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 ice coverage on 1/14/13

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

Water Quality

2011

[Graph showing Lake Erie Severity Index from 2003 to 2015]

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
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
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

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

Line 5 Oil Spill Could Cost Tourism Economy $4 Billion, FLOW Study Finds
OIL SPILLS IN MICHIGAN AND
LOUISIANA:
What can scientists, engineers and affected communities in Michigan and Louisiana learn from each other and teach policy makers?

Panelists:
Emily Suzanne Maung-Douglass, Oil Spill Research Extension Specialist, Louisiana Sea Grant College Program at LSU
Rex Caffey, Professor, MEP Director, LSU AgCenter, Louisiana Sea Grant
Steve Hamilton, Professor, Kellogg Biological Station, Michigan State University
James A. Rutherford, Health Officer, Calhoun County Public Health Department, Battle Creek, MI
Mark Ducharme, Senior Project Manager/Incident Manager at Michigan Department of Environmental Quality
Hosted by Vlad Tarabara, Civil & Environmental Engineering; associate director of ESPP

3 p.m. - 5 p.m. Corniche Room, Kellogg Center
Thursday Nov. 5
register at http://bit.ly/1Rx6CPa
join in at https://msu.zoom.us/j/782615702

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 |
| 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 Makowski, 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 Folguier, BP unified Command liaison; Lanie Naco, Vessels of Opportunity Response; Dominique Sobott, USCG Bio assessment |
| 2:30 - 2:45 | Overview of clean-up/remediation technologies used to remediate Kalamazoo River oil spill | Paul Makowski, Environmental Health Director, Calhoun County |
| 2:45 - 3:00 | Hydrocyclones and vortexal separation | 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 other methods | Dana Boglaenko, Electrical Engineering, MSU |
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