Climate-change, infrastructure risks and vulnerability of Arctic coastal communities: a case study from Arctic Bay

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Abstract
There is widespread agreement that significant climate warming has occurred in the north, with discernible impacts on sea-ice, permafrost and ground ice, slope stability, and coastal hazards. These changes are affecting both infrastructure and livelihoods of northern communities. Interdisciplinary research in ArcticNet projects 4.2 and 1.2, partially funded by the Climate Change Impacts and Adaptation Program (NRCan), was designed to assess the climate vulnerability of infrastructure in Arctic coastal communities. This poster reports on findings from 3 years of research conducted with the community of Arctic Bay, Nunavut.

1. Assessing infrastructure vulnerability

The research uses the approach developed by Ford and Smit (2004) to characterize vulnerability, where vulnerability is conceptualized as a function of exposure and adaptive capacity (Fig. 1).

The first stage identifies and characterizes those conditions (exposures) that are significant for community infrastructure and establishes a baseline of community response (adaptive capacity). To achieve this we conducted 65 interviews with residents and community officials between 2004 and 2006. Geomorphic mapping was then carried out in summer 2006 to assess the level of exposure to hazard types. Aerial photographs, archival ground photographs and high resolution satellite imagery were combined to assess the timing and impact of individual and cumulative hazard events. Field observations and community images were geo-referenced and queried in a GIS database.

The second stage assesses future vulnerability by estimating both the directional changes in exposure and the constraints and opportunities for community adaptation.

2. Case study: Arctic Bay

Arctic Bay is located on north Baffin Island, Nunavut (Fig. 2). Steep hills surround the settlement on three sides with a nearly land-locked bay on the fourth side (Fig. 3). The community itself sits on a low gravel beach near the water. The community has population of around 700 people (93% Inuit).

3. Current exposure

One of the primary products resulting from the exposure assessment is a landscape hazard map of Arctic Bay. The provisional map (Fig. 4) shows the occurrence and distribution of hazard types on the community landscape.

Four hazard types were considered to be of primary relevance to Arctic Bay. They are discussed sequentially.

4. Current adaptive capacity

The community is actively trying to manage infrastructural hazards. Diversion channels, for example, have been constructed to divert surface run-off away from housing. However, the response to emerging hazards has been largely ad hoc and has involved limited long-term strategic planning. Research is currently being conducted with local decision makers to evaluate in greater depth how hazards are managed, and to characterize the adaptive capacity of the municipality.

5. Future vulnerability

To assess future community exposure, future research will: a) Establish a monitoring program for landscape hazards in Arctic Bay, b) From regional climate scenarios, determine future directions in climate variables affecting community-identified landscape hazards (e.g. temperature, seasonal precipitation, sea-ice duration, storminess), c) From previous studies, determine arctic landscape responses to predicted climate changes.

Participatory community planning processes will be used to explore means to support ongoing adaptation and to enhance adaptive capacity. Institutional responses (i.e. by local government and organizations) will be examined in detail to ensure that their policy (including municipal land use plans), programs and infrastructure investments contribute to community resilience.

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Fig. 1: Framework for vulnerability analysis (Ford and Smit, 2004)

Fig. 2: Arctic Bay map

Fig. 3: The community of Arctic Bay

Fig. 4: Arctic Bay hazards map