COLLABORATIVE RESEARCH ACTION

Resilience in Rapidly Changing Arctic Systems (CRA Arctic II)

1. Background

The Arctic is changing fast: it is warming at twice the pace of the rest of the planet, sea ice is melting, permafrost is thawing, flora is changing, and both aquatic and terrestrial animals are altering their migratory patterns to adapt to the new conditions. The livelihoods and cultures of the four million arctic inhabitants, including some 400,000 Indigenous People, spread across eight nations are also changing. Arctic peoples have access to new technologies and are increasingly connected to the rest of the world. All these changes are shifting the dynamics of the unique human-Earth system that has developed over recent millennia in this harsh climate. While human activity outside the Arctic (e.g. carbon and other pollutant emissions) and resource exploitation for use by southern populations (e.g. oil extraction; mining, fisheries) is driving many of the arctic socio-ecological shifts, the consequences of these shifts extend far beyond the North. Arctic ice-albedo plays a central role in regulating Earth's climate. A warmer Arctic changes regular airflow patterns over southern regions and may result in colder winters and stunted crop growth. Transformations in the arctic marine food-web structure have impacts that extend into commercial fisheries worldwide.

The natural variability, complexity, low population density and remoteness of many arctic regions make studying, monitoring, and understanding these changes difficult. Given the magnitude of these changes for arctic and non-arctic environments and societies alike, arctic science aims at understanding, responding, and adapting to accelerating change is a global priority.

For several decades, researchers have grappled with ways to monitor and understand the complex changes occurring in the Arctic. Realizing that many transformations are irreversible, the research focus has been shifting toward buffering or coping with climate change and improving the ability of ecosystems and peoples to respond and adapt to change, also known as resilience. Researchers and stakeholders are now working together, foregoing traditional compartmentalized research approaches. They are tackling the Arctic as one socio-ecological system (or system of systems), recognizing that people are inextricably linked to earth systems, and embracing Local and Indigenous Knowledge[1] in their work. This paradigm shift and the need for research on seven interconnected elements of resilience: **natural**, **social**, **financial**, **cultural**, and **human** capitals; **infrastructure**; and **knowledge** is evidenced by the Arctic Council.[2]

[1] For references see http://www.unesco.org/new/en/natural-sciences/priority-areas/links/related-information/what-is-local-and-indigenous-knowledge/

[2] Arctic Council (2013). Arctic Resilience Interim Report 2013. Stockholm Environment Institute and Stockholm Resilience Centre, Stockholm

2. Elements of resilience

To enhance adaptive capacity, it is important to understand what processes are building (or eroding) each of the seven resilience elements.

- Arctic **natural** systems

Arctic ecosystems and climate are intricately linked to the rest of the planet; changes in the high North can trigger cascading effects outside the Arctic. Arctic ecosystems, where many species migrate during the northern summer, are essential to maintaining global biodiversity. Further, Northern peoples are dependent on arctic ecosystems for their livelihoods, identities, economy, and well-being. Adequately identifying and describing variations and shifts in arctic ecosystems requires complex surveillance of an entire region, with arrays of innovative sensors, novel sampling design, threading together of different knowledge systems, and robust upscaling procedures. Impacts such as sea-level rise (and resulting coastal erosion), permafrost thawing and implications for infrastructure, ocean warming, eutrophication, emergent agriculture, invasive species and concentrations of contaminants will affect livelihoods that are built on ecosystem-services, both in the High North and at lower latitudes that depend on arctic resources, such as fish stocks.

The social, physical and cultural well-being of arctic communities, including Indigenous Peoples', are also dependent on healthy ecosystems. There is critical need to understand the resilience of arctic ecosystems to anticipate their response and ability to withstand change.

- **Human, social,** and **cultural** elements of resilience (3 elements)

For millennia, Arctic residents have adapted to change, but the current pace threatens traditional subsistence activities, mobility patterns and settlement, and other local use of the land and sea. In parts of the Arctic, coastal erosion and thawing permafrost are displacing communities and retreating sea ice is shifting and destabilizing hunting grounds, which has further influence on identity, individual and collective behavior, spirituality and food security. Globalization and the spread of communication technologies are exacerbating the loss of indigenous languages and non-westernized curricula. At the same time, these same technologies connect remote arctic communities and, when harnessed effectively, can add to cultural resilience. They are also revealing the beauty and challenges facing the Arctic to the rest of the world, driving tourism, northward migration, and social and political pressure to preserve the region's unique ecosystems. More than ever, arctic communities will need to rely on their human, social and cultural capital, which comprises the skills, knowledge, leadership and creativity of its people, to face their many challenges. Education, defined broadly to include Indigenous ways-of-knowing, is essential to building this human capital. Self-organization is a pillar of resilient communities; Arctic Peoples are working to solve problems together, building and maintaining social connections and intra- and inter-community networks. Human and social capital cannot develop without strong cultural anchors to maintain well-being and drive the self-determination of communities towards resiliency.

- **Knowledge** asset

Despite recent efforts to incorporate Local and Indigenous Knowledge into research and decision-making processes, more work is necessary. Resilience cannot be developed without a partnership among diverse knowledge systems. What represents 'research' to academics is

'problem-solving' to others. Collaboration between the two allows for the uptake of results and legacy learning far beyond the years of a research project. Respect for and inclusion of Indigenous Knowledge brings both historical and observational perspective, built over millennia, to resilience. Local and Indigenous Knowledge confers a holistic understanding of people and their environment, much in the same way that resilience strives to support human-earth systems during periods of change.

- **Financial** capital

Arctic economies are heterogeneous. Within a single community there may be contributions from local subsistence as well as global energy markets and commercial trade. Financial decision-making may take place by individuals, local, regional or national governments, corporate arms of Indigenous organizations, and are often informed through community engagement. Investment in Arctic resources may come from very remote sources with little connectivity to Arctic customs outside of supply-demand economics; likewise, Arctic firms may re-invest their profits in southern interests. Resilient financial futures for both Arctic residents and investors will require a more detailed understanding of the human-earth system and local value systems on which they rely. Smart investments and new financial tools are needed to build diversified arctic economies that can resist variability in global markets, without compromising Indigenous and local culture and traditions.

- **Infrastructure**

In a sparsely populated region of harsh and variable climate, infrastructure can be the dividing line between life and death. The building and transport systems in parts of the Arctic have relied on a solid permafrost foundation, ice-protected shorelines, and near-continuous cold temperatures. Pipelines and building structures have been engineered to withstand certain variations in heat conductivity and thawing around their supports. Ice roads, haul roads, and airstrips assume certain ground conditions and weight tolerances. The majority of ship traffic is required to be at least ice-strengthened, if not possessing ice-breaking capabilities. As the foundational elements change (e.g., the ground warms, storms erode the coast, ice conditions vary), how arctic infrastructure will need to adapt? How will the framing of new infrastructure provide not only shelter and access, but also the evolving cultural needs of residents in the High North? What plans are there for responsive infrastructure that would be able to address oil spills, viral outbreaks, security threats, and other potential disasters of the human-health-environment variety? What role could the circular economy play in building and dismantling infrastructure?

3. Call Objectives

This joint Belmont Forum CRA calls for co-developed and co-implemented proposals from integrated teams of natural and social scientists, and stakeholders to address key areas of arctic resilience understanding and action. This collaboration of academic and non-academic knowledge systems constitutes a transdisciplinary approach that will advance not only understanding of the fundamentals of arctic resilience but also spur action, inform decision-making, and translate into solutions for resilience. The term "stakeholder" is used here in its

broadest possible sense, allowing for co-development of projects with partners from, but not limited to, civil society, government, industry, NGOs, and Indigenous organizations.

Project teams must be international in their composition and must draw off of support from minimum three organizations supporting this CRA from minimum three different countries. Please refer to the organizational annexes for more information about support available for proposed projects. Project team partners who are not eligible for funding from any of the participating funding organizations can participate in the research project at their own expense as additional partner. Please ensure that your project theme is compliant with funding specifications by contacting the listed Organizational Contact Points in the relevant organizational annex documents for this call.

Proposing consortia are required to identify and address at least **two** of the seven interconnected elements of resilience, as described above. The following examples are provided only as illustration of cross-thematic areas of interest:

Example 1: The interrelationships among changing seasonal permafrost cover; maintenance and planning of infrastructure; regional transportation and human migration; community accessibility for local, subsistence, and private sector use; and municipal budgets.

Example 2: Implications of increased access to reasonably priced, reliable, and high-speed broadband internet and cellular communications in formerly-remote or small communities. How might internet and smart phone technology influence learning, communications, and employment opportunities in the Arctic? How would broadband infrastructure impact arctic resilience?

Example 3: Warming as a precursor for new health regimes. How will arctic government systems respond to advancing species and disease vectors from the South? What governance is in place to protect current arctic flora and fauna from invasive species and pollution that could arise from increasing tourism, shipping, extractive activities, or agriculture?

4. Reporting and Evaluation

All funded projects are expected to attend kick-off, mid-term and end-term meetings organized by the Arctic II Theme Program Office for discussions and dissemination. The funders may decide on clustering these meetings with others. Project leaders will also provide an annual integrated update on their project accomplishments, using the BFgo reporting interface. The consortium lead for each award will receive log-in credentials from BFgo to complete these reports, which are due each year on June 15th for the duration of the project. Additional reporting may be required by supporting funders for a given award and should be completed per the award terms and conditions with that organization.

5. Open Data

All proposed projects will require a data management plan. If needed, data management plan

templates are available from the Belmont Forum website. The plan should include information about types of data, information, models, software, workflows and code, or other digital products being generated by the project. It should outline the accessible archives or other open repository where these products and accompanying metadata will be stored.

Belmont Forum Open Data Principles are intended to improve and promote the dissemination of knowledge, the access to the data and their reuse thereby improving the efficiency of scientific discovery and maximizing the return on research funding. The funded CRA Arctic II projects are expected to make their best efforts to ensure open access to data as soon as possible. Awarded projects will be checked for compliance to open data procedures at the mid-term and end-term valorization events using information provided to the BFgo reporting system.

6. Process and Timeline

The CRA Arctic II uses a one step process. Proposals must be written in English and submitted electronically via the Belmont Forum Grant Operations website: http://bfgo.org by June 20, 2019, 23:59 UTC.

Proposals will be evaluated according to criteria of (i) Quality/Intellectual Merit, (ii) Fit to call objectives (including user engagement and societal/broader impacts), (iii) Personnel/Quality of the Consortium and Trans-disciplinarity, and (iv) Resources and Management.

A total of 11 funders from 10 countries have committed in total 8 M€ of cash and in-kind resources for this call: Canada, Denmark, France, Japan, Iceland, Netherlands, Norway, Russia, Sweden and USA.

This call aims to support medium-sized research projects with 3 to 4 years duration, with a recommended budget of up to 1.5 M€. Note that some contributions are in-kind. See organizational annexes for specific constraints and requirements of your funding organization(s).

Projects are expected to start in late 2019 or early 2020.