

# Development of a Winter Ecosystem Observation Capability Using Cabled Instrumentation and Autonomous Underwater Vehicle Technologies



Steve Ruberg  
NOAA/GLERL



Saab Sabertooth



# Winter Ecosystem Partners

Steve Ruberg  
Program Leader

### NOAA Federal

- Steve Ruberg
- Kyle Beadle
- Steve Constant
- Dennis Donahue
- Ashley Elgin
- Ron Muzzi
- Andrea Vander Woude
- Andrew Yagiela

### Contractors/Affiliates

- Kent Baker
- Beau Braymer
- Dan Burlingame
- Lauren Marshall
- Laura Mendoza
- Todd Roetman

### Cooperative Institute for Great Lakes Research

- Tom Johengen
- Russ Miller
- Hayden Henderson
- Heidi Purcell

### USGS Federal

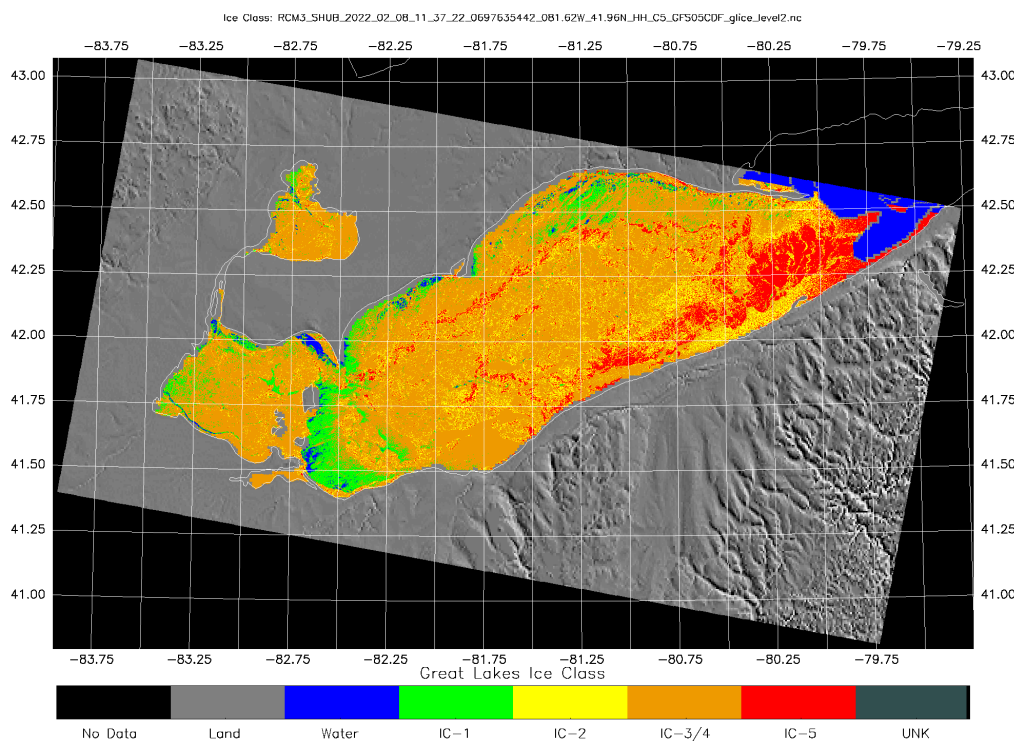
- Pete Esselman

### Hibbard Inshore

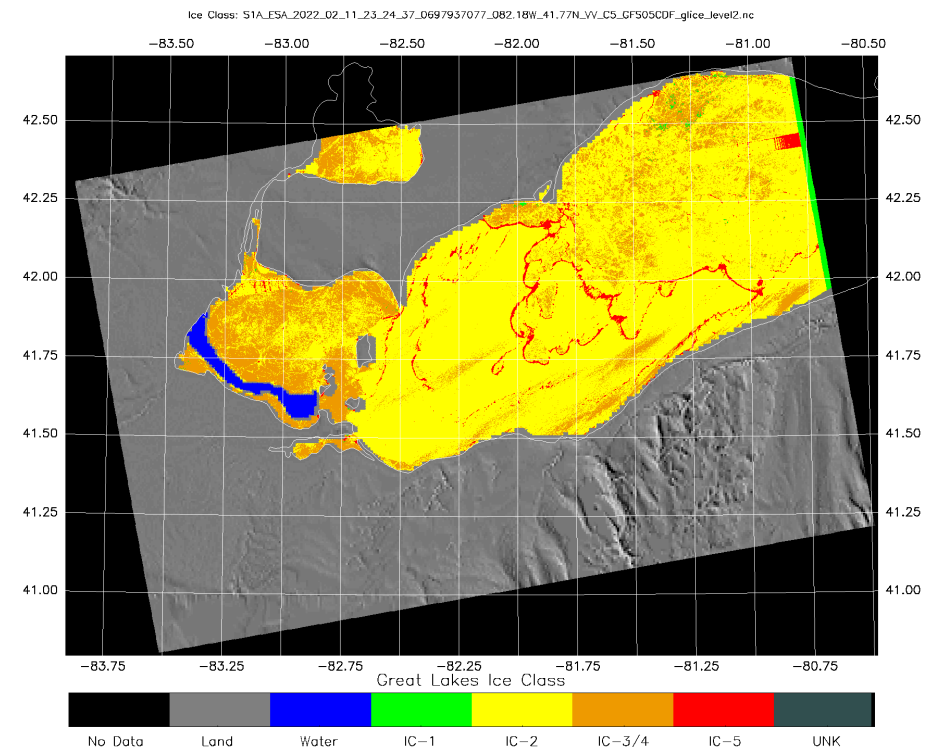
- Jay Hibbard
- Dave Malak

# GLERL/CIGLR Winter Sampling

Water sample collection and processing for chemistry and biology supported by observations from our real-time station.



February 8



February 11

# GLERL/CIGLR Winter Sampling

(Paul Glyshaw, Jeff Elliot, Hayden Henderson,  
Casey Godwin, Andrew Camilleri Feb 14-15, 2022)

Water sample collection and processing for chemistry and biology supported by observations from our real-time station.

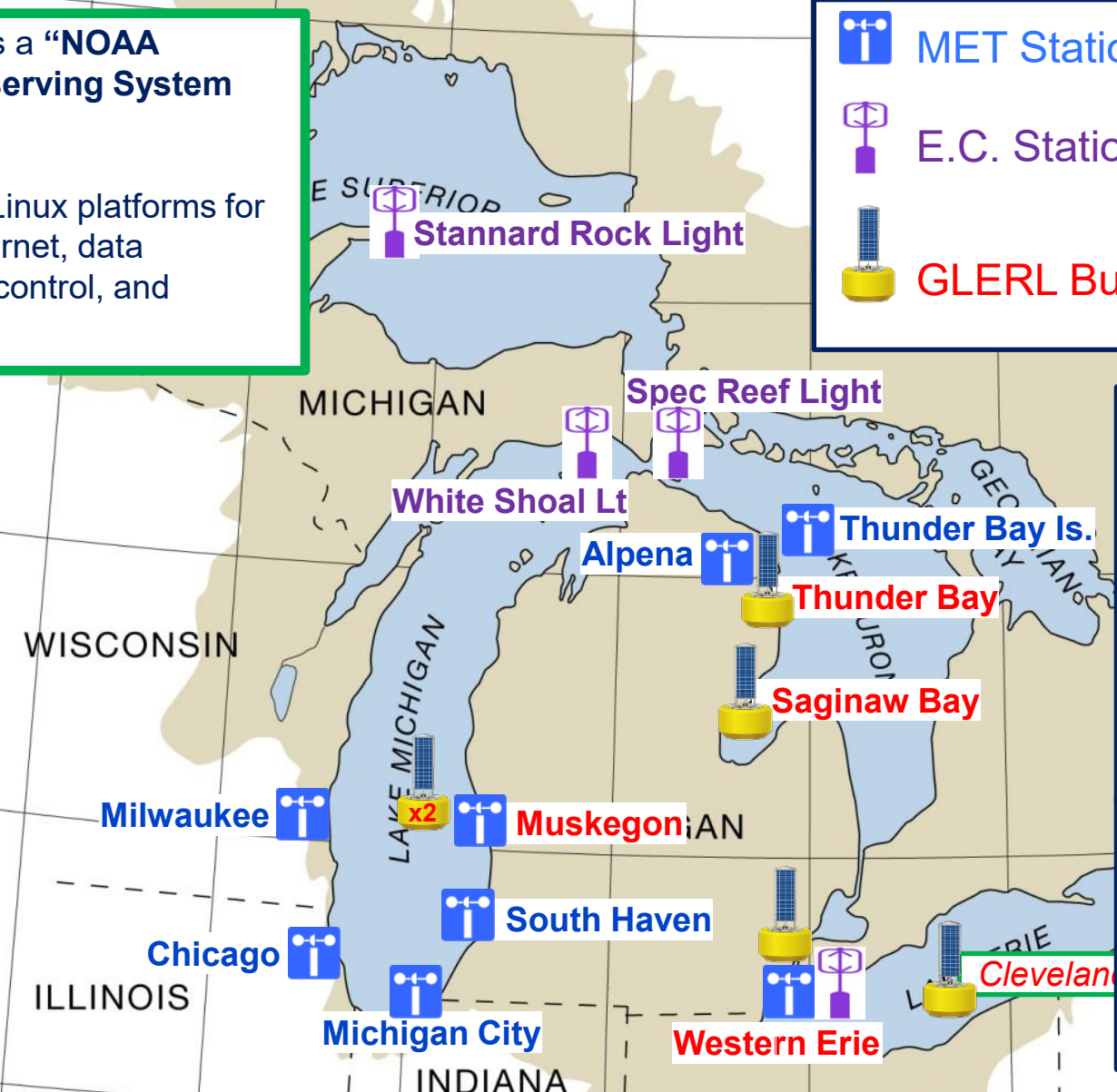


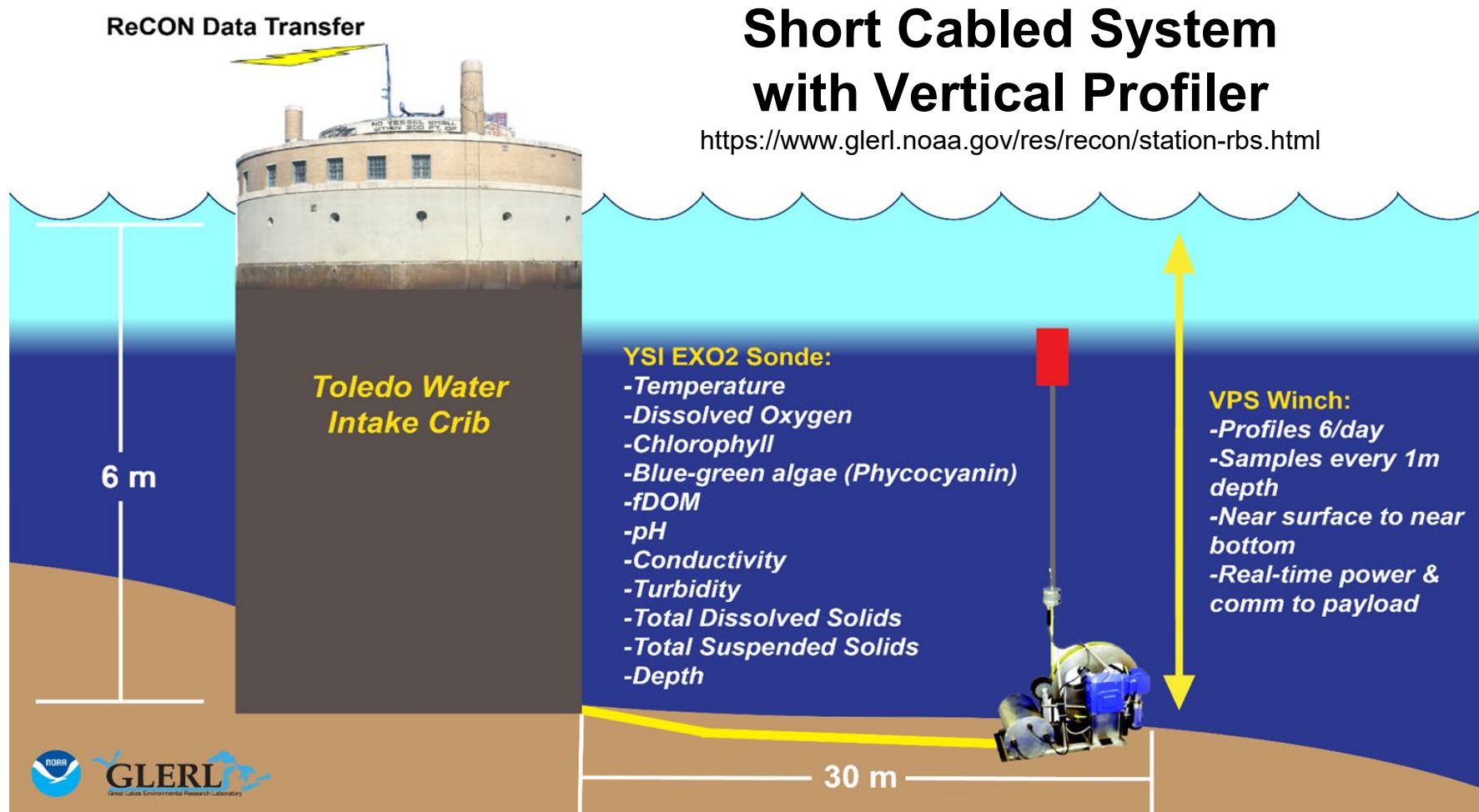
# Real-time Coastal Observation Network:

- Classified as a “NOAA Critical Observing System of Record”
- Embedded Linux platforms for internal Ethernet, data processing, control, and diagnostics

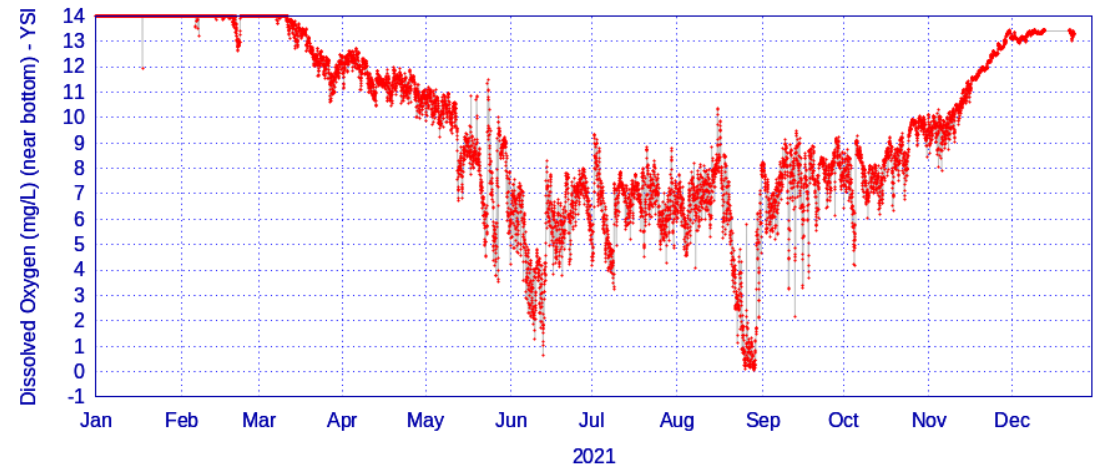
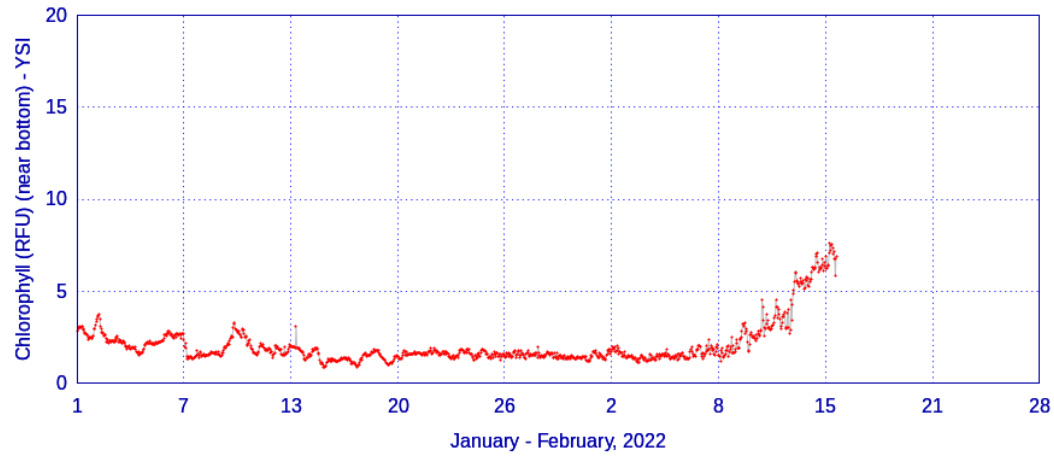
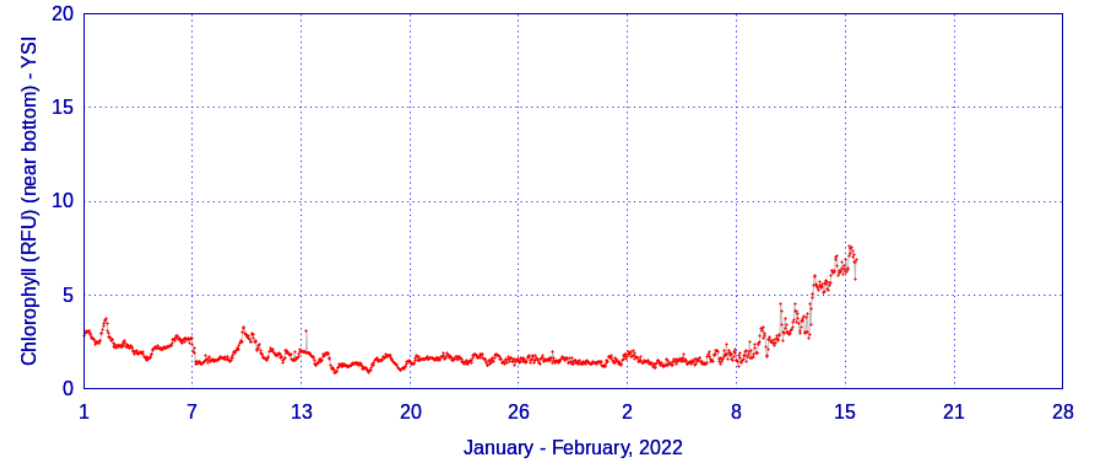
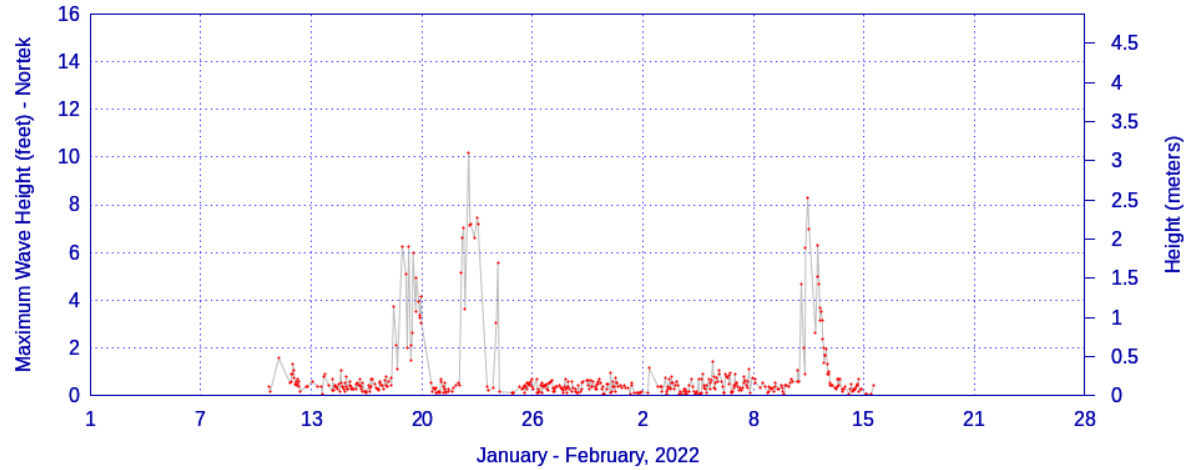
-  MET Stations
-  E.C. Stations (Evaporation)
-  GLERL Buoys (seasonal)

49°  
47°  
45°  
43°  
41°





# Year-Round Observations





## **AUV Project Background**

- **Observations of winter ecology have been difficult to obtain relative to the summer open-water period when most field work occurs. Advancements in autonomous underwater vehicle technology may now make winter ecosystem observations achievable even under ice-cover.**
- **Saab Sabertooth AUV demonstration Phase I, 2022 Q2 (UxS Funding):**
  - **Navigate in and out of the Port of Muskegon at NOAA GLERL's Lake Michigan Field Station; use long baseline (LBL) acoustic positioning for navigation**
  - **Test multibeam acoustic and video mapping of invasive Quagga mussels**
  - **Test Fish and Zooplankton Observations using ASL AZFP (70, 120, 200, 769 kHz)**
  - **Initial test of docking station ahead of Navy/DOE Project**
- **Saab Sabertooth AUV demonstration Phase II, 2022 Q3 (GLRI Funding):**
  - **Collection of water quality data, zooplankton/fish observations, and mapping of invasive mussel reefs using multibeam sonar and camera imagery**
  - **Planned test of Teledyne hydrogen fuel cell with docking station**



# Hibbard Inshore

## Sabertooth AUV Overview

- Hybrid AUV/ROV
  - Vehicle can hover, stop, and maneuver around points of interest or provide traditional survey
  - Depth 1200m, 3.7Lx1.4Wx0.45H (m), Speed 4kts, 30kW, ~ 10 hours, Max operating current 2kts
- Large Capacity for Payload Customization
  - Bottom Classification Sensors
  - Water Quality Sensors – CTD/Multiparameter
  - Midwater Fish Observation/Classification



Data Control Room



Small Vessel Launch Setup



Shore Launch

# Hibbard **Inshore**

## Sabertooth Sensor Payload for Autonomous Survey

- **Multibeam Imaging Sonar** – Object detection, navigation and avoidance sonar
- **1080P High Definition Video** – Observation and classification
- **Multibeam Survey Sonar** – this sonar will provide high density bottom classification data (R2 Sonic 2024)
- **Laser Scanner** - 2G Robotics ULS-500 PRO Laser Scanner and camera
- **Scientific Echosounder / Ice Profiler** – Fish / Ice observation and classification
- **CTD/Multiparameter Sensor** – Water conditions (conductivity, pH, temperature, pressure, dissolved oxygen, chlorophyll, phycocyanin, turbidity)

## Demonstration Plan



Area of AUV operations including A) GLERL Lake Michigan Field Station, B) future AUV docking station, C) channel entrance, D) mapping area. Image upper right looking A to B; Saab AUV upper left.

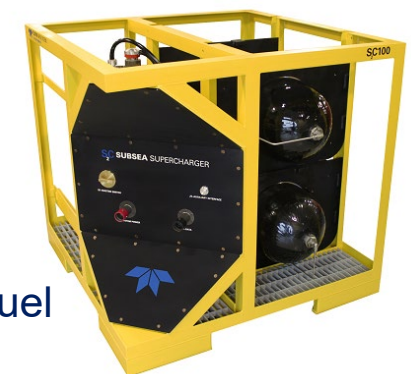
## Plans for FY22

- **System integration and mission planning**
- **Navigation, data collection and docking station demonstration at NOAA/GLERL's Lake Michigan Field Station or a Navy facility**
- **System demonstration with docking station in collaboration with Navy/DOE project in HI**
- **Lake Michigan mapping/data collection, data ingest into ReCON system; docking station integrated with off shore fuel cell**

Saab Sabertooth



Docking Station



Teledyne Fuel Cell

# Other Winter Projects

