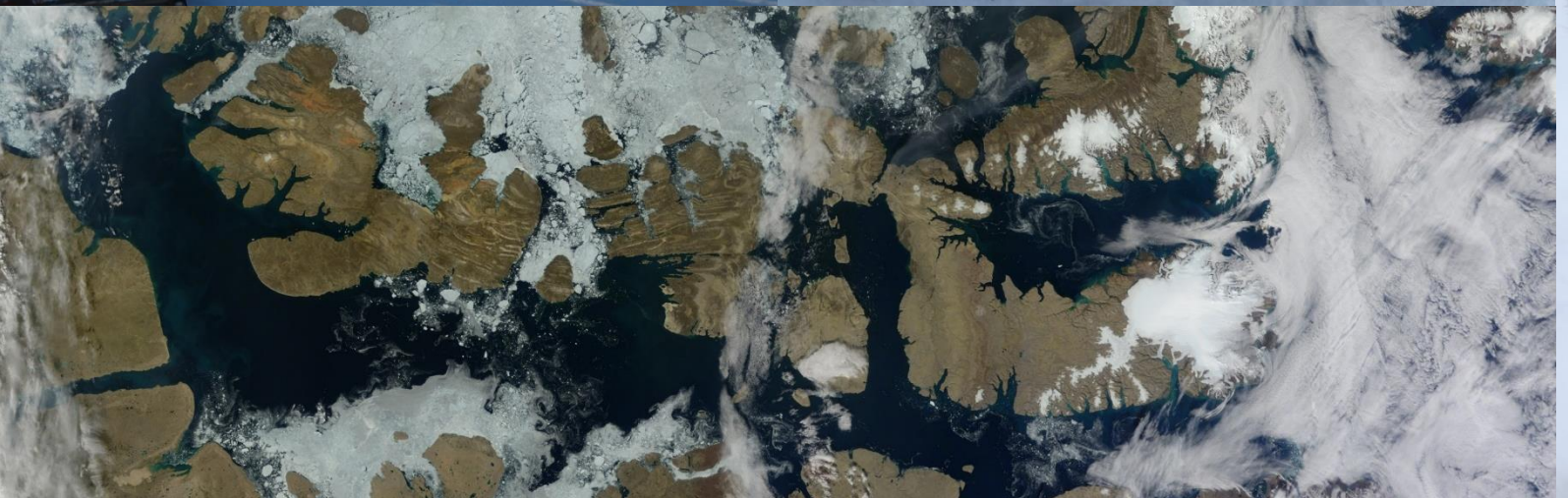
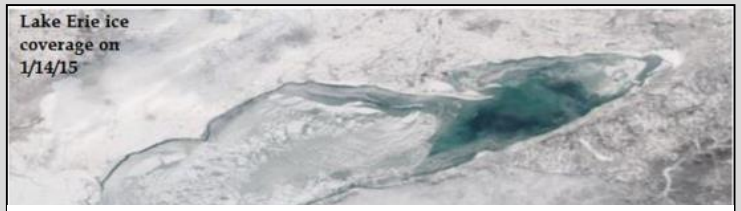
Importance and Implications of Freshwater Ice

From the Straits of Mackinac to the Arctic



Importance of Ice Covered Lakes: Socio-Economic Factors

Transportation



Lake Erie's lack of ice means shipping companies save money this winter

Last February, nearly 81 per cent of all the Great Lakes' surface area was covered with ice.

CBC News Posted: Jan 08, 2016 7:00 AM ET | Last Updated: Jan 08, 2016 1:06 PM ET

Water Quality

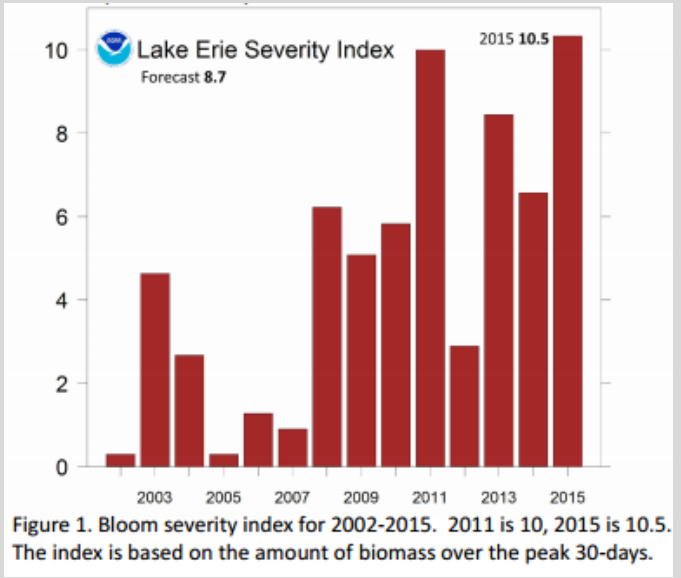
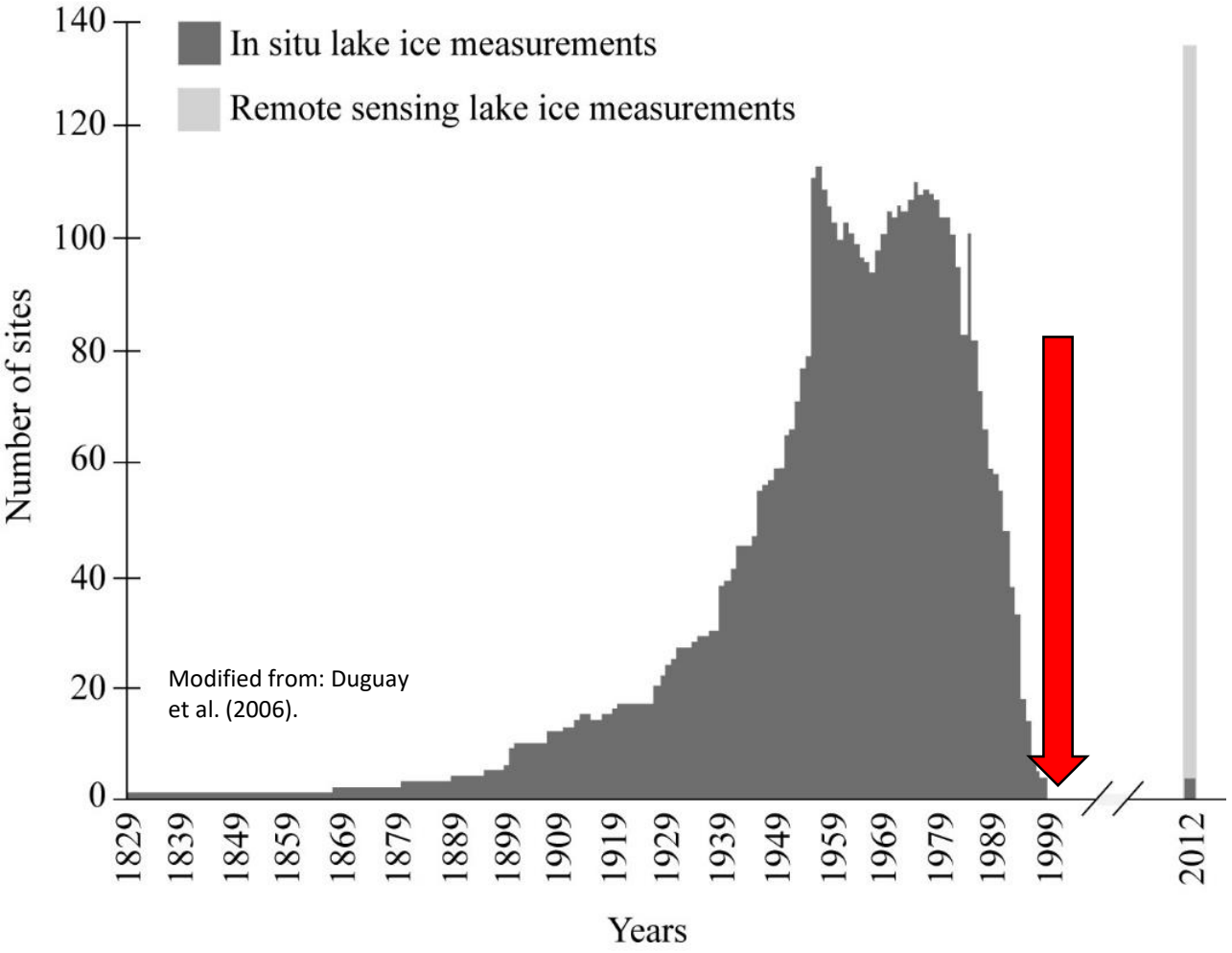
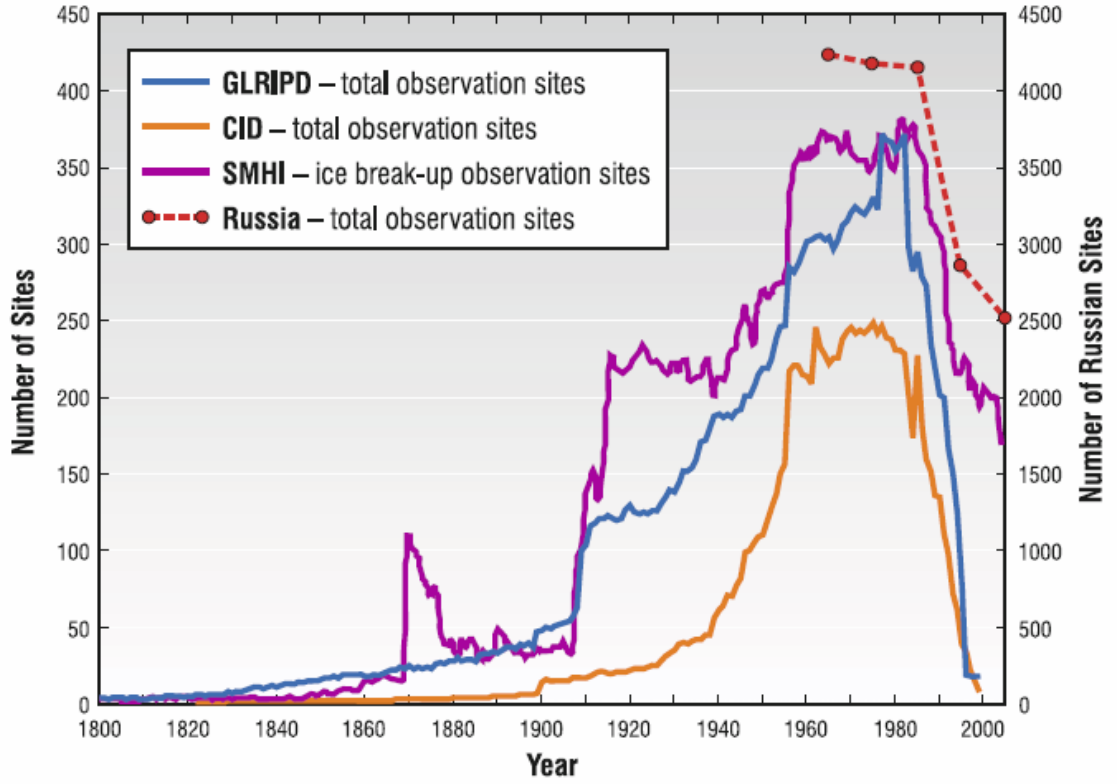


Figure 1. Bloom severity index for 2002-2015. 2011 is 10, 2015 is 10.5. The index is based on the amount of biomass over the peak 30-days.

Ice Covered Lake Measurements: The Case for Remote Sensing

- Ice monitoring networks have disappeared vs. 30 years ago
  - Little in situ data, many lakes in remote regions





Source: PROWSE et al., 2011, AMBIO,40:46-52

Ice Covered Lakes: Microwave Remote Sensing

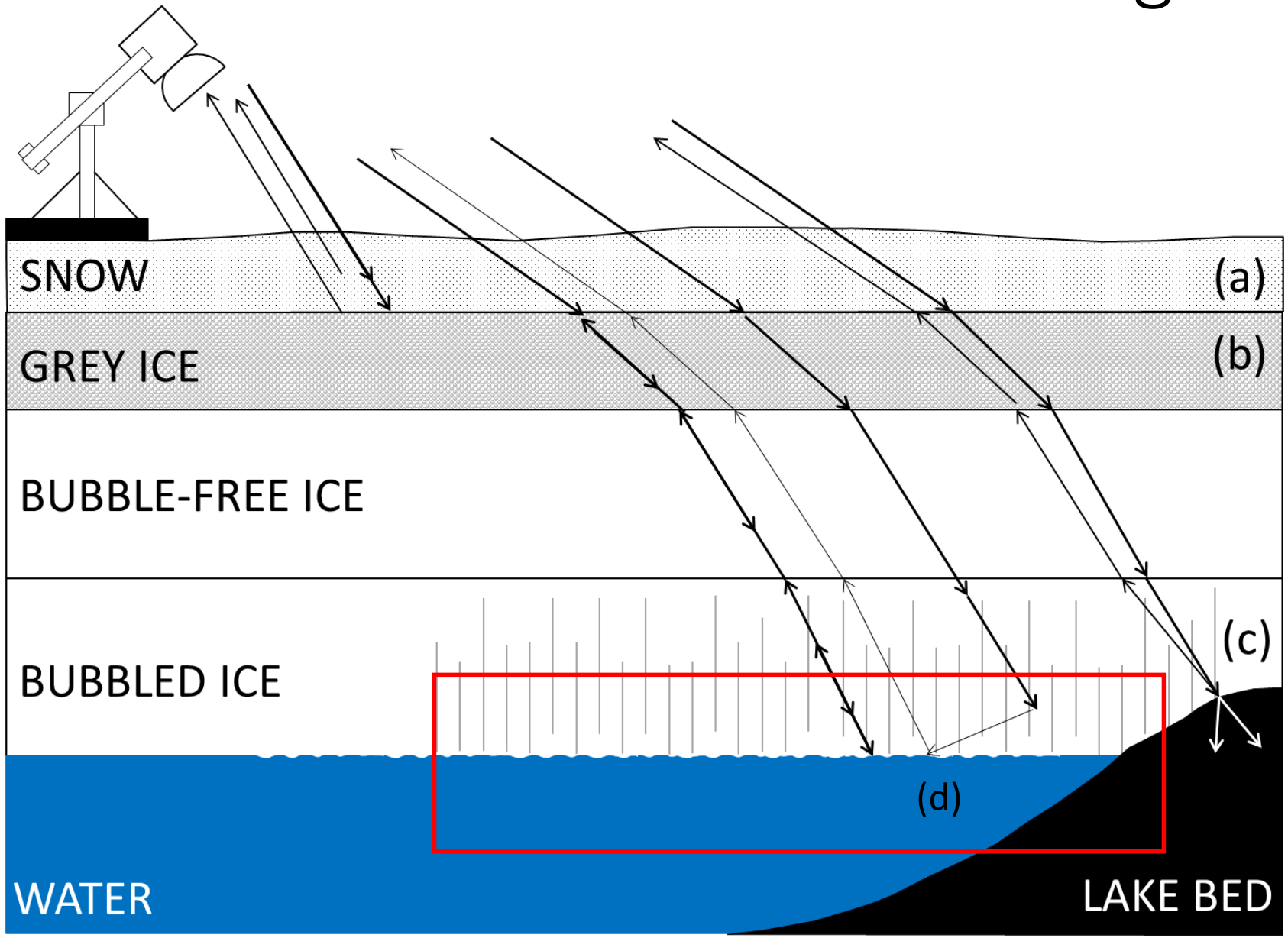
Microwave Interaction:

(a): Snow volume →

(b): Surface Ice Types →

(c): Grounded Ice →

(d): Floating, rough ice →



Implications of Ice Cover in the Straits of Mackinac

- Straits of Mackinac is critical shipping Lane in ice covered season:
  - $500 million of commercial traffic
  - 85.7 million tons of cargo transported
  - 46 million tons of iron ore steel
- US Coast Guard maintains shipping lanes.

Implications of Ice Cover in the Straits of Mackinac

- Crosses Mackinac Straits on lake bed parallel to bridge.

Public Concern

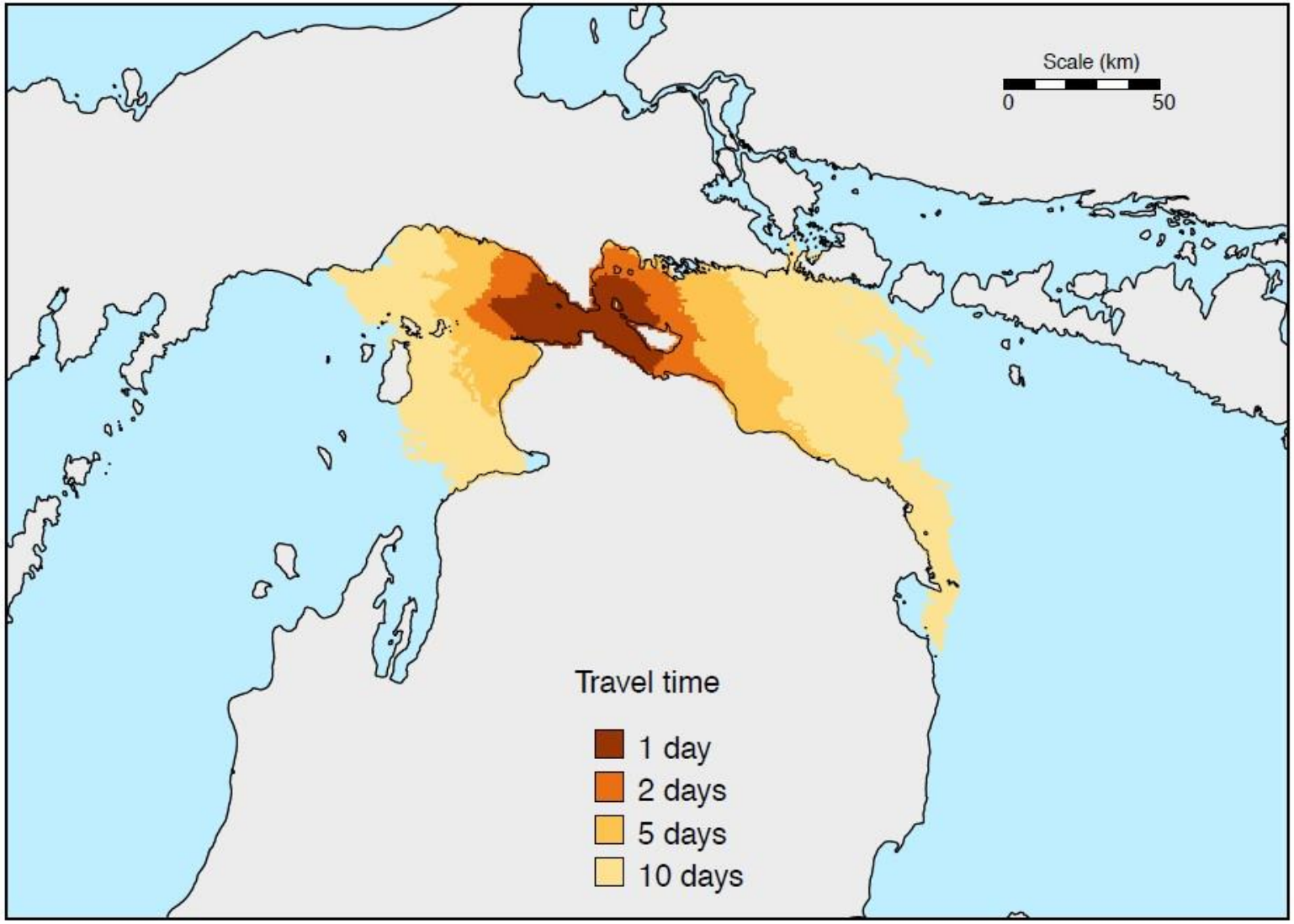
- Sparked after 2010: Line 6B spilled 840,000 gallons of crude oil into Kalamazoo River

Research Context

Modeling oil plumes completed for *open-water conditions* by University of Michigan & Michigan Tech

- Worst-case scenarios
- Probable response effectiveness

- *However no scenarios included ice-cover*



Source: Schwab, 2016


Case MHS1409300
2014-04-03 Hour 0
Elapsed time 0 days 0 hours
Percent beached 0.0
Impacted shoreline 0 km

Research Questions

Overarching research questions:

- 1. Is there appreciable roughness/topography on the ice underside that could serve as a catchment for oil?
  - 1.A. Can Ground Penetrating Radar (GPR) quantify roughness at the ice underside?
  - 1.B. If so, can we detect under-ice oil releases?

- 2. What is the fate of oil if released in ice-covered conditions?

Source: americanrivers.org

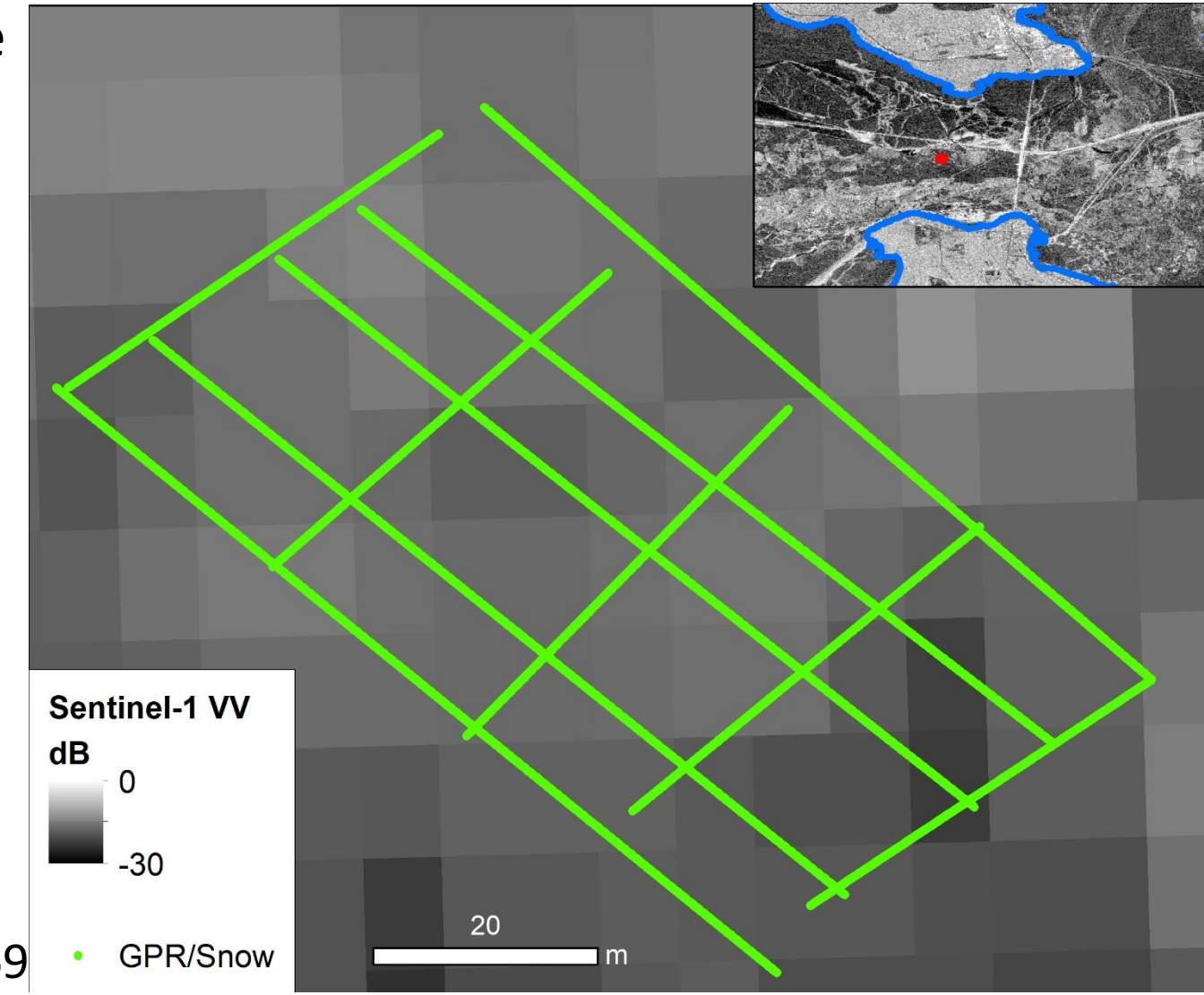
Experiment Setup in Straits of Mackinac

Working off of the USCG Mackinaw in the Straits of Mackinac over Line 5:

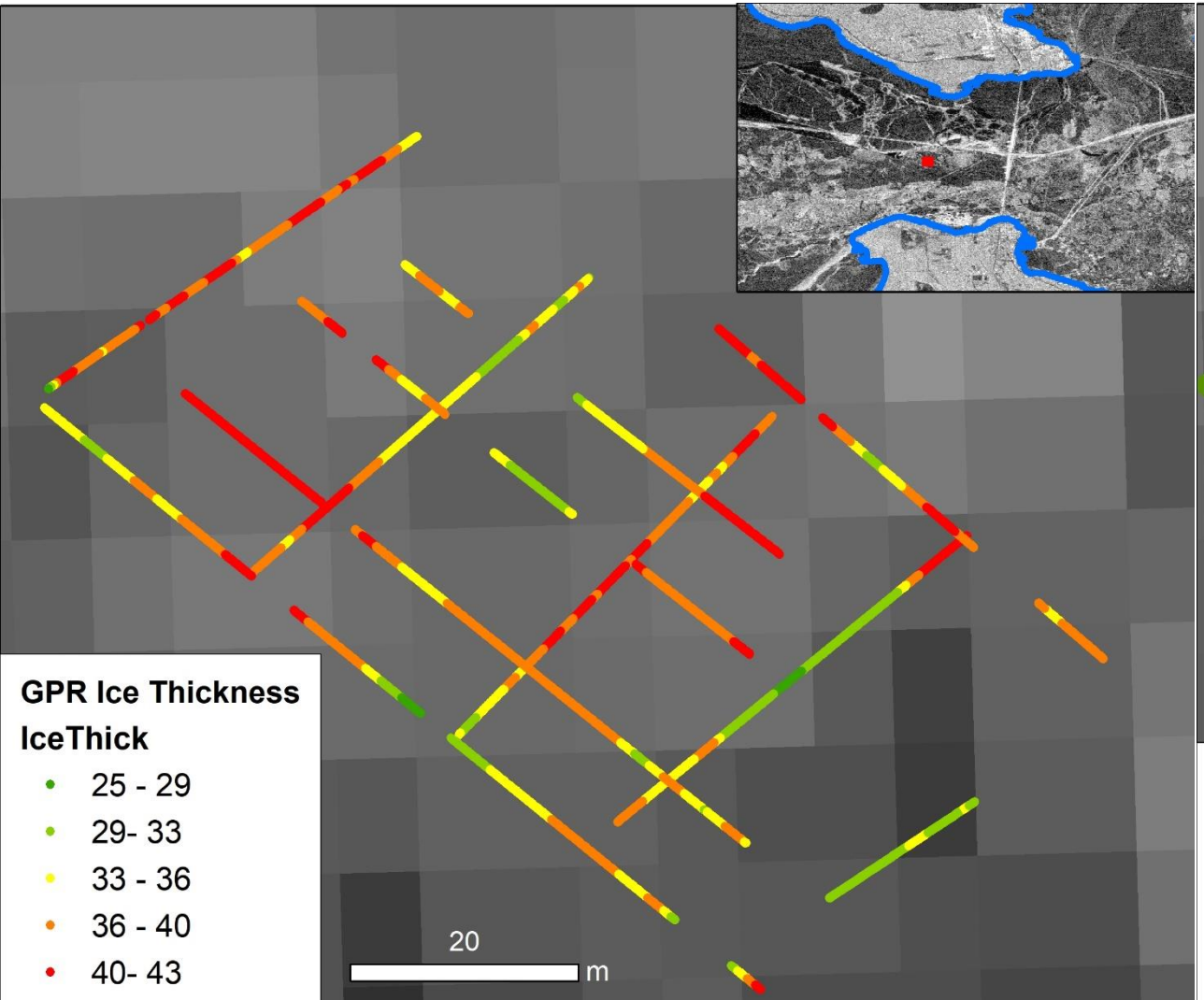
- Equipment: MALA 800 MHz Ground Penetrating Radar (GPR)
  - Retrieve height of snow, and ice depth
  - Measurement every 0.05cm

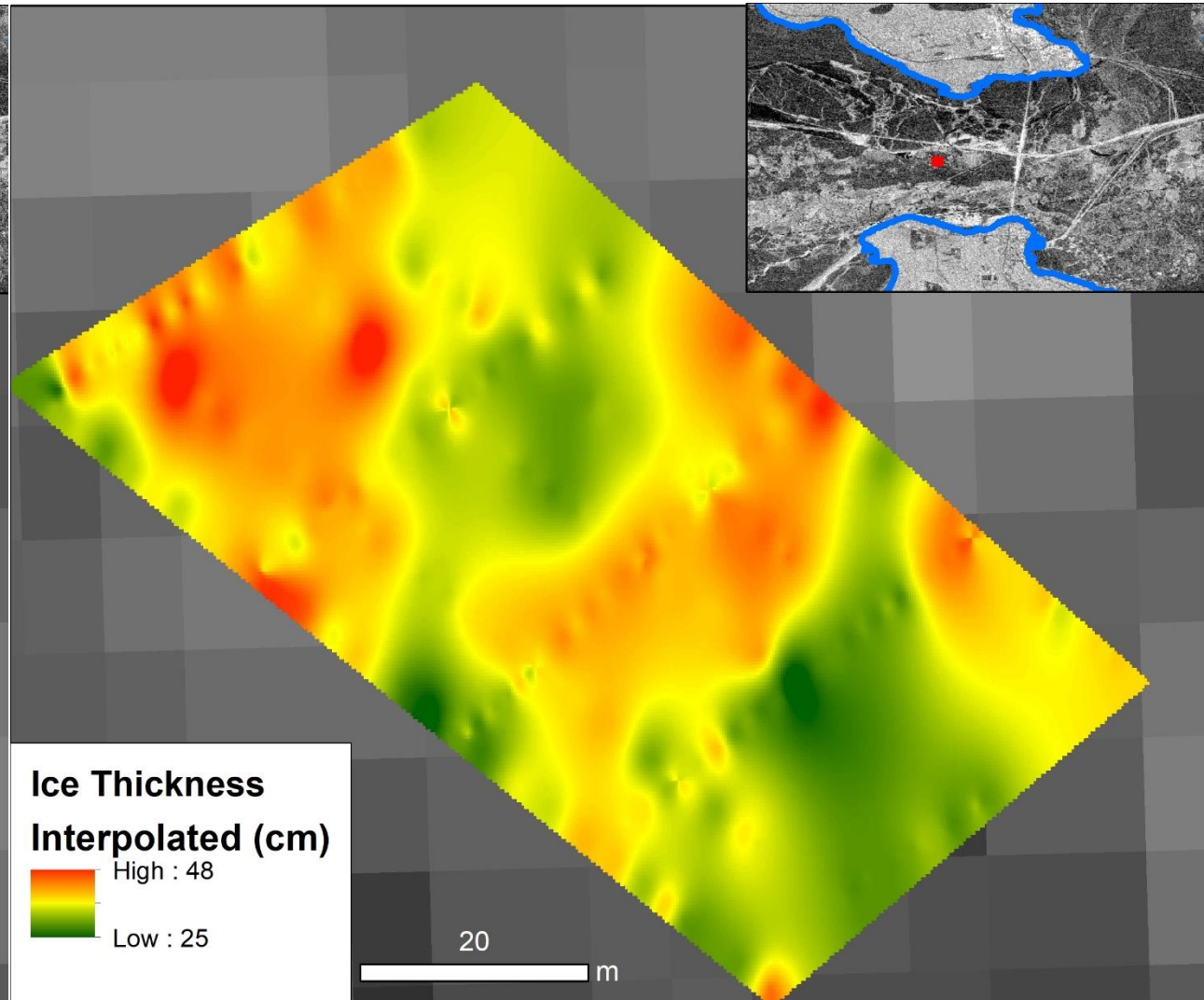
- Validation:
  - Snow Depth Measurements (*n* = 1,220)
  - Ice Thickness Observations every 5m on transect(*n* = 45)
  - Ice Cores Extracted (*n* = 4)

- Setup:
  - 5 transects parallel to SAR look direction (69

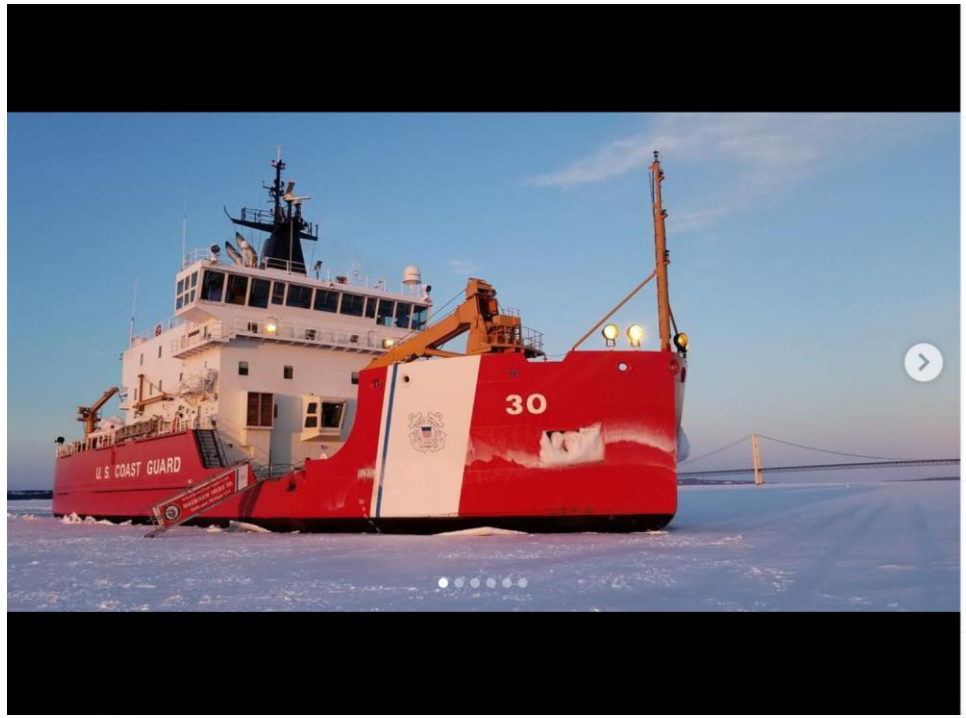


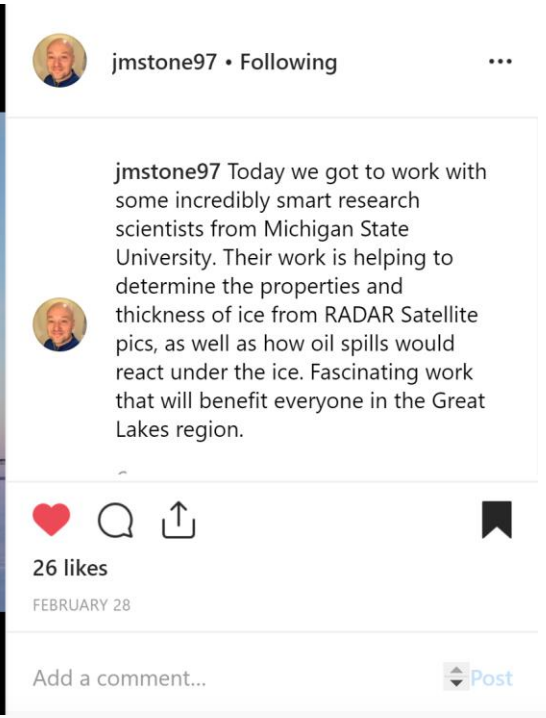
MALA Ice Bottom Topography Retrievals





Impact & Next Steps





Researchers probe questions involving ice, Straits oil spill

PETOSKEYNEWS.COM

Ice and oil: Study seeks to answer how ice impacts Straits oil cleanup

TRAVERSE CITY RECORD-EAGLE
Traverse City, MI

Line 5 Oil Spill Could Cost Tourism Economy $4 Billion, FLOW Study Finds

Mackinac Island Town Crier
A weekly newspaper serving the Mackinac Island Community

Gulf of Mexico Oil Spill and Ecosystem Science (GoMOSES) Conference, New Orleans, LA

GoMOSES workshop

Research needs in the area of physical methods of oil spill remediation: Lessons learned in remediating oil spills in the Gulf of Mexico and Michigan

The focus of the workshop is on physical methods (booms, skimmers, hydrocyclones) of oil spill remediation and on contrasting the two major spills - one in the Gulf of Mexico (Deepwater Horizon spill) and one in Michigan (Talmadge Creek/Kalamazoo River oil spill).

Day: Monday, February 6
Time: 1pm - 4pm
Location: Bolden 5; Hyatt Regency New Orleans (601 Loyola Avenue, New Orleans)

Organizers:
1) Albert P. (Rusty) Gaudé III, Associate Area Agent, LSU AgCenter Louisiana State University
2) Vlad Tarabara, Professor, Department of Civil and Environmental Engineering Michigan State University

1-1:05	Welcome remarks		Rusty Gaudé, LSU AgCenter Vlad Tarabara, MSU
Part 1: Synopsis of the Deep Water Horizon and Kalamazoo River spills			
1:05 – 1:25	Overview of the 2010 Deep Water Horizon spill		Rusty Gaudé, Associate Area Agent, LSU AgCenter
1:25 – 1:45	Overview of the 2010 Kalamazoo River spill		Paul Makoski, Environmental Health Director, Health Department, Calhoun County, MI
Part 2: Physical cleanup technologies			
1:45 – 2:30	Overview of clean-up/remediation technologies used to remediate DWH oil spill		Rusty Gaudé, LSU AgCenter Julie Falgout, BP unified Command liaison Lance Nacio, Vessels of Opportunity Response Dominique Seibert, USCG Bio assessment
2:30 – 2:45	Overview of clean-up/remediation technologies used to remediate Kalamazoo River oil spill		Paul Makoski, Environmental Health Director, Calhoun County
2:45 – 3:00	Emerging chnologies and esearch needs:	Hydrocyclones and voraxial separators	André Bénard, Mechanical Engineering, MSU
3:00 – 3:15		Membrane separation	Vlad Tarabara, Environmental Engineering, MSU
3:15 – 3:30		Oil stabilization and capture by	Daria Boglaienko,

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  - Institute for Public Policy and Social Research
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  - Doug Bessette
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  - Erin Bunting
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  - Kelsey Nyland