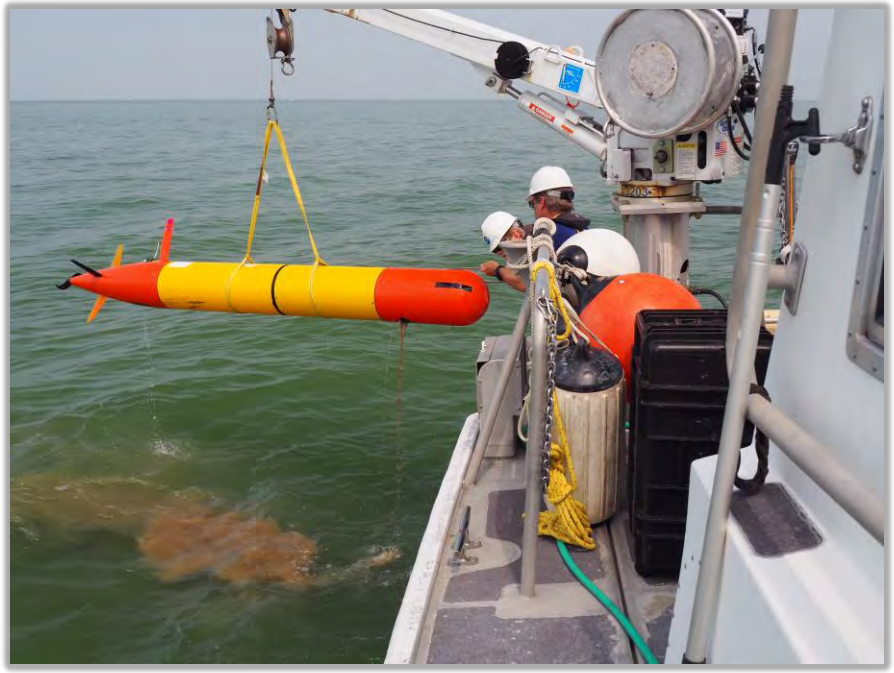
NOAA Unmanned Marine Systems



Steve Ruberg
Great Lakes Environmental Research Lab

GLASS Meeting
January 9, 2020

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

Commercial Engagement Through Ocean Technology (CENOTE) Legislation

December 21, 2018

- Directs NOAA to coordinate UMS development with universities, Navy, and the private sector to achieve mission objectives.
- Establish procedures for acquisition and use of data from UMS technology.
- Encourages a NOAA-Navy partnership for procurements and assessments.
- UMS data should be free and available to the public.

- The bill is legislating what has happened already: NOAA/PMEL works closely with Saildrone. GLERL currently has UMS arrangements with MBARI, CIGLR (UofM, MTU).
- RADM Gallaudet (NOAA DA) has a strong UMS emphasis.

NOAA UMS Symposium

October 30 – November 1, 2018
Stennis Space Center

Recommendations:

- Expand and develop partnerships with internal partners and external partners in academia, industry and government that contribute to the NOAA mission (CENOTE).
- Build upon and support current success such as IOOS glider work, OCS hydrographic mapping and Saildrone/PMEL observations.
- Develop a process to efficiently transition from research and development to operations.
- Analysis of alternatives and engineering test programs will be a part of this process.
- Data users/modelers must be connected with the data collectors. Data should support the models and the models should support the decision making. As UMS data collection expands, the infrastructure to archive, access, and analyze must keep pace.

NOAA UMS Symposium

October 30 – November 1, 2018

Stennis Space Center

Recommendations (continued):

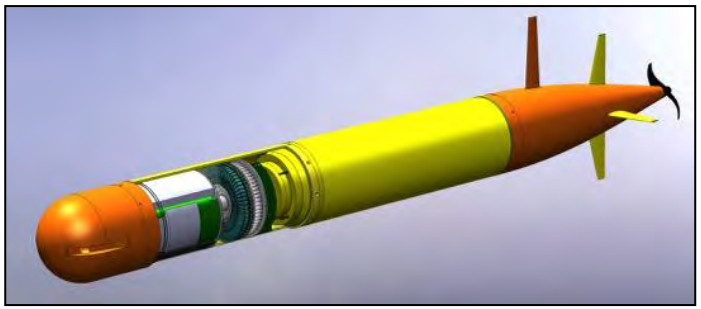
- NOAA should develop a concept of operations that is adaptable - Consider the UAS and Small Boat programs as models, and develop a handbook to document best practices.
- Establish a community of practice that meets regularly with partners in academia, industry and government.
- Best practices should be developed for operations, platform identification, data management plans, sensor integration, engineering design, training (to include basic operator training as well as an apprenticeship program), safety, environmental compliance and cybersecurity.

Summary

- UMS use for data collection is increasing in NOAA
- GLERL science applications in Great Lakes model/forecast development and ecosystem and toxin observations
- UMS can operate in locations and in weather conditions where vessels can’t
- Application in repetitive operations that require persistent observations

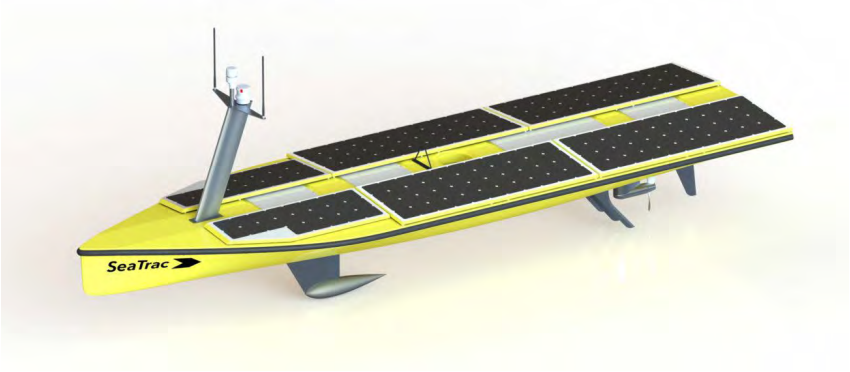
Autonomous Systems for Research

Wave Gliders



MBARI LRAUV

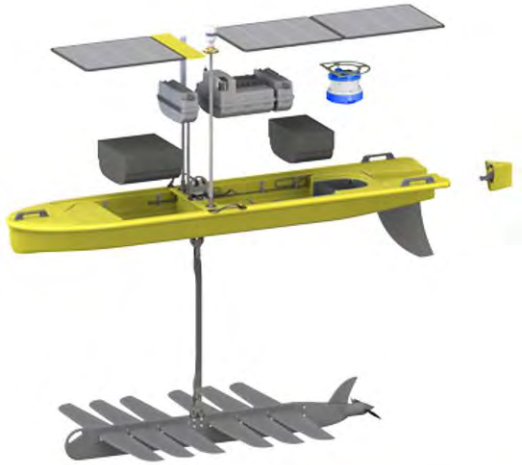
Slocum Glider

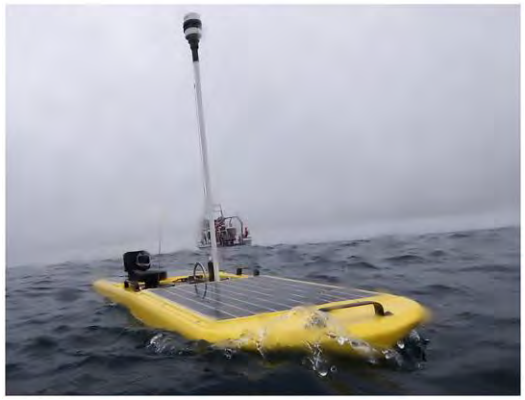


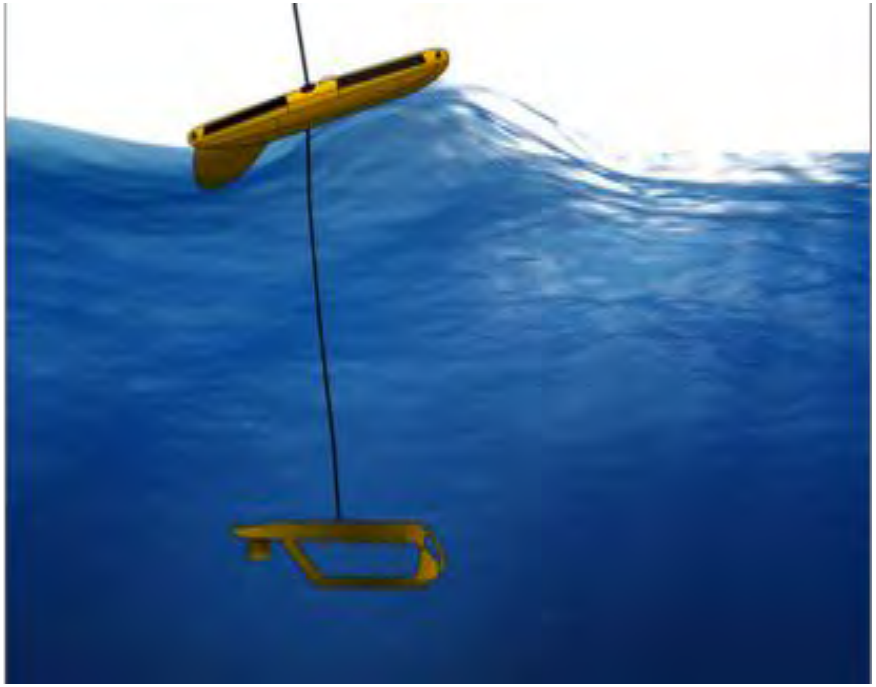
SeaTrac

Wave Glider v2

Tested on Lake Huron. Collaborating with MTU on deployments.

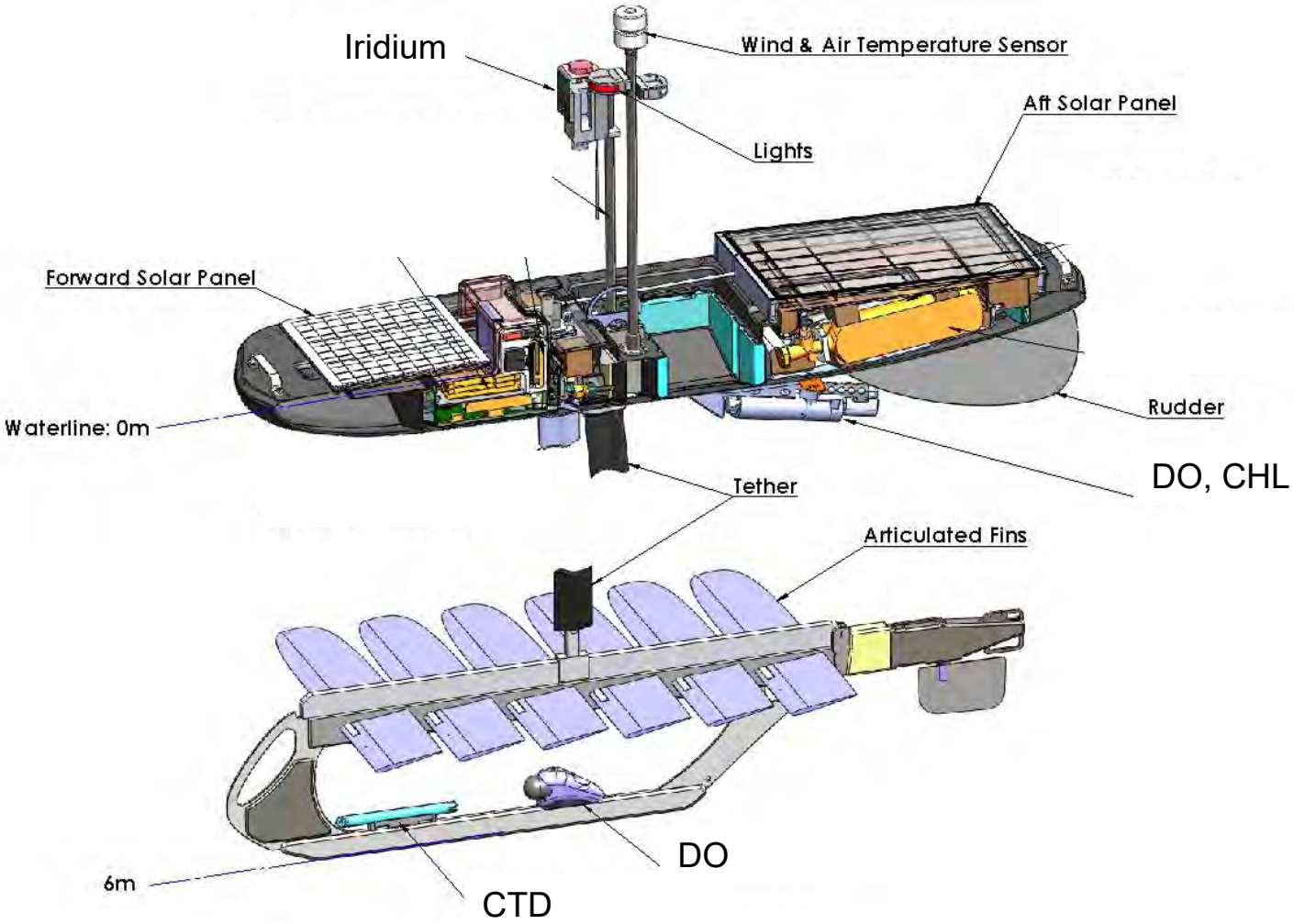






Wave Glider v2 – CSMI L Michigan

- Primary productivity; satellite product validation

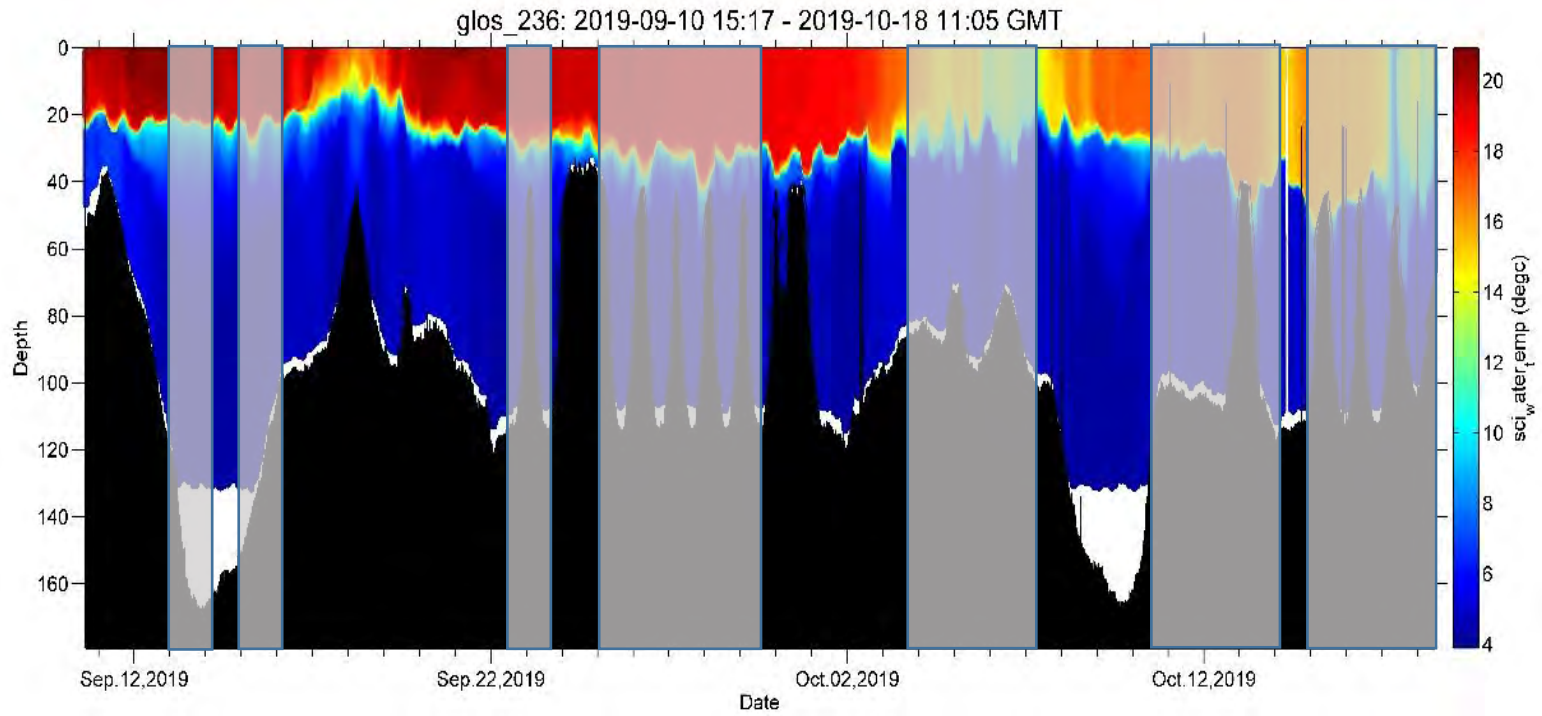


Slocum Glider: GLERL model and forecast development and validation (Russ Miller)

2015 Lake Michigan CSMI

- Slocum Glider – glos_236
- Deployment up to 60 days, 1km/hr
- Typical depth for operation >30m
- 200m depth limit
- Iridium satellite modem
- Battery + Comms costs approx. $150/day
- Approx 10 in GL - CIGLR, EPA Duluth, LLO, Univ of Windsor

Lake Michigan Sept/Oct 2019 Glider Deployment



Wave events

Glider deployments

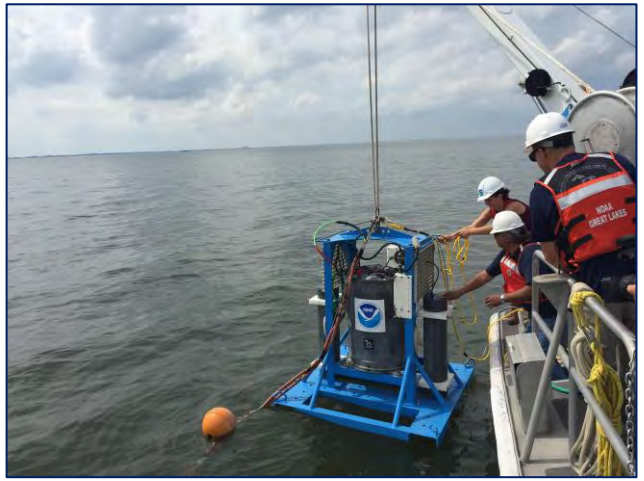
Year	# Deployed	# days	Lakes	Sensors
2012	1	22	Michigan	CTD, ECO Puck
2013	4	66	Michigan, Ontario	CTD, ECO Puck
2014	3	93	Michigan	CTD, ECO Puck
2015	3	88	Michigan	CTD, ECO Puck, PAR
2016	3	42	Michigan	CTD, ECO Puck, PAR
2017	2	78	Saginaw Bay	CTD, ECO Puck, PAR
2018	3	93	Michigan, Ontario	CTD, ECO Puck, PAR
2019	1	39	Michigan	CTD, ECO Puck, PAR, DO

Total Glider Days = 520+ | Number of Deployments = 20

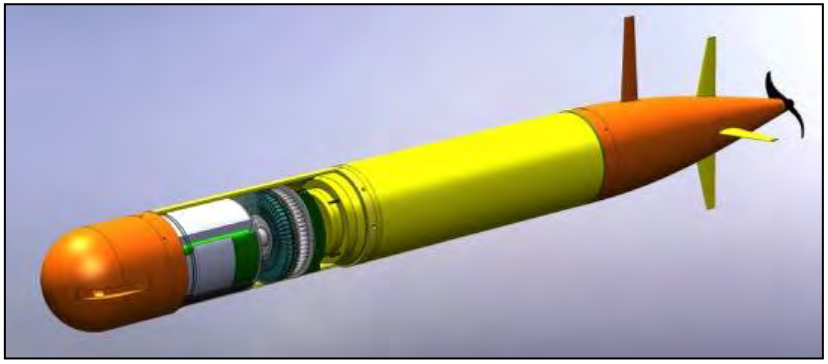
Profiles per Day ≈ 120+ | Profiles per Hour ≈ 5+

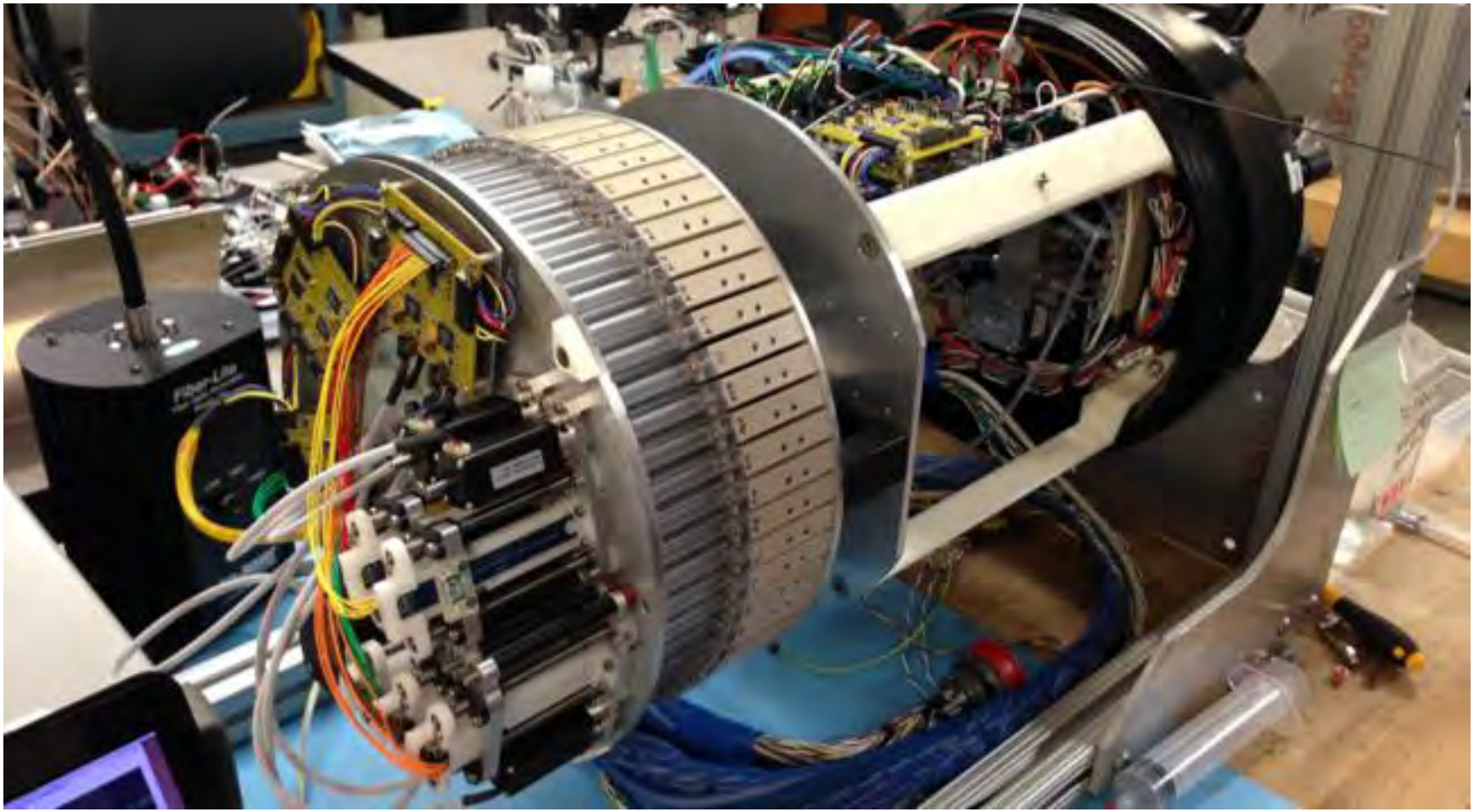
HAB Toxin Detection with MBARI 2nd Generation Environmental Sample Processor (Reagan Errera)

- Fewer than 20 worldwide
- GLERL/CIGLR will deploy three ESP 2Gs in 2019
- Reports real-time microcystin toxin observations
- Built by McLane Labs



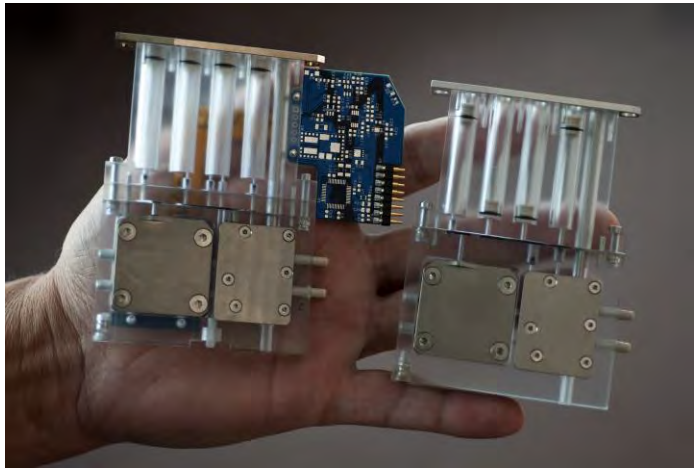
MBARI long range AUV demo on WLE with 3G ESP:

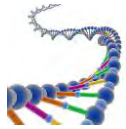




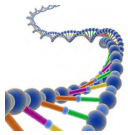
3G DNA Sampling and Lysing

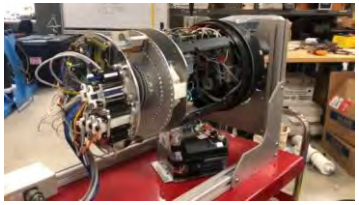
Requirements:
Small size, low power, self-contained
Archive sample, or process sample

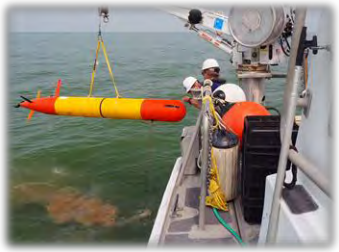




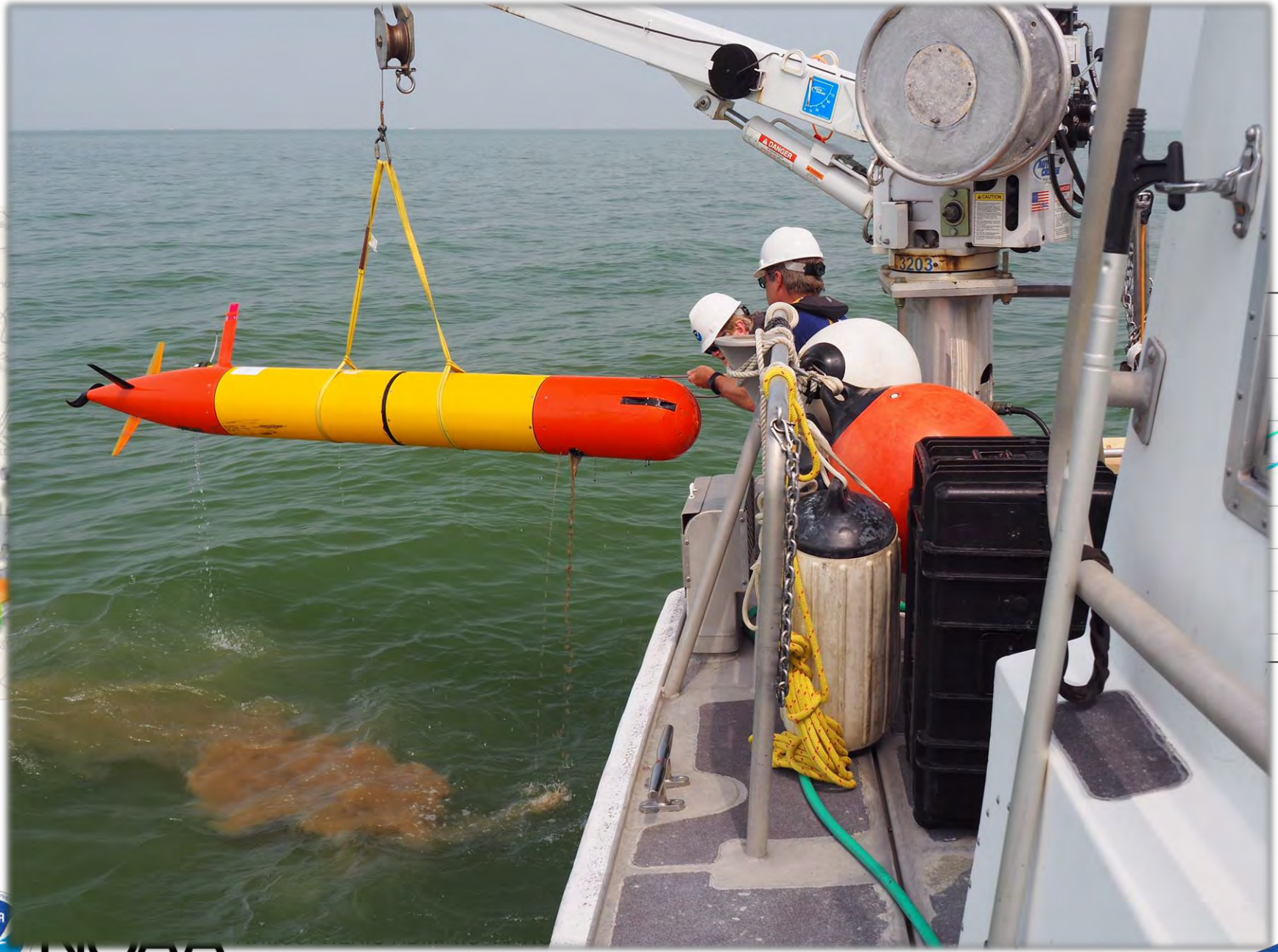
3G Workflow







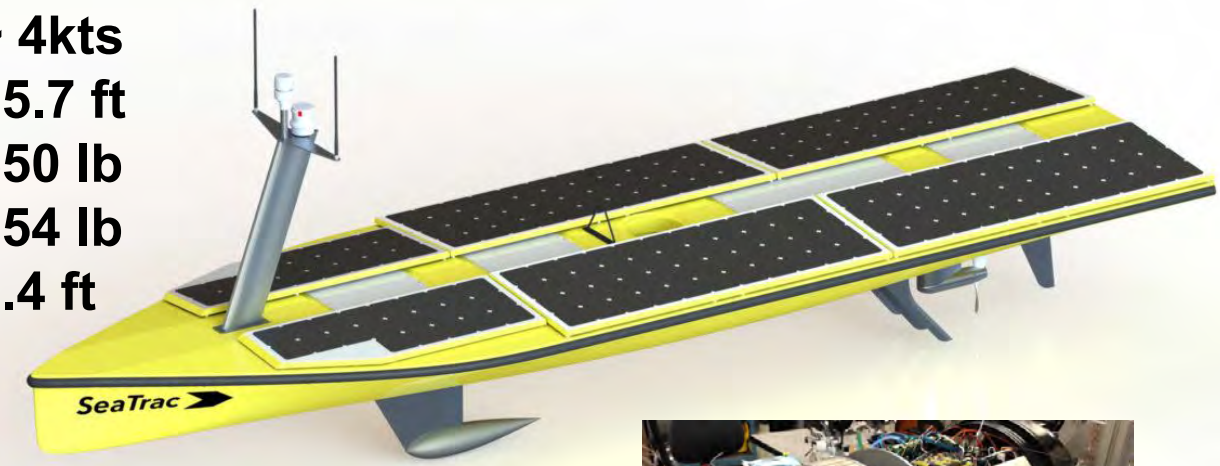
Archive
(add preservative)
Sampling
(filter water)
Process
(create
homogenate)
Toxin Sensor
Cartridge
Analytical Module

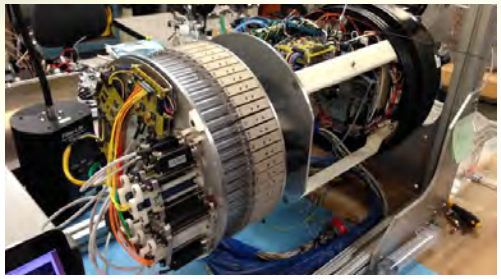

DANGER
CAUTION
3203

Next Steps for 3G ESP

Integrate 3G ESP into SeaTrac ASV for shallow water toxin observations (NOAA PCMHAB RFP)

Electric Motor	~ 4kts
Length	15.7 ft
Weight	550 lb
Payload	154 lb
Draft	1.4 ft



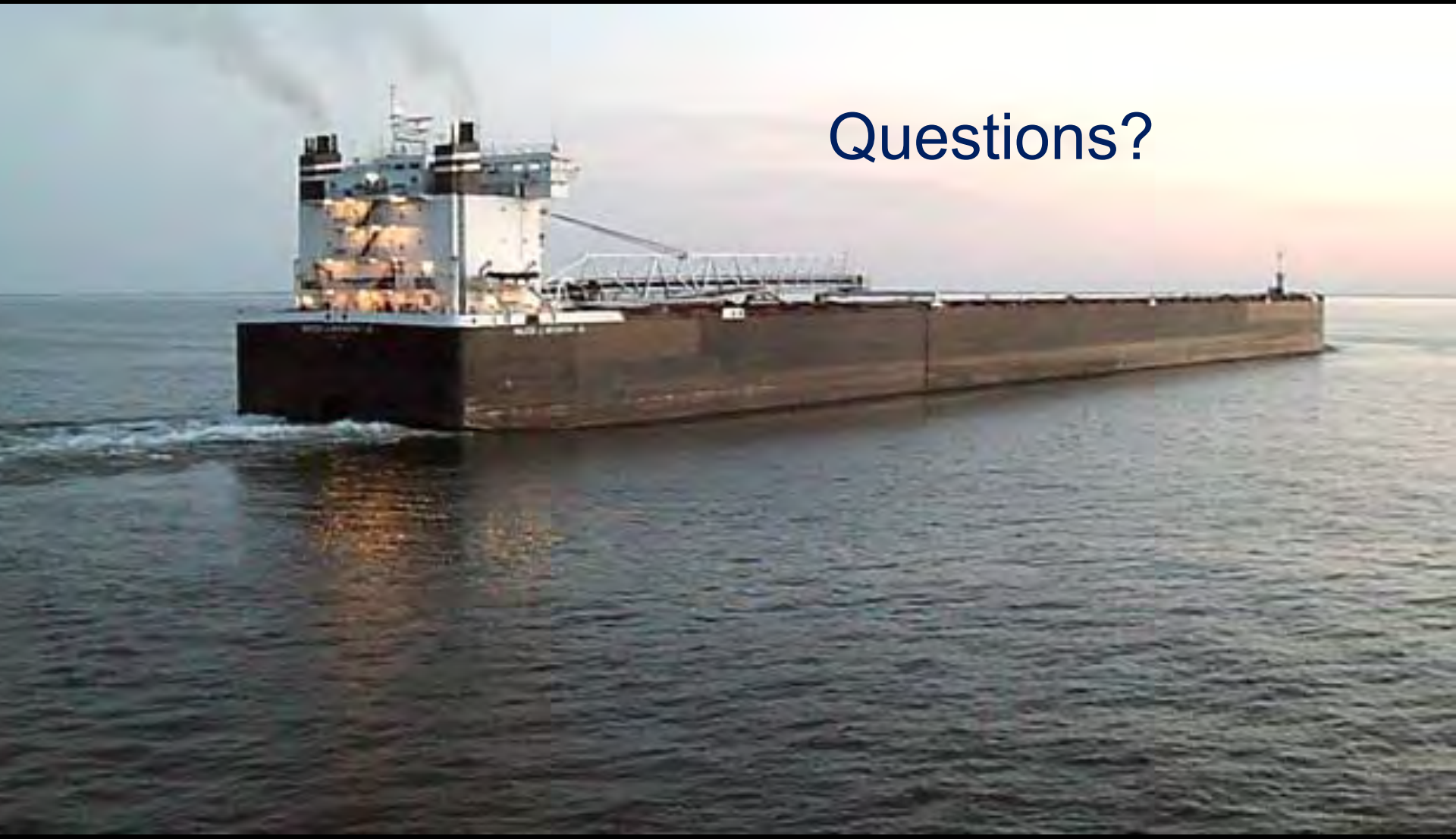


Technology Common Agenda

- Develop a strategic plan for interagency cooperation on the use and development of in situ advanced survey technologies to validate models, answer long term research questions, and fulfill monitoring needs.
- Address GLRI adaptive management and GLWQA monitoring efforts.
- Project leads: Steve Ruberg (NOAA/GLERL), Peter Esselman (USGS), Beth Hinchey (EPA GLNPO), Russ Miller (CIGLR), John Bratton (LimnoTech)
- Technology assessment meeting February 25-26, 2020.

Collaborators

Michigan
Technological
University


Questions?