UNIVERSITY OF MANITOBA

CANADA FOUNDATION FOR INNOVATION
Innovation Fund

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Notice of Intent

1. Completed NOIs must be submitted by the Associate Dean (Research)/Research Liaison Officer of the "Lead" Unit to the Office of Research Services to: Birtukan.Gebretsadik@umanitoba.ca by May 15, 2018.

Proposed name of project: Community based research in support of freshwater-marine coupling and climate change in the Canadian Arctic (CBR-Arctic).	**Estimated Total Project Costs:** $9.8M

Designated Project Leader/Faculty/Dept: Dorthe Dahl-Jensen **CV:** x

List Principal Users/Faculty/Dept:

1. Julienne Stroeve CV: x
2. Soeren Rysgaard CV: x
3. Igor Dmitrenko CV: x
4. Tim Papakyriakou CV: x
5. Zou Zou Kuzyk CV: x
6. Jens Ehn CV: x

'Lead' Unit ADR/RLO:

Name: David Barber, ADR CHR Faculty of Environment Earth and Resources

Briefly describe (max 2 page, 12 pt. font size, 2 cm margins):

- The proposed research and how it is world-class, innovative and demonstrates clear benefits to Canada.
- The infrastructure and how it will enhance the University's existing research capacity.
- The excellence of the team, including expertise and existing collaborations necessary to conduct the proposed research.
- Plans to secure matching funds and the potential funding sources for the operation and maintenance of the infrastructure.

Freshening of the Arctic Ocean is part of an intensification of the global hydrological cycle. Associated changes include declines in sea ice, ice caps and glaciers (McClelland et al. 2006; Rignot et al. 2011; Bamber et al. 2012; Stroeve et al. 2012), and increased freshwater (FW) inflow from circumpolar rivers (*e.g*. Déry et al. 2016). Freshwater in the Arctic Ocean underpins physical, biological and biochemical processes that define the ocean's thermodynamic setting, regulates the marine ecosystem, and can initiate complicated feedbacks further affecting the biological and climate systems over a wide range of spatial and temporal scales (*cf.* Carmack et al., 2016). Inuit and other northern Indigenous peoples are concerned about the rapid rate of change they are witnessing, particularly in the coastal marine environment, as these changes threaten traditional ways of life, adaptation strategies, food security and food industries, safe marine transportation, ecotourism, and the sustainable development of extractive and hydroelectric industries. It is therefore of utmost importance that northerners are meaningfully involved in scientific studies that seek to address the fundamental questions about Arctic freshening and environmental change.

To address these needs, infrastructure is requested to support Community-Based Research in Arctic regions (hereinafter **CBR-Arctic**) that will investigate the causes and impacts of freshening. CBR-Arctic will provide critical scientific infrastructure to two regionally-specific CBR programs that are central to the Arctic System Science research of the Centre for Earth Observation Science (CEOS) and our Arctic Indigenous partners. The regions identified for research represent two prominent and complex ecologically and biologically significant marine areas (EBSAs) that are 'downstream' of the Arctic Ocean and vulnerable to impacts from the freshened Arctic Ocean outflow. The more northerly CBR (CBR-N) will be located in northern Baffin Bay, in the Pikialasorsuaq region (or NOW polynya), and the southerly CBR (CBR-S) in the James Bay/Hudson Bay complex. Both regions are ecological hotspots that are among the most productive marine systems in the northern hemisphere. They host a vast number of ecologically, socially and economically important habitats and species, which are vulnerable to altered hydrologic conditions, and they also include many important sites and features for Inuit cultural resources and coastal interactions. Climate change is occurring particularly fast in these regions. In addition, socioeconomic development, including oil and gas development, marine shipping, increased tourism, cruise ship expeditions, extraction of nonrenewable (e.g., minerals) and renewable (e.g. fisheries) resources, and hydroelectric power development, are experiencing rapid growth and affecting environmental and cultural change.

The proposed infrastructure (~$9.8M total request) includes state-of-the-art equipment for the CBR programs in both regions supporting high-resolution study of freshwater sources and impacts on key processes that modulate the thermodynamic, biological, and biogeochemical state of the coastal marine environment. Infrastructure will allow for long- and short- term *in-situ* deployment at fixed locations to study temporal variability, ship or small boat-based measurement to study spatial variations, sensors to facilitate process studies across spatial and temporal scales exploiting leading edge air- and space-borne remote sensing technology. In Baffin Bay offshore and deep water locations, sensors will monitor ocean circulation, water chemistry, and biological activity, while near-shore observatories in and adjacent to coastal communities will provide data on water quality, biology, sea ice thickness, and glacier processes. In the Hudson and James Bay complex, similar infrastructure will propel an existing community-based research program towards a sustainable long-term monitoring program. In Baffin Bay, the infrastructure will allow initiation of coordinated process studies between Canada and Denmark and Greenland. Coastal marine research will be conducted in Baffin Bay using research vessels, military vessels, and community-based ships of

opportunity owned by Canada, Greenland and Denmark, and in the Hudson Bay Complex, using the CMO ship *(MV William Kennedy).* Data collected from mobile platforms in both regions (surface vehicles, drifters and gliders), autonomous oceanographic moorings, and satellites will complement observations from fixed observatories on the seabed at coastal and offshore locations. A network of shore-based field stations will be established to actively engage northerners in the science. These stations will provide meteorological, ice and ocean data to support studies of air-sea CO_2 and CH_4 exchange, sea ice formation and melt as well as ice hazards. These stations will address existing gaps in environmental data coverage, improve the data available for local decision-making related to safe travel on coastal ice and waters, and ultimately support the development of better weather forecasting and climate models in the region. Residents of local communities will be trained to use portable field equipment and mobile computing technologies to enhance data collection on snow and sea ice thickness, seawater properties, marine species activities and other coastal zone environmental variables including those prioritized by Inuit. CBR will involve the expansion of SIKU (Inuit Knowledge and Social Mapping Platform; http://arcticeider.com/) in both CBR locations, and data will be integrated into UM's CanWin data depository following protocols established by the CFI-Cyberinfrastructure project, Canadian Consortium for Arctic Data Interoperability (CCADI), and will be managed through a partnership between the UM and coastal communities.

CEOS leads the UM's "Established Signature Area of Research" in Arctic System Science and Climate Change, as outlined in the University's 2015 strategic plan. CEOS has the opportunity to host its second and UM's only Canada Excellence Research Chair (CERC – D. Dahl-Jensen); UM's only Senior Canada 150 Chair (J. Stroeve), CERC Laureate (S. Rysgaard), and we also host two Canada Research Chairs (Barber and Wang) both at Tier 1. The UM-CERC unit consists of 37 faculty members (Tenure and non tenure track); 19 of these are core members in CEOS and 18 come from other units (Faculties of Engineering, Asper, Agriculture, Arts, and Science) at UM or through Adjunct professor positions. The research unit is fully coordinated, internationally recognized for research excellence in Arctic marine sciences. Our UM-CERC unit also works closely with the CERC Laureate's from Laval University (Babin) and Dalhousie (Wallace) on the UM led BaySys and CMO programs (funded), GreenEdge (Takuvik, ULaval), and NCE ArcticNet.

CEOS faculty members have years of experience in community-based research in the Canadian and Greenlandic Arctic. Researchers lead ArcticNet Integrated Regional Impact Study (IRIS) initiatives for Hudson Bay and the Western Arctic, and currently participate in research networks and programs with communities surrounding Hudson Bay, in Qikiktarjuak (Baffin Island), and Nuuk (Greenland).

UM and partners provide significant operational support affording world-class opportunities for our faculty, staff, students and partners. We would plan to submit for a provincial match to this CFI. We will also secure academic discounts from the various suppliers. The CEOS group generates $5-8M in annual operating revenue from a variety of private and public sector partners. The cumulative history for operating funding illustrates a high-achieving group with a strong growth trajectory. Our ongoing partnerships and existing major funding programs (CERC and C-150) will provide the operating funds to this application, and create substantive leverage in support of subsequent network grant proposals.