Coastal processes, hazards impacts, and resilience in Canadian Arctic communities

Gavin K. Manson[1], Donald L. Forbes[1,2], Norman R. Catto[2], Karissa Belliveau[2], Kathleen Parewick[2], Steven M. Solomon[1], Evan N. Edinger[2], and Tanya Brown[2]

1. Geological Survey of Canada (Atlantic), 1 Challenger Drive, P.O. Box 1006, Dartmouth, NS, B2Y 4A2 <gmanson@nrcan.gc.ca> ¶ 2. Department of Geography, Memorial University of Newfoundland, St. John's, NL, A1B 3X9

Arctic regions are expected to be more affected by climate change than temperate regions. Potential impacts include: increased rates of relative sea-level rise for areas already undergoing transgression or transition to a transgressive regime in areas where relative sea level is currently stable or falling; reduced sea ice extent resulting in increased effective fetch and more frequent high waves; increased air and ground temperatures and increased thaw of ice-rich cliffs; and increased frequency of the most severe storms. Overall, increased rates of coastal change (cliff retreat and beach reworking) and increased frequency and severity of flooding are expected.

In many Canadian Arctic communities, baseline data are insufficient to understand the impacts of coastal processes and hazards such as flooding and erosion on communities, in the context of both community infrastructure and socio-economic well-being. Without baseline data, climate change impacts assessments and evaluation of adaptation strategies are not possible. This research, part of ArcticNet Project 1.2 (Coastal Vulnerability in a Warming Arctic), aims to develop or expand the necessary baseline data to determine impacts and, in consultation and collaboration with community organisations, incorporate results into decision-making and adaptation strategies that will build community resilience.

The communities under consideration include: in the

NWT: Tuktoyaktuk, Sachs Harbour, Paulatuk, and Holman; in Nunavut: Kugluktuk, Gjoa Haven, Resolute, Arctic Bay, and Qikiqtarjuaq. These have been selected to reflect an east-west cross-section across Canada's Arctic. Continuously operating GPS sites have been installed at Inuvik, Tuktoyaktuk, Sachs Harbour (discontinued), Holman, Resolute, Alert and Qikiqtarjuaq to monitor rates of vertical crustal motion. To establish rates of eustatic sea-level change, tide gauges have been installed at Tuktoyaktuk, Holman, Alert and Qikiqtarjuaq. High accuracy GPS surveys have been carried out at least once in all communities to establish baseline data on coastal morphology. In several communities, multiple surveys have been completed and rates of change are known. Aerial photography and satellite imagery are being used to extend the survey record back in time and expand it spatially. Some survey profiles have been extended offshore using an echosounder linked to a differential GPS and nearshore morphology has been further investigated using sidescan sonar and bottom grab sampling with differential GPS positioning. Community consultation is occurring in all communities and will be enhanced in selected communities with particularly severe coastal hazards or strong community interest.

In general, the western Arctic is transgressive and shorelines tend to be composed of ice-rich glacial and marine sediments whereas the central and eastern Arctic are regressive with greater amounts of rocky shoreline. In the absence of ice, fetch is greater in the west than in the east and storms tend to occur earlier in the open water season. Depending on community resilience and adaptability, climate change impacts may affect coastal communities in the western Arctic more than in the eastern Arctic.