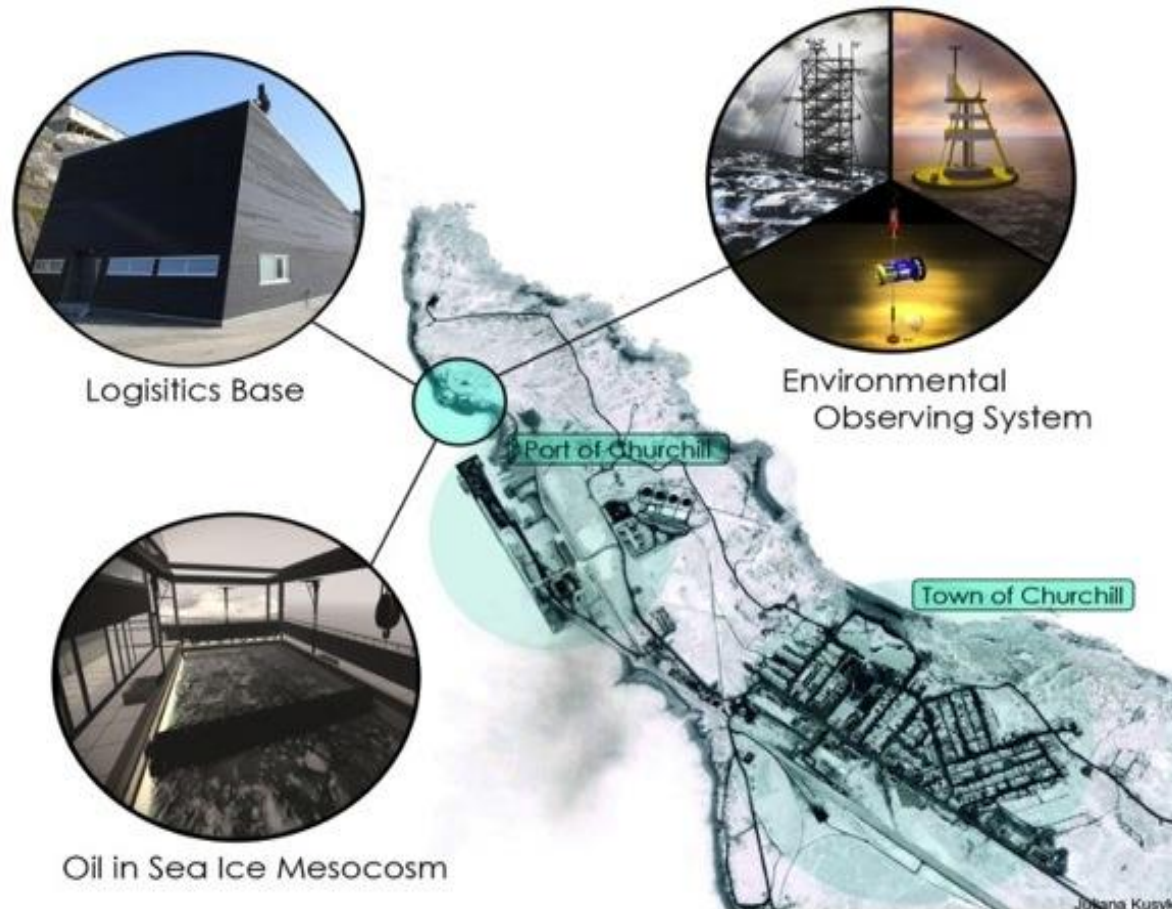


The Churchill Marine Observatory (CMO)

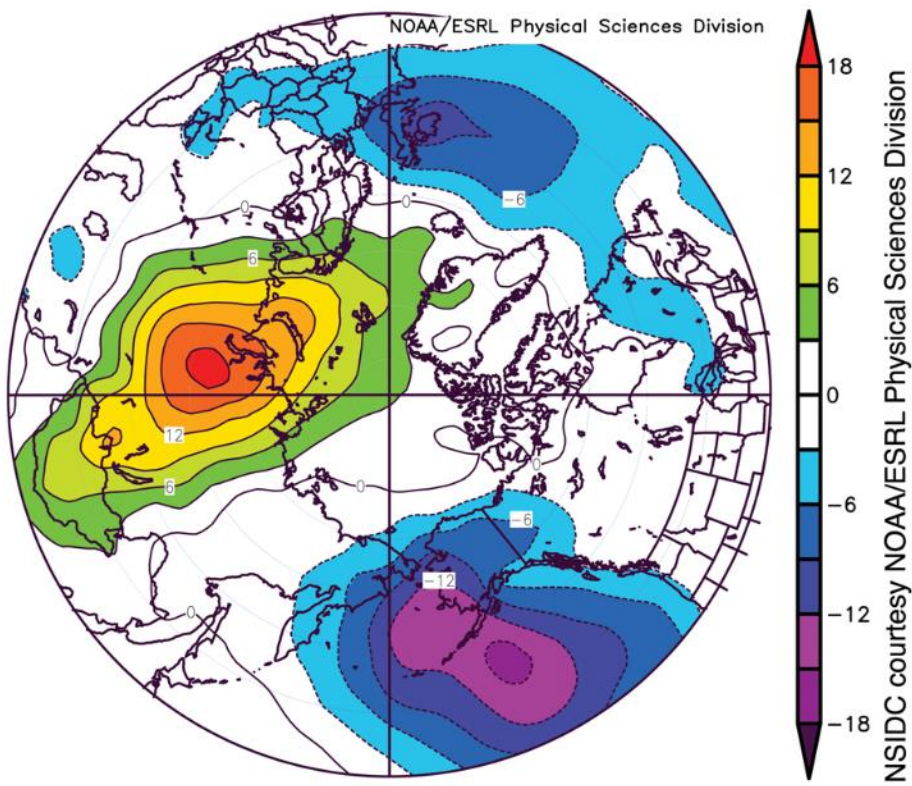


Dr. John Yackel, Professor and Head, Dept. of Geography, University of Calgary

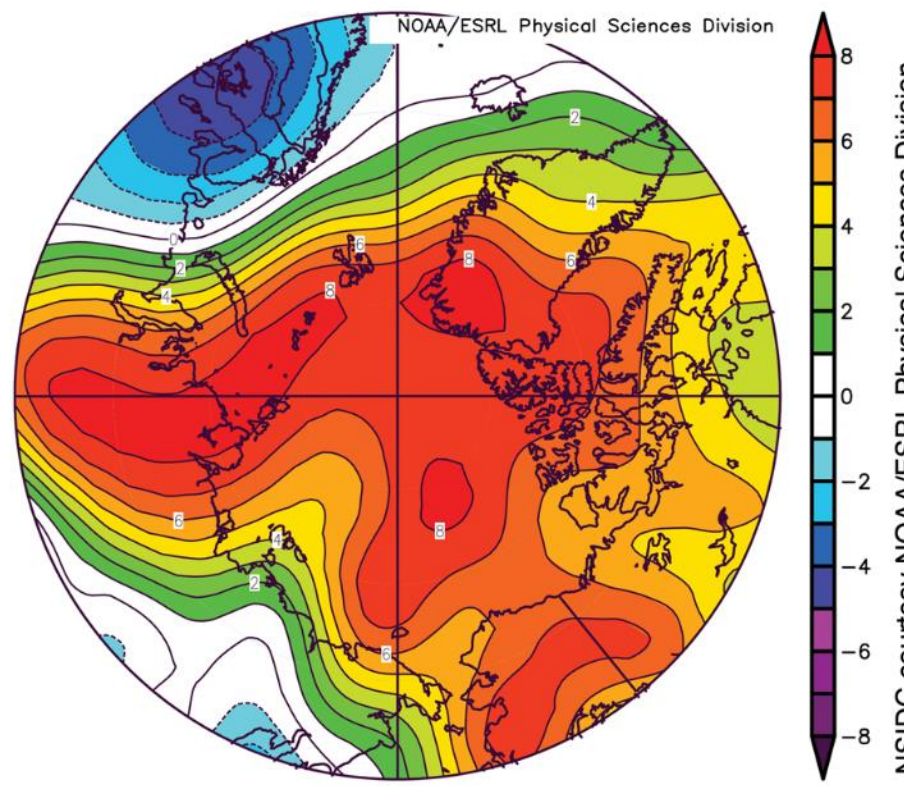


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Sea Level Pressure Anomaly January 2016



Air Temperature Anomaly January 2016



Arctic Sea Ice Extent

(Area of Ocean with at least 15% sea ice)



Reset zoom

Extent (Millions of square kilometers)

17
16.5
16
15.5
15
14.5
14
13.5
13
12.5
12
11.5
11

1 Jan

1 Feb

1 Mar

1 Apr

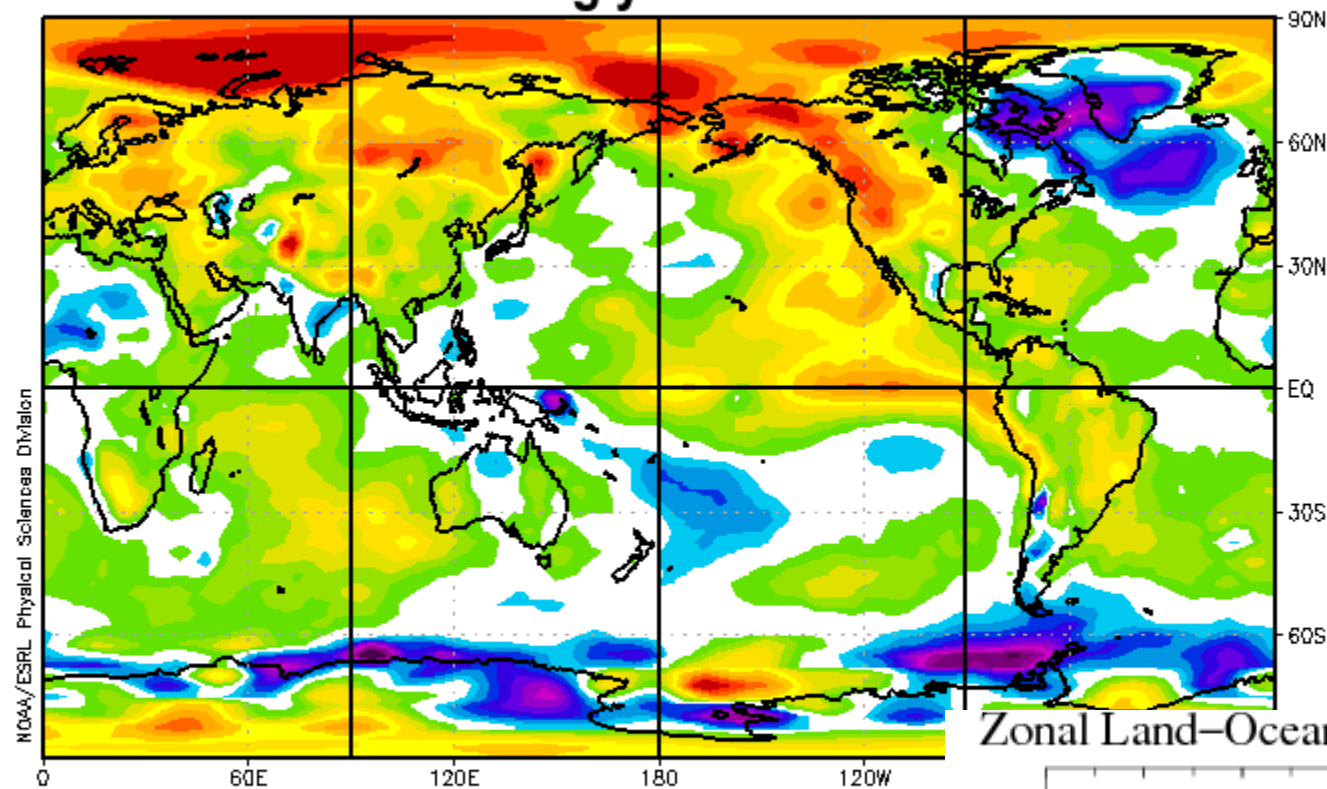
1 May

Date

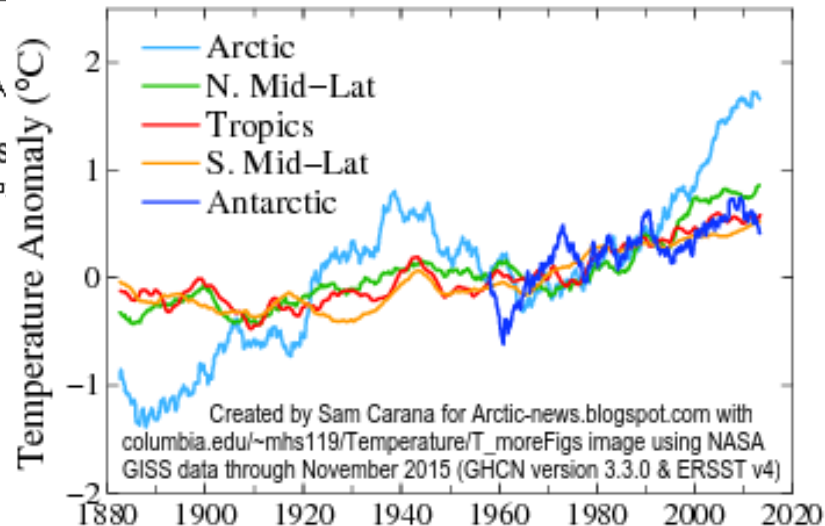
BETA - National Snow and Ice Data Center, Boulder, CO



As 2015 shapes up to be the warmest year on record, it becomes clear how strongly the heat is felt in the Arctic

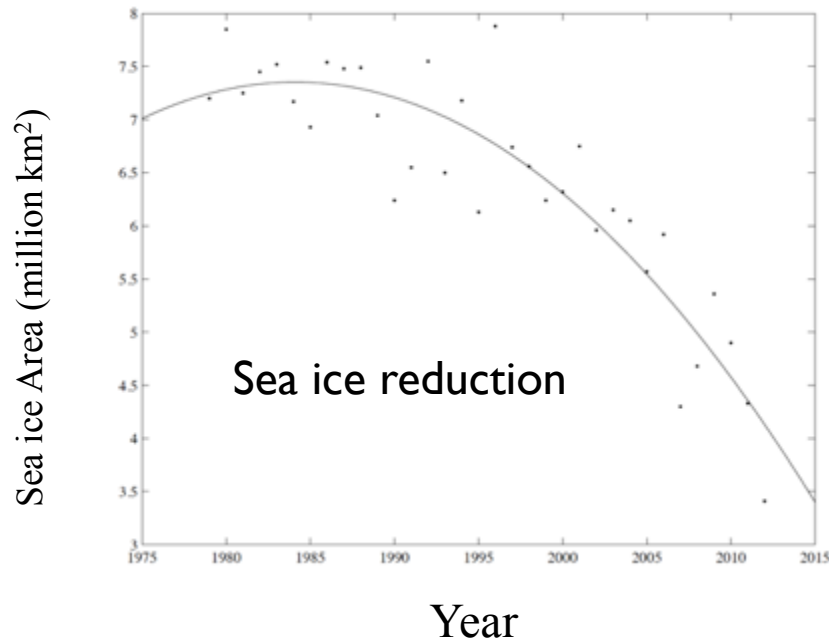


Zonal Land–Ocean Temperature Change



The Churchill Marine Observatory (CMO)

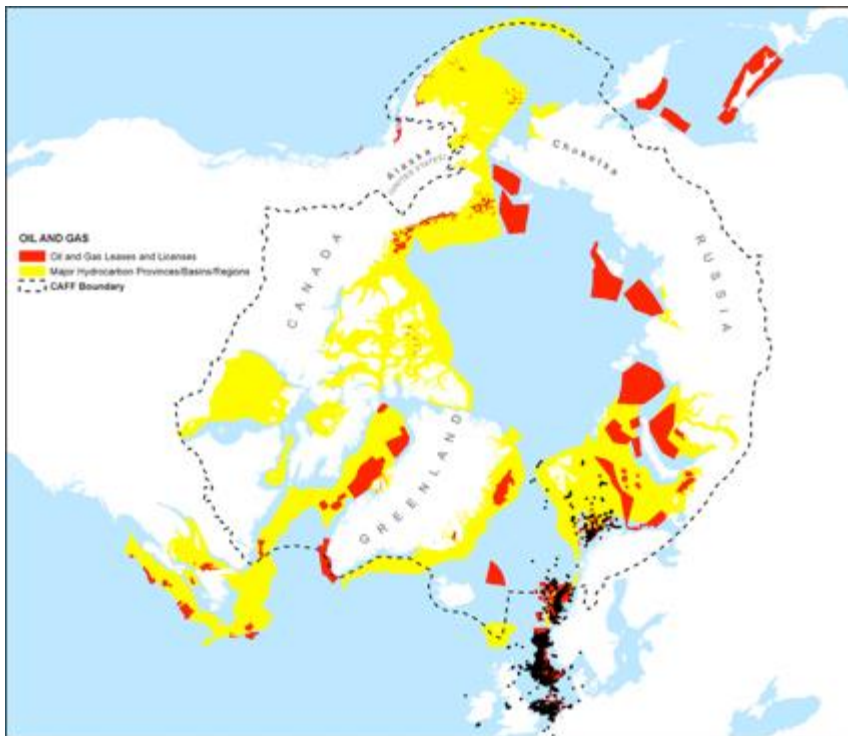
A concept whose time has come!



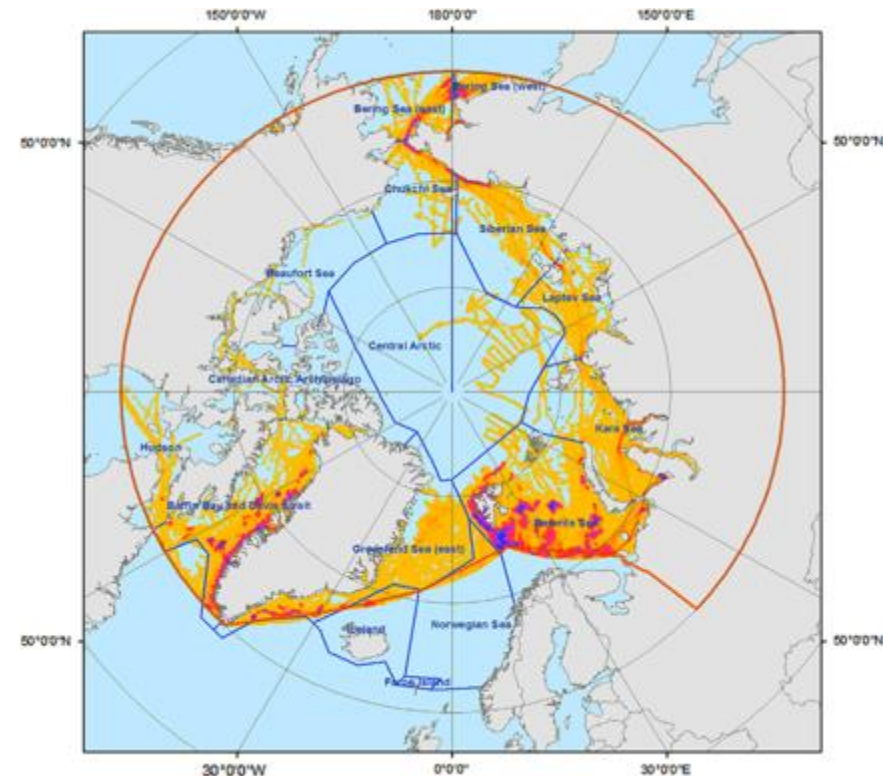
Oil in sea ice
Question of when not if.

The Churchill Marine Observatory (CMO)

A concept whose time has come!

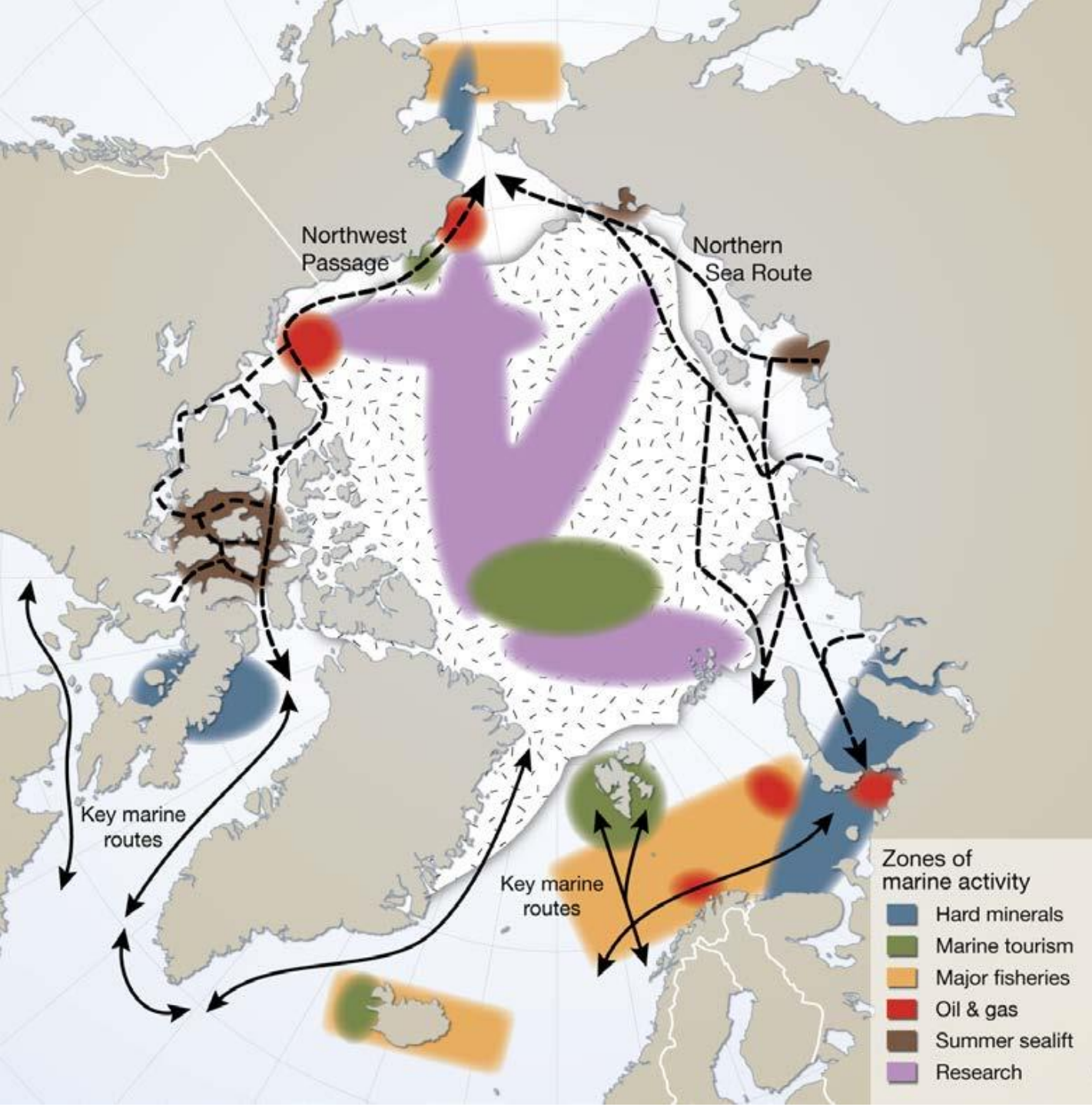


Hydrocarbon resources



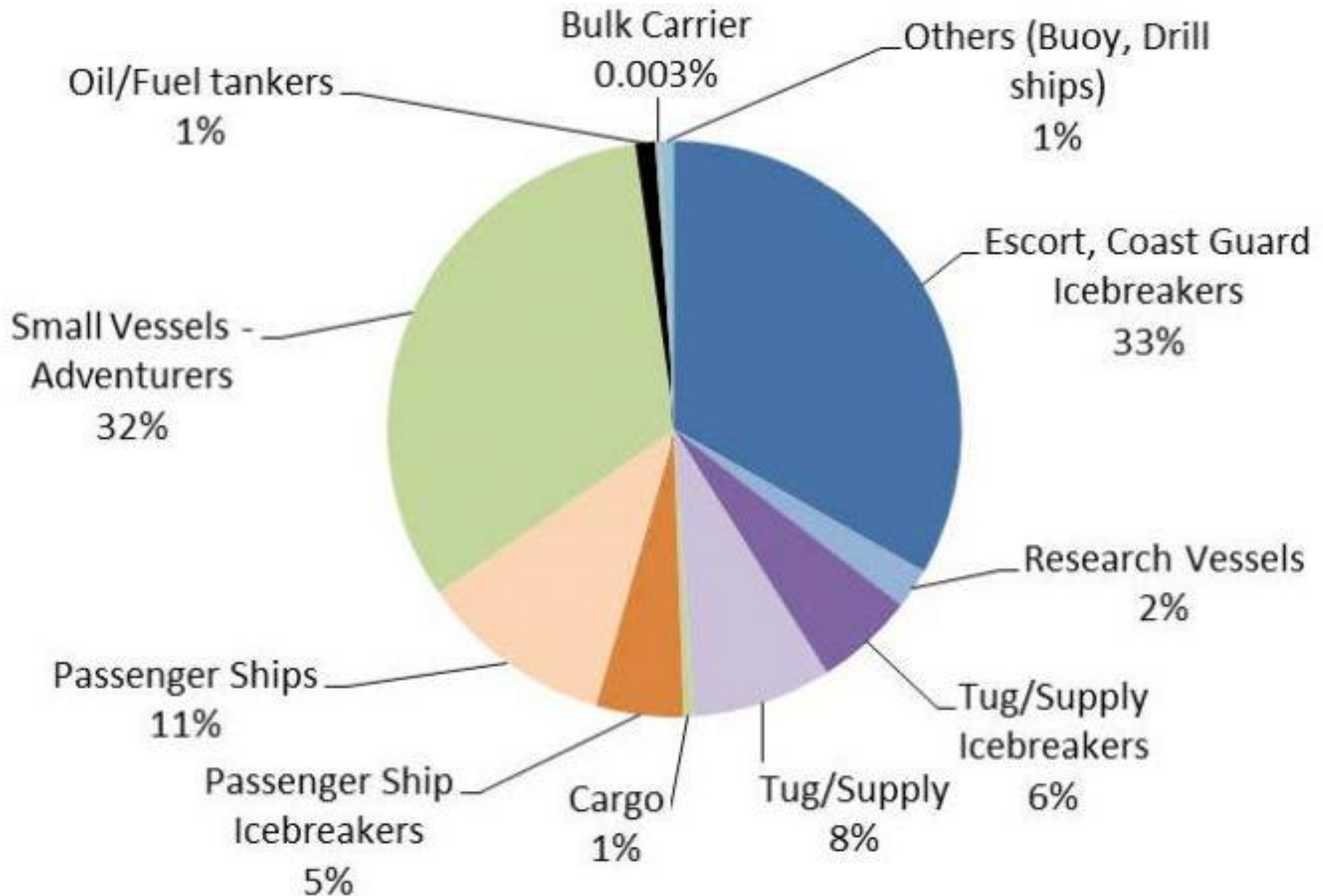
Marine Transportation



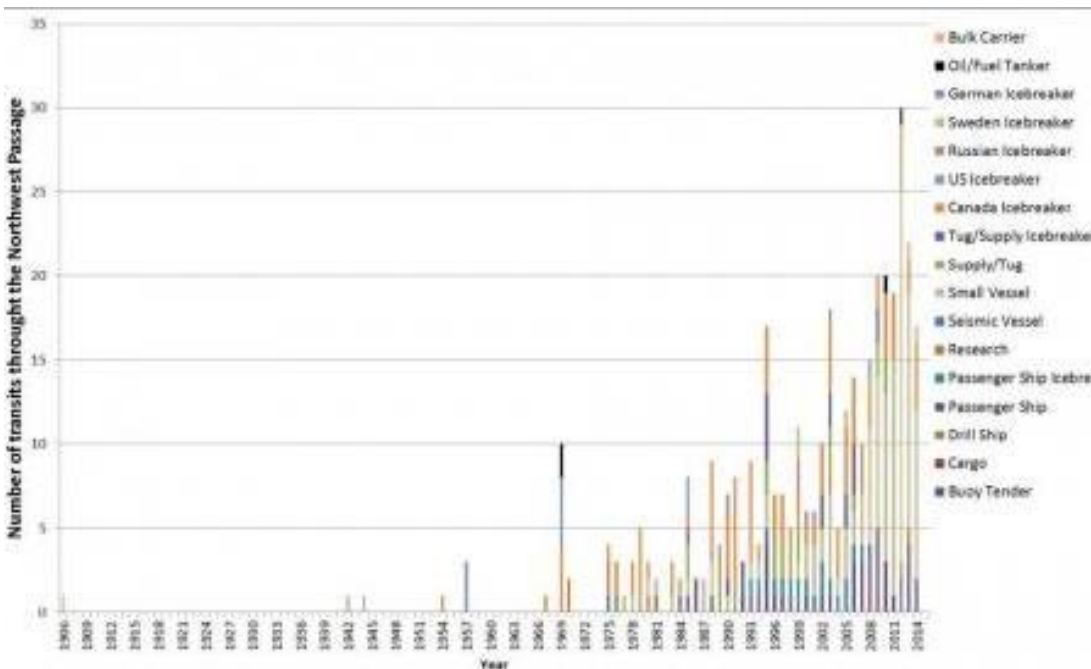


Zones of marine activity (map) - From ArcticData Download by Arctic Council CAFF/PAME. (Downloaded 19 May 2011)

Type of ships in the Northwest Passage



Ship Traffic through the NWP



Transits through the Northwest Passage by type of ship. Source: NORDREG; Data complete for 2014.

Climatic Change (2014) 123:161–173
DOI 10.1007/s10584-013-1038-3

Changing sea ice conditions and marine transportation activity in Canadian Arctic waters between 1990 and 2012

Larissa Pizzolato · Stephen E. L. Howell ·
Chris Derksen · Jackie Dawson · Luke Copland

Received: 8 August 2013 / Accepted: 19 December 2013 / Published online: 24 January 2014
© Crown Copyright as represented by: Environment Canada 2014

Abstract Declining sea ice area in the Canadian Arctic has gained significant attention with respect to the prospect of increased shipping activities. To investigate relationships between recent declines in sea ice area with Arctic maritime activity, trend and correlation analysis was performed on sea ice area data for total, first-year ice (FYI), and multi-year ice (MYI), and on a comprehensive shipping dataset of observed vessel transits through the Vessel Traffic Reporting Arctic Canada Traffic Zone (NORDREG zone) from 1990 to 2012. Links to surface air temperature (SAT) and the satellite derived melt season length were also investigated. Between 1990 and 2012, statistically significant increases in vessel traffic were observed within the NORDREG zone on monthly and annual time-scales coincident with declines in sea ice area (FYI, MYI, and total ice) during the shipping season and on a monthly basis. Similarly, the NORDREG zone is experiencing increased shoulder season shipping activity, alongside an increasing melt season length and warming surface air temperatures (SAT). Despite these trends, only weak correlations between the variables were identified, although a step increase in shipping activity is apparent following the former summer sea ice extent minimum in 2007. Other non-environmental factors have also likely contributed to the observed increase in Arctic shipping activity within the Canadian Arctic, such as tourism demand, community re-supply needs, and resource exploration trends.

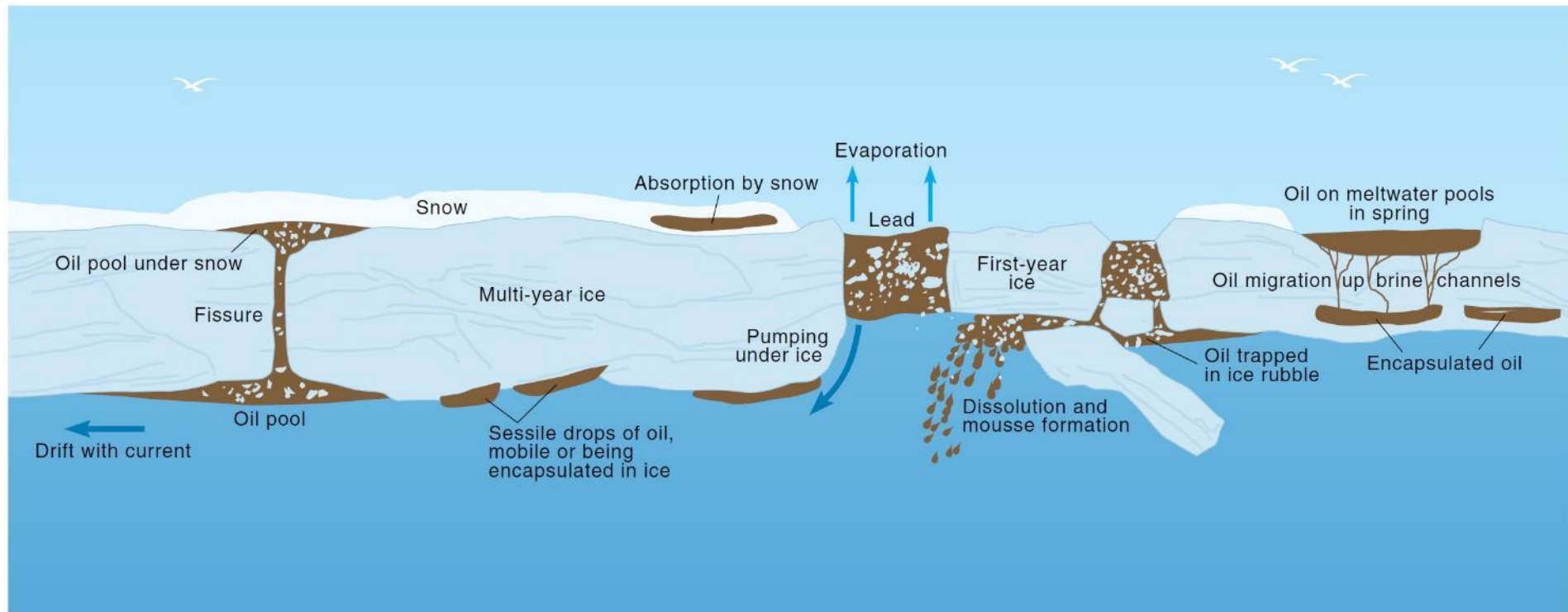
1 Introduction

Two major shipping routes extend through Canadian Arctic waters, the Northwest Passage (NWP), and the Arctic Bridge (Fig. 1). Navigating through the Arctic via the NWP provides an alternative shipping route to the Panama Canal which can potentially result in distance savings.

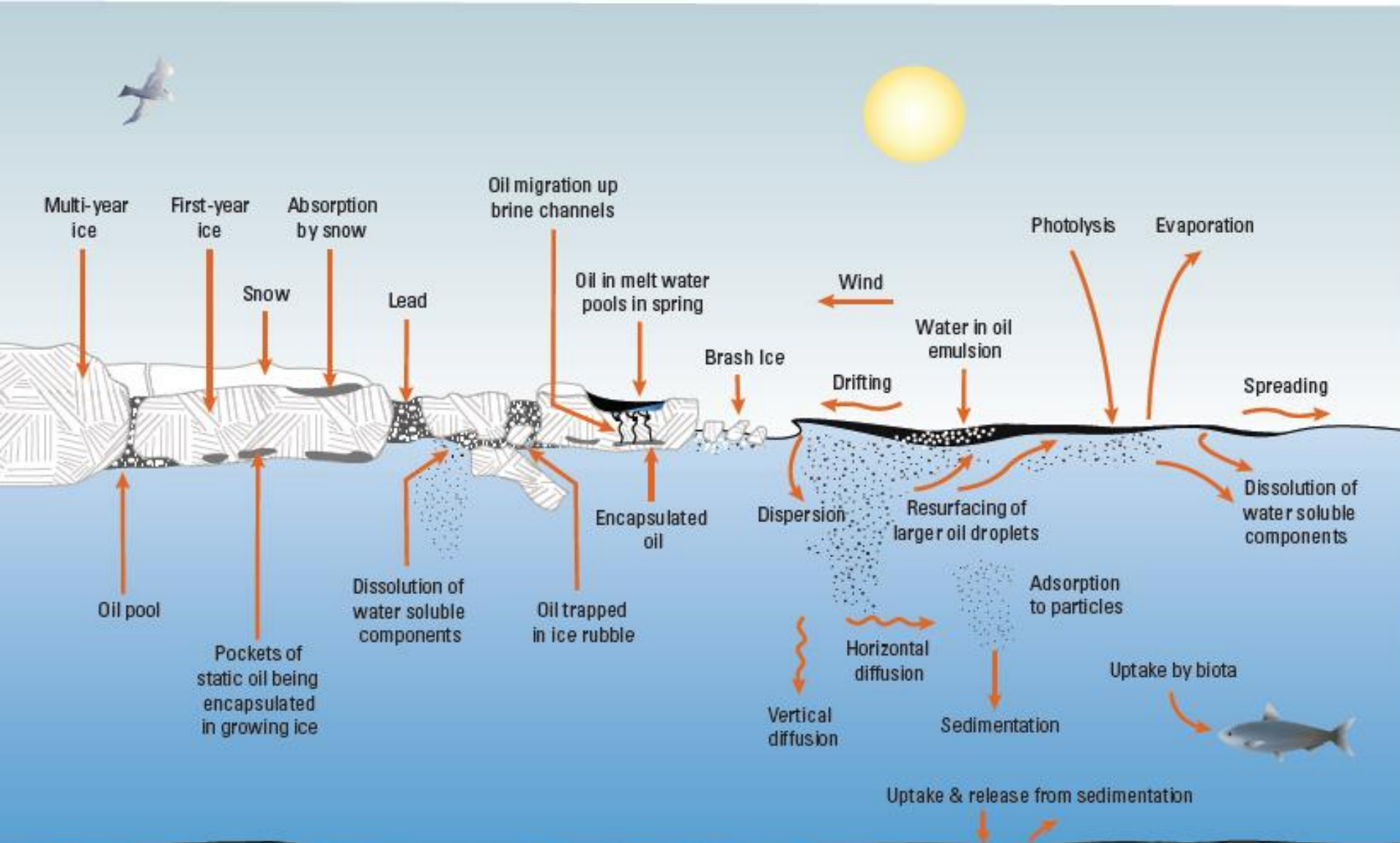
Behaviour of Oil in Sea Ice

- ▶ Currently, Canada has a world-leading system to ensure that ships entering its Arctic waters are capable of safe operations in the ice conditions being encountered (Arctic Ice Regime Shipping System under the regulations of the *Arctic Waters Pollution Prevention Act*).
- ▶ In addition, the National Energy Board completed an extensive review of Arctic offshore drilling practices and regulatory requirements in 2011 and is moving to enact those recommendations and apply them to new development
- ▶ Despite these developments, there are knowledge gaps regarding how to safely increase Arctic development and shipping, and a very limited capacity to respond in the event of a spill.

Behaviour of Oil in Sea Ice

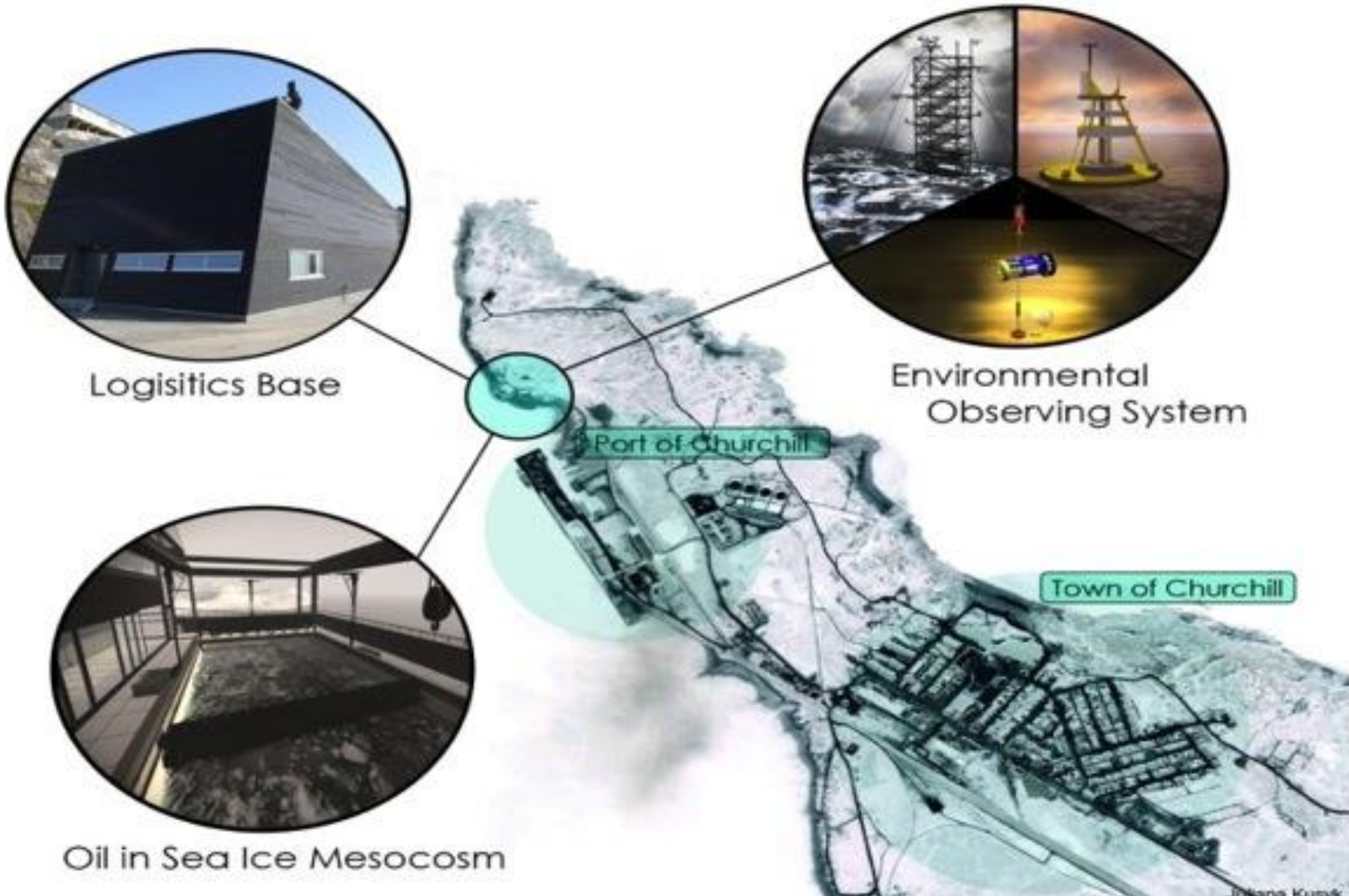


Behaviour of Oil in Sea Ice



SOURCE: Modified from Daling et al. (1990) and A.Allen

The Churchill Marine Observatory (CMO)



The Churchill Marine Observatory (CMO)

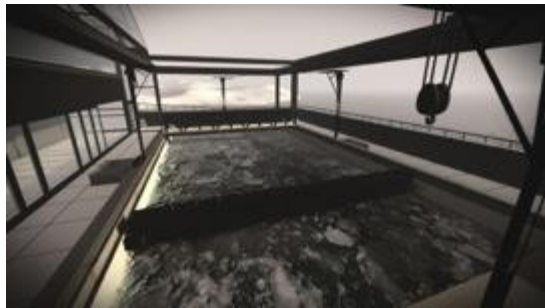


- ▶ Oil in Sea Ice Mesocosm (OSIM)
 - ▶ labs
- ▶ Environmental Observatory (EO)
 - ▶ Atmosphere
 - ▶ Ocean
 - Ecosystem
 - ▶ Contaminants
 - ▶ Freshwater
- ▶ Marina/Wharf
 - ▶ Garage

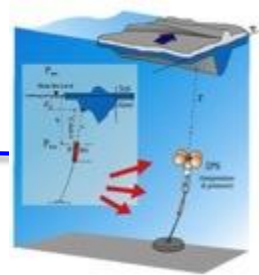


The Churchill Marine Observatory (CMO)

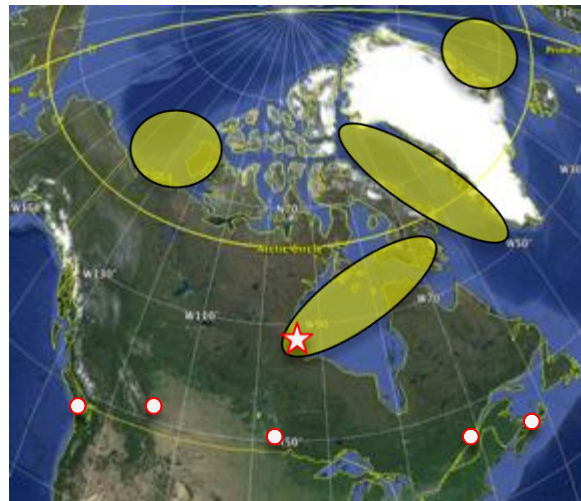
A national centre with an international mandate.



OSIM process studies

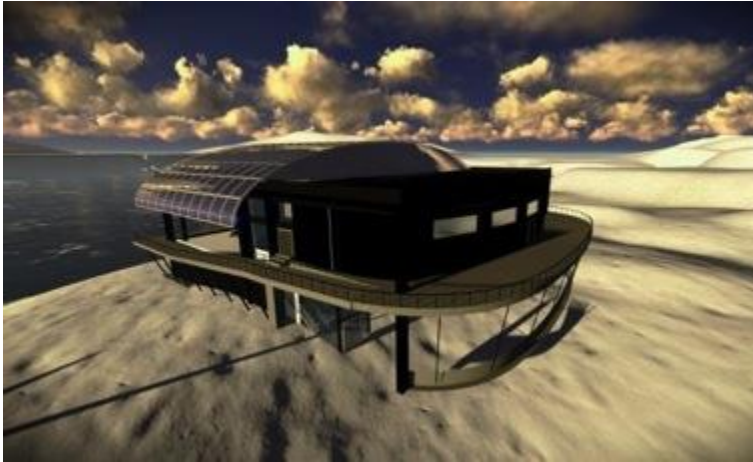


Scaling Arctic wide through EO system, CHARS, and international field programs

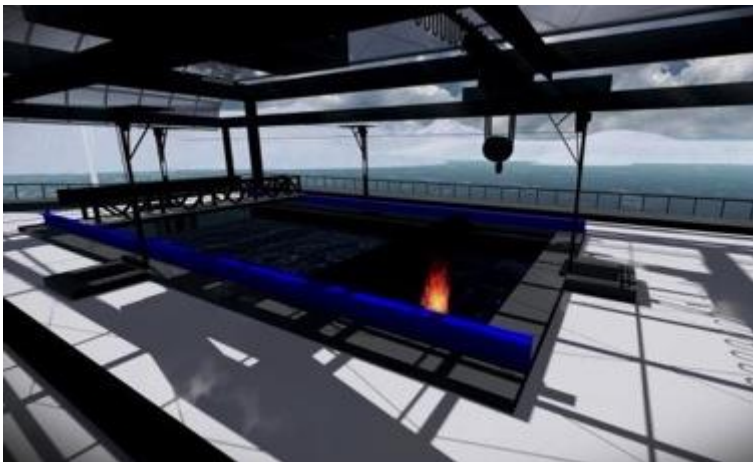


- 170 researchers
- 6 CDN universities
- 10 gov. departments
- 10 private sector
- 4 NGO, co-management

Oil in Sea Ice Mesocosm - OSIM



- ▶ A concept to allow controlled testing of the ocean, sea ice system response to oil, LNG, and contaminants.
- ▶ Science would concentrate on
 - ▶ **Detection** (of oil in sea ice)
 - ▶ **Impacts** (of oil spills on marine ecosystems)
 - ▶ **Mitigation** (of oil spills in sea ice using both genomics-enhanced bioremediation technologies and conventional techniques)



Sea-ice Environmental Research Facility (SERF)



- ▶ First experimental sea-ice facility in Canada
- ▶ Equipped with a movable roof to control snow cover and ice growth, and various sensors and instruments to allow real-time monitoring



Sea-ice Environmental Research Facility (SERF)



- ▶ Polarimetric scatterometer investigation
- ▶ Mobile 'oil tub'

(Photos by Dr. Fei Wang)



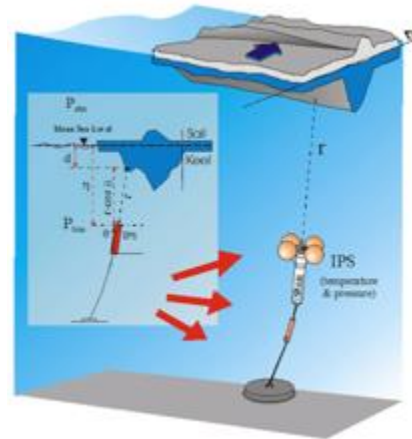
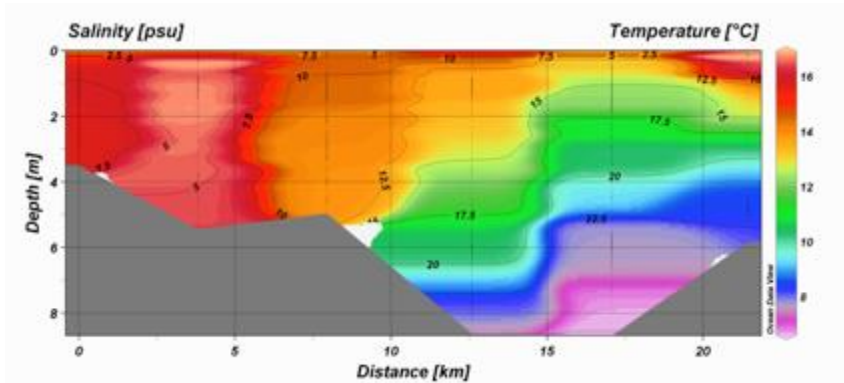
OSIM – Labs

- ▶ Wet, dry, and cold labs would support on-site processing of samples
- ▶ Data Acquisition room for observatories
- ▶ On-site storage facility for equipment.



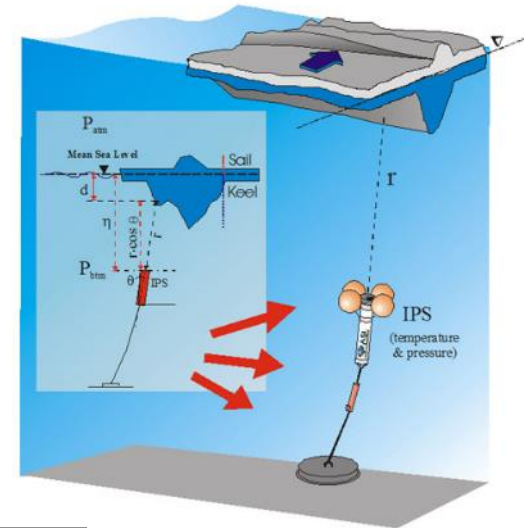
Environmental Observatories (EOs)

- ▶ Estuary
- ▶ Ocean
- ▶ Atmosphere
- ▶ CHARS

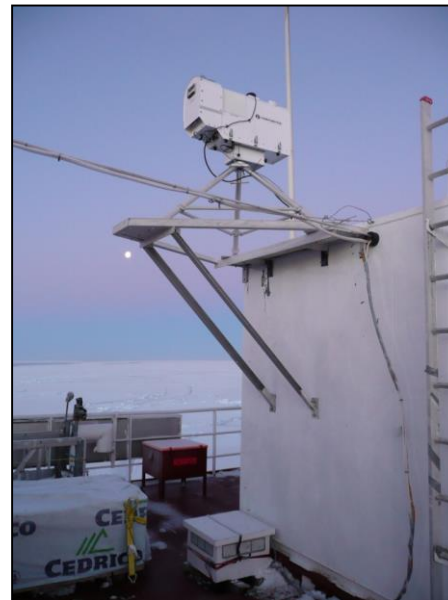


Environmental Observatory (EO)

- ▶ Ocean Observatory
 - ▶ Cable network for real time measurements (CTD, IPS, ice mass balance, ocean fluorescence,....)
- ▶ Atmosphere Observatory
 - ▶ Cable network for real time measurements (atmospheric LiDAR, cloud ceilometers, microwave profiler, ...)
- ▶ Real time satellite calibration



Courtesy:ASL Services



Environmental Observatory (EO)

► Ecosystem Observatory

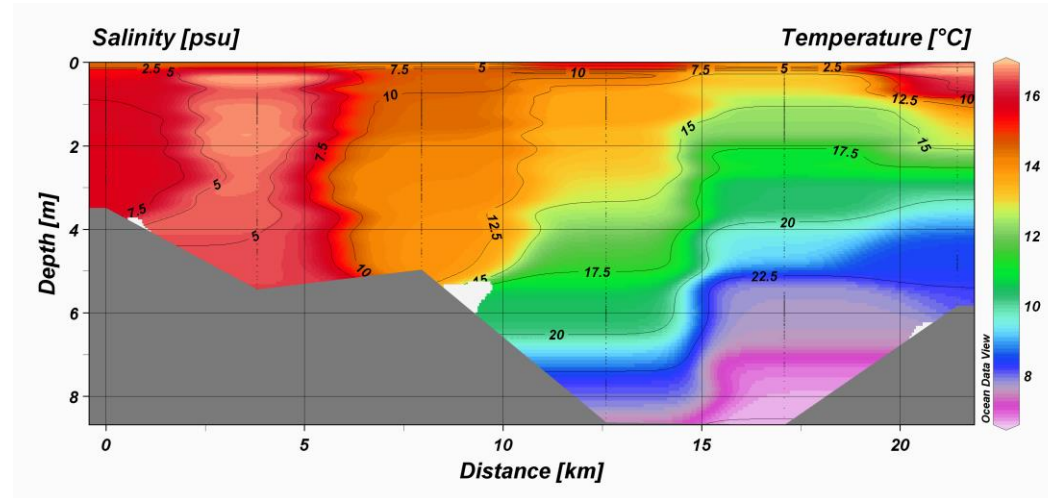
- Whale active acoustic system
- Lower trophic levels

► Freshwater Observatory

- Cable network for real time measurements (turbidity, chlorophyll, nutrients,....)

► Contaminant Observatory

- Cable network for real time measurements (Mercury, POPS, PAHs).

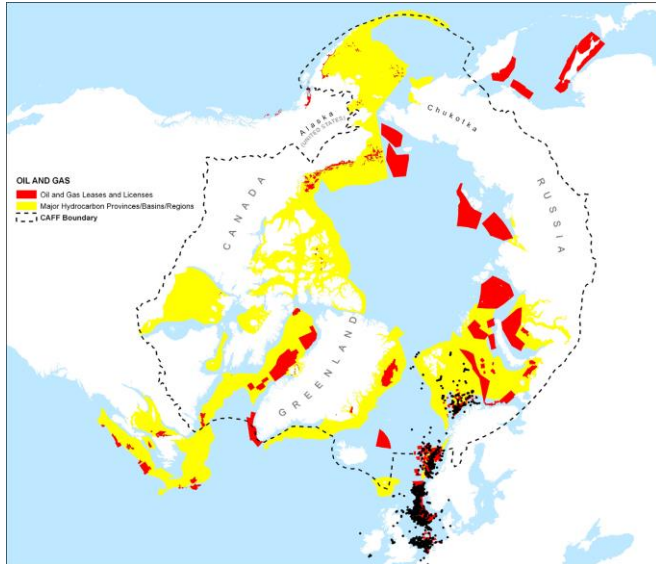


Wharf, Garage, boats, truck, etc.

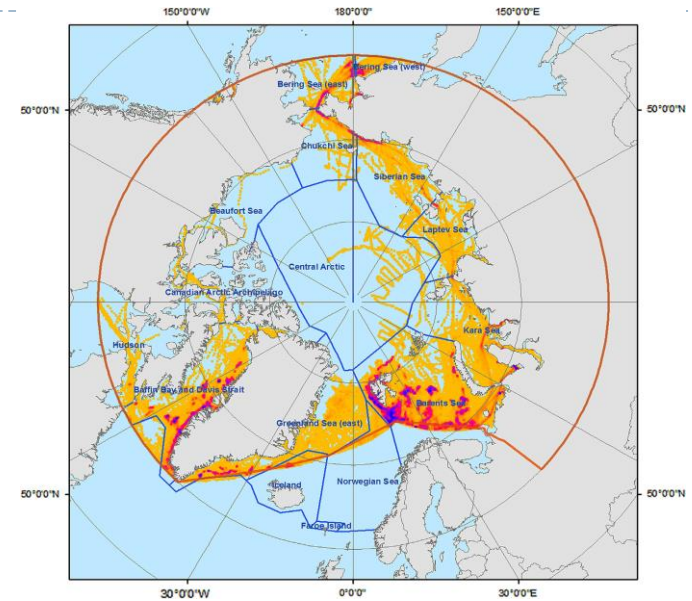
- ▶ A weather-protected site for launching, fueling and mooring of small craft adjacent to the Port wharf
- ▶ Support direct access to estuary, and Bay for collection of samples, maintenance of monitoring equipment
- ▶ Storage and workshop



Scientific integration



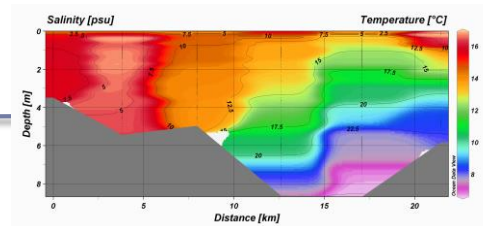
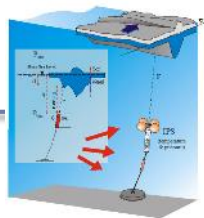
Oil and Gas



Marine Shipping



OSIM process studies



Scaling Arctic wide through EO system and international field programs



Institutional priorities and commitments

▶ Link to priorities

- University of Manitoba: 1 of 3 Signature Areas in new SRP
- University of Calgary: New Earth-Space Technology and Energy Innovation strategic research theme
- University of Victoria: Environment, Oceans and Climate research theme

▶ Commitments

- UM: 3 new tenure-track faculty to support CMO (\$530k pr/yr); 2 technicians based in Churchill; \$30k annual operating cost
- Six collaborating universities: technical support (\$350k pr/yr)

Institutional resources

► UM Facilities:

- Centre for Earth Observation Science
- 77 faculty/research associates/technical and support staff; 50 grad students
- CERC in Arctic Geomicrobiology and Climate Change
- New \$16M Nellie Cournoyea Arctic Research Facility (66,000 sq.ft)

Previous CFI investment:

- SERF (only sea-ice research facility in Canada)
- Amundsen
- Sea ice, meteorology, oceanographic, contaminants

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- Amundsen
- Sea ice, meteorology, oceanographic, contaminants

Principal users

- ▶ Barber, David – P.I. University of Manitoba, Centre for Earth Observation Science
- ▶ Babin, Marcel - Université Laval, Faculté des sciences et de génie
- ▶ Deming, Jody - University of Washington, School of Oceanography
- ▶ Hubert, Casey - University of Calgary, Biological Sciences
- ▶ Mundy, Christopher - University of Manitoba, Centre for Earth Observation Science
- ▶ Rysgaard, Søren - University of Manitoba, Geological Sciences
- ▶ Shafai, Lotfollah - University of Manitoba, Electrical and Computer Engineering
- ▶ Stern, Gary - University of Manitoba, Centre for Earth Observation Science
- ▶ Wang, Feiyue - University of Manitoba, Environment and Geography
- ▶ Yackel, John - University of Calgary, Geography

Anticipated Outcomes

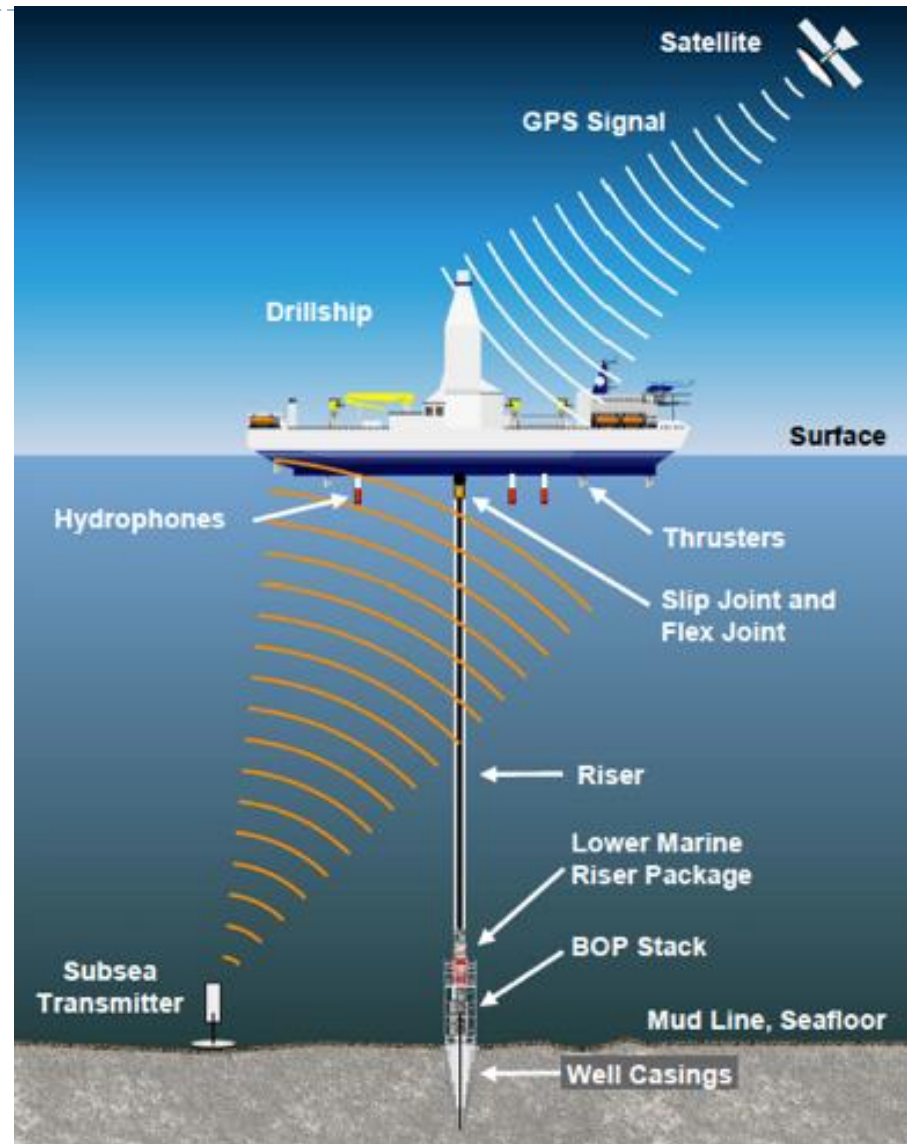
- ▶ The CMO is proposed as a national facility, serving national and international needs
- ▶ Gathering over 170 researchers from six Canadian universities, three international universities (Aarhus, Denmark; Greenland Climate Research Centre, Greenland; and University of Washington, Seattle, Washington),
- ▶ 10 government departments, and 10 private sector partners.
- ▶ This facility will present an exceptional opportunity to train a new generation of experts on Arctic sustainable development.

Anticipated Outcomes

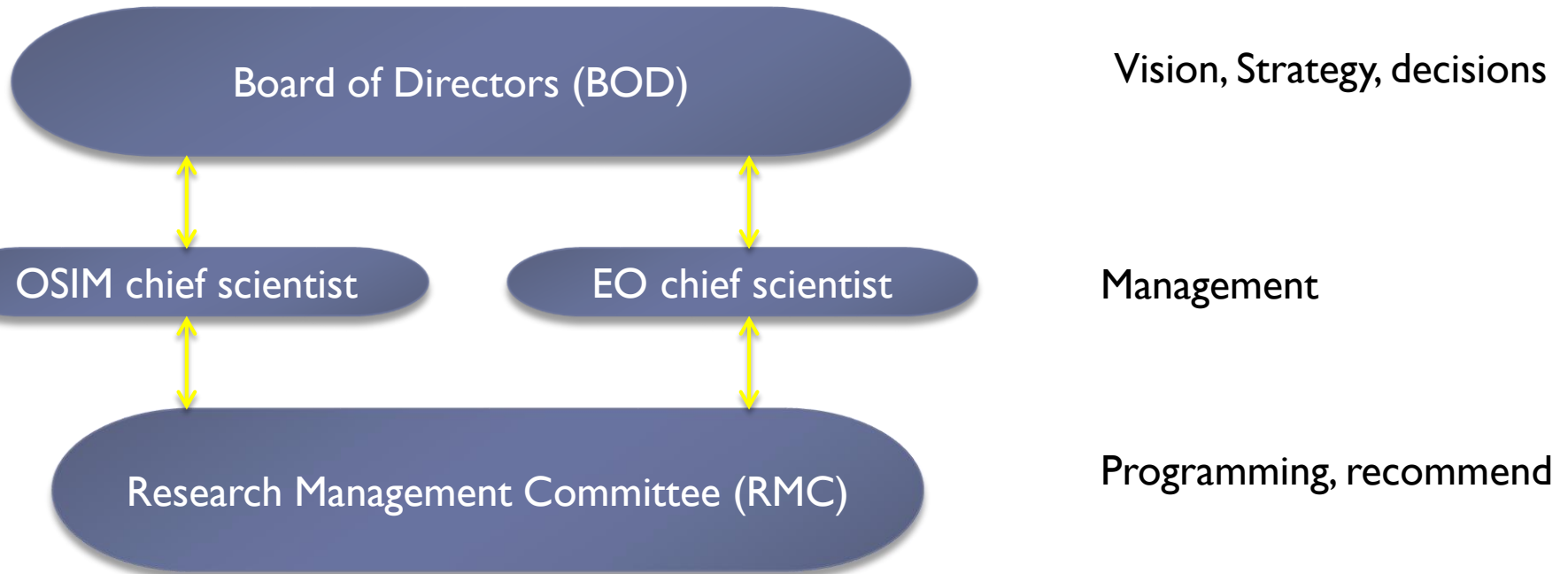
- ▶ CMO will lead direct integration of industry, government and academic interests, and ensure an ability to forge and foster productive, value-added partnerships within and among institutions, sectors and disciplines.
- ▶ Industry and government members of a CMO Board of Directors will be able to capitalize on scientific knowledge from academic members, allowing them to commercialize technologies and techniques first developed in CMO.
- ▶ Pre-competitive research will focus around detection, impacts and mitigation of oil in ice technologies.

Partnerships:

- Industry
- Government
- Inuit (ICC, FJMC)
- National
- International
- BOD



Management:

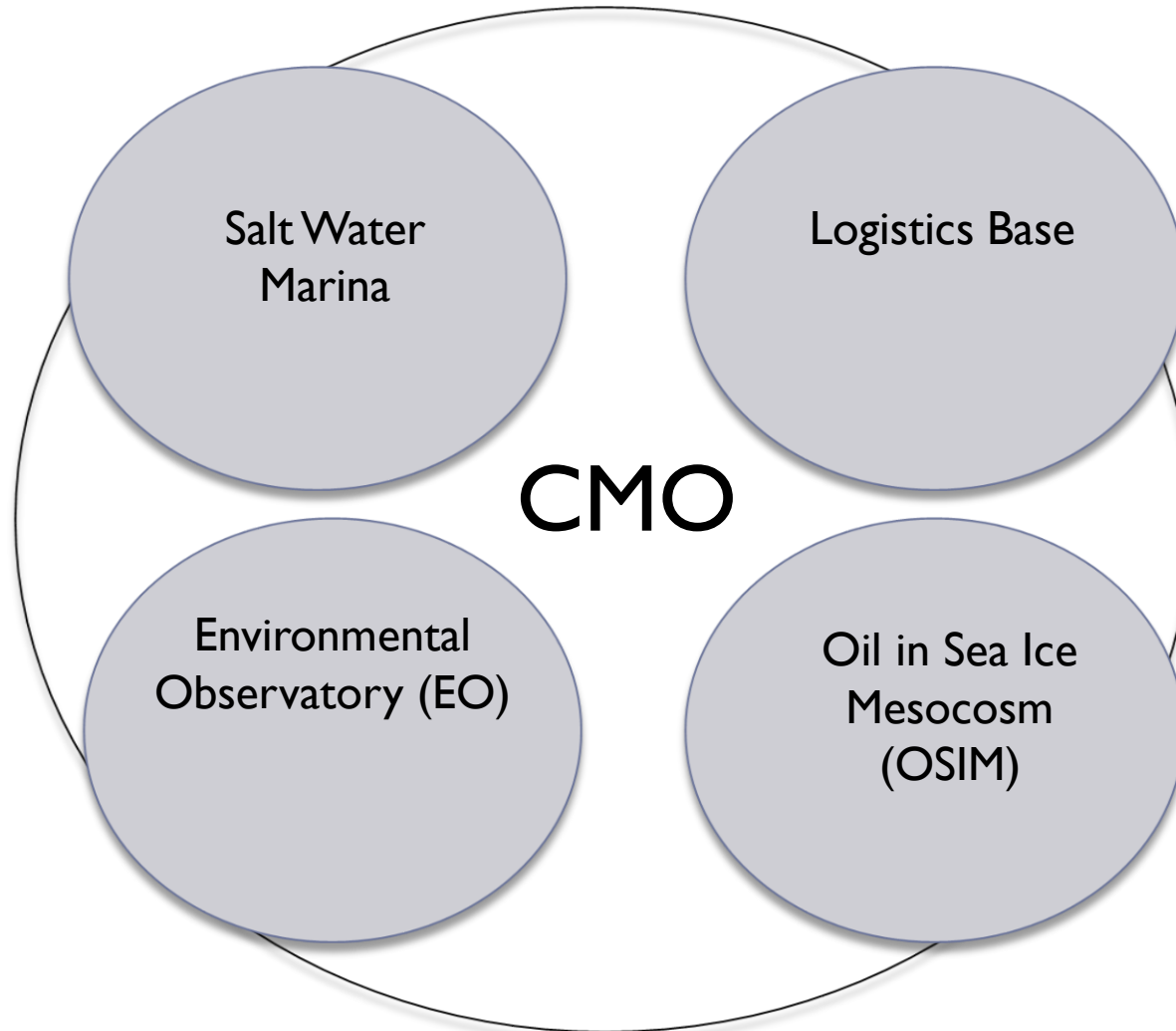


Why this is a good investment for Canada:

- Track Record
- Operating costs
- International
- Economy
- Policy regulation
- Sustainability



CMO – Funding envelopes



40 – 40 – 20 funding model



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Management and Operations of the CMO

- ▶ **Endowment fund**
 - ▶ Endowed Chairs
 - ▶ Two technical support staff In Churchill
- ▶ **NSERC Industrial Chairs**
 - ▶ Three chairs
 - ▶ Three technical support staff In Churchill
- ▶ **Indirect costs from CFI**
 - ▶ Five technical staff at CEOS (5 years only)
- ▶ **User fees (OSIM)**
 - ▶ Technical support staff and instrument maintenance
 - ▶ \$X per week

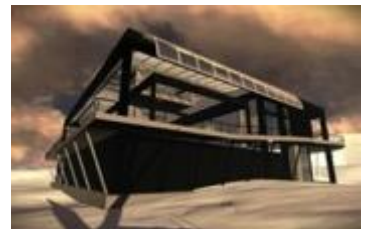
University Partners

- University of Manitoba (lead)
- University of Calgary
- Memorial University
- Victoria (Oceans Network Canada)
- UQARimouski
- Laval

Eight Compelling Arguments:

The CMO will:

1. provide leading edge transformative research
2. invent ground-breaking technologies
3. assist companies to innovate through science
4. train the next generation of HQP
5. assist Inuit, governments and industry in regulation and co-management
6. be led by a team with international excellence and a proven track record
7. provide significant scientific, technological and economic benefits for Canada
8. be globally unique

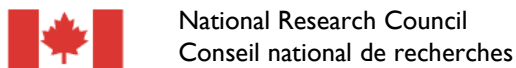
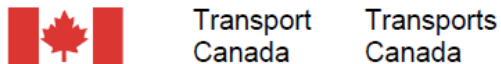


The Churchill Marine Observatory (CMO)

Current Issues:

1. Finalizing partnership funding
 - a. CHARS, Denmark, Laval, Dalhousie, equip matches, ARF, IRC's, EO position (completed)
 - b. Provincial matches (in process)
2. Environmental Assessment (MB to determine)
3. RFP for build (in process)
4. Omnitrax role minimized but not removed (Access to Estuary for Dock/Utilidor, coastal ship).
5. Road access and power to site (in process)
6. Community Engagement and announcement
7. Build-start May-Oct 2016; complete 2017

Role of Potential Partners



Thank you

Questions welcome



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