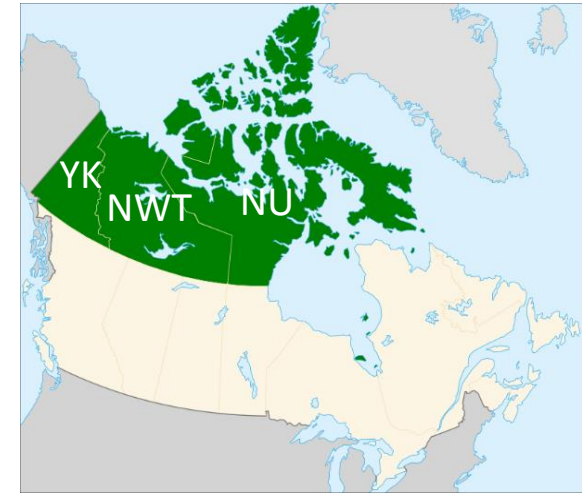


Overview of Research in the Canadian Arctic

David Fissel, Chair, CMOS Arctic Special Interest Group

Background and History

- Canada has more Arctic land mass than any other country
- Canada has the world's longest coastline (202,080 km); two thirds of this is in the Arctic
- As of 2017, approximately 120,975 Canadians live in the Arctic Territories
- The majority of these Canadians are Indigenous Peoples (Inuit and Inuvialuit)
- Canada's Arctic land is included within the administrative regions of the Northwest Territories (NWT), Nunavut (NU), and Yukon (YK)
- History of Canadian Arctic Research (Highlights):
 - Canadian Arctic Expedition: 1913-1918
 - International Geophysical Year was an international scientific project that lasted from July 1, 1957, to December 31, 1958
 - creation of the Polar Continental Shelf Project in 1958
 - International Polar Year (IPY) (2007-2008)
- Research Impetus from Climate Change in the Arctic
- Present Research: Government Labs,



Universities, Private and Non-Profit Organizations



Arctic Research (Government)

Polar Knowledge Canada (PKC)

Polar Knowledge Canada (POLAR) is responsible for:

- advancing Canada's knowledge of the Arctic,
- strengthening Canadian leadership in polar science and technology, and
- promoting the development and distribution of knowledge of other circumpolar regions, including Antarctica.

POLAR operates the **Canadian High Arctic Research Station (CHARS)** campus and conduct world-class cutting edge Arctic research out of this extraordinary facility.

A separate presentation on Polar Knowledge Canada will follow:

“Polar Knowledge Canada - Advancing Knowledge for a Better Tomorrow”

By Jennifer Sokol, Senior Policy Analyst, PKC

Arctic Research (Government)

Natural Resources Canada

Geological Survey of Canada - Representative Arctic Research Projects:

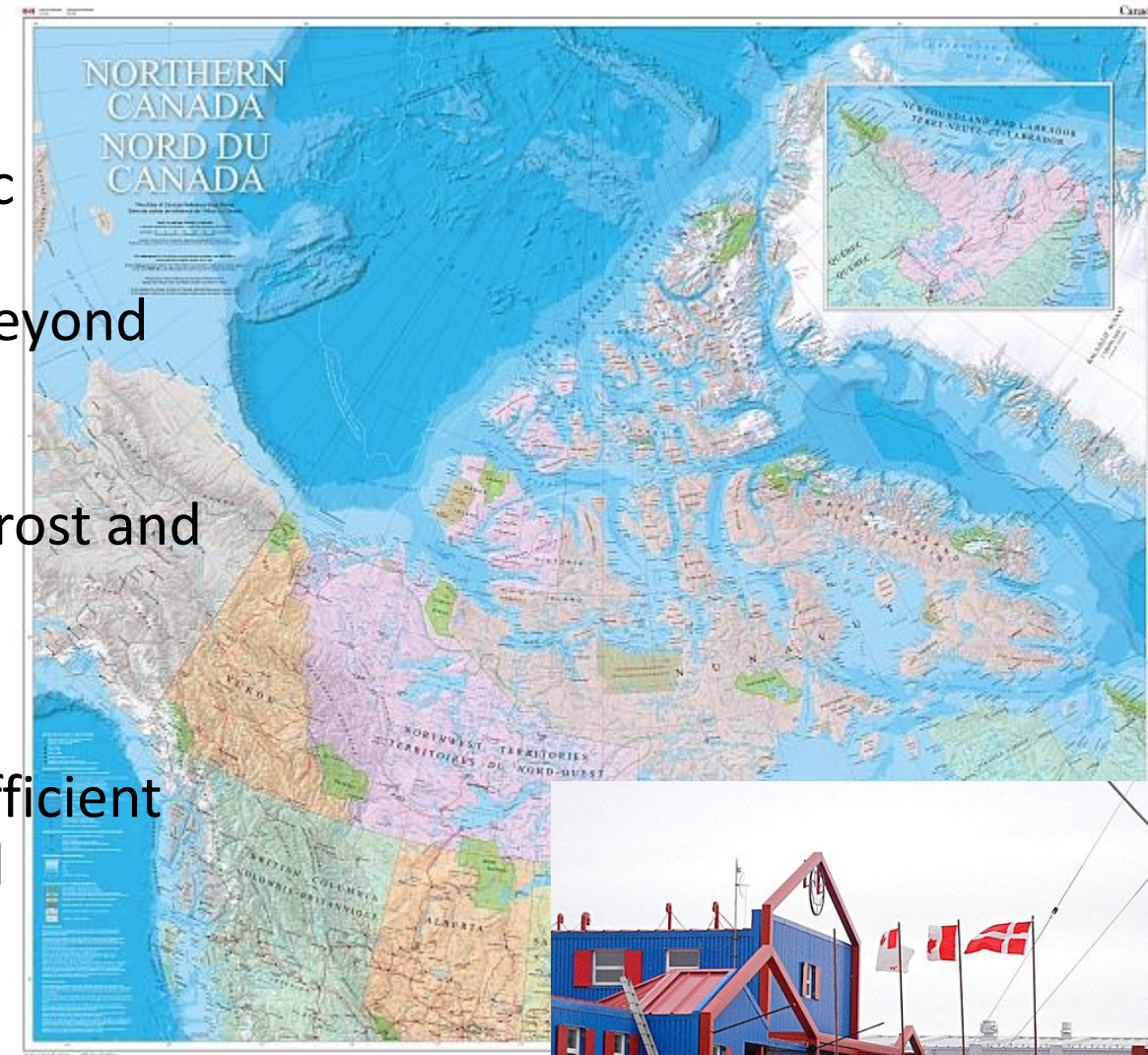
Claim for Extension of Canadian Continental Shelf beyond 200 nm (UNCLOS)

GEM: Geo-mapping for Energy and Minerals

Melting Glaciers, Rising Sea Levels, Thawing Permafrost and Unpredictable Groundwater Levels

Coastal Erosion in the Canadian Beaufort Sea

Polar Continental Shelf Program - providing safe, efficient and cost-effective logistics in support of science and Government priorities



Arctic Research (Government)

(just released) **Canada's Changing Climate Report:**

Focus on Arctic Changes – 2-3 times larger than in southern regions of Canada

www.nrcan.gc.ca/canadas-changing-climate-report/21177

Environment and Climate Change Canada

Arctic Research is Conducted Through:

- Meteorological Service of Canada (for weather and climate forecasting and research)
 - Recherche en Prévision Numérique (RPN) – Research in Numerical Prediction
 - Canadian Centre for Climate Modelling and Analysis (CCCma) – Development of Advanced Climate Models
 - Canadian Ice Service: mission is to provide the most timely and accurate information about ice in Canada's navigable waters.
 - Developed North American Node of WMO Arctic Regional Climate Centre Network (ArcRCC-Network)
- Science and Technology Branch: Atmospheric and Climate Science

Ouranos – Quebec: *Consortium on regional climatology and adaptation to climate change*



Arctic Research (Government)

Fisheries and Oceans Canada (DFO)/ Canadian Coast Guard

Arctic Research Conducted within three DFO Regional Scientific Research Centres:

- Maritime Region – Bedford Institute of Oceanography, Dartmouth, NS
- Central and Arctic Region – Freshwater Institute, Winnipeg MB
- Pacific Region – Institute of Ocean Sciences, Sidney BC
- Arctic Region (established October 2018) based in Rankin Inlet NU and Yellowknife NWT.
(DFO is the first department in the federal government to recognize the Arctic as a separate region comprising of the four areas of the Inuit Nunangat lands)
- In August 2018, the Government of Canada awarded a contract for the purchase of 3 icebreakers to ensure ongoing research capabilities in the decades to follow.

Arctic Research (Government)

Department of National Defence (DRDC)

- Defense Research and Development Canada (DRDC) All-Domain-Situational Analysis
- launched in June 2017, commits Defence to increasing focus on the Arctic, to produce innovative solutions to surveillance challenges in the North.
- In recent years (2010-present), DRDC (and other groups) are developing surveillance system to monitor Arctic waters for underwater threats and targets.
- Dr. Garry Heard, a veteran DRDC researcher: “We need to know who is travelling in Canada’s Arctic.”

National Research Council of Canada

Researching the effects of ice and waves on ships, structures and shorelines from:

- Ocean, Coastal and River Engineering Research Centre, Ottawa ON
- Institute for Ocean Technology, St. John’s NL

Arctic Research (Government)

Northern Contaminants Program

*Indigenous Relations and Northern Affairs Canada**
1991-present

Environmental Monitoring and Research

- Monitor contaminant levels and trends in the Arctic environment.
- Research into environmental change on levels and trends of Arctic contaminants
- Conduct research into the effects of contaminants on the health of Arctic ecosystems.
- Support the assessment of human health risks using information on levels and trends of contaminants in traditional/country foods.
- Support, through collaboration and mentorship, projects that are funded under Community Based Monitoring and Research, and other NCP subprograms.
- Produce scientific information supporting domestic and international chemical management initiatives.

* *Crown-Indigenous Relations and Northern Affairs Canada (effective July 2019)*

Arctic Research (Government)

Nunavut Territory

Nunavut Research Institute
Nunavut Arctic College

Northwest Territories

Aurora College (Inuvik, Fort Smith and Yellowknife)

Research Conducted within Regions: Inuvik, Sahtu, Dehcho, North Slave and South Slave
through Regional Organizations: example Inuvialuit Regional Corporation Programs



Yukon Territory

Government of Yukon Supports 9 Yukon Research Facilities, examples are Beaver Creek Permafrost Test Site and Kluane Lake Research Station
Yukon College, Whitehorse, YK

The University of the Arctic (UArctic)

a cooperative network of universities, colleges, and other organizations committed to higher education and research in the North. Members share resources, facilities, and expertise to build and offer post-secondary education programs that are relevant and accessible to northern students.

Arctic Research (Indigenous)

Inuit Tapiriit Kanatami



Inuit Tapiriit Kanatami (ITK, formerly the Inuit Tapirisat of Canada) was founded in 1971. It is the national organization representing and promoting the interests of Canada's Inuit in a wide variety of environmental, social, cultural, and political issues and challenges.

www.itk.ca

Research

ITK carries out and oversees research that informs federal agencies, lawmakers and other stakeholders about the status of Inuit as well as the effectiveness of current programs.

ITK research helps ensure that federal agencies and others are informed about:

- the issues important to the Inuit, and
- that policies or interventions impacting Inuit are effective and based on evidence.

UNIVERSITIES AND RESEARCH INSTITUTES
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 UNIVERSITÉS ET INSTITUTS DE RECHERCHE

Aarhus University	Institut national de la recherche scientifique	Takuvik	University of Hawaii
Alfred Wegener Institute	Institut polaire français Paul-Ernile Victor	Trent University	University of Manitoba
Aurora Research Institute	Marine Research Institute of Iceland	Université de Montréal	University of Notre Dame
Cape Breton University	McGill University	Université du Québec à Montréal	University of Ottawa
Carleton University	Memorial University of Newfoundland	Université du Québec à Rimouski	University of Saskatchewan
Centre d'études nordiques	Nasivvik Centre for Inuit Health and Changing Environments	Université du Québec à Trois-Rivières	University of the Sunshine Coast
Centre de recherche du Centre hospitalier de l'Université Laval	Nord University	Université Laval	University of Toronto
Centre for Earth Observation Science	Nunavik Research Centre	University of Aberdeen	University of Victoria
Centre national de la recherche scientifique	Nunavut Arctic College	University of Alaska Fairbanks	University of Waterloo
Dalhousie University	Nunavut Research Institute	University of Alberta	University of Windsor
Greenland Institute of Natural Resources	Ontario Veterinary College	University of British Columbia	University of Winnipeg
Groupe international vétérinaire	Québec-Océan	University of Calgary	Wilfrid Laurier University
Institut de recherche en biologie végétale	Queen's University	University of Georgia	Yukon College
		University of Guelph	
		University of Hamburg	

Since 2004

ArcticNet

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Network of Centres of Excellence (NCE)

Université Laval, Québec, Quebec (\$146.2 million for 2003-24);

Many other universities

ARCTICNET is an Academic-Inuit-Government-Industry research effort aimed to help cope with the impacts and opportunities brought by climate change and globalization in the Arctic

ArcticNet

CORE RESEARCH PROGRAM

Marine and Terrestrial Systems



Health and Education



Policy and Development



Renewed for a 5 years
\$32.5M CA (2019-24)



Arctic Blue Economy Partnerships



Knowledge Exchange

ArcticNet
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Research In the North by the North for the North

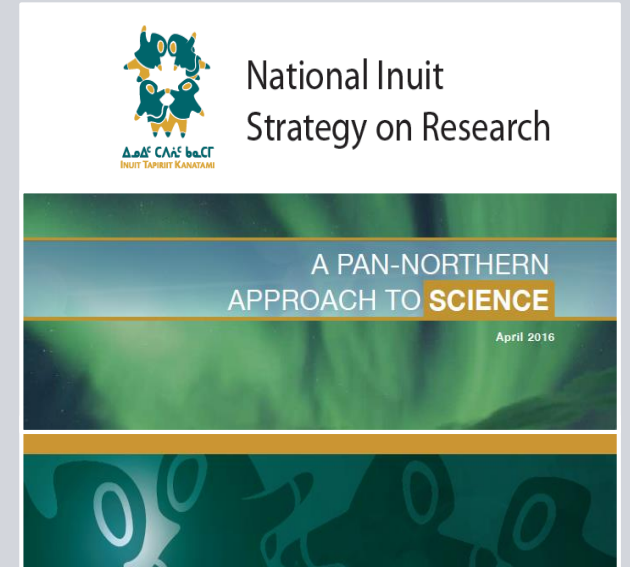
To establish a Northern-led research and innovation network generating and mobilizing knowledge to improve long-term Inuit health and well-being

NORTHERN COLLEGE-LED PROGRAM



Catalyzing training, education, and science capacity

INUIT-LED PROGRAM



Supporting the National Inuit Strategy on Research

AMUNDSEN SCIENCE



- Coordinate the access to the research icebreaker **CCGS Amundsen** for science
 - 152 dedicated science days / year
 - 40 scientific berths
 - Multidisciplinary missions
- Provide logistical, technical and financial support to user programs
- Maintain and develop the CCGS Amundsen's pool of scientific equipment (\$45M in oceanographic instruments)
- \$22.7M CAD (2017-2023) from the Canada Foundation for Innovation



UNIVERSITÉ
DE QUÉBEC

UNIVERSITÉ
DE LAVAL

Amundsen Science Ship-Time Subsidies

- Supplemental financial support (matching funds) for Canadian-international academic programs
- Can provide up to a maximum of 60% of the total program funding for ship time as of 2020
- Ship-time application deadline: 30 September of any given year to join the expedition the following year

**AMUNDSEN
SCIENCE** ▼



amundsen.ulaval.ca
info@as.ulaval.ca

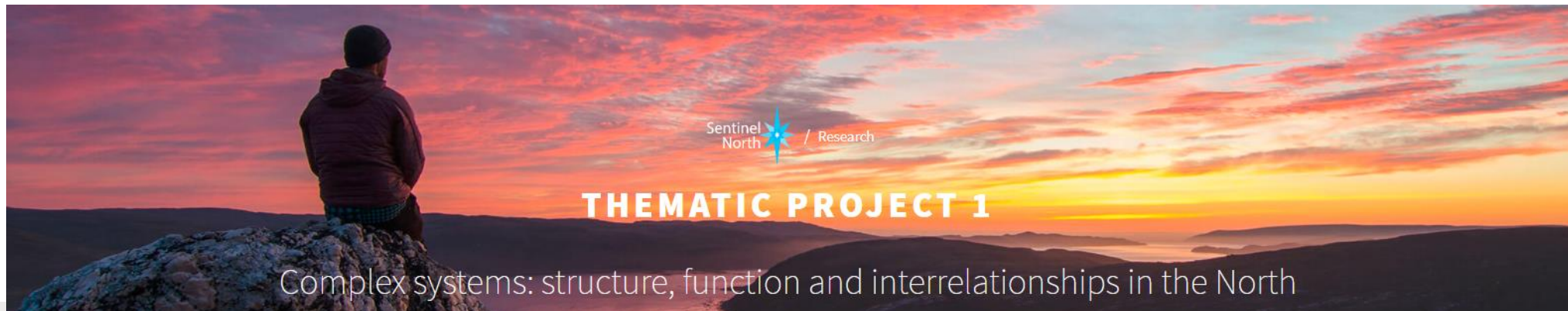
Arctic Research (Universities)

Leading Operational Observations and Knowledge for the North – LOOKNorth (CECR)

St. John's, Newfoundland and Labrador
(\$20.6 million for 2011-23)

Sentinel North - Canada First Research Excellence Fund Université Laval

research to develop innovative new technology, train the next generation of transdisciplinary researchers and improve our understanding of the northern environment and its impact on human beings and their health.



Arctic Research (Universities) ***Marine Environmental, Observation, Prediction and Response Network – MEOPAR (NCE)***

*Dalhousie University, Halifax, Nova Scotia (\$53.5 million for 2012-22);
Many other universities*

Strengthening Canadian Resilience
And Economic Opportunity In The
Changing Marine Environment

57

RESEARCH
PROJECTS

256

HIGHLY QUALIFIED
PERSONNEL

174

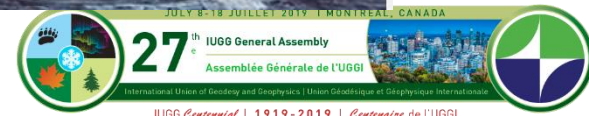
GOVERNMENT,
INDUSTRY & NGO
PARTNERS



CMOS-SCMO

Canadian Meteorological and Oceanographic Society
Société canadienne de météorologie et d'océanographie

CMOS Arctic Special Interest Group – Annual Meeting – Jul. 2019



Arctic Research (Universities) – Climate & Atmospheric Sciences

Major Representative Projects to 2017

Canadian Sea Ice and Snow Evolution Network (CanSISE.ca)

Principal Investigator: Paul Kushner, University of Toronto

Research Related to the Polar Environment Atmospheric Research Laboratory (PEARL): Probing the Atmosphere of the High Arctic

Principal Investigator: James Drummond, Dalhousie University

Ventilation, Interactions and Transports Across the Labrador Sea (VITALS)

Principal Investigator: Paul Myers, University of Alberta

Canadian Network for Regional Climate and Weather Processes

Principal Investigator: Laxmi Susham, Université du Québec à Montréal

Changing Cold Regions Network (CCRN)

Principal Investigator: Howard Wheeler, University of Saskatchewan

Arctic Research (Universities) – Cont'd

Canada 150 Research Chair

- Julienne Stroeve, Canada 150 Chair in Climate Sea Ice Coupling, University of Manitoba

Canada Excellence Research Chairs – Selected Examples

- Marcel Babin, CERC in Remote Sensing of Canada's New Arctic Frontier, Université Laval
- Søren Rysgaard, CERC in Arctic Geomicrobiology and Climate Change, University of Manitoba
- Dorthe Dahl-Jensen, CERC in Arctic Ice, Freshwater Marine Coupling and Climate Change, University of Manitoba

Canada Research Chairs (CRC) – Selected Examples:

- David Barber, CRC in Arctic-System Science, University of Manitoba
- Louis Fortier, CRC in Arctic Marine Ecosystems and Climate Change, Université Laval
- Rachel Chang, CRC in Atmospheric Science, Dalhousie University, Halifax NS
- Oliver Sonnentag, in Atmospheric Biogeosciences at High Latitudes, Université de Montréal
- Feiyue Wang, CRC in Arctic Environmental Chemistry, University of Manitoba
- Guillaume St-Onge, CRC in Marine Geology, Université du Québec à Rimouski
- Christophe Kinnard, CRC in Cryospheric Hydrology in Université du Québec à Trois-Rivières
- Philip Marsh, CRC in Cold Regions Water Science, Wilfrid Laurier University

Arctic Research (Other) – Presentation by Ryan Flagg

Ocean Networks Canada

Canada Foundation for Innovation (CFI) Major Science Initiative, *University of Victoria,*

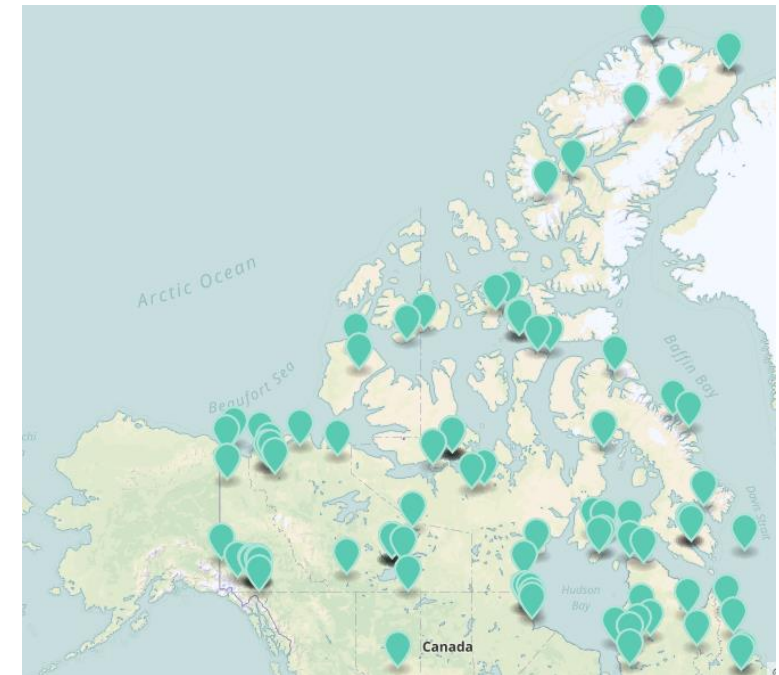
- *Cambridge Bay NU Community Observatory, 2012 – present*
- *Arctic Drifter Buoys (with DFO)*

Canadian Network of Northern Research Operators

A network of research support facilities providing specialized technical services to these sectors:

- academic,
- government, private
- international scientific research

Member facilities provide the know-how and infrastructure that make research possible in Canadian Arctic and sub-Arctic regions.



Arctic Research (Other)

Environmental Non-Governmental Organizations

World Wildlife Fund

World Wildlife Fund Canada is Canada's largest international conservation organization.

Offices in Victoria, Toronto, Ottawa, Montreal, Halifax, St. John's, Iqaluit and Inuvik.

Other Organizations

Oceans North (oceansnorth.org/en/)

Bellona Foundation

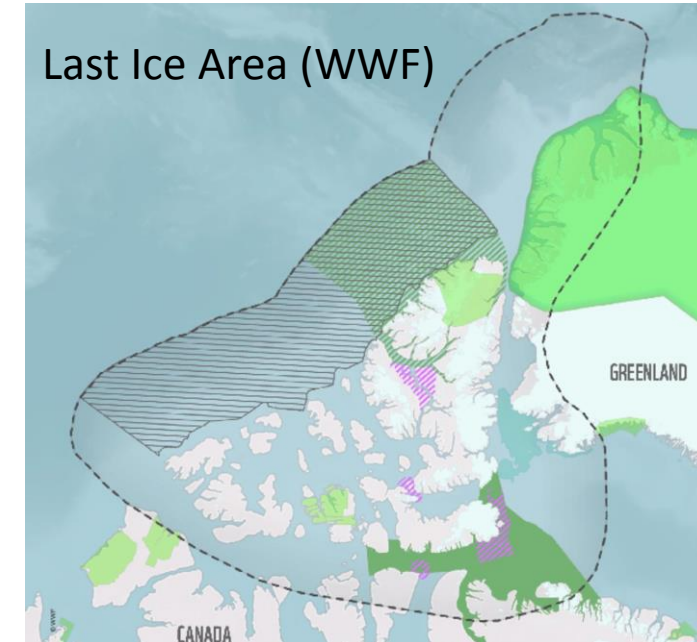
Canadian Arctic Resources Committee

Canadian Parks and Wilderness Society: CPAWS

Climate Action Network

Greenpeace Canada

Sierra Club Canada Foundation
and Others...



ARCTIC SHIPPING



Learn about WWF's work on **Arctic shipping**.

Arctic Research (Other) ***Canadian Ice, Ocean Science & Technology and Engineering Companies***

Ice, ocean, atmospheric technologies, Maritime services

ASL Environmental Sciences Inc.

BMT Fleet Technology

Campbell Scientific Canada Corporation

Canatec Associates International Ltd.

C-CORE

CIDCO

Enfotec Technical Services Inc.

Info-Electronics Systems Inc.

Innovation Maritime

Kongsberg Digital Simulation Ltd.

LR Tech

Martech Polar Consulting Ltd.

PAL Aerospace

Rockland Scientific Ltd.

Rutter Inc.

Seaformatics

SL Ross Environmental Research Limited

Vard Marine Inc.

Virtual Marine Technology - and Others...

SubC Imaging Inc.

SULIS Subsea Corporation

Ultra Electronics Maritime Systems Inc.

Northern infrastructure, engineering and design

ATCO

BGC Engineering Inc.

Challenger Geomatics Ltd.

EVOQ

Flexiport Mobile Docking Structures Inc.

Golder Associates Ltd.

Lateral Office

LFL Group

Nuna Innovations Inc.

Qikiqtaaluk Corporation

Sayle Group Inc.

SoilVision Systems Ltd.

Sprung Structures

Stantec Consulting Limited

WorleyParsons Group

and Others...

Summary of Canadian Arctic Research

- Canada Occupies a Vast Area within the Arctic Region of Earth
- Extensive Arctic Research Activities for over 100 years
- Conducted by Government Research Groups, Universities, Non-Profit and Private Organizations
- Much International Collaboration with Opportunities to Do More

