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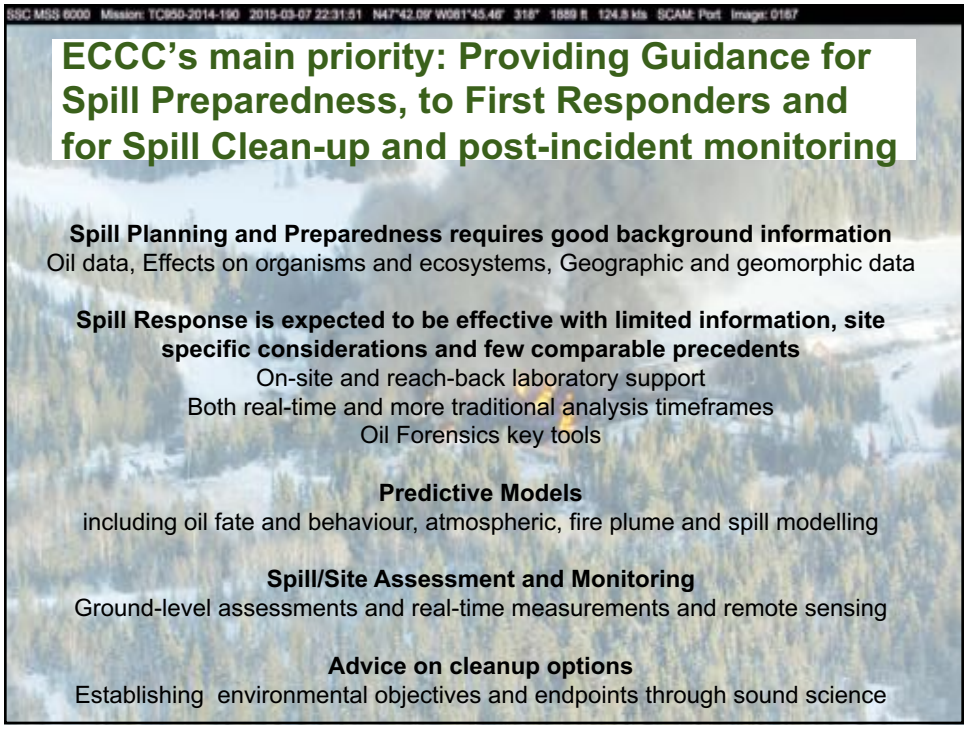
Oil Spills in the Arctic:

Perspectives from Environment and Climate Change Canada (ECCC)
OSICA Workshop
13 March 2017



ECCC's main priority: Providing Guidance for Spill Preparedness, to First Responders and for Spill Clean-up and post-incident monitoring

Spill Planning and Preparedness requires good background information
Oil data, Effects on organisms and ecosystems, Geographic and geomorphic data

Spill Response is expected to be effective with limited information, site specific considerations and few comparable precedents
On-site and reach-back laboratory support
Both real-time and more traditional analysis timeframes
Oil Forensics key tools

Predictive Models
including oil fate and behaviour, atmospheric, fire plume and spill modelling

Spill/Site Assessment and Monitoring
Ground-level assessments and real-time measurements and remote sensing

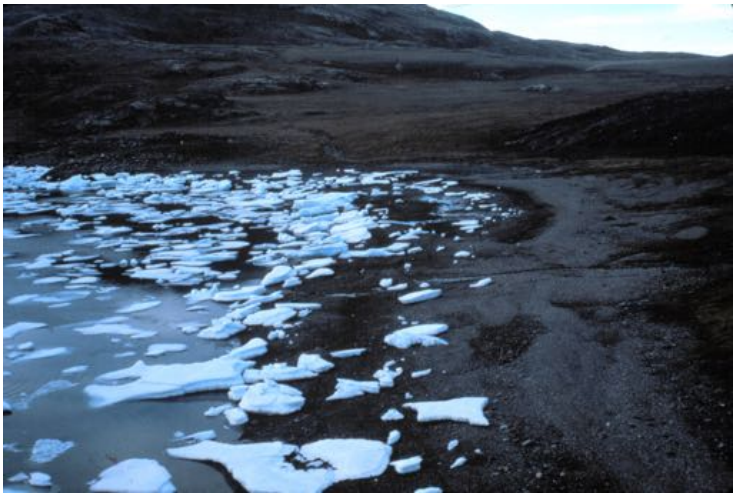
Advice on cleanup options
Establishing environmental objectives and endpoints through sound science

ECCC's Past Oil in Ice Research

- Arctic research on oil spills and impact assessment with Beaufort Sea Studies in 1973
- In 1976 major funding provided for AMOP - Arctic Marine Oilspill Program
- In 1976-1981 major studies on fate, behaviour and countermeasures for oil
- Baffin Island Oil Spill Experiment (BIOS) 1979-1985
- Newfoundland Oilspill Burn Experiment (NOBE) 1990-1992
- Artic oils measurements (Beaufort oils, Alaskan oils, NL offshore) 2010-present
- Arctic oils/arctic Sediments studies 2008-2012
- Freshwater oil-in-ice studies at spills of opportunity (Wabamun lake 2005, Gogama 2015)

Beaufort Sea

BIOS Beach Study



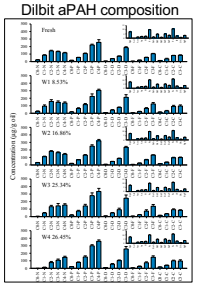
Major Research Interests

- Oil behaviour and fate in Arctic circumstances
- Predicting oil, shoreline, ocean and ice behaviour and fates
- Detection, tracking and remote sensing
- Countermeasures
- Clean-up endpoints

Oil Fate and Behaviour

- Continuing Research Questions
  - Oils of the Arctic Regions
  - Oil interactions with sediments in freezing waters, fresh, brackish, saline (with and without ice)
  - Oil interactions with intermediate ice coverage (3/10 to 7/10)
  - Oil-ice interactions (adhesion, diffusion through ice, retention in ice fields)

Dilbit aPAH composition



Oil drops refloating from a beach during rising tide

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Oil Fate and Behaviour Under Ice

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Oil in Pack Ice

Oiled Beach Trials

Freshwater Ice

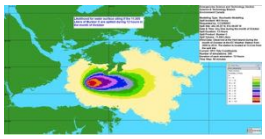
Oil/Ice/Ocean Modelling

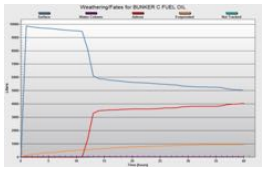
- Research Questions
  - Integration of existing ice trajectory and hydrodynamic models with oil trajectory models.
  - Integration of oil weathering into models
  - Integration of new oil behaviours
    - Oil breakdown behaviours
    - Oil/sediment interactions
    - Salinity gradients
  - Model Ground-truthing and testing

Spill Modelling: Two Worlds

Sophisticated ocean and ice models: current and future physical state of marine environment (waves, currents, temperature, salinity, sea ice, storm track) using observational platforms and numerical models.

- Atmosphere-Ocean-Ice
- Hydrological models
- 3D circulation models for the Great Lakes, Waves
- 1D and 2D hydraulic models
- Models of the ecosystem, socio-economics, etc.
- Mgmt, Decisions, Policies





Operational spill modelling
Oil Fate and Behaviour
Oil Weathering
Limited hydrodynamics

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Research Questions

- Oil Detection & Monitoring
  - Airborne detection in open water and pack ice
  - Detection under ice?
  - Real-time/near RT oil identification and forensics
  - Under ice oil capacity?
- Oil monitoring on shorelines and ice
  - Pre-spill surveys background data: ground, air or satellite based
  - Use of Shoreline Cleanup Assessment Technique in Arctic Conditions
  - New data analysis techniques

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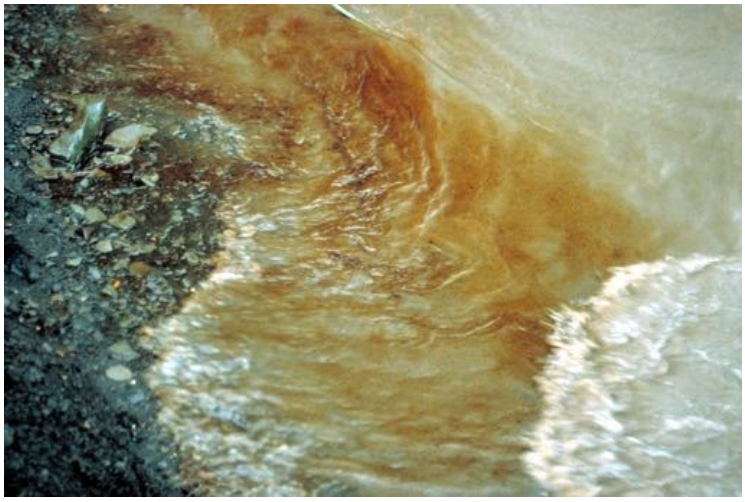
Oil Detection & Remote Sensing

Clean-up technologies

- Continuing Research Questions
  - In-situ remediation (bio and reworking)
  - Burning and use of chemical herders
  - Cold-water dispersants and treating agents
  - Oil “weathering” and condition windows for appropriate use?
  - Appropriate endpoints for Arctic environments

Sediment Relocation

Surf Washing



In-situ Burning

Heavy Oil Burning in Ice

Closing thoughts

- ECCC maintains focus on operational needs during spills and for risk and damage assessments
- Research needs to be cognizant of questions faced by planners, modelers and responders.
- Considerable work has already been done, literature reviews are essential.
- However, in many ways, spill science is still in it's early stages, especially in Arctic regions

Thank-you!