prepared for the next high-water period, and understanding how shorelines respond to these extreme events is an important step in helping communities prepare.

By Hazem Abdelhady, Purdue University. Abdelhady received the 2023 IAGLR Scholarship for his research on coastal changes and water level fluctuations.



Shoreline changes detected from satellite images at the 11 study sites around Lake Michigan, with the red lines indicating eroded areas.

Leveraging satellite Earth observations in the monitoring strategy for tracking the health of Lake Victoria

Sustainable and affordable operational monitoring is critical for keeping track of the health of aquatic environments that support the *blue economy*, or the reasonable use of water resources for economic growth, improved livelihoods, and jobs, while preserving the healthy state of these ecosystems. In Lake Victoria, the blue economy includes activities that exploit aquatic resources (e.g., fisheries, mining, petroleum, biotechnologies) or use aquatic environments (e.g., maritime transport, coastal tourism), ideally in an integrated, fair, and circular manner. The blue economy in this region's context supports over 40 million people's livelihoods and US$1.14 billion through fisheries to the riparian governments.

For Lake Victoria, scientists and managers from Uganda, Kenya, and Tanzania have regular ship-based sampling programs to monitor the fisheries and water quality of the lake to help manage the resources. While classic monitoring from research vessels does offer valuable data, the information gathered tends to be limited in geographic and temporal coverage, restricting scientific, evidence-based understanding of biogeochemical and physical dynamics in water bodies. One complementary monitoring strategy is satellite remote sensing, offering frequent wide-area observations over water and estimates of *indicators-of-change* (e.g., total suspended matter, color of water, algae levels, temperature). Open-access satellite imagery and derived maps of indicators-of-change are operationally available through various space agencies (e.g., EU Copernicus Sentinel, USGS Landsat, and NASA VIIRS and PACE missions).

To support capacity development for application of remote sensing to Lake Victoria, a group of academic and research organizations have offered workshops in the region since 2021, providing an introduction to optical water quality methods and satellite data processing for more than 50 trainees from across the African Great Lakes. Collaborators include the African Center for Aquatic Research and Education, IEEE Geoscience and Remote Sensing Society, Rochester Institute of Technology, Kings College London, Makerere University, Lake Victoria Fisheries Organization, Kenya Marine and Fisheries Research Institute, Ugandan National Fisheries Resources Research Institute, Tanzania Fisheries Research Institute, Jaramogi Oginga Odinga University of Science Technology, Carl von Ossietzky Universität Oldenburg, Science Systems and Applications, Inc./ NASA Goddard Space Flight Center, and University of Wisconsin. Trainees have gained experience in operating and processing ship-borne hyperspectral radiometric observations along with validation data such as Secchi disk depth, Forel-Ule color index, chlorophyll-a, and total suspended sediment concentrations. Satellite data processing was introduced through Google Earth Engine to give lessons in data access, mapping, cloud masking, and estimating water surface indicators-of-change. Advancing the knowlege base of the next generation of experts will foster a better interdisciplinary understanding of these resources for the blue economy and the millions whose livelihoods depend on Lake Victoria.

Future water quality experts undergo practical training of determining the color of water using a classical tool, the Forel-Ule scale. Photo by Shungu Garaba.

By Shungudzemwoyo Garaba, Carl von Ossietzky Universität, Oldenburg-Germany; Anthony Gidudu and Lydia Letaru, Makerere University; Ajode Z. Migeni and Ted Lawrence, African Center for Aquatic Research and Education/International Institute for Sustainable Development; and Anthony Vodacek, Rochester Institute of Technology.

COMMUNITY NEWS

Trent University, Michipicoten First Nation to investigate resource extraction impacts

At the Michipicoten First Nation (MFN) 2024 Youth and Elders Gathering, Trent University and MFN leadership signed a historic partnership committing to work together for the next three years to investigate the impacts of resource extraction activities on the environment. This work also aims to establish environmental health baseline data in MFN Territory and to support MFN youth engagement and training. The Trent team in attendance included Mary-Claire Buell, assistant professor cross appointed with Trent School of the Environment (TSE) and Department of Forensic Science, several students from her lab group (TRACE Lab), who are doing research with MFN, as well as TSE faculty Autumn Watkinson and Kaitlyn Fleming. Several other Trent faculty members are a part of this agreement, as it draws on Trent's outstanding expertise across several disciplines, to support MFN's vision for caring for the environment in their territory amidst resource extraction pressures.
By Mary-Claire Buell, Trent University.

New report highlights ecosystem approach successes

A recent study by the Healthy Headwaters Lab of the University of Windsor reviewed 12 ecosystem frameworks and recommended several actions to advance the use of an ecosystem approach. This inherently collaborative approach calls for boundary spanners, widely sharing information and knowledge, building trusting relationships that incorporate Traditional Ecological Knowledge, and education about the ecosystem approach.

The report also shares 45 *exemplars*—practical examples of ecosystem-based management where progress is being made toward long-term ecosystem health. These examples vary in scale and institutional arrangements, yet all share in common a boundary organization.

An Ecosystem Approach: Strengthening the Interface of Science, Policy, Practice, and Management is available for download. Learn more at this Great Lakes Now article from lead author John Hartig.

New conservation research center to monitor Ontario's aquatic biodiversity

The River Institute plans to significantly expand its research capacity as part of the establishment of the Environmental and Climate Change Observatory of Ontario (ECCO-Ontario). This new research partnership, which includes Queen's University, the River Institute, and the Mohawk Council of Akwesasne Environment Program, among other institutions, aims to help address challenges in regional waterways and wetlands that are experiencing unprecedented degradation and species loss.

The Government of Canada recently announced CA$4.6 million in support for ECCO-Ontario through the Canada Foundation for Innovation's Innovation Fund. The funding includes support for the construction of a new environmental DNA biology lab at the River Institute (see rendering), as well as a new Environmental Science Research Centre and Indigenous Centre at the Queen's University Biological Station, state-of-the-art instrumentation for Queen's University, and the provision of specialized research equipment for members of the partnership. *By Elsie Lewison, River Institute.*

Baril named IJC Canadian co-chair

The International Joint Commission announced the appointment of Pierre Baril as Canadian commissioner and co-chair of the organization in July. Baril is an agricultural engineer who has worked the last 20 years with the Government of Québec, occupying a variety of executive roles. Most recently, he led a team dedicated to the modernization of environmental regulations in Québec. A graduate of Laval University in Québec, Baril also holds master's and doctoral degrees in engineering from the École Polytechnique Fédérale de Lausanne in Switzerland.

Churchill Fellow visits Great Lakes organizations

In July, Scott Hardie (fourth from right), a freshwater scientist who works for the Tasmanian State Government in the Department of Natural Resources and Environment spent six weeks in New Zealand, the United States, and Canada to learn about water management as part of a Churchill Fellowship. His visits in the Great Lakes basin include Algoma University in Sault St. Marie, Ontario, the conservation authorities and Environment and Climate Change Canada in Toronto, and the International Joint Commission (IJC) and the River Institute in Eastern Ontario. IAGLR Executive Director Jérôme Marty (second from left) participated in discussions on governance and integrated water management with both organizations. Photo courtesy of IJC.

U-M center to study connection between climate change, Great Lakes algal blooms, human health

Green scum from a cyanobacterial harmful algal bloom in western Lake Erie. Photo credit: Colleen Yancey.

The Great Lakes Center for Fresh Waters and Human Health has been renewed with another five years of funding (US$6.5 million) from the National Science Foundation and the National Institute of Environmental Health Sciences to study the links between climate change, cyanobacterial harmful algal blooms, and human health. Founded at Bowling Green State University in 2018, the center's administrative home has now moved to the University of Michigan (U-M) due to the retirement of founding director George Bullerjahn at BGSU.

The center is co-directed by Gregory Dick (U-M) and David Kennedy of the University of Toledo (U-T) and involves 10 U.S. universities and a Canadian allied partner, the University of Windsor. More than 28 faculty researchers and dozens of students and staff at the universities are expected to be involved.

Cyanobacteria can produce toxins harmful to humans, pets and wildlife. "Toxic cyanobacterial harmful algal blooms are a growing threat to freshwater ecosystems, drinking water supplies and coastal communities worldwide," says Dick, a professor in U-M's School for Environment and Sustainability and the Department of Earth and Environmental Sciences.

"Our region has long grappled with algal blooms, and communities are eager for answers regarding their impact on human health," notes Kennedy, an associate professor of medicine at U-T. "Our research aims to provide vital insights, identifying at-risk populations and offering evidence-based information for healthcare providers and policymakers to enhance the health of our region."

The center is organized around several overarching themes. The first is to resolve how climate change influences the occurrence of cHABs and the transport of the toxins they produce. The second is to understand toxin production and how toxins impact health, through both airborne and waterborne exposure. The third is to develop new technologies for enhanced monitoring and forecasting. In collaboration with agency and community partners the team will integrate findings into state-of-the-art forecasts and other data products that reach a wide stakeholder audience. A Community Engagement Core led by Chris Winslow of The Ohio State University will connect center science to relevant communities, promoting co-design of research and communication of research outcomes to stakeholders. The center's studies will combine observation, experiment, and modeling at the nexus of lake science, climatology, microbiology, and biomedical science. *By Gregory Dick, University of Michigan.*

COMMUNITY NEWS

Navigating the connectivity conundrum: FishPass and the science of selective fish passage

Rendering of FishPass looking upstream with focus on the fish-sorting channels (left) and nature-like bypass channel (right). The bifurcated design enables dual research and recreational access to the Boardman/Ottaway River.

The connectivity conundrum—tension between improving aquatic connectivity for fishery restoration versus using dams and barriers to manage invasive species—is one of the greatest issues facing fishery managers globally. Selective connectivity, where organism movement is selective based on restoration or conservation goals, presents a potential solution to the connectivity conundrum.

The Great Lakes Fishery Commission and its partners are developing an approach to selective fish passage that integrates fish ecology and biology with engineering at FishPass. The FishPass project will replace the last of four legacy barriers on the Boardman/Ottaway River in Traverse City, Michigan, with an improved barrier and adaptable fishway designed to develop and test tools to selectively pass desirable fish while blocking and/or removing undesirable fish, like the invasive sea lamprey. Under the management of the U.S. Army Corps of Engineers, the prime contractor, Spence Brothers, broke ground this spring on construction of the in-stream components of FishPass including the new labyrinth spillway and fish-sorting channels. We estimate FishPass construction will be complete in 2027.

While construction progresses, the FishPass Advisory Board will continue to support supplementary research projects aimed at informing operational procedures, and supporting future decisions associated with selective connectivity in the Boardman/Ottaway River as well as research and development of fish sorting tools and analyses techniques. The FishPass Advisory Board comprises approximately 35 representatives of all primary project partners and researchers with expertise in behavioral ecology and engineering. Together, their role is to provide guidance on facility usage and formulate an annual and long-term research program that includes both directed research and external research proposals. Specific details on the FishPass research plan and model are available on the project website.

Generally, the process used to select and configure fish sorting tools will follow an approach inspired by material recycling, and will emphasize automation and the integration of multiple technologies that target sortable attributes of fish (phenological, morphological, behavioral, and physiological). During the initial 10-year research phase of the project, FishPass will operate as an adaptive management project where researchers will annually assess fish communities and habitat use above and below the facility, apply different treatments to optimize fish sorting and passage efficacy focused on species native to the Upper Great Lakes, and adapt operations to maximally benefit the watershed and accommodate stakeholder desires.

During the research phase the Michigan Department of Natural Resources, in consultation with the Grand Traverse Band of Ottawa and Chippewa Indians and the public, will identify “desirable” species, thereby prioritizing needs for long-term passage. Once optimized, the fish-sorting channels will be converted to a permanent long-term selective fish passageway. Lessons learned from this novel project will be applied to similar rivers and optimized to create selective fish passage at new sites. The project is anticipated to have regional, national, and global implications.

By Daniel Zielinski, principal engineer and scientist at the Great Lakes Fishery Commission.

White Lake Area of Concern a decade after delisting

White Lake is a 2,571-acre drowned river mouth Lake Michigan tributary in Muskegon County, Michigan, designated an Area of Concern (AOC) in 1985. White Lake was impacted by industrial waste discharges from chemical and leather tanning industries, sewage, and habitat loss (Revord, 2018). The White Lake Public Advisory Council (WLPAC), stakeholders, and local, state, and federal partners worked for over two decades to restore the impairments impacting White Lake. Federal and state expenditures for the AOC included US$3.9 million for wastewater treatment upgrades, US$6.4 million for contaminated sediment removal, US$2.4 million for habitat restoration, and US$1 million for invasive species management and other stewardship activities (Hartig et al., 2019). In 2014, White Lake was delisted as an AOC, marking a significant environmental milestone (Riley, 2014). The WLPAC was discontinued after delisting. Below are highlights of the ongoing efforts to maintain and improve the lake's health and lessons learned along the way.

Post-delisting achievements

Current stewardship activities are handled by local government units, citizen groups, the Muskegon Conservation District, and the White Lake Association. Restoration efforts have included the acquisition of 164 acres of floodplain celery fields by the City of Whitehall, protected by a conservation easement (pictured below, right). Water quality monitoring continues, and ongoing issues with *E. coli* and cyanobacteria blooms are being evaluated. A grant was also obtained to prioritize the remediation of additional coastal wetlands. Groundwater remediation activities continue at contaminated sites.

Ongoing needs

The absence of the WLPAC has created a void where no single organization reviews the status of local environmental issues, analyzes trends, and builds consensus for future actions to improve environmental health and resilience. This void can be filled by offering community forums with stakeholders and partner organizations to develop action plans and build community capacity and support.

Lessons learned

White Lake's restoration offers valuable lessons for other AOCs. Community activism and partnerships were instrumental in driving and sustaining restoration efforts. The WLPAC provided a platform for community input and oversight, ensuring alignment with local needs and priorities. After delisting, the lack of transition funds and dissolution of the WLPAC slowed environmental sustainability into the future, a lesson for current AOCs.

Conclusion

White Lake's restoration showcases the power of community-driven efforts and strategic collaboration. Significant progress has been made in addressing past impairments and fostering a healthier ecosystem. Continued efforts are essential to maintain and enhance the lake's health. The lessons learned from White Lake can inspire and guide efforts to restore other AOCs and protect impaired water bodies, ensuring a healthier environment for future generations.

By Tanya Cabala, lakeshore outreach organizer with the West Michigan Environmental Action Council and a founder of the White Lake Public Advisory Council, and Richard Rediske, emeritus professor of water resources at Annis Water Resources Institute, Grand Valley State University.

Dredging contaminated sediments from Tannery Bay (at left); wetlands acquired for future restoration (right).

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for graduate research in large lake fisheries

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for graduate research using applied mathematics to advance understanding and management of Great Lakes ecosystems

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for doctoral research making a significant contribution to the understanding of large lakes

IDEA+ Presenter Scholarship
for broadening participation in IAGLR by welcoming and involving people from historically marginalized communities

IDEA+ Research Scholarship
for graduate research that adds to the diversity of perspectives regarding large lake science, management, education, communication, policy, and community

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Planning to present your research at the IAGLR 2025 conference? Apply for a scholarship! All winners receive a free conference registration to present their research.

iaglr.org/awards-scholarships