Global Water Futures Observatory
RAEON Operations

Aaron Fisk
University of Windsor

raeon.org
@RAEON_

RAEON

Multi-institutional Canadian Foundation for Innovation-Innovation Fund (CFI-IF), Ontario Research Fund Research Infrastructure (ORF-RI) & partners ($17.4 million – 2018-2023) grant to develop an extensive real-time observation network for freshwater ecosystems.

TRENT UNIVERSITY

University of Windsor

Western UNIVERSITY · CANADA

Carleton UNIVERSITY

UNIVERSITY OF SASKATCHEWAN

UNIVERSITY OF TORONTO SCARBOROUGH

INNOVATION.CA
CANADA FOUNDATION FOR INNOVATION | FONDATION CANADIENNE POUR L'INNOVATION

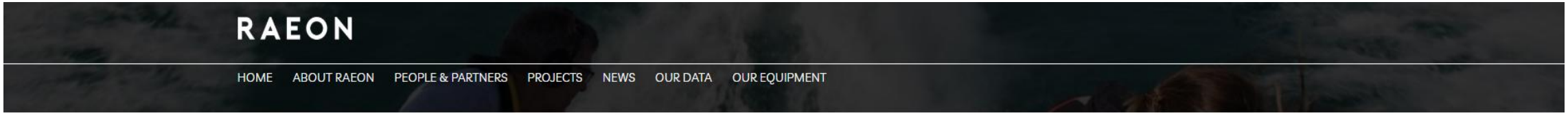
Ontario Research Fund

Mission, Vision and Partners

RAEON provides the infrastructure, staff and data management that Canadian researchers need to carry out cutting-edge, integrated and transformative research on the Great Lakes.

RAEON contributes to improving our understanding of the mechanisms and processes of large lake ecosystems and to the management, rehabilitation and enhancement of their ecosystem services.

GWFO/RAEON Instrumentation: *request online*



RAEON EQUIPMENT SHARING

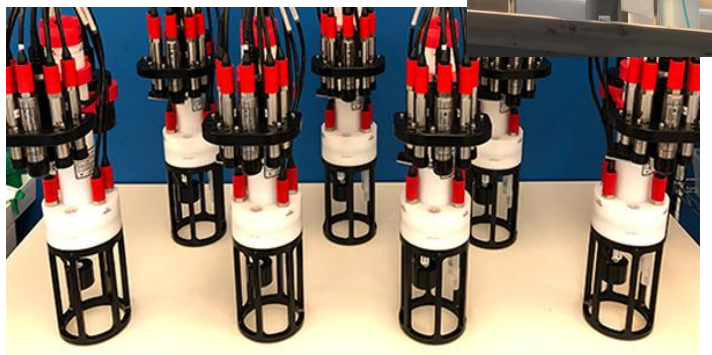
The Real-Time Aquatic Ecosystem Observation Network provides instrument loans to Canadian academics and partners. If interested, please 'request' an item and fill out a loan form. For non-Canadian academics, please contact us to discuss opportunities. Note: RAEON has a set of criteria for loaning out instruments which works on a first come, first serve basis.

1. REAL TIME SENSORY ARRAY

CFI #	VENDOR	EQUIPMENT	AVAILABLE	LOCATION	DESCRIPTION	
1.1	InnovaSea	AquaHub	Y	UW	Modem outfitted for a buoy, allows real-time communication and sensor communication.	Request
1.1	InnovaSea	Dissolved oxygen sensors	Y	UW	Communicates with AquaHub in real-time and internally logs data. Can be outfitted to buoy or on a separate sensor line up to approx. 1 km away from buoy.	Request
1.1	InnovaSea	Salinty sensors	Y	UW	Communicates with AquaHub in real-time and internally logs data. Can be outfitted to buoy or on a separate sensor line up to approx. 1 km away from buoy.	Request

GWFO/RAEON Instrumentation

- *In situ* autonomous instruments
  - **Instruments**: acoustic telemetry (fish tracking), water quality sondes/profilers, eDNA collectors, GPS drifters



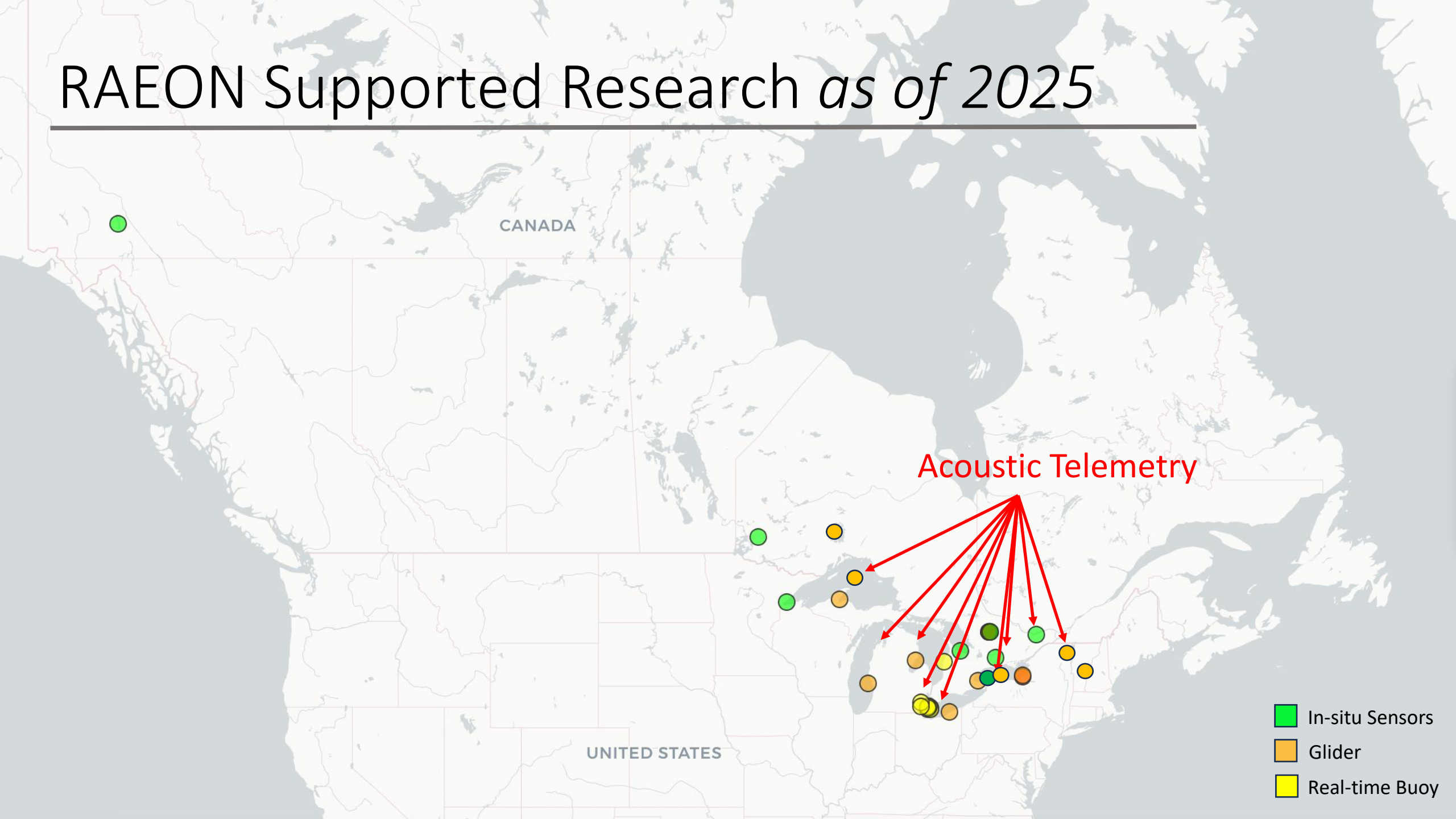
- Real-time sensory arrays
  - **Instruments**: buoys: acoustic telemetry, video, weather, wave, chlorophyll, CDOM, turbidity, salinity, DO, and blue-green algae, water current

G3 Slocum Gliders (AUVs)

- **Instruments**: telemetry, water quality, hydroacoustics (75, 120, 760 kHz), oil detection

- Field support vehicles
  - Boats (29, 27 and 18 foot), efisher boats (19 and 17 foot)
  - 3 trucks

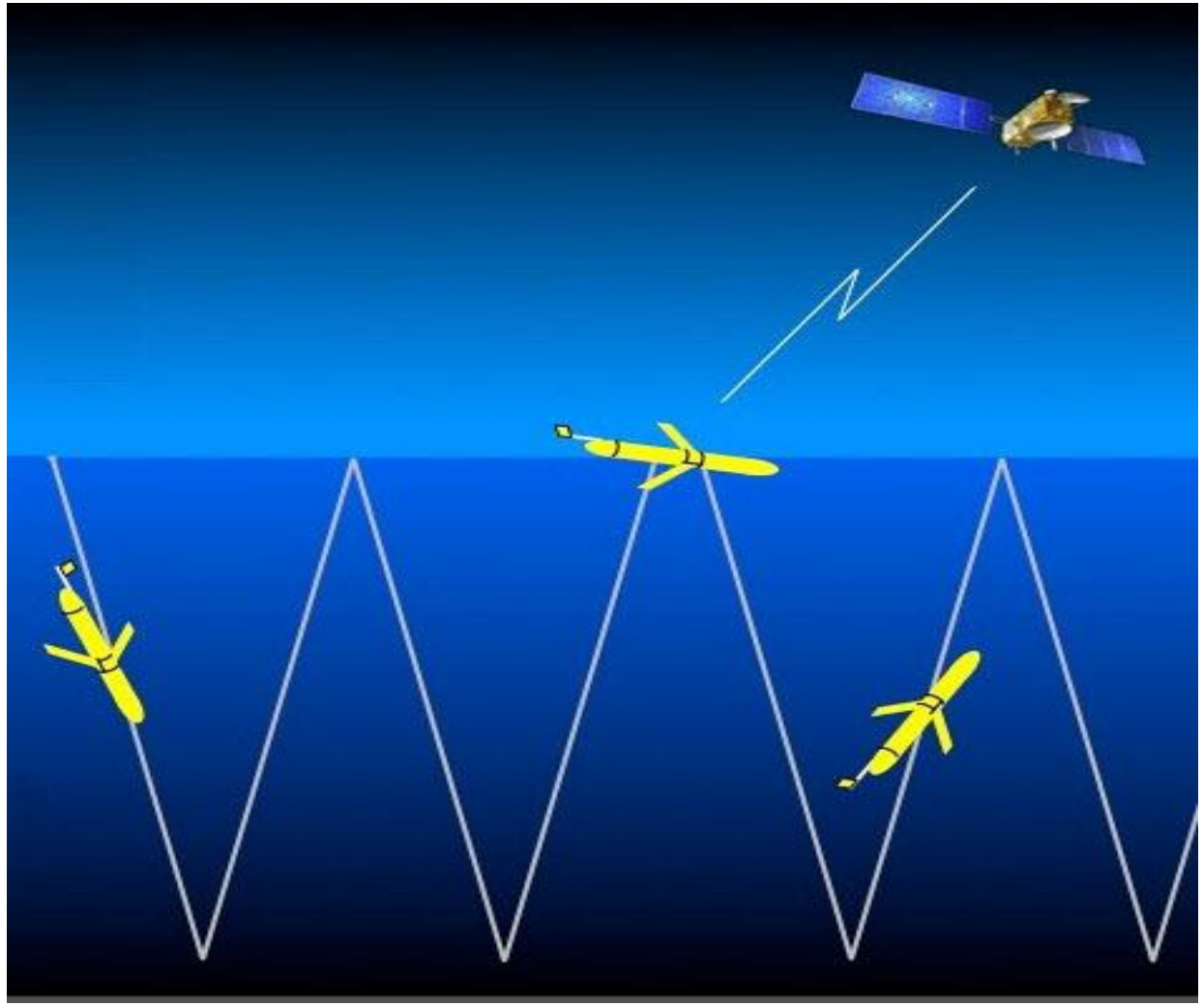
RAEON Supported Research *as of 2025*



RAEON *Headquarters* – U. Windsor

- Katelynn Johnson, Research and Operations Director
- Todd Leadley, Field and Equipment Manager
- Lydia Paulic, Glider Pilot (GLOS & GLFC)
- *Elizabeth Striano, Communications*
- Dr. Edward Millar, Citizen Science Coordinator
- *Nojah Parker, CTL*
- Karly Dominato, FCL
- Sharon Lackie, eSEM Tech
- Shelby Mackie, Genomics
- Faculty: Fisk (SoE), Mundle (Chem), Saber (SoE),McKay (GLIER), Hammond (Physics), Carriveau (Eng), Weisener (GLIER)

Slocum Glider (AUV - autonomous underwater vehicle)



Buoyancy driven changes volume relative to surrounding water

Water in = -ve buoyant (sink)

Water out = +ve buoyant (climb)

Real-time, high frequency data collection

Cost-effective and efficient – overcoming the logistically impossible

Long-term deployment (days to months), in most weather conditions

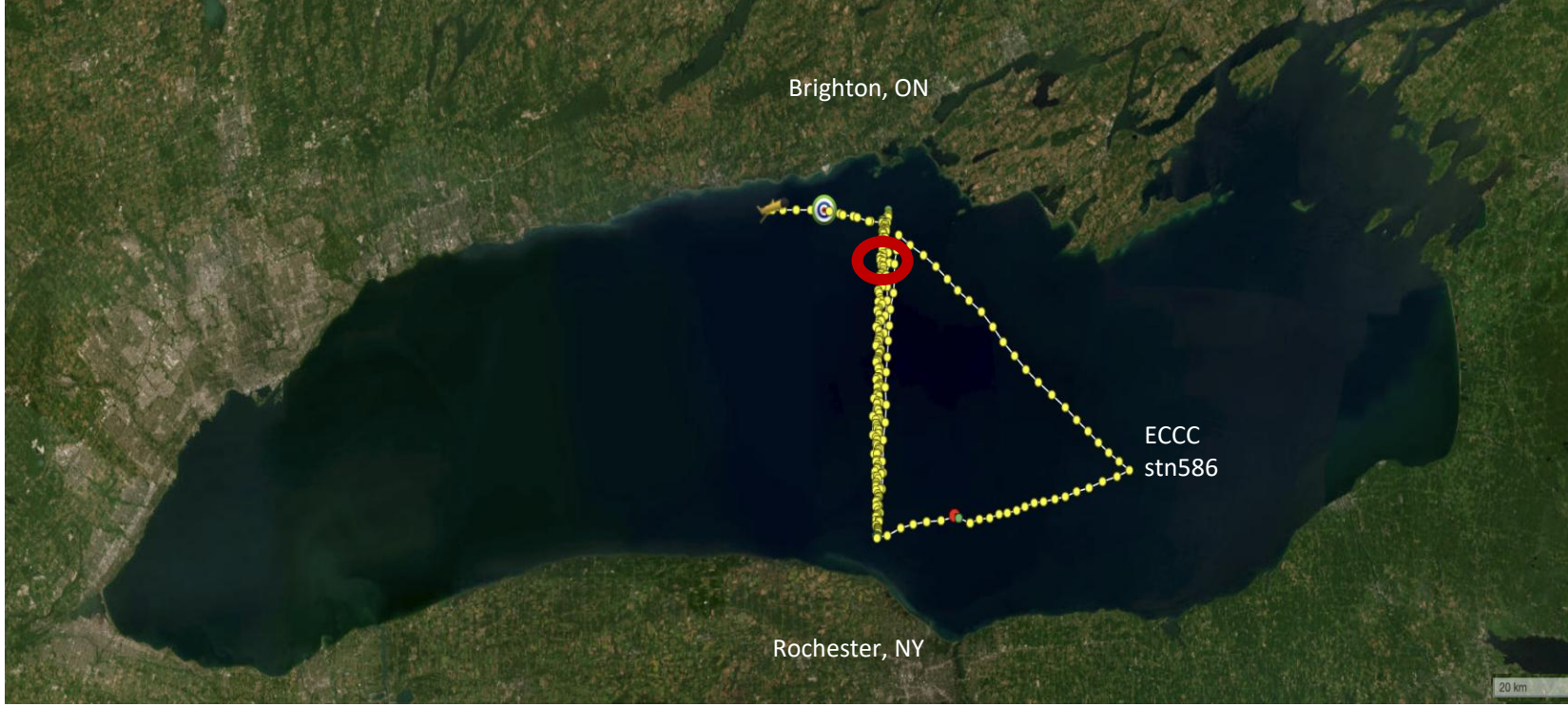
GWFO/RAEON Glider missions planned for 2026

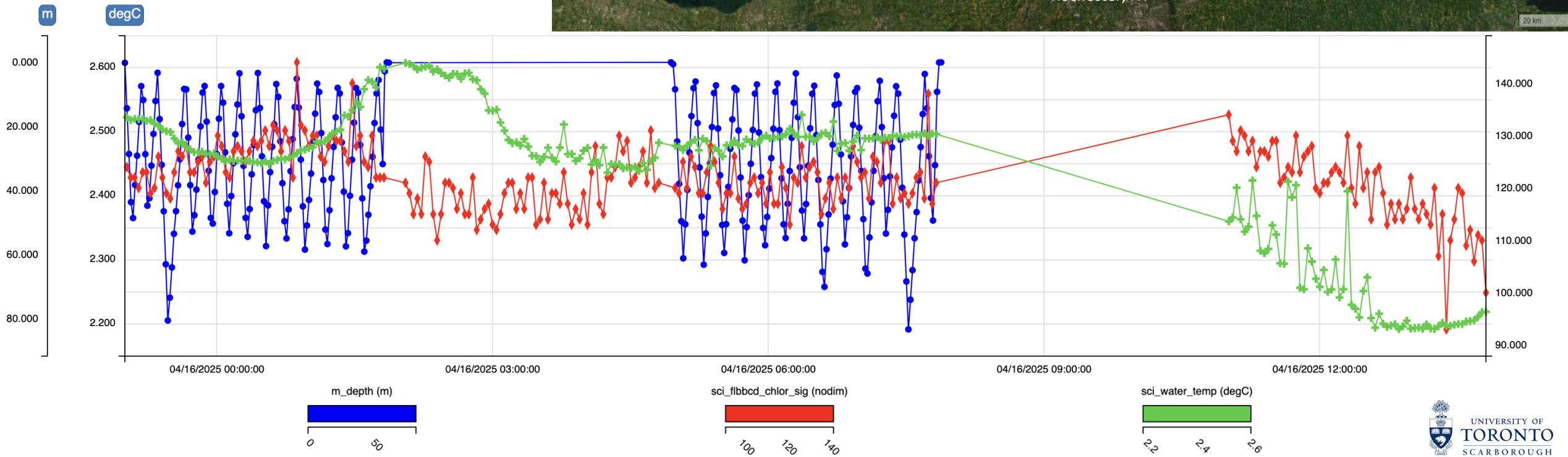
- *NOAA Great Lakes Observing System (GLOS), one of the 13 IOOS regions, committed ~$62,500 USD/year for glider pilot salary from 2026 until 2030 (5 years)*
- U. Toronto/Windsor 40-day mission to document water temperatures and spring turnover in Lake Ontario from April 10 through end of May
- NOAA/U. Michigan mission in Lake Erie to quantify water parameters in shoulder seasons March to April
- U. Guelph (NSERC funded) mission in Parry Sound, Georgian Bay to conduct hydroacoustic surveys end of April
- U. Windsor (GLFC funded) to search for tagged alewife in Lake Ontario in June
- OMNR funded fish hydroacoustic survey in Lake Nipigon in August\
- U. Windsor/DFO/NOAA in Hamilton Harbor in summer to test oil detector
- Preliminary discussion with ECCC for missions in Lakes Huron and Ontario

Lake Ontario

Environmental monitoring

- 30-day mission
  - > 2 million complete temperature profiles collected





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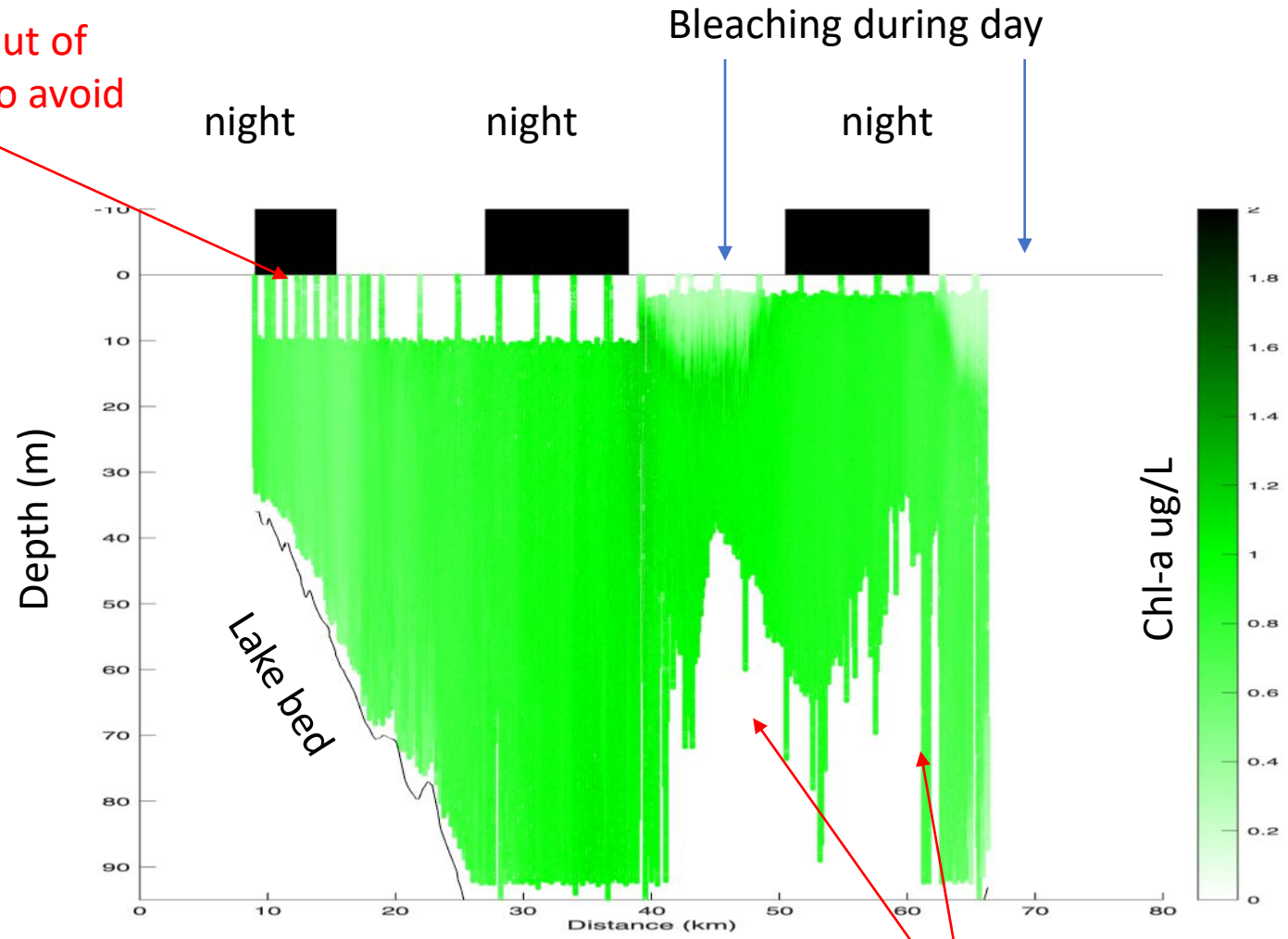
CHl-a transect on first line going south. It is interesting that Chl-a is pretty well mixed vertically – is this a consequence of solar driven convection?

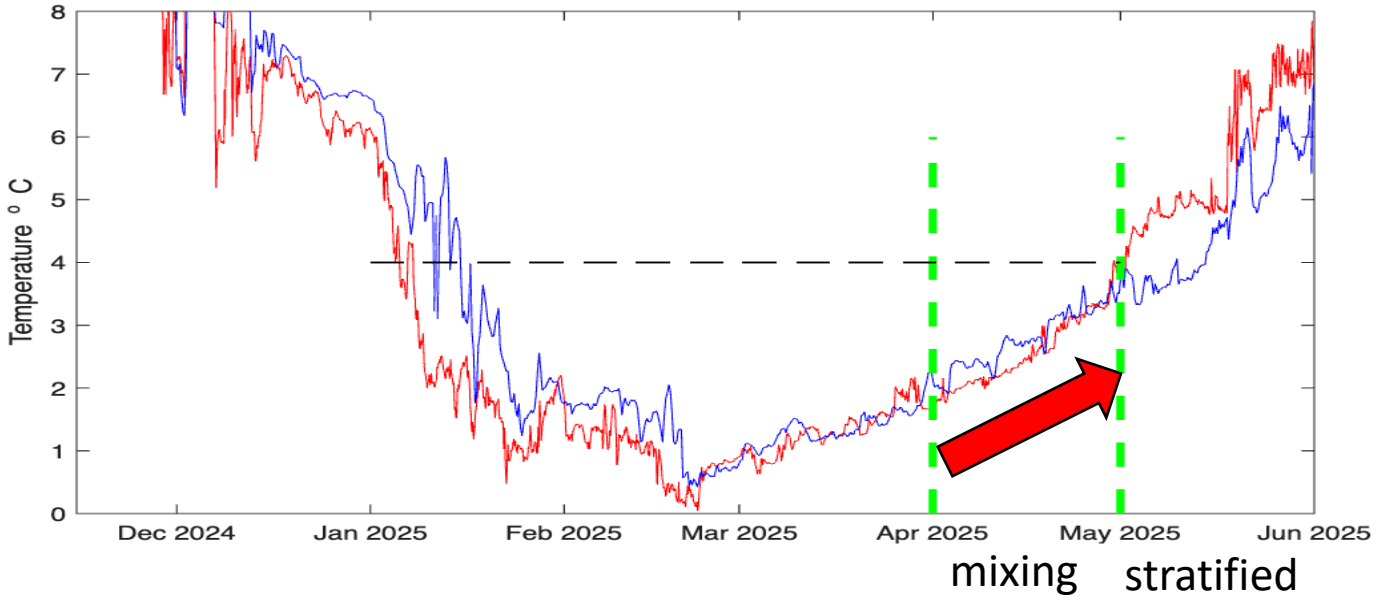
Staying out of surface to avoid boats



This first track caught the early spring peak in Chl-a, after this the values of chlorophyll decreased.

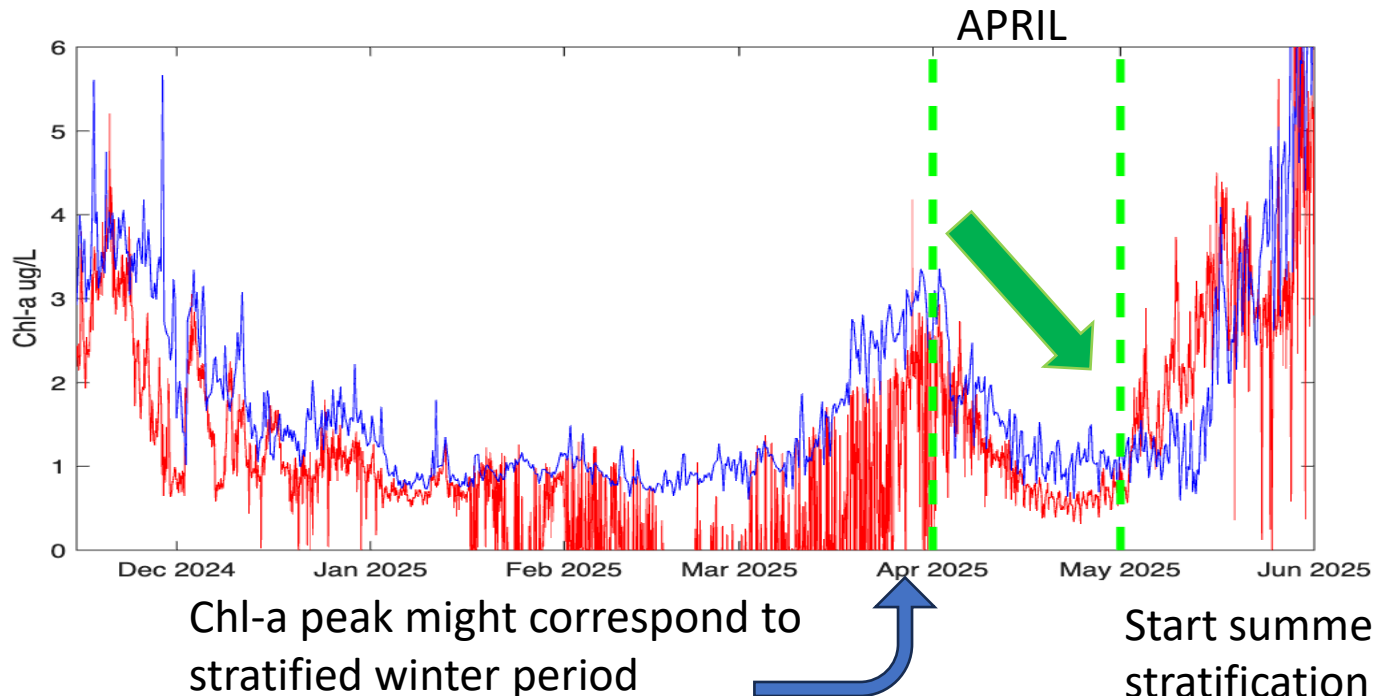
Maximum pressure rating was 100 m, so glider stayed above this.

Some problem with deep dives on USA side?



Tim Johnson deployed two RBR Maestros at about 20m depth in eastern Lake Ontario at PPW_016 and PPW_028 sites.

During April, the water temperatures warmed from 2 to 4°C



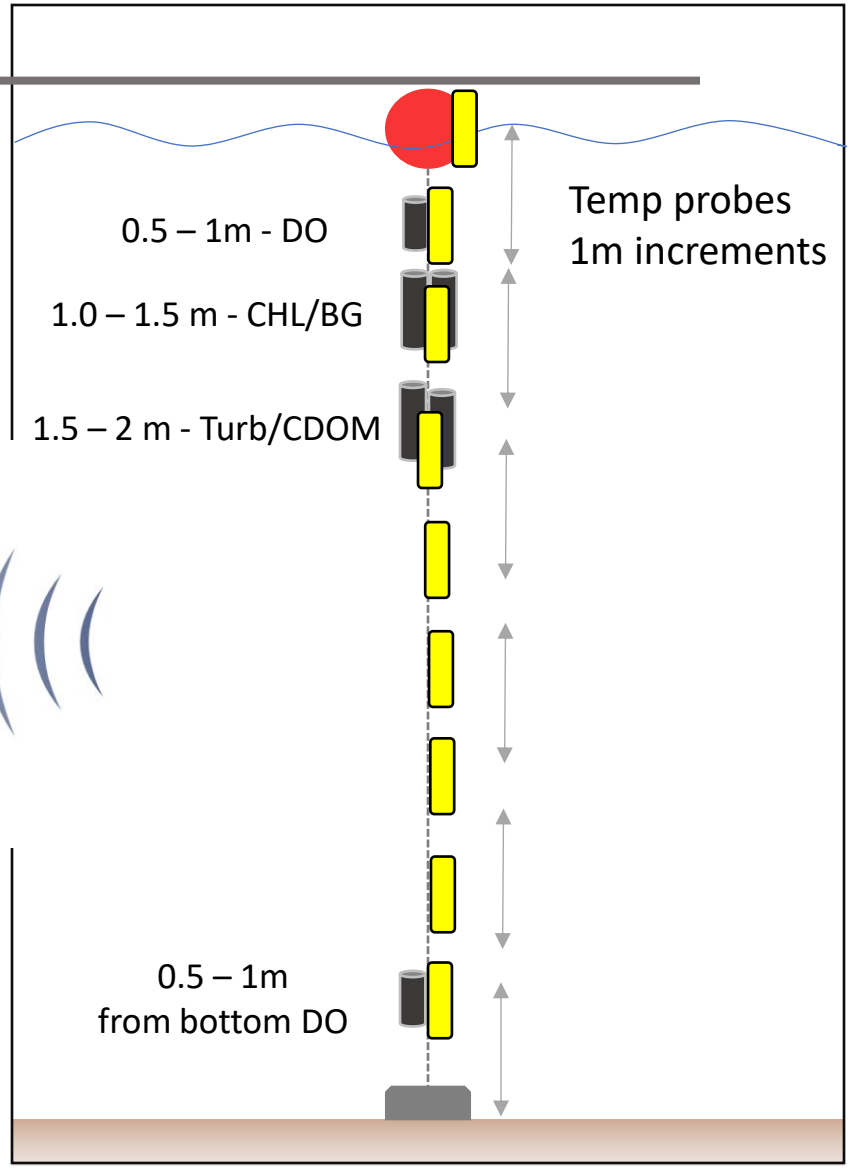
The start of April saw a peak in Chl-a, it then declined the rest of the month.

This is consistent with SLOCUM measurements.

Real-time sensory arrays

CB450
w/ weather station

SUNA – NO_3



GWFO/RAEON Real time buoys 2025

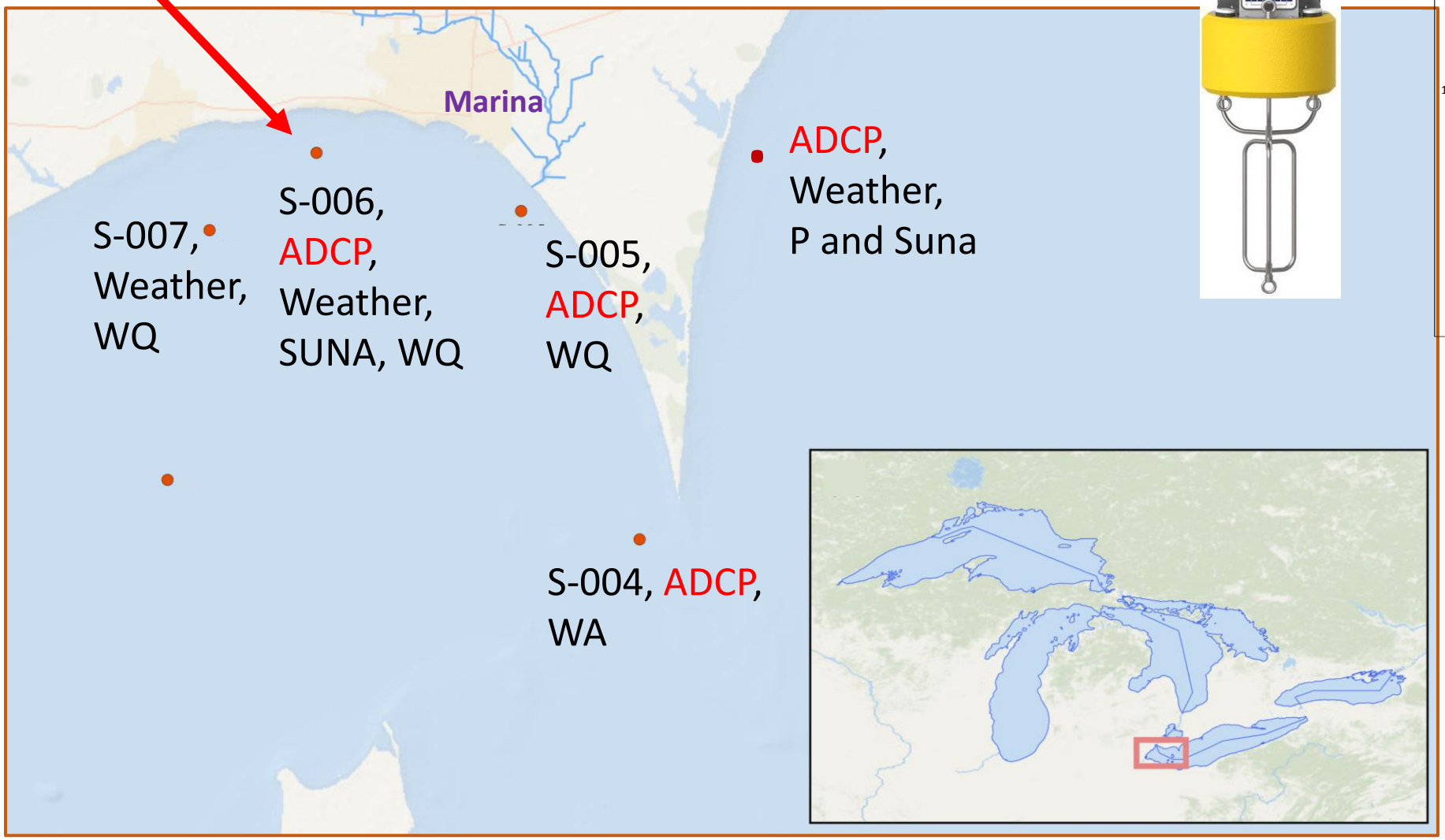
- U. Waterloo buoys (n = 3) in Lake Huron (Port Elgin) and Lake Ontario (east of Point Pelee and Prot Stanley) to study beach erosion
- ECCC funded buoy (n = 1) in Lake Erie west of Point Pelee to collect water quality data as part of their monitoring mandate
- U. Windsor (Union Water Supply System funded) (n = 4) in Lake Erie west of Point Pelee as part of early warning system for water utility
- U. Windsor (CWA funded) in Lake Erie near Hillman Marsh as part of nutrient fate study
- User fees: $96,040

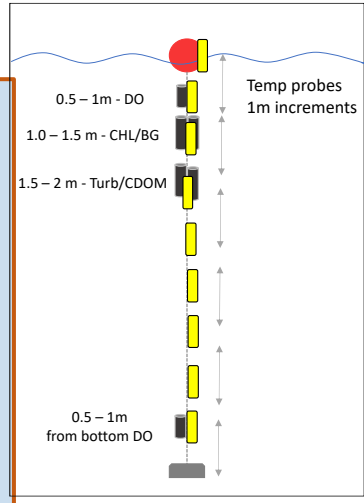
GWFO/RAEON Real time buoys 2026

- ECCC funded buoy (n = 1) in Lake Erie west of Point Pelee to collect water quality data as part of their monitoring mandate
- ECCC funded buoys in Lake St. Clair, Lake Huron and Central basin of Lake Erie
- U. Windsor (Union Water Supply System funded) (n = 4) in Lake Erie west of Point Pelee as part of early warning system for the water utility
- U. Windsor (CWA funded) in Lake Erie near Hillman Marsh as part of nutrient fate study

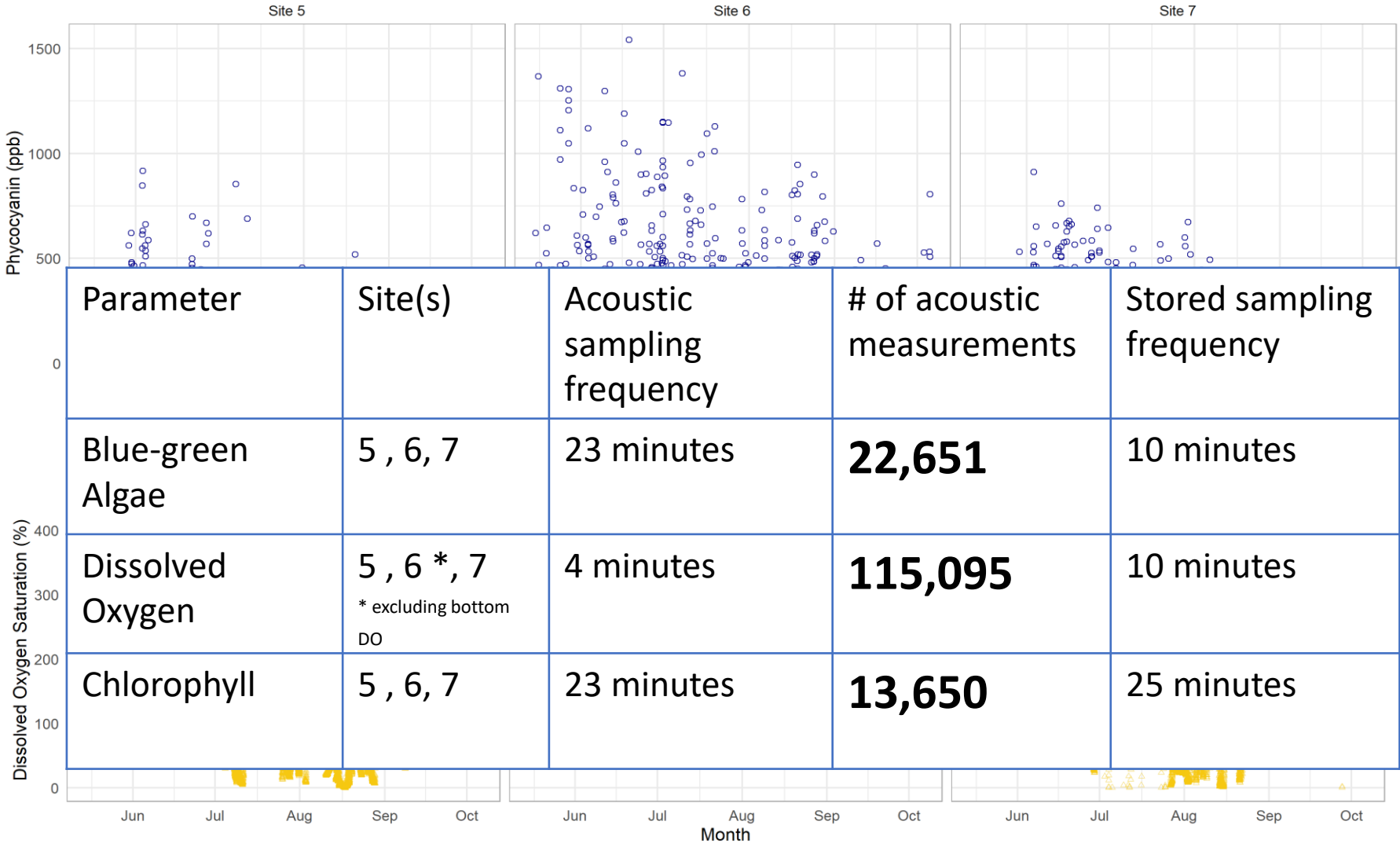
BUOYS – 25

UWSS water in take





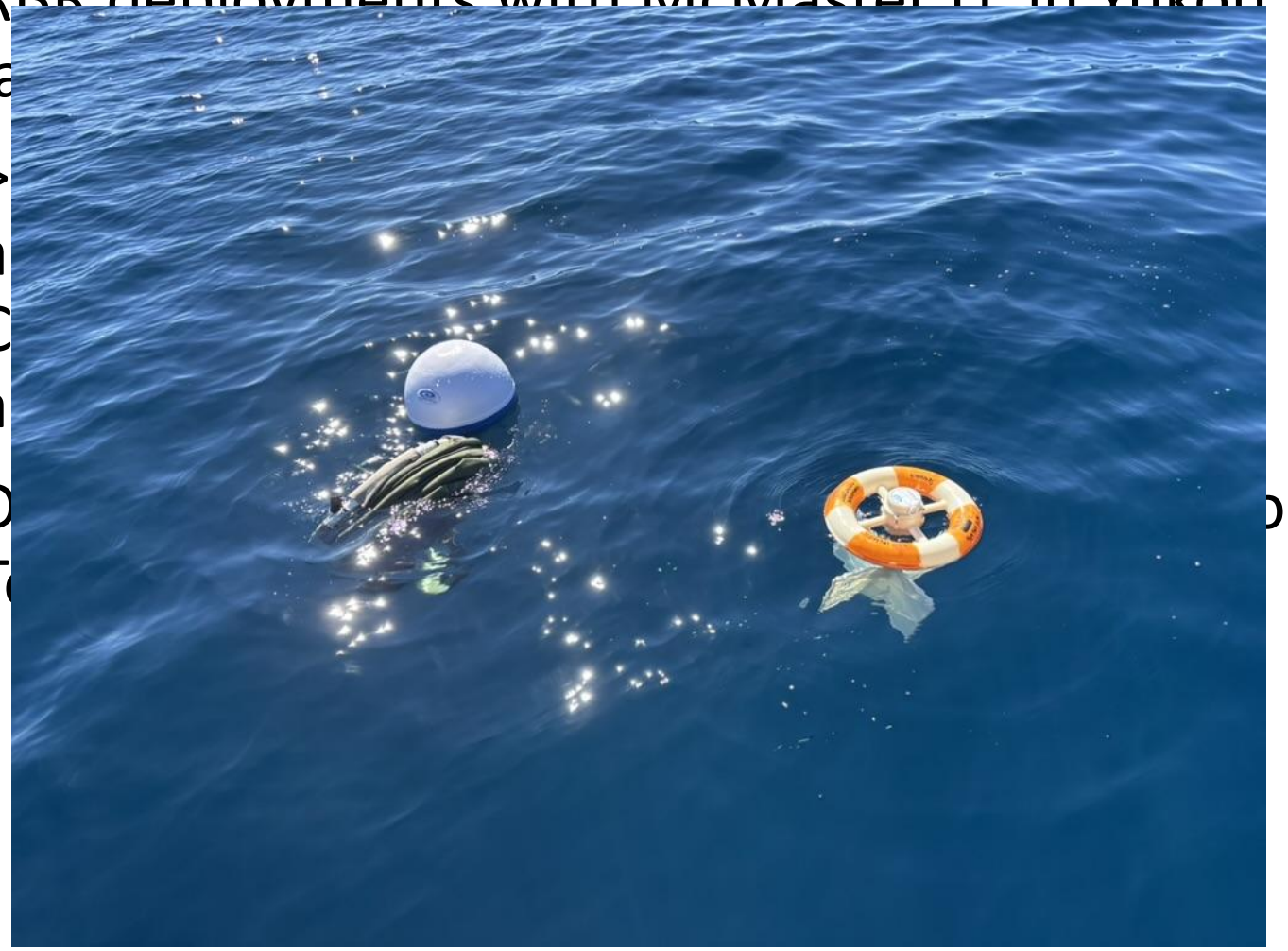
Freshwater Blue-Green Algae

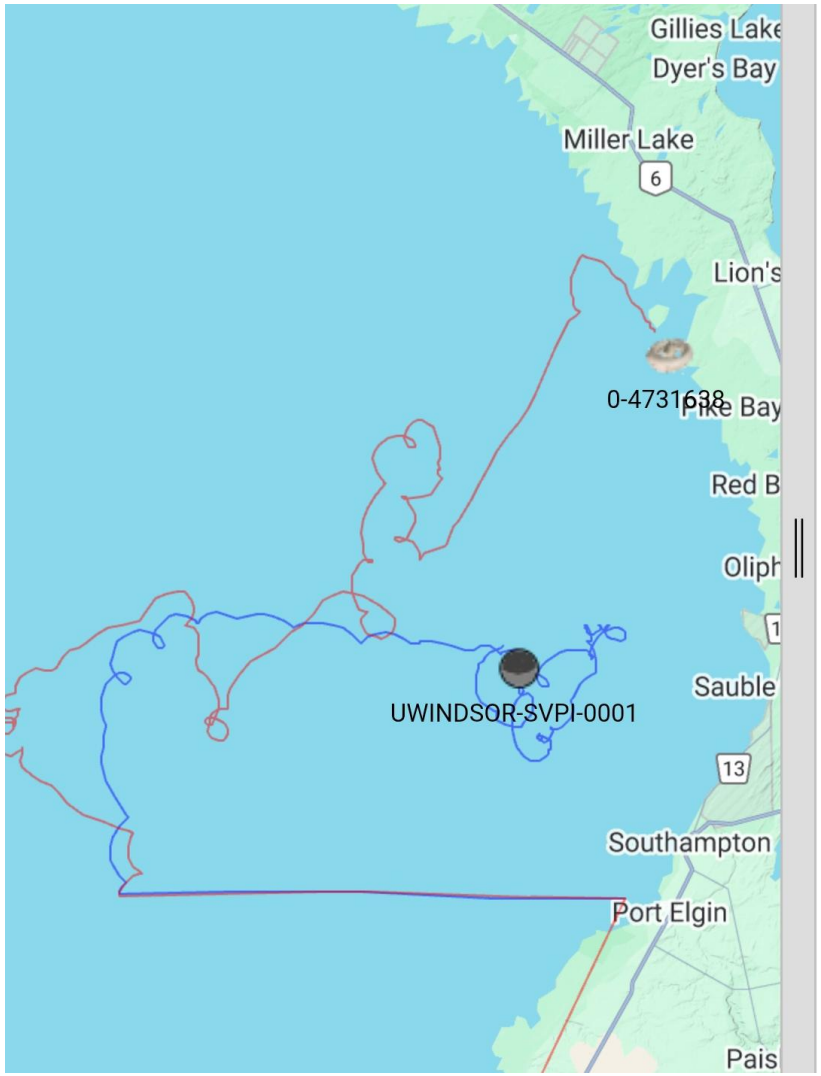


Parameter	Site(s)	Acoustic sampling frequency	# of acoustic measurements	Stored sampling frequency	# of stored measurements
Blue-green Algae	5 , 6, 7	23 minutes	**22,651**	10 minutes	**61,842** > 3 sensors
Dissolved Oxygen	5 , 6 *, 7 * excluding bottom DO	4 minutes	**115,095**	10 minutes	**99,722** > 5 sensors *
Chlorophyll	5 , 6, 7	23 minutes	**13,650**	25 minutes	**24,883** > 3 sensors

GWFO/RAEON Misc. Deployments 2025

- RBR deployments with McMaster U. in Yukon
- >
- D





GWFO Laboratories - U. Windsor

- **Chemical Tracer Laboratory (CTL)**: $\delta^{13}C$, $\delta\ ^{15}N$ and $\delta^{34}S$ analysis of bulk samples (3 IRMS, new microsample system to come online November 2024)
  - *User fees ~$80,000 (2 multi year contracts with DFO)*
- **Freshwater Chemistry Laboratory (FCL)**: $\delta^{13}C$ and $\delta\ ^{15}N$ analysis of gases, nitrate, and plastics
- **Environmental Genomics Facility**: range of genomic analyses, particular expertise in fish
  - *User fees ~$109,300*
- **Centre for Advanced Microscopy and Materials Characterization**: eSEM and AFM/Raman
  - *User fees ~$25,000*

Trent Water Quality Centre

The Trent Water Quality Centre (WQC) is the most comprehensive mass spectrometry facility in Canada. Specializes in method development and the application of new and innovative techniques for trace amounts of organic and inorganic contaminants in water and other environmental compartments. Offers analytical services and mass spectrometer training courses to researchers, government agencies and private companies.

RESEARCH AREAS

- nanoparticles
- trace metals in lake water
- isotope ratio determination
- source partitioning of mercury input into lakes
- Pharmaceuticals release from waste treatment facilities
- metal(oid) speciation analysis

Western Aquatic Performance Facility

Guppy Breeding

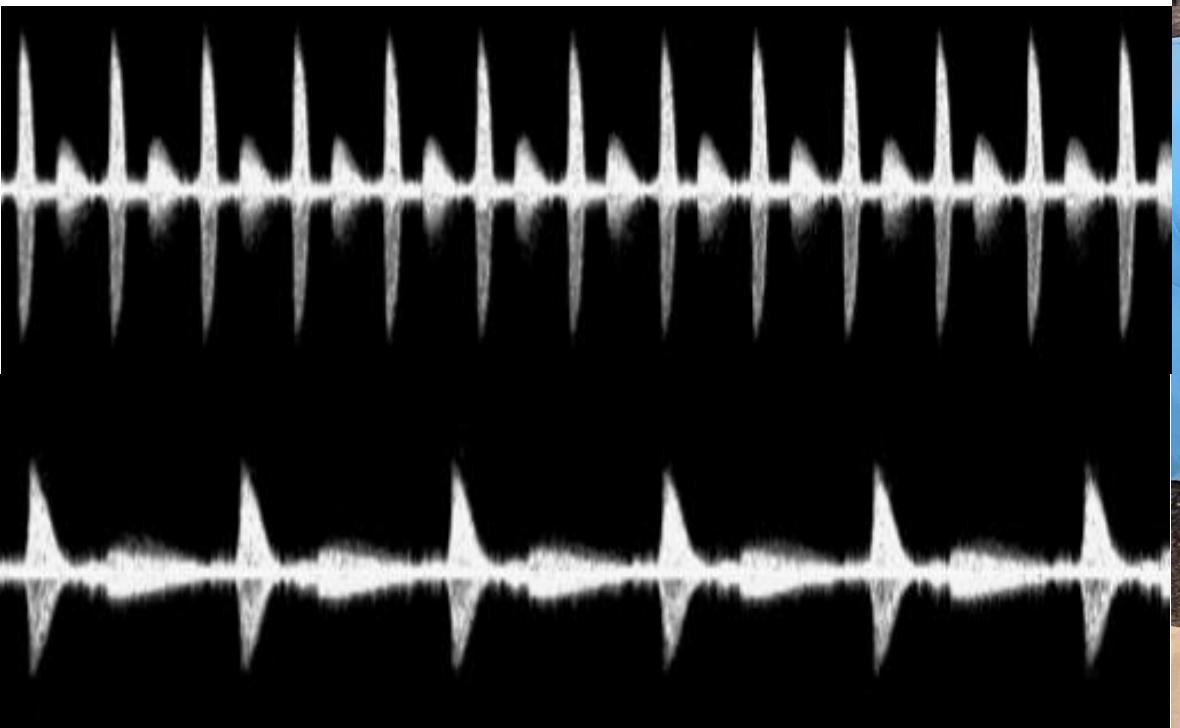
Atlantic salmon and lake trout

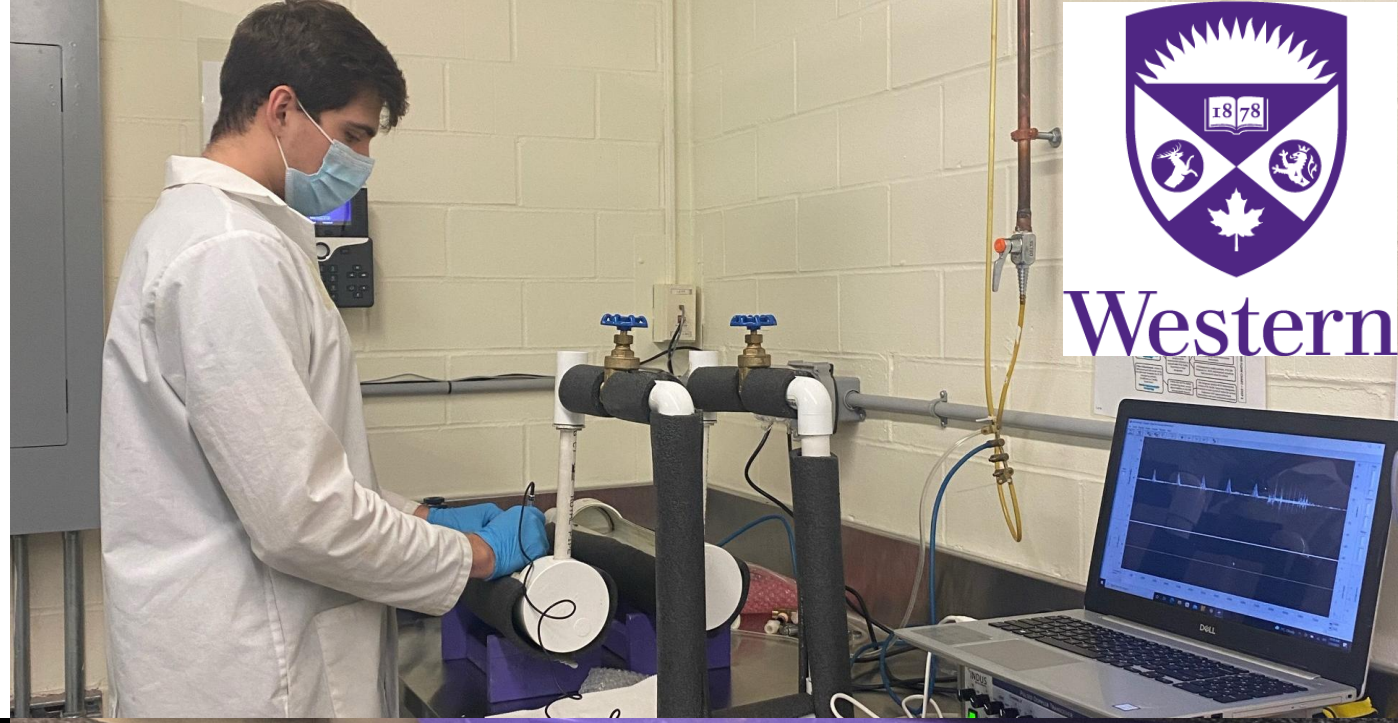
Cardiac Morphology

Doppler Signal Processing System

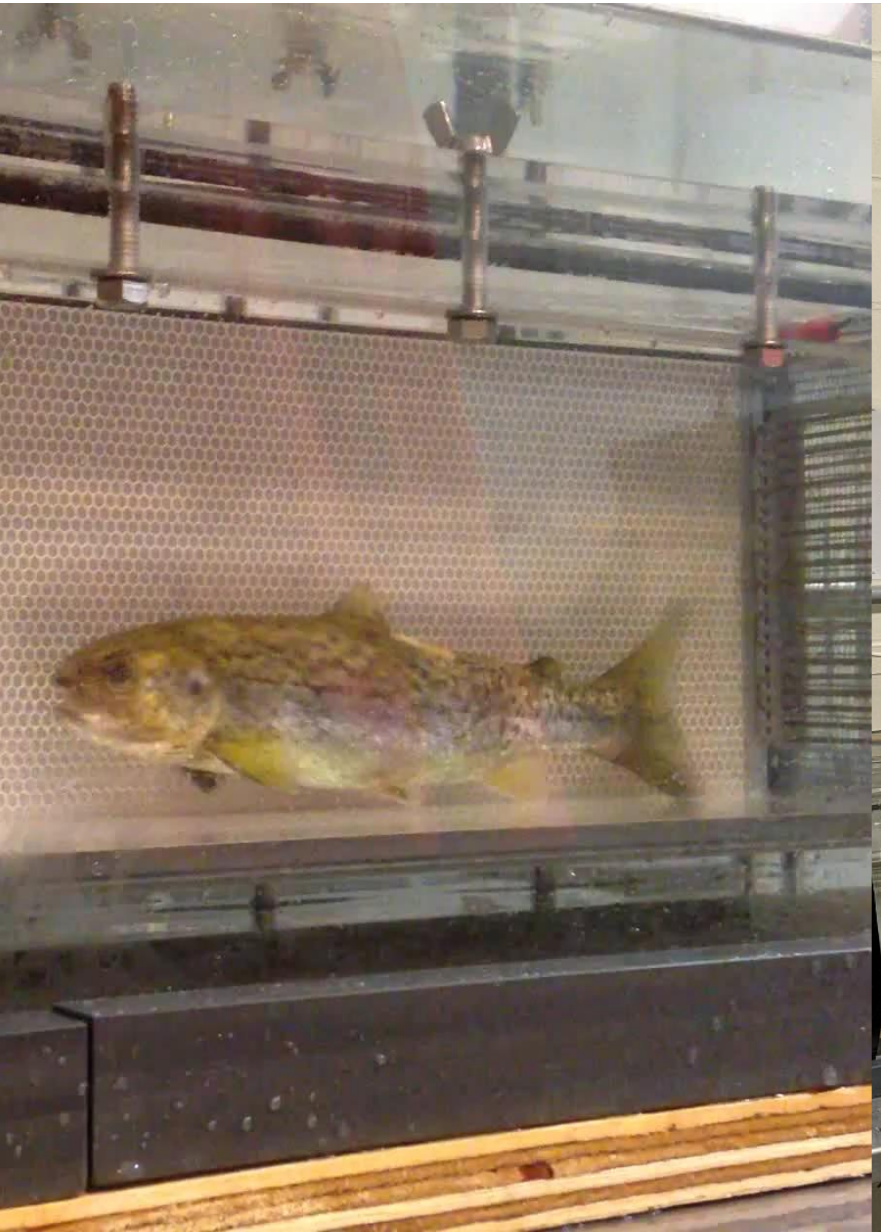
- Records heartbeat to assess heart rate

- Used to determine temperatures when heartbeat becomes irregular





Swim Flume for assessing swim performance



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TRACES Centre

ANALYTICAL TESTING AND TRAINING SERVICES

With over 25 years of combined experience in analytical testing, the Teaching and Research in Analytical, Chemical and Environmental Science (TRACES) Centre offers instrumentation in support of diverse chemical analyses to academia and the public.

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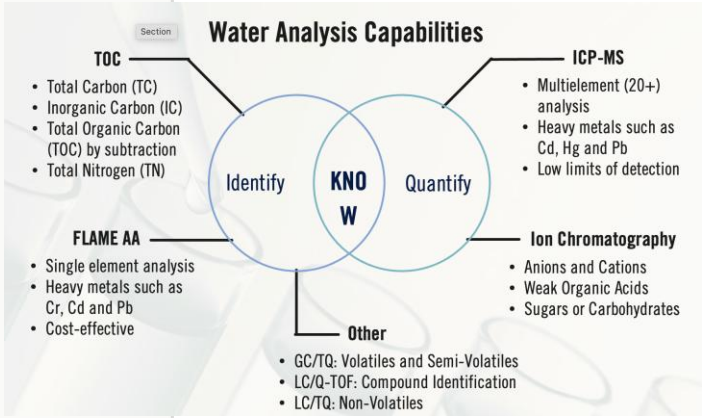
About TRACES

TRACES Centre is located on the 2nd floor of the Environmental Science and Chemistry Building at the University of Toronto Scarborough. The room number for the lab is EV215.

TRACES is a state-of-the-art analytical facility for use on the UTSC campus. It contains all the modern analytical instruments required for a leading-edge chemical, environmental and physical science department. TRACES provides both instrumentation and training for a very large and diverse field of users. The Centre is used by UG students in Chemistry and Environmental Sciences



TRACES Centre

UNIVERSITY OF TORONTO SCARBOROUGH | PHYSICAL & ENVIRONMENTAL SCIENCES

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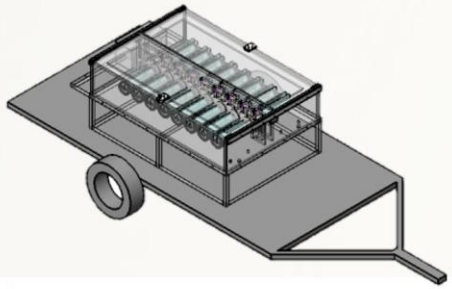
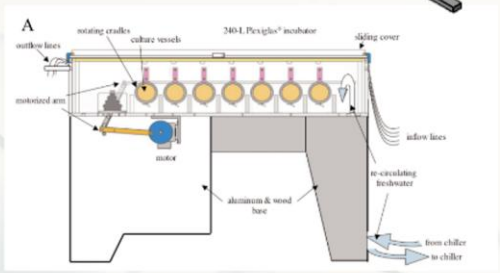
Harmful Algal Analytic Unit – UTSC (Field Instrumentation)

Mobile Harmful Algal Analytical Unit

Ecostat – Continuous culturing system





Fleet Vehicles

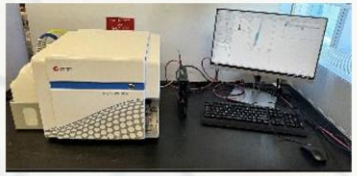
Jeep Wrangler

Ford F150

Harmful Algal Analytic Unit – UTSC (Lab Instrumentation)

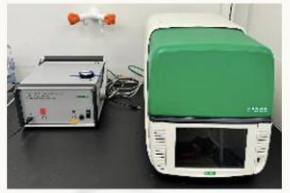
Growth Chambers – Eppendorf Innova S44i - Cyanobacteria Culture Library

FlowCam Cyano– Fluid Imaging Technologies



Flow Cytometer– CytoFLEX Beckman Coulter

Fluorescence and Absorbance Spectrometer– Duetta HORIBA



PHYTO-PAM-II Phytoplankton & Photosynthesis Analyzer – WALZ

Real-Time PCR Systems – CFX Opus 96 Biorad

Watercraft

10' Jon Boat (with 3hp trolling motor)

16' Jon Boat (with 20hp mercury motor)

Paleolimnological Studies
Gravity corers and Sediment extruders (custom made for transport)

Chlorophyll Fluorometers
Field spectrofluorometers with algae classification

BBE AlgalTorch

BBE BenthoTorch

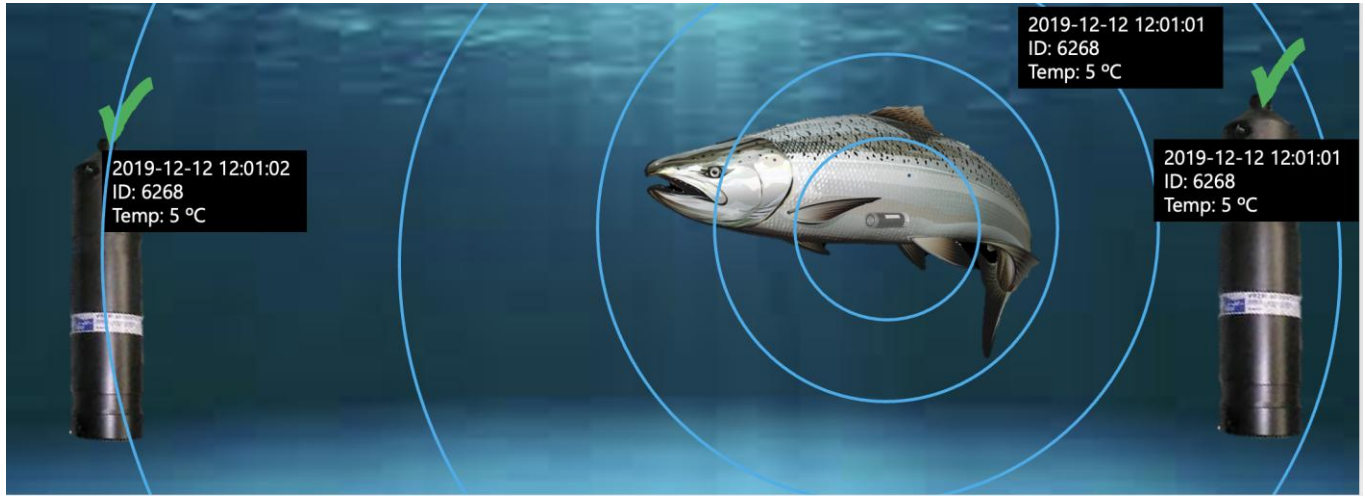
BBE PhycoLabAnalyser

BBE FluoroProbe

Carleton UNIVERSITY

FISH ECOLOGY AND CONSERVATION PHYSIOLOGY LABORATORY

- Range of acoustic telemetry (receivers) and biologging instrumentation
- eFishing and telemetry receiver deployment boat
- Part-time tech support person



RAEON University updates….

Western

- NSERC, Genome Canada and GLFC funded research on Great Lakes Food Webs and Competition
- NSERC and Genome Canada funded research on Thiamine Deficiency in Salmonids
- NSERC and Genome Canada funded research on Rainbow Smelt colonization and invasion in the Great Lakes

Trent

- Ecosystem and biogeochemistry studies using gliders and DO loggers (several papers and talks over the past year)
- Outreach with cottagers using multi-parameter sondes and buoys in Ontario lakes (Kawartha Lakes)

Carleton

- Partnership project with various lake associations in eastern ON focused on understanding the space use of fishes relative to protected areas and to inform restoration
- Seasonal biology of snapping turtles in a river in the Great Lakes Basin funded by NSERC

Toronto - SC

- Supported 9 graduate students and 11 undergraduates with GWFO instruments and labs in 2025/2026; 5 technicians support GWFO

We invite you to join RAEON and co-host INCUBATOR Art Lab for an evening during which art, science, and water technologies will come together.

Learn how new innovations are protecting our Great Lakes while enjoying art, food, drinks, and great conversation.

Watershed Assessment and Management (WAM) Network – CFI-IF Proposal (~$35,000,000)

Led by Todd Gillis (Guelph) and Bailey McMeans (UT-Mississauga)

WAM will bring together cutting edge in situ instrumentation with the diverse expertise of users, specifically targeting their needs to achieve the goals of sustainable land practices, healthy freshwater ecosystems, and water security in Canada

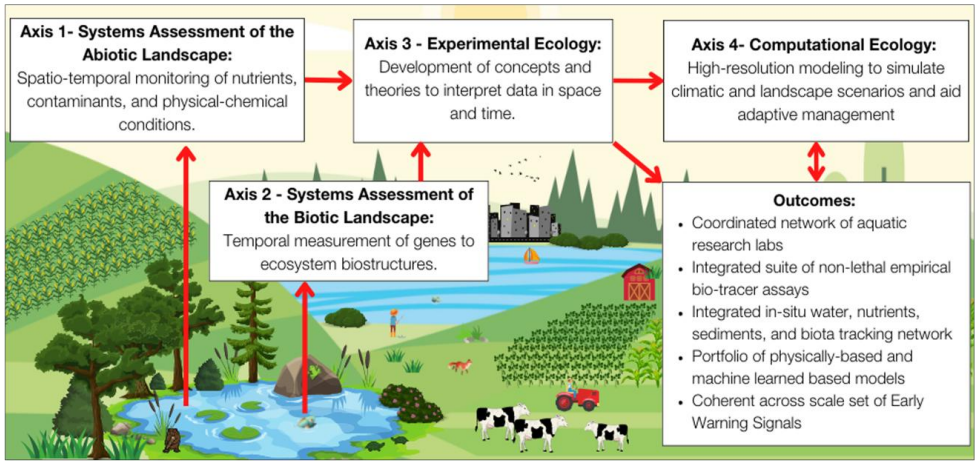


Figure 1. Axes and expected outcomes for the WAM network.