

# Michigan Technological University

Great Lakes Research Center

November, 2017

Trondheim, Norway



**Guy Meadows, PhD.**

**Director, Great Lakes Research Center**

**Robbins Professor of Sustainable Marine Engineering**



# Michigan Technological University Great Lakes Research Center (GLRC)

[http:// http://www.mtu.edu/greatlakes/](http://www.mtu.edu/greatlakes/)



# What We Do.....



- Observing Systems
- North Slope Science Initiative (NSSI)
- Small Autonomous Platforms
- Underwater Exploration and Mapping
- Ice Studies

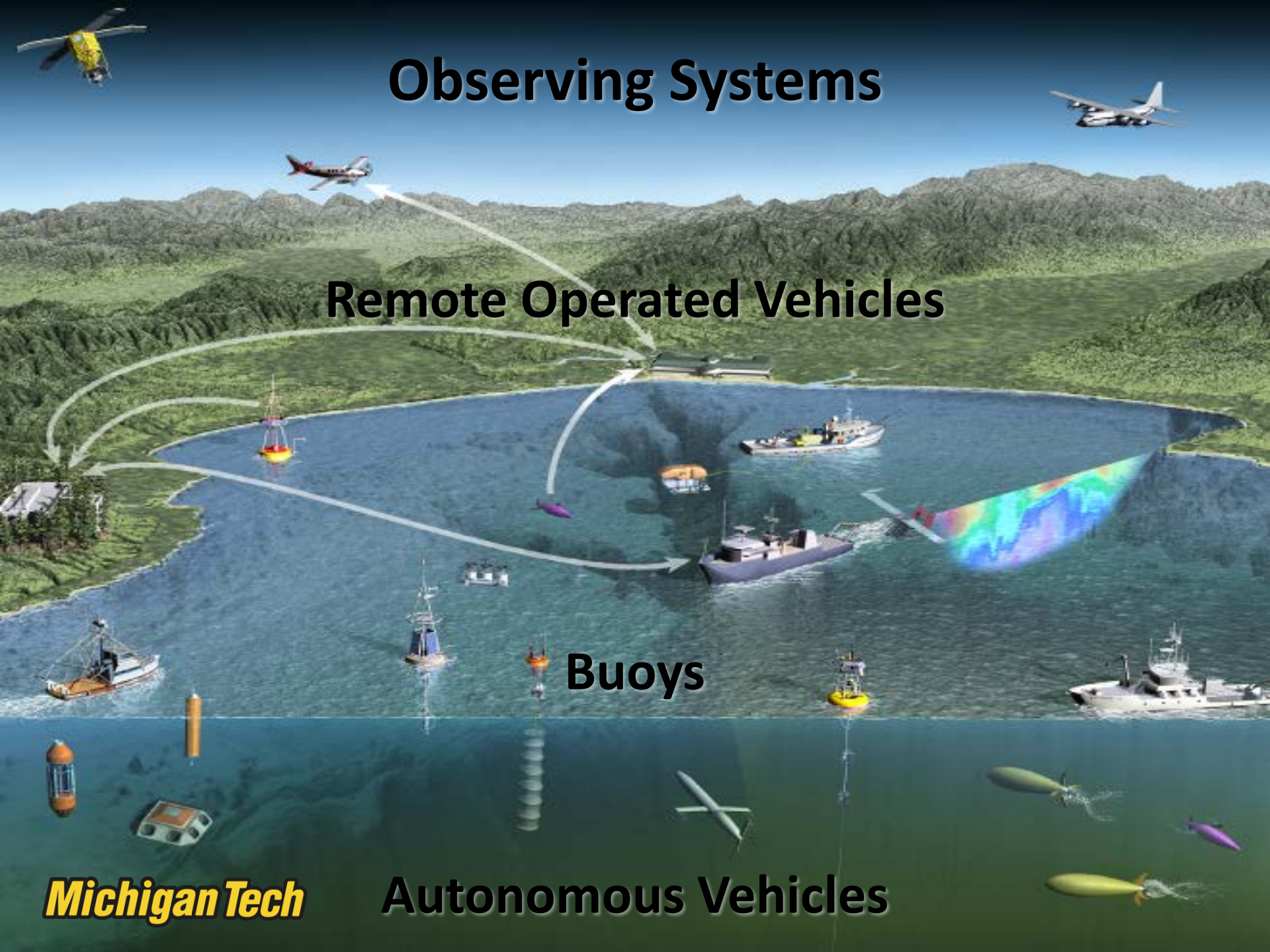
# Observing Systems

Remote Operated Vehicles

Buoys

**Michigan Tech**

Autonomous Vehicles



# U-GLOS

## Upper – Great Lakes Observing System

<http://uglos.mtu.edu/>



2010

In Partnership with  
MTU

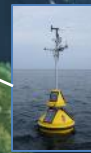


2011



2008

2010



In partnership with UM Bio-Station



2011



2009

In partnership with local communities



2011

In partnership with community



In partnership with LimnoTech, Inc.  
and Nuclear Power Industry

**Michigan Tech**



# What are we... ?

- *Shared cutting-edge equipment:*

Monitoring Platforms

“Large” and Small Vessel Support

Advanced Underwater Vehicles  
and Platforms



Advanced Sonar Systems



# Advancing Great Lakes Science & Coastal Ocean Forecasting

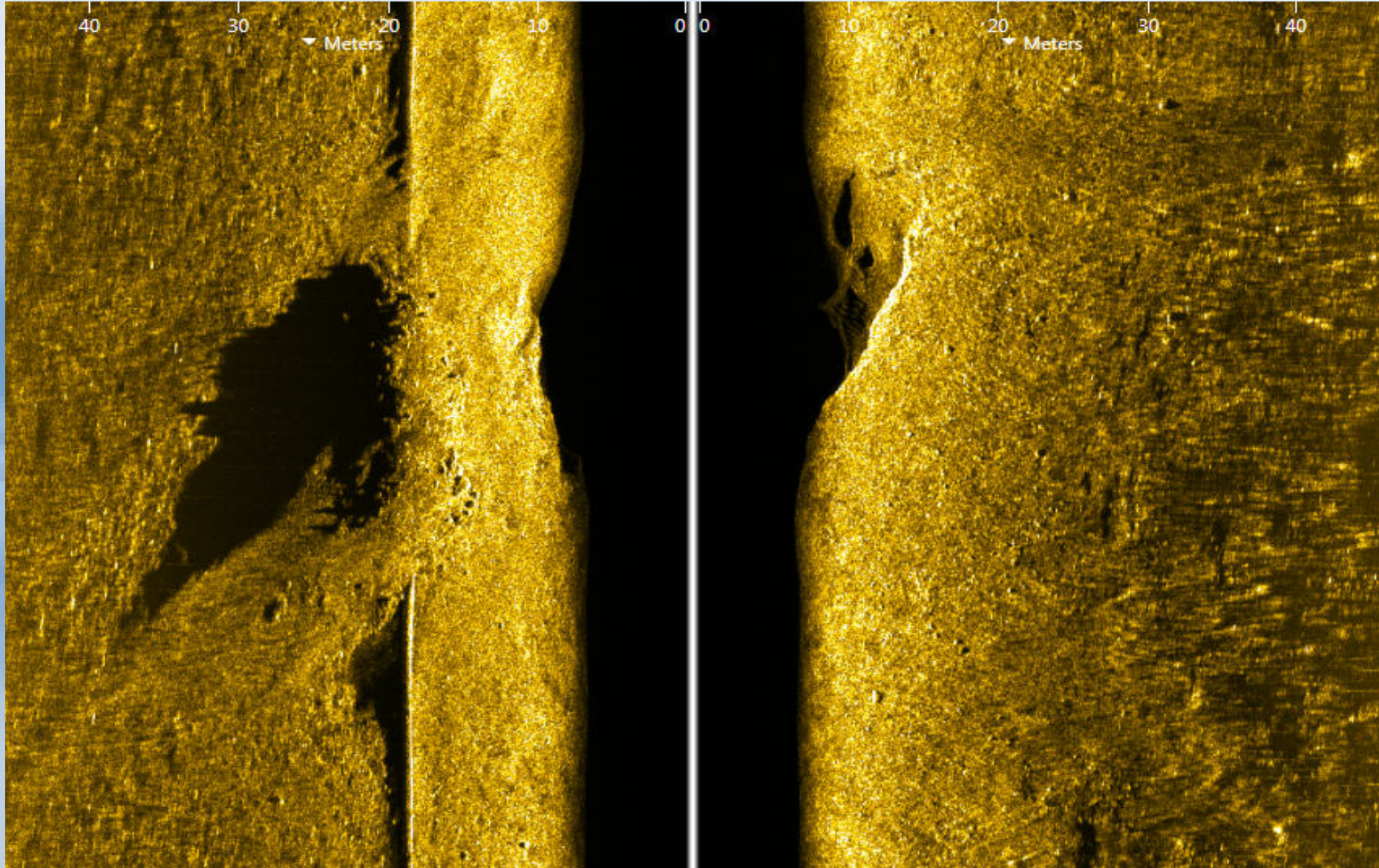
- Research Vessels
- Autonomous Underwater Vehicles
- Remotely Operated Vehicles
- Great Lakes Observing System



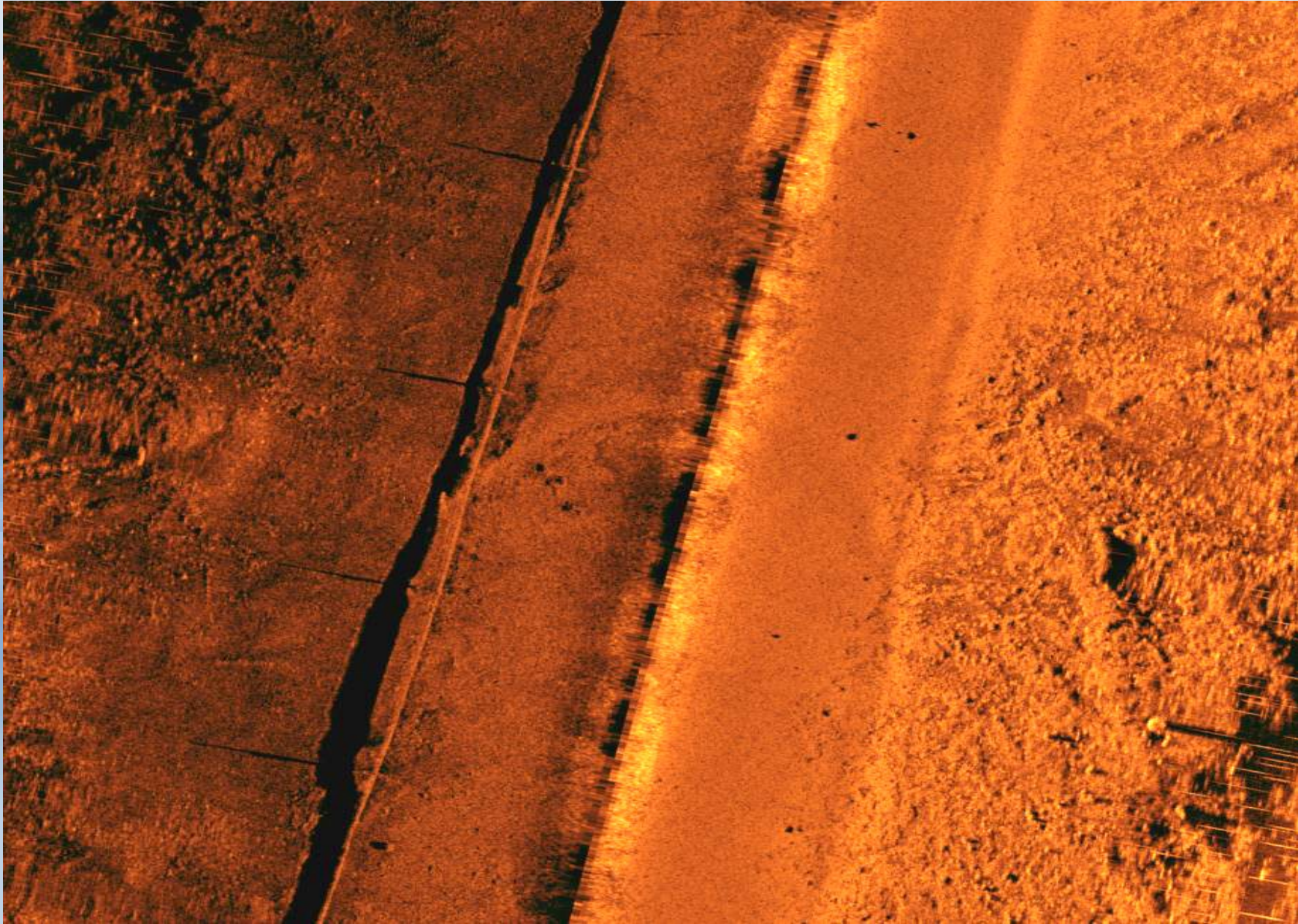
# Autonomous Underwater Sensing



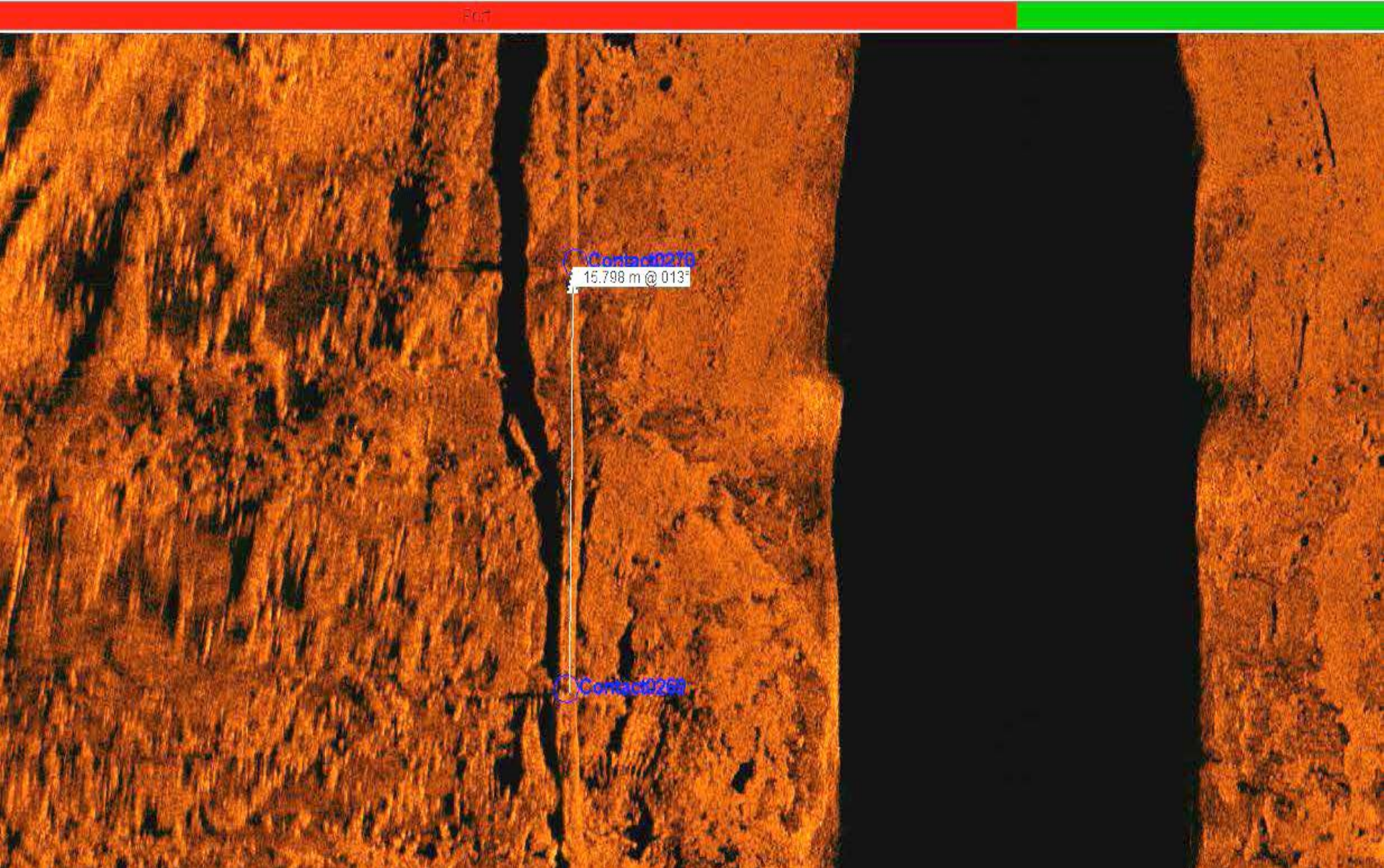
# High Resolution Sonar Surveys and Advanced Processing of Bottom Terrain



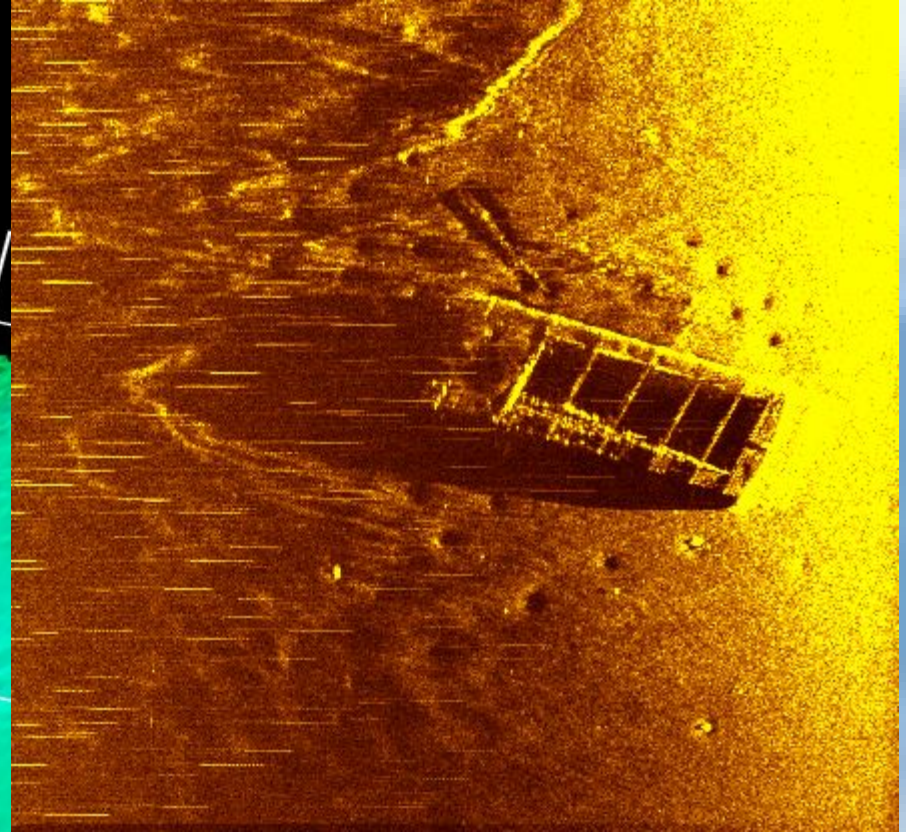
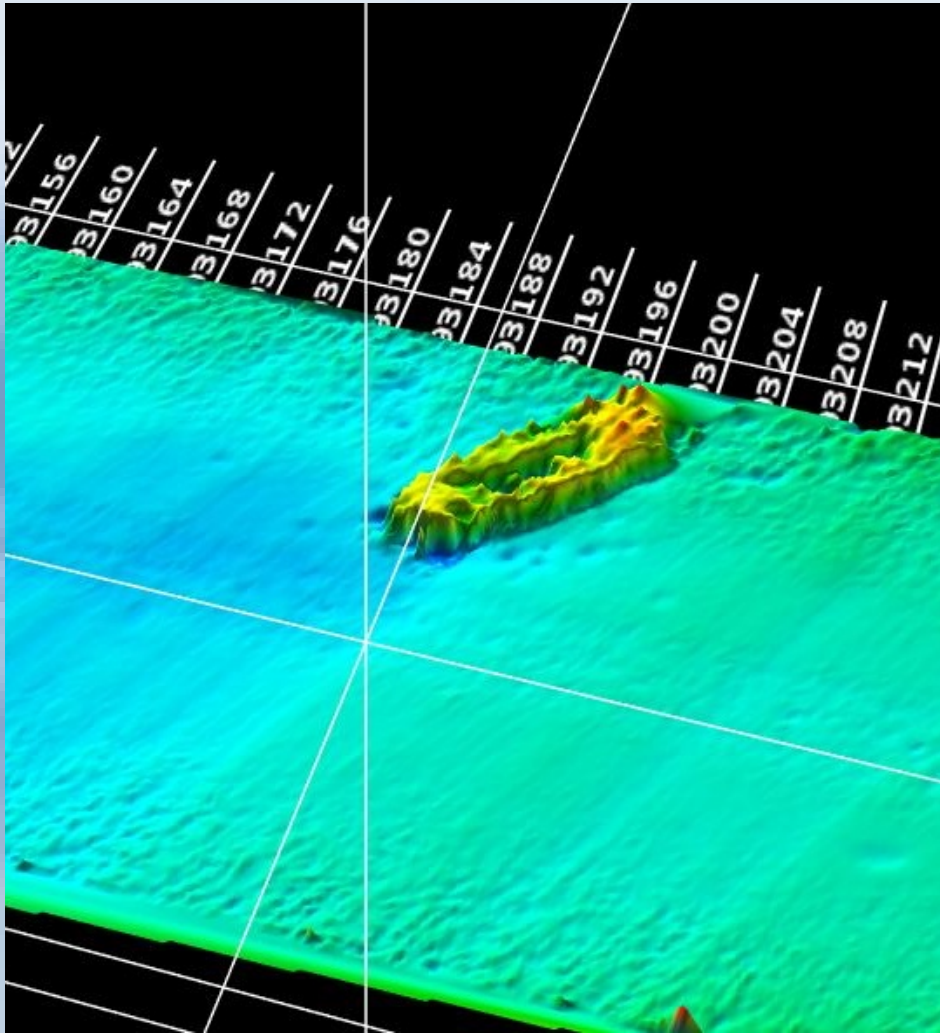
# Pipeline Measurement



# Point to Point Measurements



# Sunk Wood Barge – late 1800's 3-D point cloud mapping





**Great Lakes  
Research Center**

Michigan Technological University

80

70

60

50

40

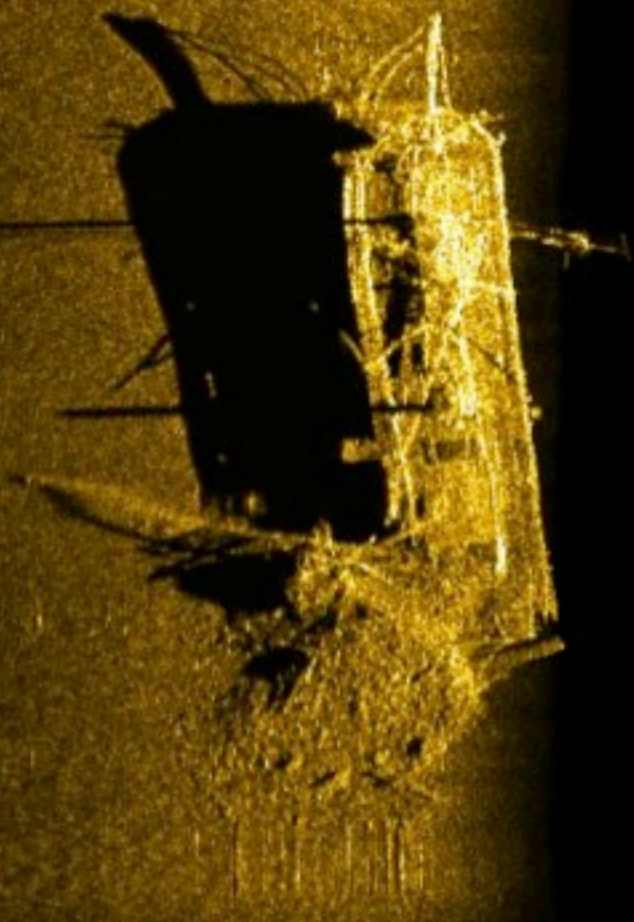
30

20

10

0

▼ Meters



70

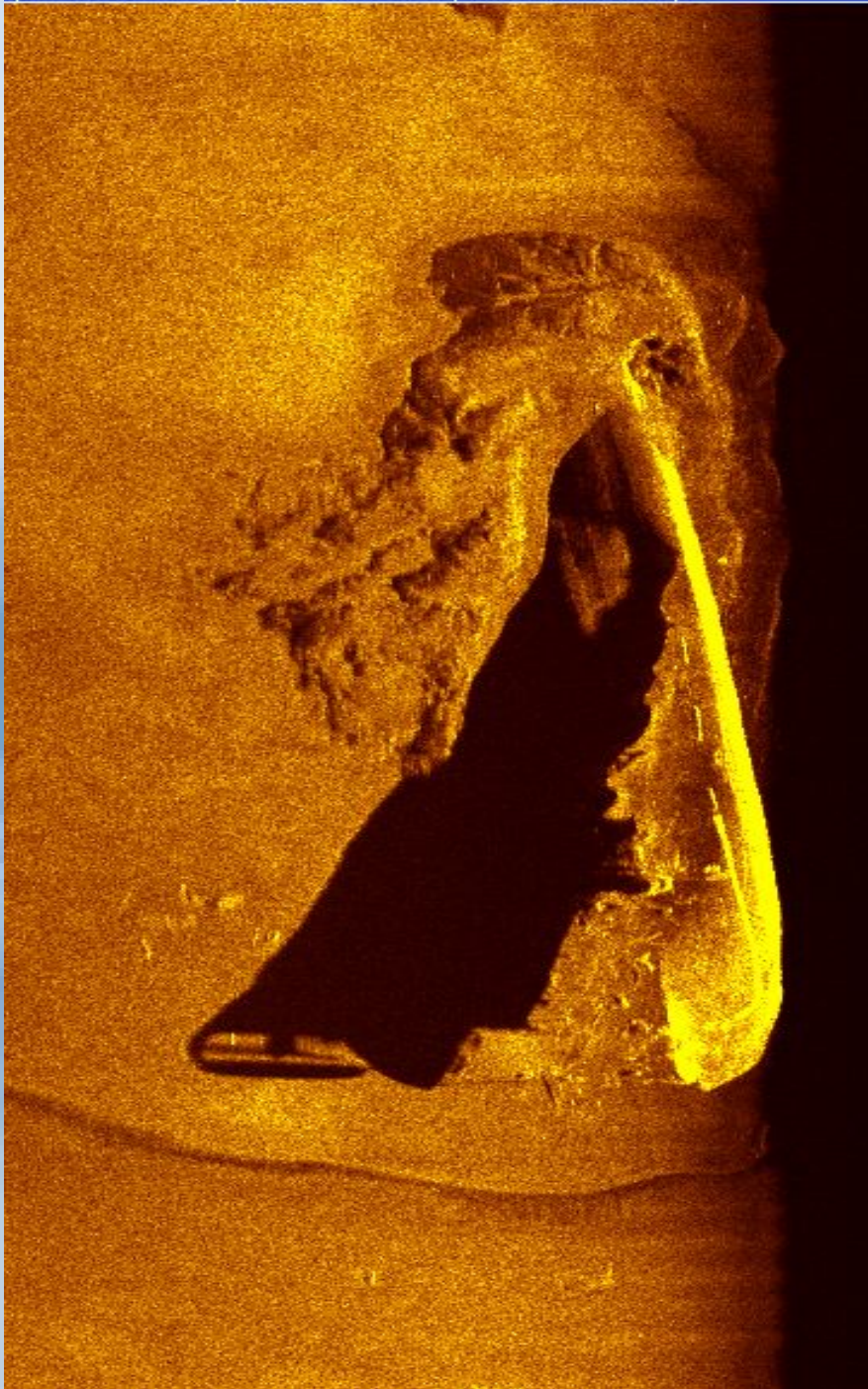
60

50

40

30

20



90

80

70

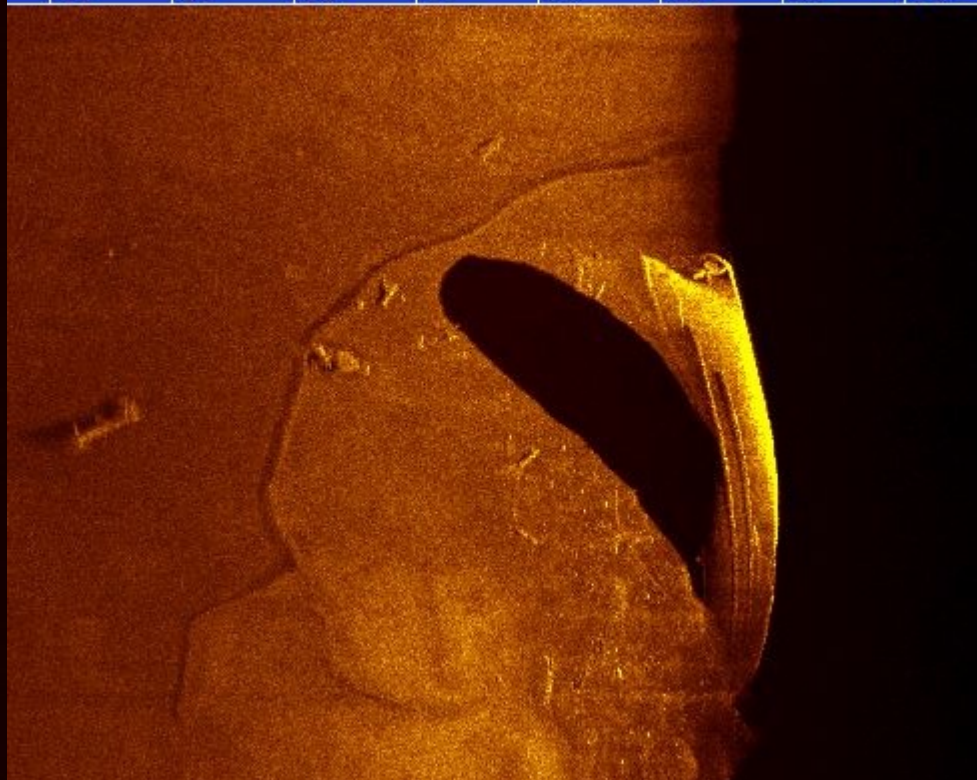
60

50

40

30

20



**Great Lakes  
Research Center**  
Michigan Technological University

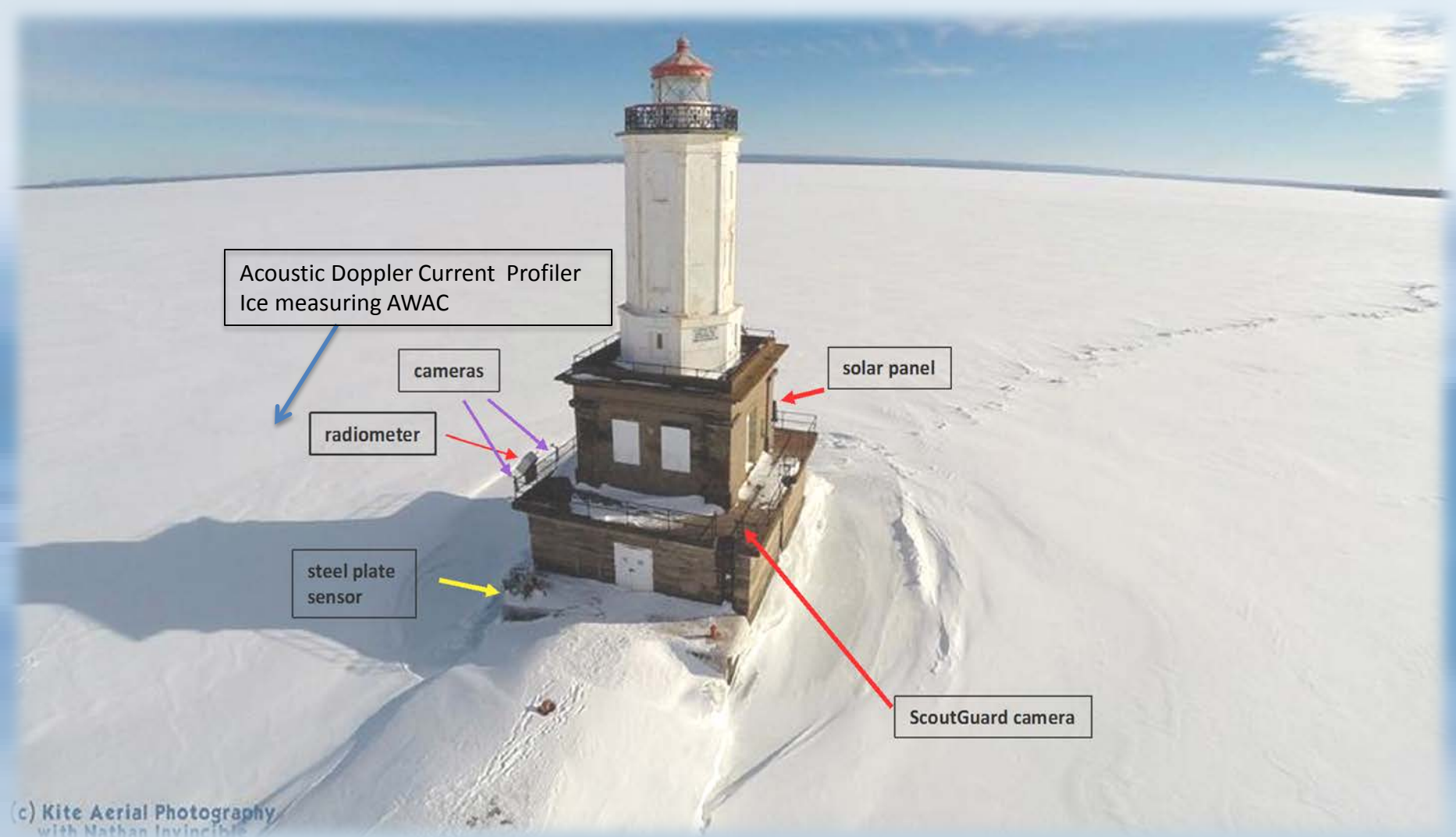
# “Arctic Research” Right Outside the Door



# Ice-Bound Seas



# DOE Ice Impact Loads



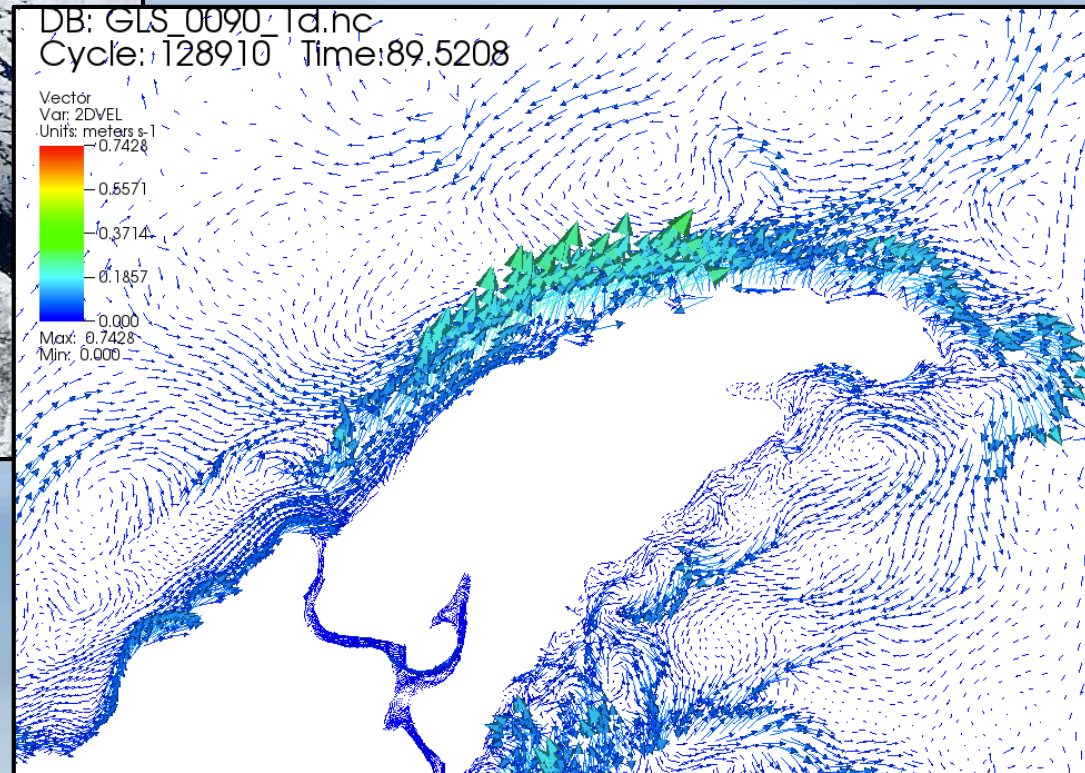
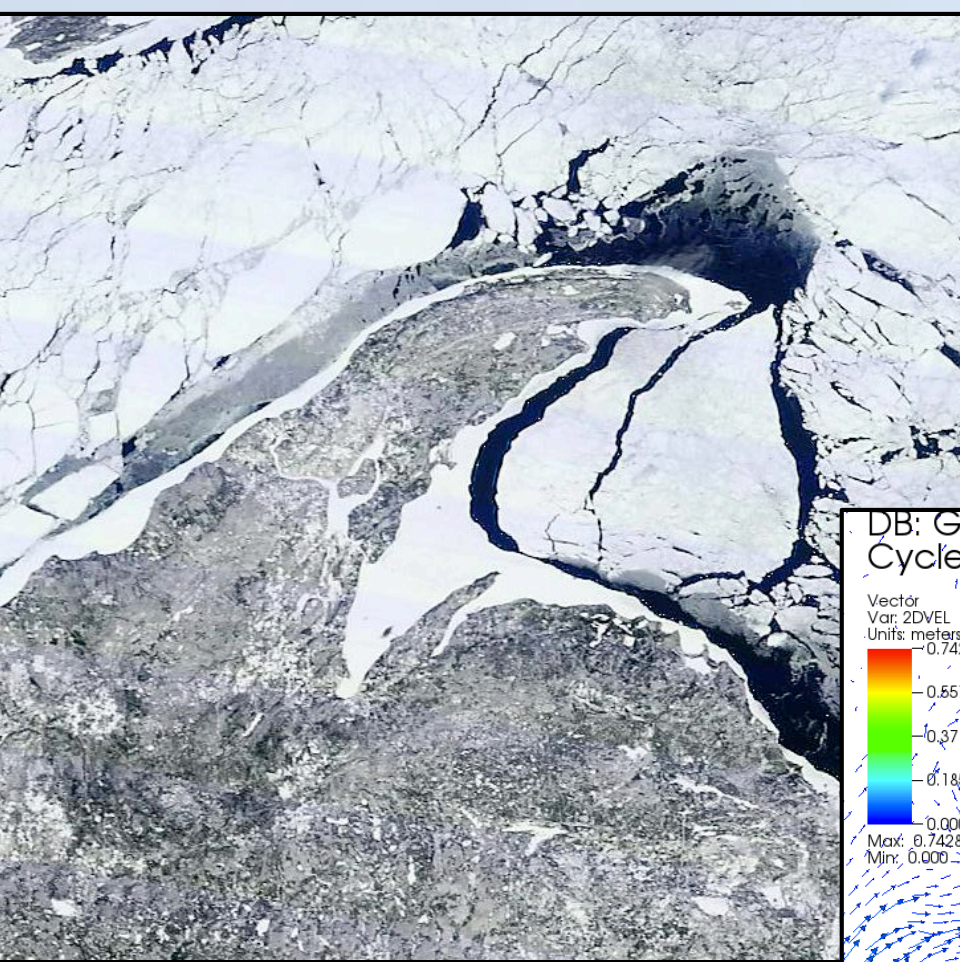
# Coastal Ice Shove



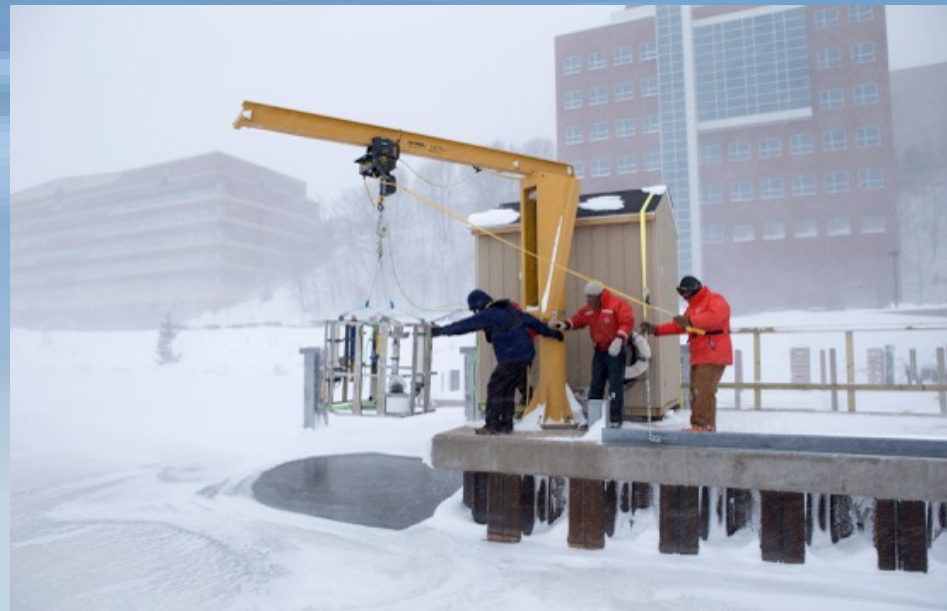
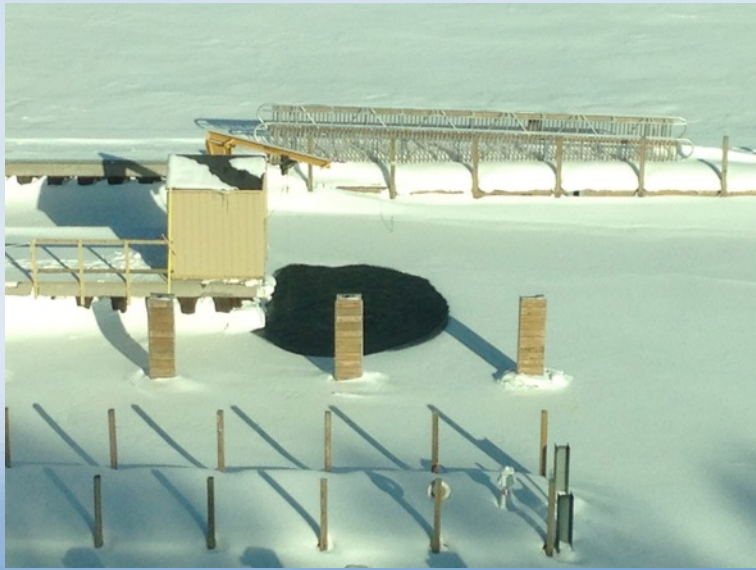
# Hazards to Navigation



# Numerical Modeling of Ice and Ice Flows



...and on the bottom





# Autonomous Surface Vehicle Workshop

## PROCEEDINGS



November, 2015  
National Level Workshop  
funded by:  
NOAA/NOS/IOOS

[http://www.act-us.info/Download/Workshops/2015/CBL\\_Autonomous\\_Surface/](http://www.act-us.info/Download/Workshops/2015/CBL_Autonomous_Surface/)

Reference:

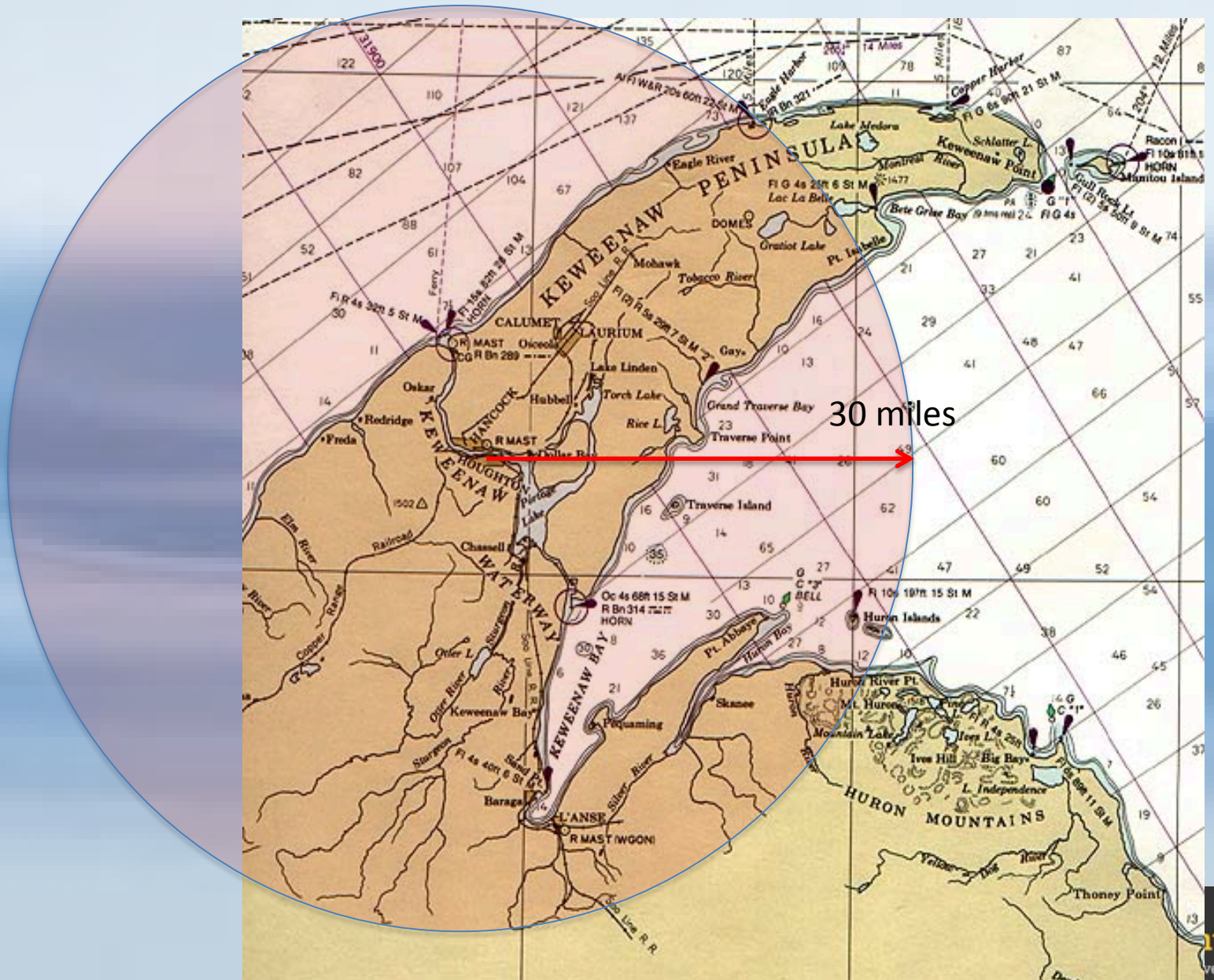
Meadows, Guy, V. Schmidt, M. Luther and R. Downs 2015. "Autonomous Surface Vehicle Workshop Proceedings." U.S. Integrated Ocean Observing System (IOOS), CBL 2016-005.

November 18-20, 2015  
Solomons, MD

Funded by the National Oceanic and Atmospheric Administration (NOAA) through the U.S. Integrated Ocean Observing System (IOOS). [UMCES] CBL 2016-005



# RTK and VRS GPS/GNSS Coverage Region



# Types of Survey Environments

**Rock Shoreline  
– Steep Slopes**

**Met–Ocean  
Buoy 45023**

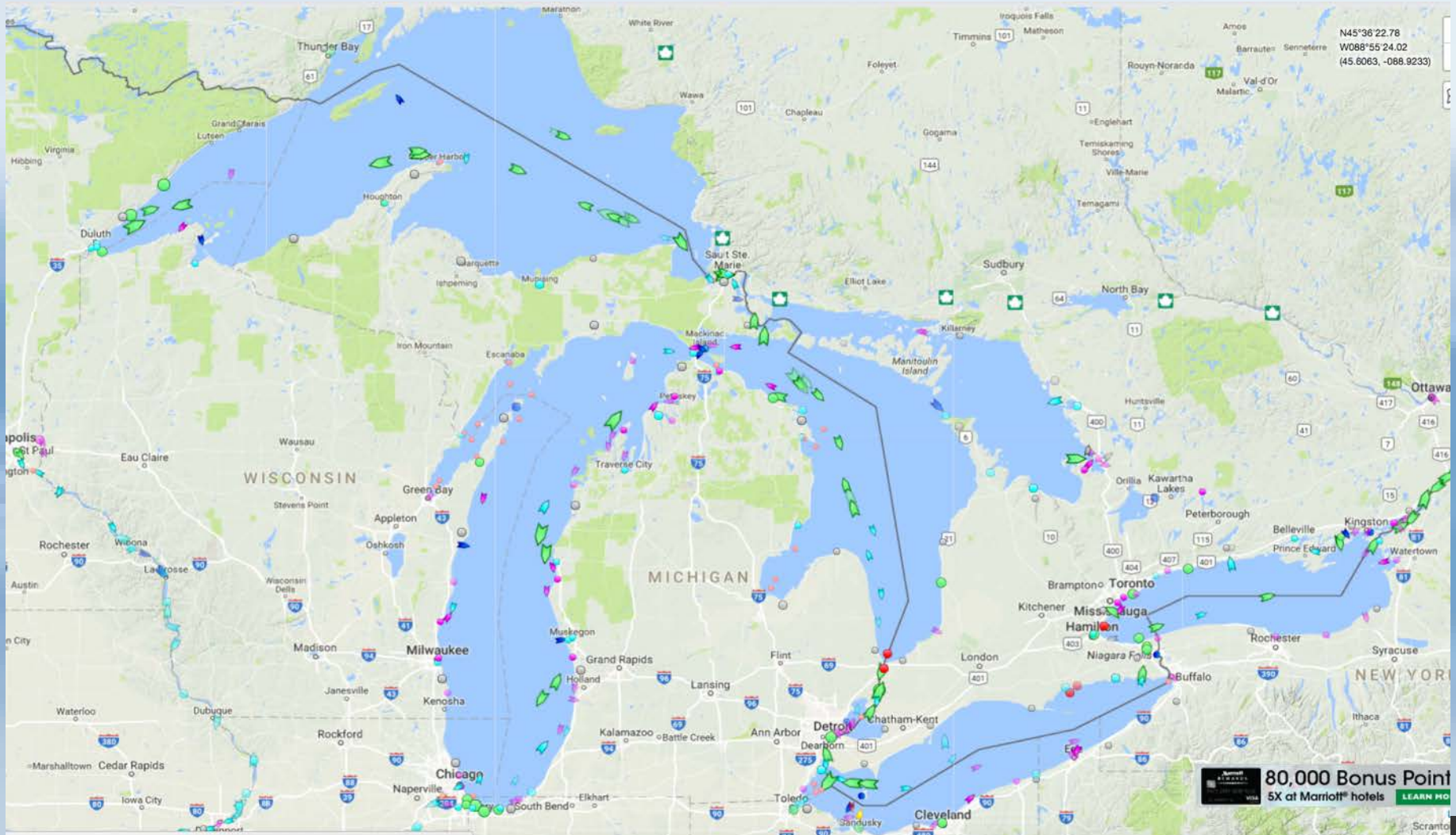
**Sand and Sandstone  
Shoreline – Rapidly shifting**

**Urban-Industrial  
Harbors**

**Met-Ocean  
Buoy 45025**

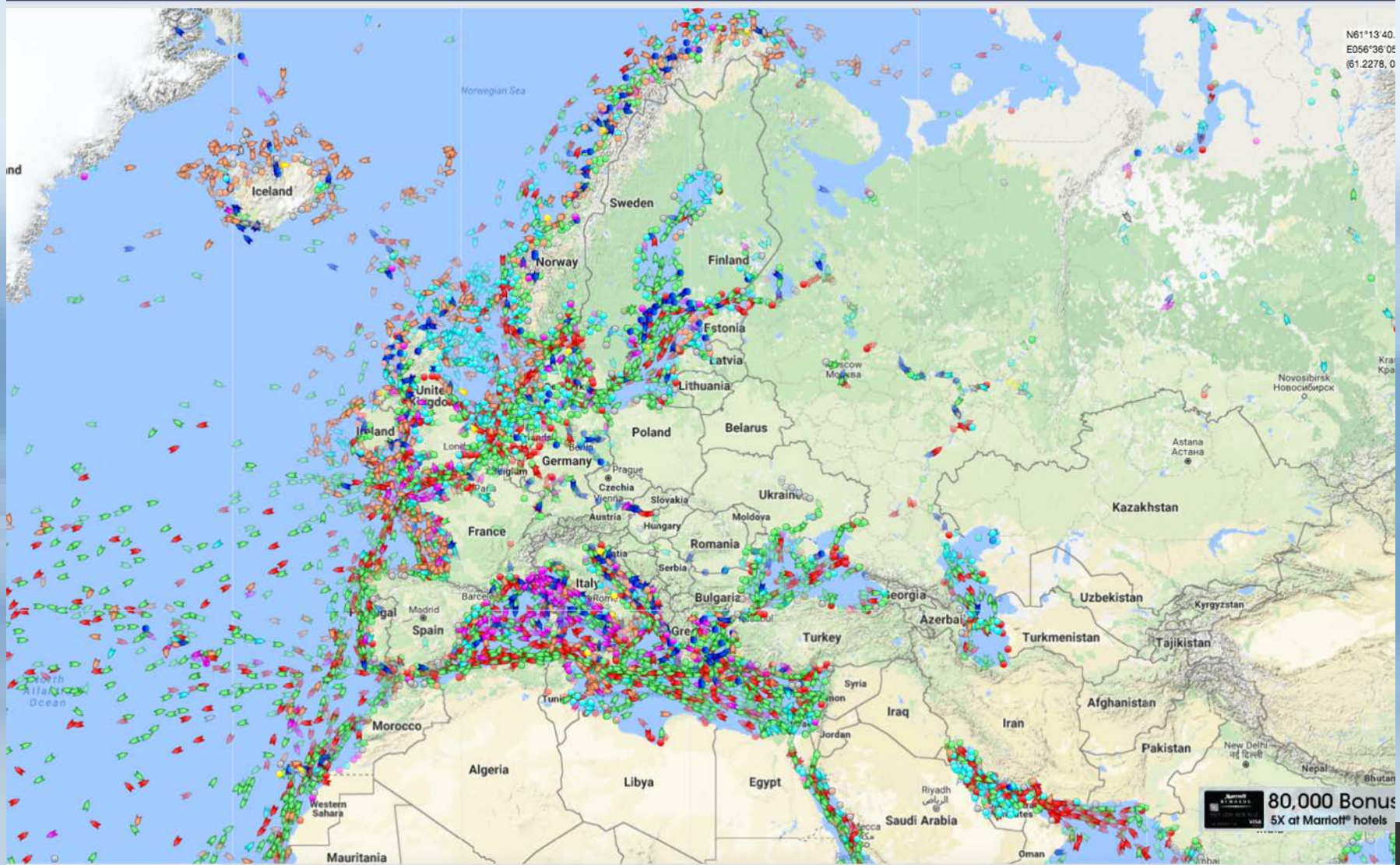


# Low Density of Marine Traffic

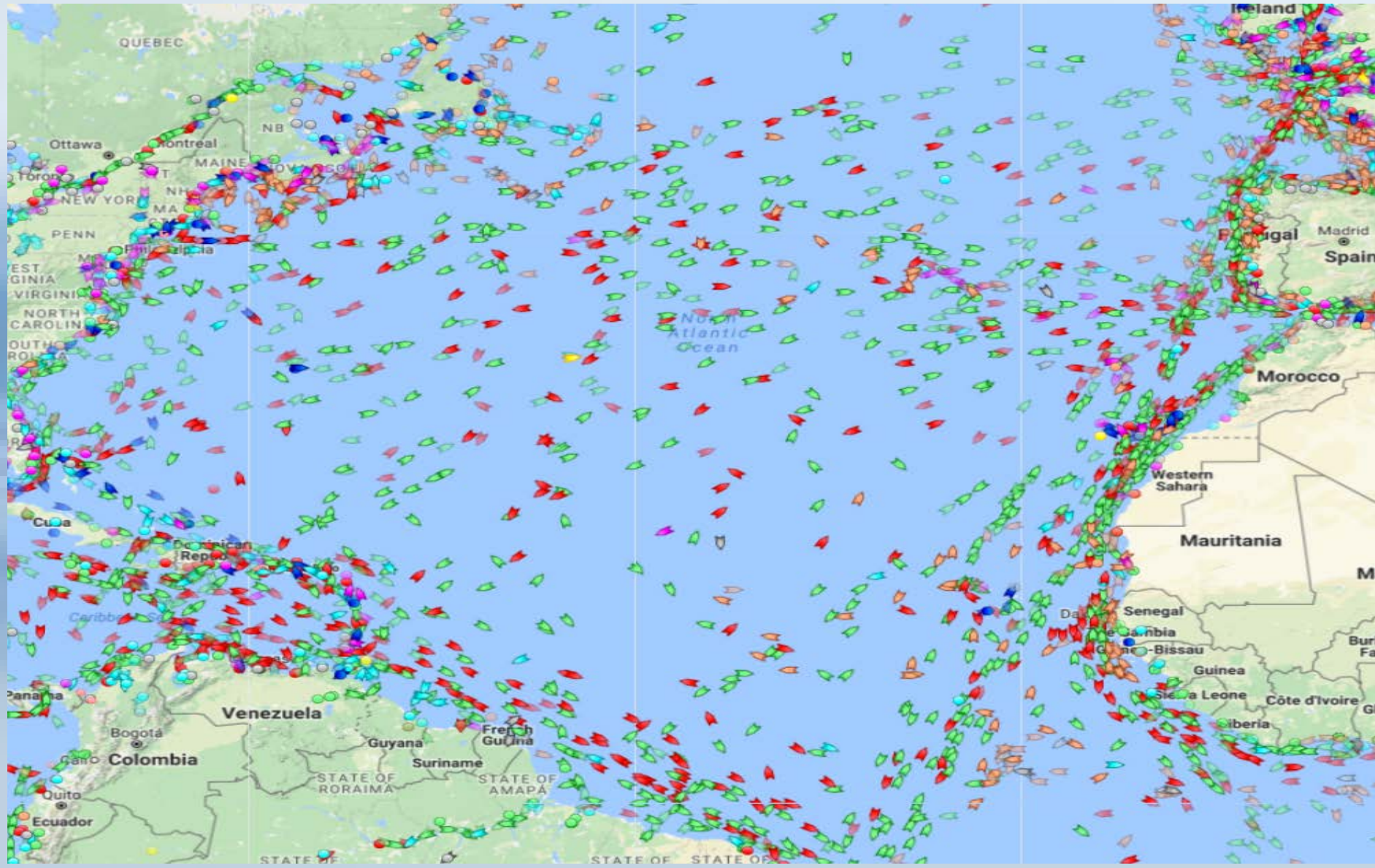


80,000 Bonus Points  
5X at Marriott® hotels [LEARN MORE](#)

# High Traffic Density



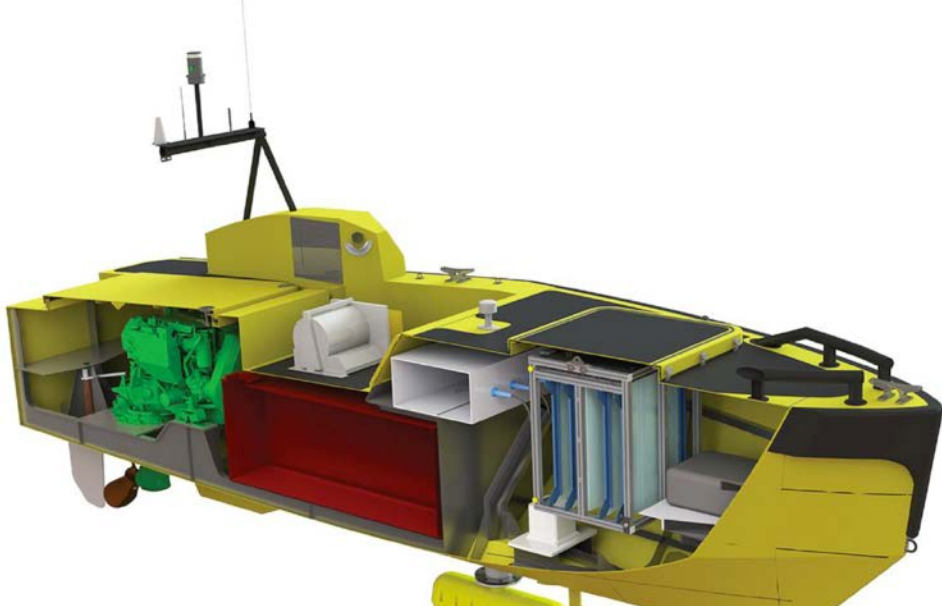
# High Traffic Density



Plans to Acquire an ASV Global  
Co-Worker 5  
Operate as a Research/Survey Vessel



# Co-Worker 5



**ASV** unmanned marine systems

## C-Worker 5

### TECHNICAL SPECIFICATIONS

C-Worker 5	
Length	5.5m
Beam	1.7m
Draft	0.9m
Weight	1900kg
Propulsion	Direct driver fixed propeller 1 x Yanmar 57hp diesel engine
Speed	Up to 10 knots
Endurance	Up to 7 days at 7 knots
Payload power	1kW
Control	ASView for direct, semi-autonomous or autonomous control
Communications	IP Radio

# Thank You!

## Questions ?



Photo courtesy of FTC&H