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PRNL Oil Spill Response R&D Overview

2021 C-NLOPB Spill Prevention and Response Forum

January 14, 2021

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- Industry-led R&D facilitator active in Atlantic Canada for 20+ years
- Canadian, federally-incorporated, not-for-profit organization
- Members are operators of licenses in the NL offshore
- Strategic focus areas include digital transformation and sustainability (including GHG emissions reduction)

Chevron

equinor

ExxonMobil

Husky Energy

SUNCOR ENERGY

Historical Oil Spill Response Work at PRNL

- PRNL has supported oil spill R&D for over 20 years
  - Fate & effects
  - Detection & characterization
  - Response options
- Outreach and education - Have worked with industry, response organizations, leading academic and governmental institutions to deliver workshops and presentations, communicate needs and priorities
- “Adjacent research” has also supported oil spill prevention and response capabilities – e.g. current modeling

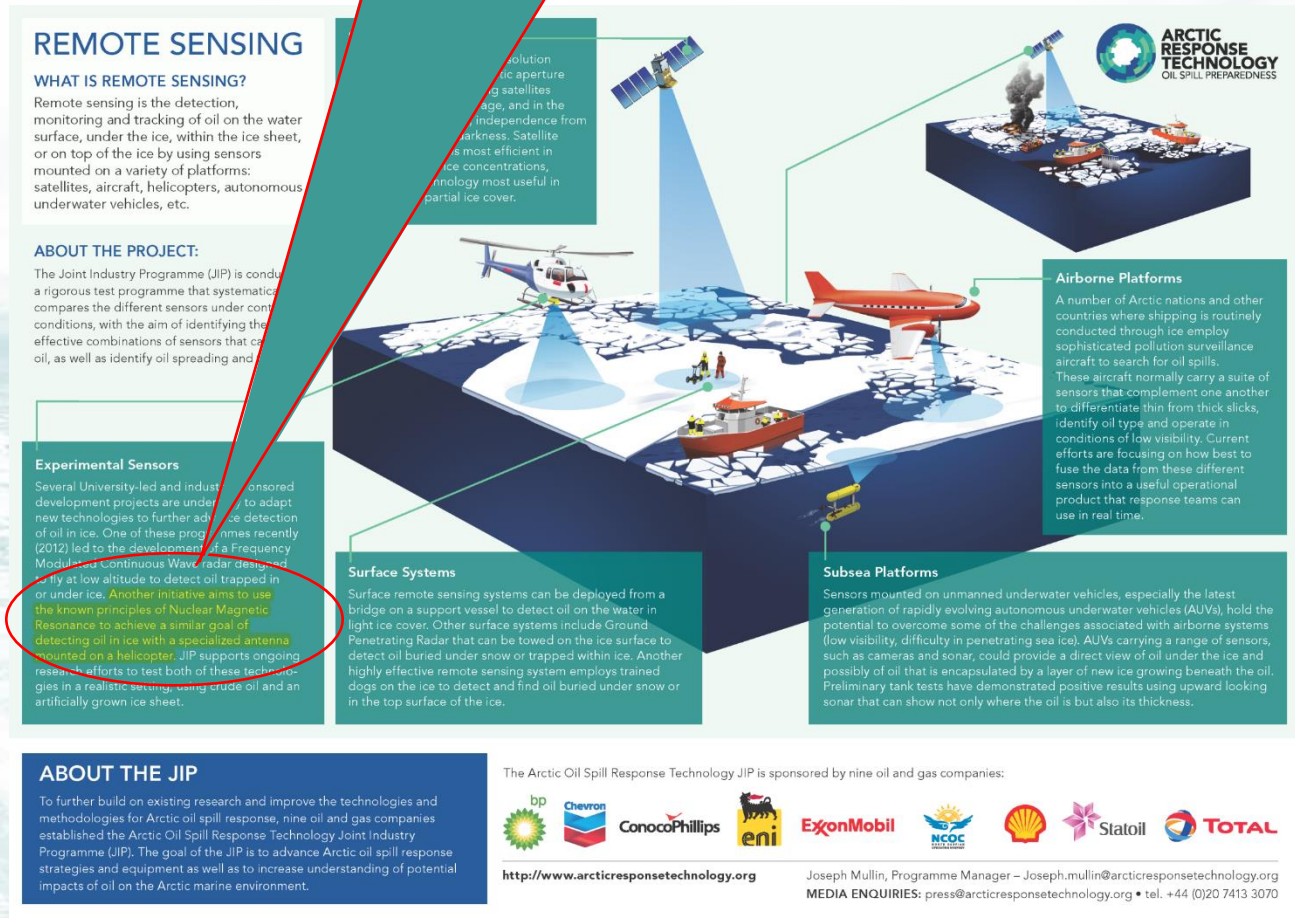
Fugro NMR Research & Development Project

Earth's Field Nuclear Magnetic Resonance to Detect Oil Under Ice

Project Overview

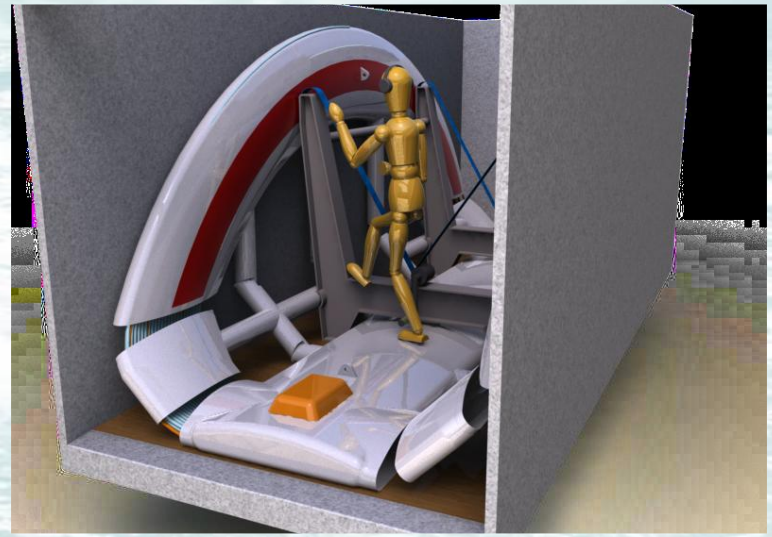
- The detection of oil in and under ice is a key limitation to responding to an oil spill in the Arctic and in ice-prone regions
- Current methods to detect oil under ice involve people drilling holes in ice. This poses safety risks and is slow
- NMR deployed by helicopter holds the potential to detect oil through snow and ice. Safer, faster and much less prone to signal loss through ice than most other remote sensing techniques
- **Objective:** Build on research conducted by ExxonMobil Upstream Research Company (URC) with world-renowned NMR researcher, Dr. Eiichi Fukushima, to advance the technology to a commercially-ready state
- **Deliverable:** A ruggedized system capable of being operated from a helicopter in harsh environments

Another initiative aims to use the known principles of Nuclear Magnetic Resonance to achieve a similar goal of detecting oil in ice with a specialized antenna mounted on a helicopter.



Results

- Safe deployment of full-scale commercial prototype
- Successful delineation of the oil surrogate in real time by an operator inside the helicopter operating purpose-built software
  - System met initial objective of the detection of ~ 1 cm of oil below ~ 1 m of ice in a reasonable time frame
- NMR system and software can be stored in a standard shipping container and deployed in an operational setting
- The system is currently stored in St. John's

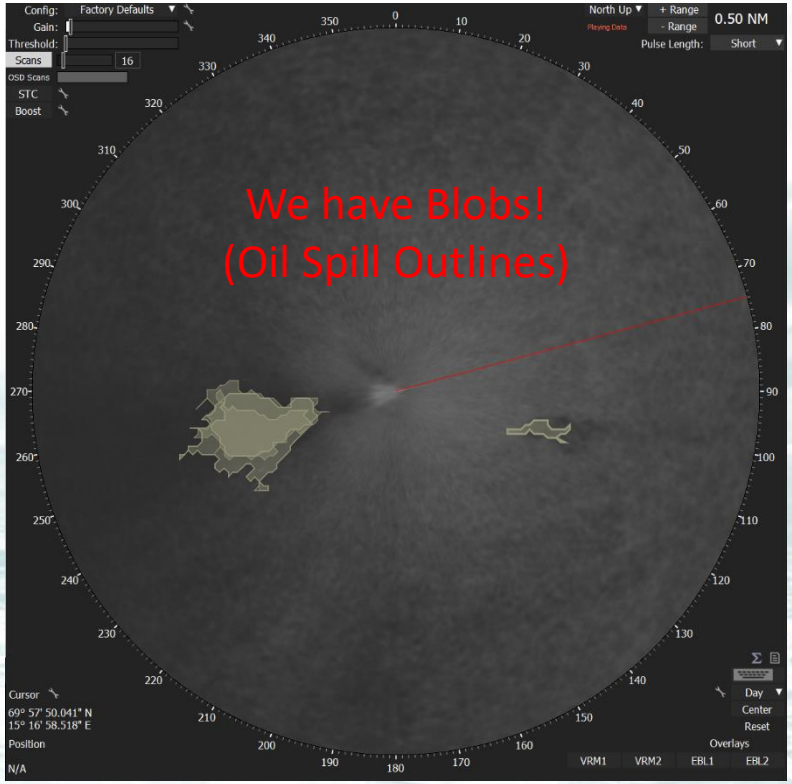


Rutter Marine Radar Sigma 6 (S6) Oil Spill Detection

- Marine Radar S6 Oil Spill Detection (OSD) is an operationally proven technology - but prone to false alarm target “look-alikes”
- Rutter systems widely deployed in offshore NL - an opportunity exists to improve oil spill detection by developing and deploying new capabilities
- Can we reduce false alarms by integrating other remote sensing technology?

Project Overview and Status

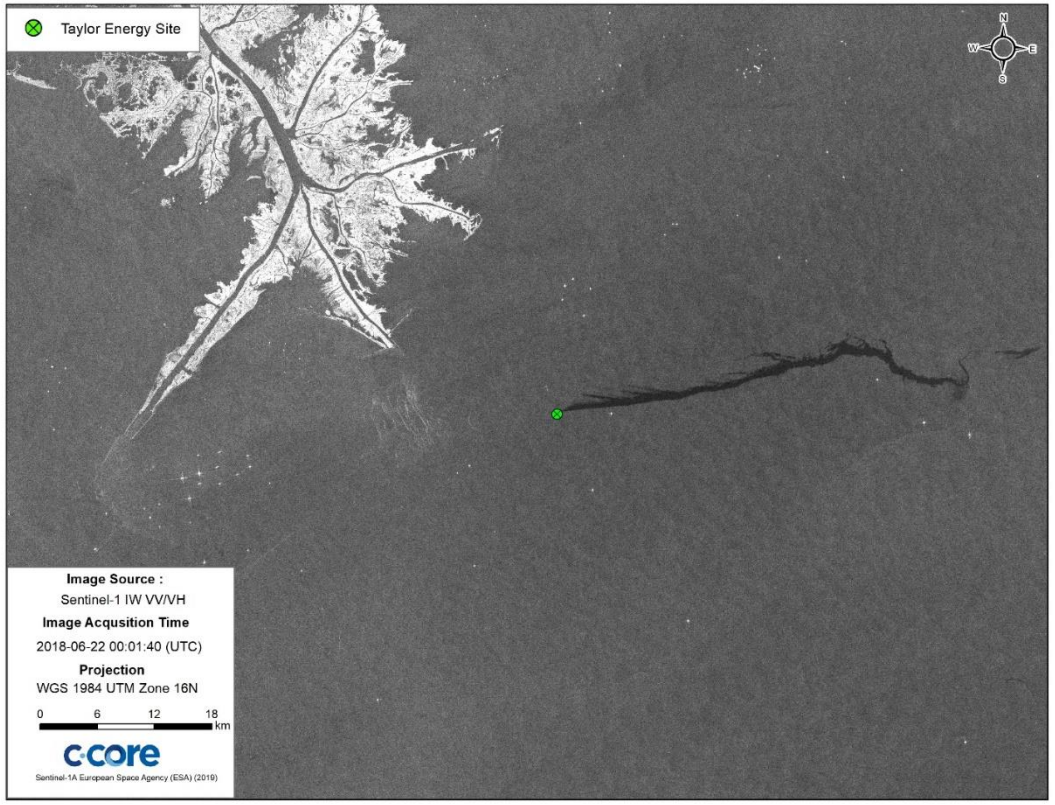
- Objective: Advance X-band radar oil spill simulation and detection capability
- Approach:
  - Create an Oil Spill Detection Simulation tool to determine expected Probability of Detection given specific radar parameters and environmental condition
  - Data fusion algorithms (combining data from multiple sensors) to aid in automatic detection and alarms for true events, mitigate false positives and reduce associated crew distraction
    - Electro-Optical InfraRed Cameras
    - AIS (Automatic Identification System)
    - Oceanographic (currents and waves)
  - Deploy prototype system to a vessel of opportunity for data collection and performance evaluation
- Future work: Rutter Internet of Things (IoT) Project will migrate Rutter systems into an IoT-enabled solution, offering remote monitoring and enhancing onshore connectivity – OSC funding and Husky partnership



Contact: Des Smith at dsmith@rutter.ca

Advanced Satellite Observations for Oil Spill Response (SpillSight)

- Large volumes of freely or commercially available satellite data streams on a daily basis
- SpillSight aims to develop and implement a comprehensive capacity for detecting oil slicks in Newfoundland and Labrador waters
- Improve identification of and filter common look-alikes and reduce false positives

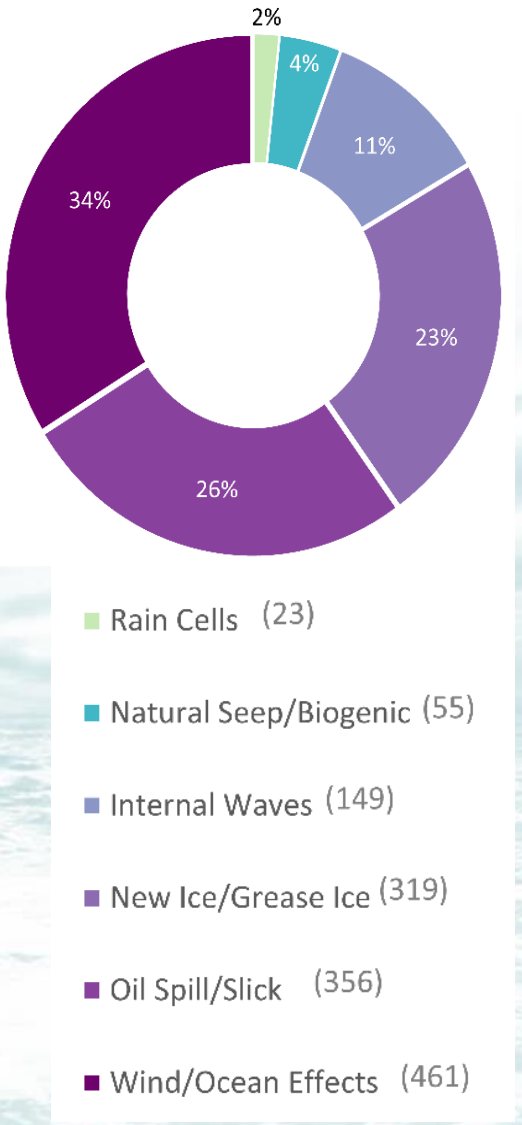


Project Overview and Status

Project Approach:

- Perform automated analysis of satellite imagery using machine-learning techniques
  - Algorithms under development (“training”) using large volumes of Sentinel 1 data from other spills (Taylor Energy, Corsica tanker collision)
  - Discrimination of common look-alikes
- Integrate in-situ observations and metocean features
- Establish automated workflow with quality control

- System will be compliant with industry best practices and standards such as the Common Operating Picture and Open Geospatial Consortium – interoperable with other systems
- Project approach could be applied to future data streams such as the Radarsat Constellation Mission to deliver near daily observations on the Grand Banks



Contact: Kelley Dodge at kelley.dodge@c-core.ca

Digital Transformation and Oil Spill Response

- Digital transformation will expand the capability of industry to detect and respond to oil spills and leaks
  - Rutter: Sensor innovations, data integration and “edge computing” (pre-processing and packaging of data for enhanced onshore connectivity)
  - C-CORE: Application of machine learning to large volumes of data to improve detection, reduce false positives and improve quality and productivity of analysis

Digital Offshore Canada

- A collaborative platform for development, validation and commercialization of digital twins for offshore applications
  - A virtual test-bed to accelerate the deployment of emerging digital solutions

- Example: Subsea Field Modelling & Operations (UIDs)
  - Develop a digital twin of a subsea east coast field architecture for the advancement and virtual testing of a range of underwater IMR technologies, including autonomous or hybrid UIDs
  - Explore feasibility of twinning the subsea infrastructure at MI Holyrood to create a dual physical-digital subsea test bed
  - Expand our understanding of the operational limits of seabed-resident systems and requirements of supporting infrastructure
  - Extend the capabilities of new systems beyond inspection to intervention, maintenance and repair operations
  - Seabed-resident UIDs could provide faster inspection and are less constrained by surface conditions

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HATCH

VIRTUAL MARINE

GRI SIMULATIONS

MNP

MEMORIAL UNIVERSITY

MARINE INSTITUTE

Questions?

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