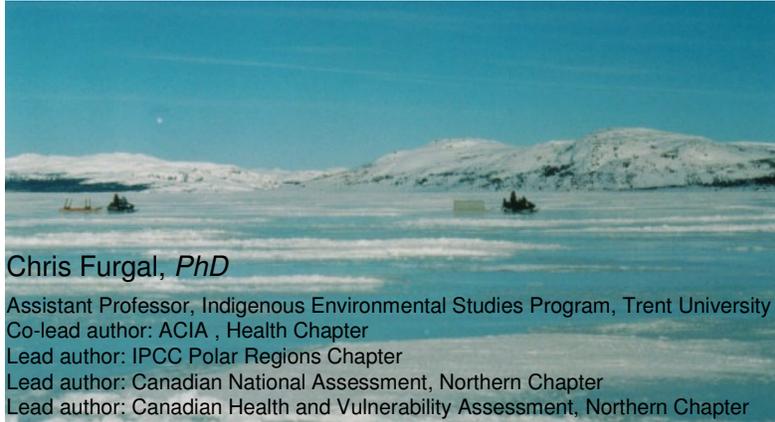


PRESENTATIONS

Trends in Canadian Arctic Climate and Health Research: Reflections on impacts, vulnerability and adaptation



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Lead author: IPCC Polar Regions Chapter
Lead author: Canadian National Assessment, Northern Chapter
Lead author: Canadian Health and Vulnerability Assessment, Northern Chapter



Overview

- Arctic Climate Impact Assessment



- IPCC – Fourth Assessment Report



- Canadian National Assessment Initiatives

Key IPCC AR4 findings for Arctic

- Reductions in thickness and extent of glaciers and ice sheets
- Reductions in the extent of sea ice and permafrost, increased coastal erosion, increase in the depth of permafrost thaw
- Changes in natural ecosystems with detrimental effects on many organisms (e.g. migratory birds, mammals and higher predators)
- Impacts for residents, resulting from changing snow and ice conditions for example, will be mixed. Detrimental impacts for infrastructure and traditional indigenous ways of life.
- Beneficial impacts may include reduced heating costs and more navigable northern sea routes

Projected impacts on northern residents

- Temperature and extreme event related injuries
- Exposure to new diseases
- Travel hazards and injuries
- Threats to traditional components of food security
- Impacts on sanitation and other health infrastructure
- Changed exposure to environmental contaminants
- Psychosocial stress related to threats to village sites and socio-cultural change
- Opportunities for expanded economic development



Change is already occurring and communities are adapting

- Changes in personal behaviours (e.g. hunting and traveling)
- Investments in technology (personal equipment and industry design)
- Use of Traditional Knowledge systems



- Forces such as social and economic change challenge individual adaptability
- Significant investments will be required for communities to adapt

Key messages on climate change and human impacts in the Arctic

- Many components of the Arctic ecosystem are already changing
- Influence on safety and suitability for human activities
- Impacts are regionally and locally variable
- Some opportunities exist
- Indigenous and coastal communities are particularly vulnerable
- Adaptive abilities are being challenged
- Economic and institutional initiatives to strengthen resilience and adaptation are required

From Impacts to Adaptation:
Canada in a Changing Climate 2007
Chapter 3 - Northern Canada

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Photo D Vaughan



Context of Chapter 3 – Northern Canada

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Context of NRCan Report – Chapter 3

- IPCC Third Assessment Report



- Arctic Climate Impact Assessment



- International Polar Year



- IPCC Fourth Assessment Report



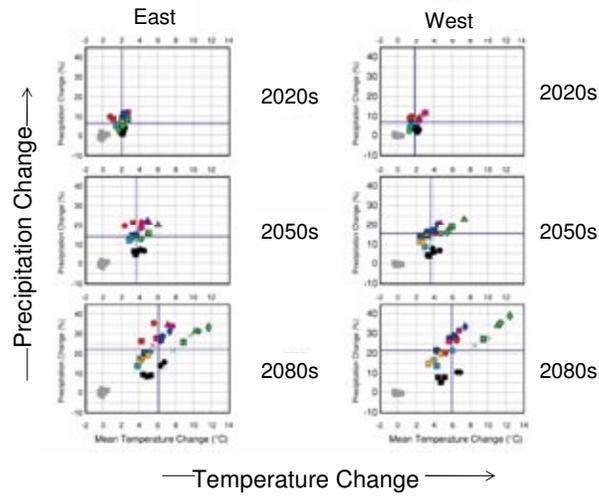
- NRCan Regional Experts Meetings

Chapter 3 – Northern Canada (Yukon, NWT, Nunavut)



Figure 1.1. Communities and political boundaries of the Canadian North. The Territorial North includes nearly 100 communities spread across almost 60% of Canada's landmass (from Furgal et al., 2003).

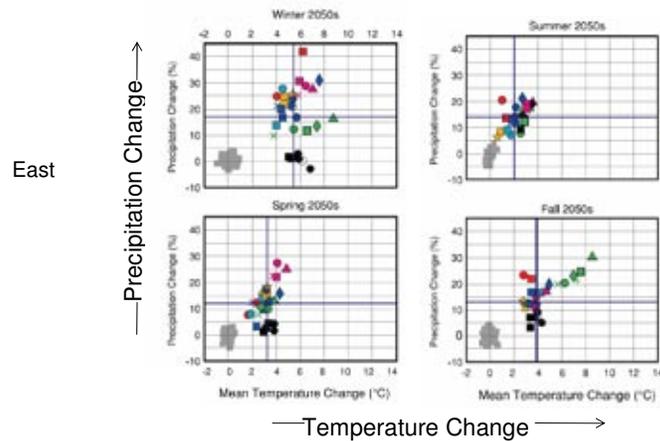
Chapter 3 – Temperature & Precipitation Projections



2080

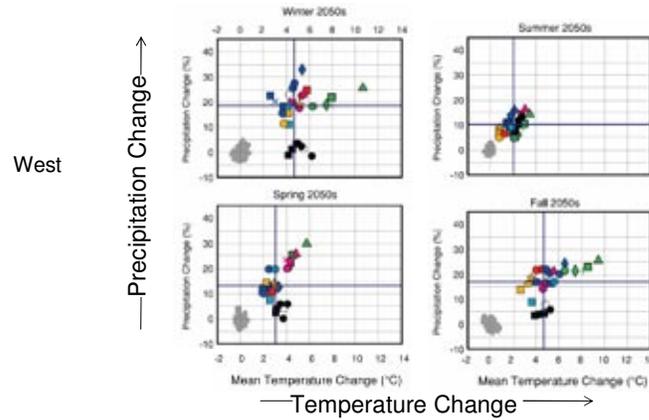
- A predominantly warmer and wetter future is projected throughout the North
- Median temperature change of +6°C (ranging from +3.5°C - +12°C)
- Median precipitation change of +22% (ranging from +5% - +40%)

Chapter 3 – Temperature & Precipitation Projections



- Warming will be more significant in winter and fall months
- Eastern winter temperature projections are slightly warmer than West
- Range of precipitation increases (0% to 40%) during winter months

Chapter 3 – Temperature & Precipitation Projections

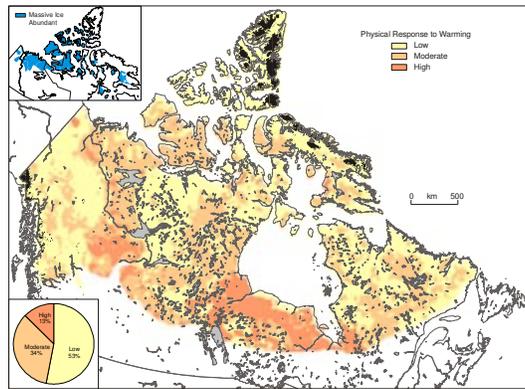


- Greatest temperature changes will occur at higher latitudes; particularly in the extreme northwest
- Greatest annual precipitation increases over more northerly regions
- High degree of variability stresses need for consideration of range of 'potential futures'

Chapter 3

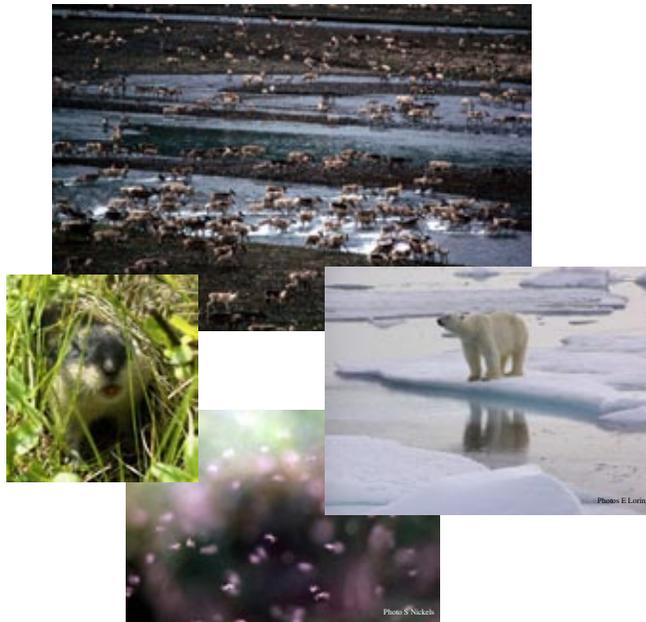
Key Findings from Chapter 3: Northern Canada

Chapter 3 – Key Findings



- Climate-induced changes in the cryosphere (permafrost, sea ice, lake ice and snow) will have large implications for infrastructure maintenance and design
- Increase in active layer depth (0-50%) projected to be greatest in the Yukon

Chapter 3 – Key Findings



- There will be consequences for biodiversity shifts and in ranges and distribution of many species with impacts on availability, accessibility and quality of resources upon which human populations rely

Chapter 3 – Key Findings

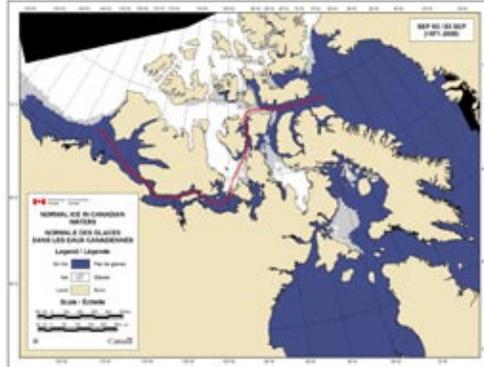


Figure 4.5.1: Typical route for the Northwest Passage, on charted median ice concentration (1971-2000) for September 3.

- Increased navigability of Arctic marine waters and expansion of land- and fresh water-based transportation networks will lead to a less 'remote' northern Canada, bringing both opportunities for growth in a range of economic sectors, and challenges associated with culture, security and the environment

Chapter 3 – Key Findings

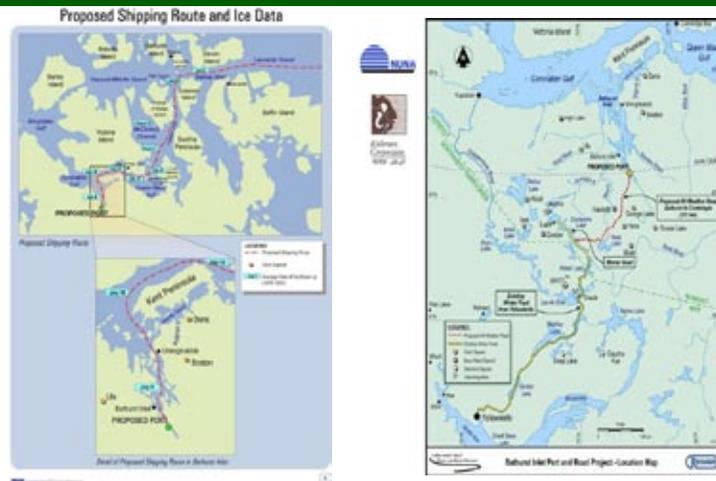
- While maintaining and protecting aspects of traditional and subsistence ways of life in many Arctic Aboriginal communities may become more difficult in a changing climate, some new opportunities will also be presented



Chapter 3 – Northern Canada

Themes and Case studies

Chapter 3 – Case Study – Mining and Transportation



- Decreased ice cover and extent presents new opportunities for marine transport and planned resource development

Chapter 3 – Case Study – Northwest Passage

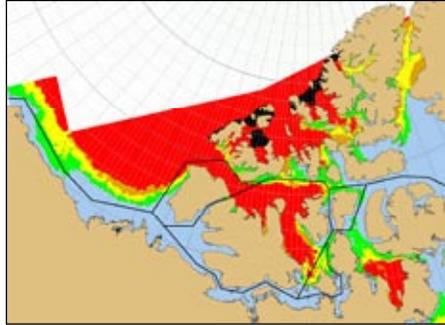


Figure 4.5.1: Typical routes for the Northwest Passage, superimposed on charted median ice concentration (1971-2000) for September 3. Colour indicates ice concentration in tenths: Blue 0-1, Green 1-3, Yellow 4-6, Brown 7-8, Red 9-9+, Black 10.

- Increased pressure to protect Canadian position on NWP
- Enhanced traffic through the NWP is likely to lead to issues such as : spread of new and exotic diseases and, increased risks of environmental damage and pollution, threats to traditional ways of life, opening of opportunities for economic development

Chapter 3 – Case Study – Forest Management

Biophysical impact	Socioeconomic impacts
Changes in forest productivity	Changes in timber supply and net value
Increased atmospheric greenhouse gases	Introduction of carbon credit-permit mitigation policies that create a carbon sequestration market
Increased disturbances	Loss of forest stock and non-market goods
Northward shift of eczones	Change in land values and land-use options
Change in climate and ecosystems	Economic restructuring leading to social and individual stresses
Ecosystem and specialist species changes	Changes in non-market values
Ecosystem changes	Dislocation of parks and natural areas, increased land-use conflicts

Table 10. Examples of the impacts of climate change on the northern forest sector (modified from Lemmen and Warren, 2004)



- Many projected impacts already visible (e.g. Temperature and precipitation patterns, spruce bark beetle outbreaks, loss of merchantable timber)
- Such disturbances are likely to continue
- Northern forest managers are adapting and proactive adaptation will continue to be required

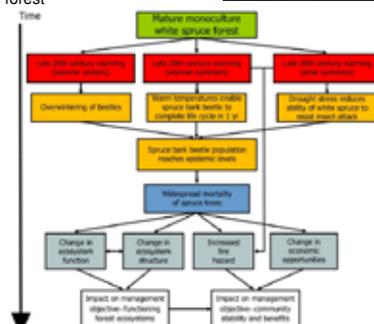


Figure 4.6.2 Influence of climate warming on spruce bark beetle populations in the southwest Yukon (Source Ogden, 2006).

Chapter 3 – Case Study – Fisheries



Figure. Lifting whitefish nets on Great Slave Lake.
Photo courtesy of George Low.



- Projected 50% increase in number of 'optimal growing season days' for cold water *spp.*
- In shallow waters, climate changes will stress some *spp.* (e.g. Lake trout) and be beneficial for others (e.g. Lake whitefish)
- Structural shifts in lake ecosystems with introduction of southern *spp.*
- Adaptive management will be required considering cumulative effects including non-climate stresses
- Similar changes will impact access by Aboriginal harvesters and local scale adaptation will be required

Chapter 3 – Theme – Hydroelectric, Oil and Gas

Hydroelectric Development

- Changing climate will affect capacity and operations of current and future facilities
- Increased winter runoff from rainfall and enhanced snowmelt = decline in winter snow storage
- May require expanded reservoir capacities
- Increased need to determine changes in future flow and dangers (river ice-jamming)



Oil and Gas

- Exploration is most likely activity to be impacted
- Thawing permafrost and changes in snow cover necessitate focus on low-impact vehicles and seasonal scheduling of exploration
- Winter and road uncertainty will require flexibility
- Off-shore exploration will be affected by decreased sea-ice cover
- Great attention required on infrastructure stability

Chapter 3 – Theme – Transportation

Freshwater Transport

- Increase in river ice-free season will expand potential period for Mackenzie barge season
- Water levels and river flow regimes will impact these opportunities
- All-season roads could be seen as alternative in face of increasing challenges with river transport

Winter Roads

- Mackenzie River crossing delayed by >3 weeks since 1996
- Reduction in maximum load capacity
- May require flexibility in scheduling or concentration of transport into max ice periods
- Increased difficulties in resupply of communities and industrial sites during winter months



Chapter 3 – Theme – Aboriginal Perspectives



- Aboriginal observations and knowledge are some of the best and only information on impacts and adaptation at local scale
- Significant contribution to understanding of climate change throughout the North and beyond
- Climate change poses a significant threat to many Aboriginal communities in lifestyles, livelihoods and traditions
- Small, more isolated communities, reliant on a smaller variety of resources are particularly vulnerable yet potentially most resilient and adaptive to some impacts because of Traditional Knowledge and skills

Chapter 3 – Theme – Adaptive Capacity



- Traditional Capacities – social, economic and cultural change stress socio-ecological resilience
- Economic Resources – populations which are educated and mobile will be able to take advantage of economic opportunities that may be created
- Information and Technology – Access to both Traditional Knowledge and skills as well as new technologies will enhance the ability to adapt to a changing environment
- Policies and Institutional Capacity – policies should aim at supporting aspects of resilience (e.g. flexibility in management regimes, strengthening the transmission of traditional skills and knowledge, economic support for traditional activities/livelihoods, new skills training and development)
- Mainstreaming Climate Policies - include consideration of climate concerns in existing policy and program areas

Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity

What Health Canada assessed?



Contents:

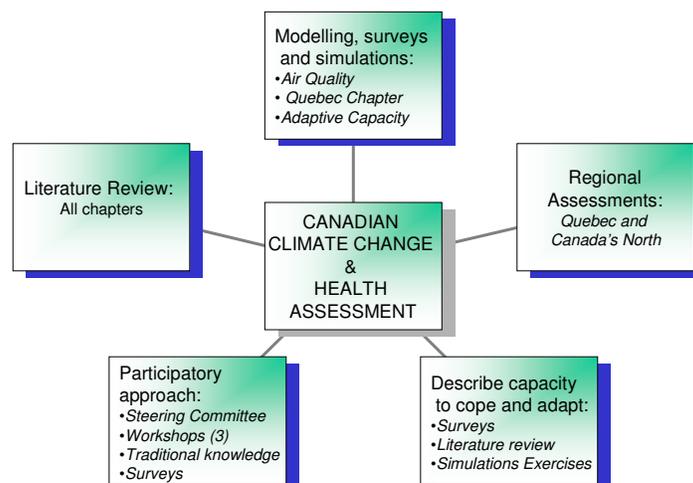
- [Introduction](#)
- [Assessment Methods](#)
- [Air Quality, Climate and Health](#)
- [Vulnerabilities to Natural Hazards and Extreme Weather](#)
- [Impacts of Climate Change on Water-, Food-, Vector- and Rodent-borne Diseases in Canada](#)
- [Health Impacts of Climate Change in Quebec](#)
- [Health Impacts of Climate Change in Canada's North](#)
- [Vulnerabilities, Adaptation and Adaptive Capacity in Canada](#)

Human Health in Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity

Objectives of Report

- To provide baseline information on key health risks and vulnerabilities faced by Canadians from climate change
- To raise awareness of the impacts of climate change on the health and well-being of Canadians
- To encourage action on implementing adaptation strategies at all levels

Human Health in Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity



Northern Chapter

C Furgal, D Martin, V Edge, L Chan, N Ogden, M Buell

- Identifies health and well-being impacts and exposure to climate change health risks
- Highlights current status of adaptations and adaptive capacity
- Identifies key vulnerabilities
- Identifies gaps and recommendations

Concepts

Vulnerability

The degree to which a system is susceptible to, or unable to cope with adverse effects of stress(es)

Exposure

The degree to which a system is in contact with a particular stress

Sensitivity

The degree to which a system is adversely or beneficially affected by stimuli

Adaptive Capacity

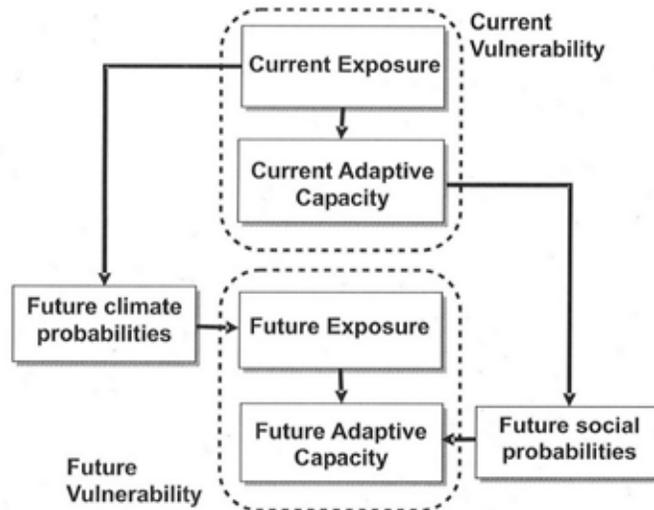
A system's ability to adjust, to moderate possible harm, to realize opportunities or cope with consequences

(IPCC, 2001)

$$V = f(E, A)$$

(Smit and Pilifosova 2003)

Vulnerability Framework



Ford and Smit, 2004

Community Adaptive Capacity

Adaptive capacity is the ability of a system to adjust to climate change (including variability and extremes) to moderate potential damages, take advantage of opportunities or cope with the consequences.

McMichael et al (2003)

Potential Factors that Influence Adaptive Capacity

Availability of options	Access to resources
Governance and power	Decision making processes
Human and social capital	Risk-spreading mechanisms
Information management	Public perception of the issue

Smit and Pilisova (2001)

Community Adaptive Capacity

What do we know about ?

Access to resources - \$\$, human capital (trained individuals)

Governance and power – plans and preparations

Human and social capital – health and well-being status

Information management - data availability and monitoring

Public perception of the issue

Availability of options – opportunities for adaptation

Current and Future conditions

Community Adaptive Capacity

Table 13. Summary of current responses taken by individuals and communities in the North, as reported in the literature, assisting in their adaptation to climate change and variability.

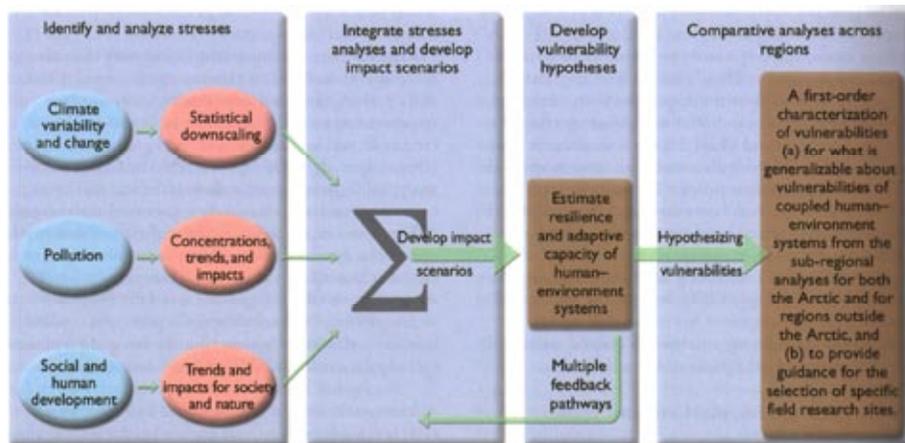
Environmental change and impacts / threats to health and well-being	Existing responses
Precipitation extremes and natural disasters <ul style="list-style-type: none"> • property damage, injuries and death, increased travel risks 	<ul style="list-style-type: none"> • Relocation of buildings in avalanche hazard zones • Increased needs for local Search and Rescue teams
Unpredictability of weather <ul style="list-style-type: none"> • limitations on hunting and traveling • increased travel risks and injuries • increased damage to equipment • decreased access to traditional foods 	<ul style="list-style-type: none"> • Increase use and dependence on built (shelters) and natural (protected bays) refuges from storms • Increased communication among hunters • Increased preparations for travel and hunting • Decreasing outings during variables times • Use of technology (GPS)
Temperature related injuries <ul style="list-style-type: none"> • changes in incidence of cold-related injuries • increased heat stress 	<ul style="list-style-type: none"> • Reduce physical activity • Increasing house ventilation and accessing cool areas

Community Adaptive Capacity

Table 13. Summary of current responses taken by individuals and communities in the North, as reported in the literature, assisting in their adaptation to climate change and variability.

Environmental change and impacts / threats to health and well-being	Existing responses
Warming temperatures and changing ice conditions <ul style="list-style-type: none"> • increased travel risks • increased injuries and deaths (e.g. drowning) associated with uncharacteristic and dangerous ice conditions • impacts to equipment and household economies • decreased access to traditional food access • disruption of traditional cycles and impacts on social cohesion and mental well-being 	<ul style="list-style-type: none"> • Shifting hunting patterns (e.g. times) • Using multiple means of transportation for same trip • Increasing community monitoring and communication of ice conditions • Use of new or alternate routes of travel • Use of technology (GPS, satellite imagery)
Increased exposure to UVB <ul style="list-style-type: none"> • increased incidence of sun burns, rashes and blisters 	<ul style="list-style-type: none"> • Increased use of protective creams • Stay out of sun and indoors
New and emerging diseases <ul style="list-style-type: none"> • increased incidence and exposure to zoonotic diseases • increased exposure to new vectors 	<ul style="list-style-type: none"> • Increased use of insect repellents and bug nets • Increased selectivity of animal meat consumed to screen for parasites and other abnormalities

Assessment of Vulnerability to Multiple Stressors



McCarthy and Long Martello, 2005



Ittaq Heritage and Research Centre Clyde River, Nunavut

S Gearheard, U Colorado and N Illauq, Clyde River Nunavut

- First community-based Inuit-led research centre in Nunavut
- Several environmental research and monitoring programs



Photos courtesy of S Gearheard



Igliniit ("Trails") Project

Hunters' use and observations of the local environment



Photos courtesy of S Gearheard



• vegetation and permafrost mapping/monitoring



• documentation of snow and glacier changes

Photos courtesy of S Gearheard

Mapping Inuit Sea Ice Knowledge and Use

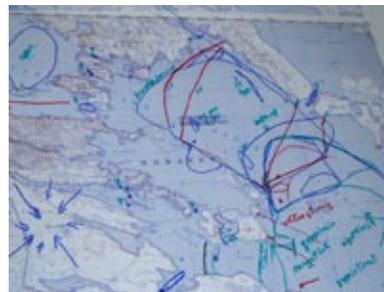
Gita Laidler

GCRC, Carleton University

ISIUOP

Mapping Inuit Sea Ice Knowledge and Use

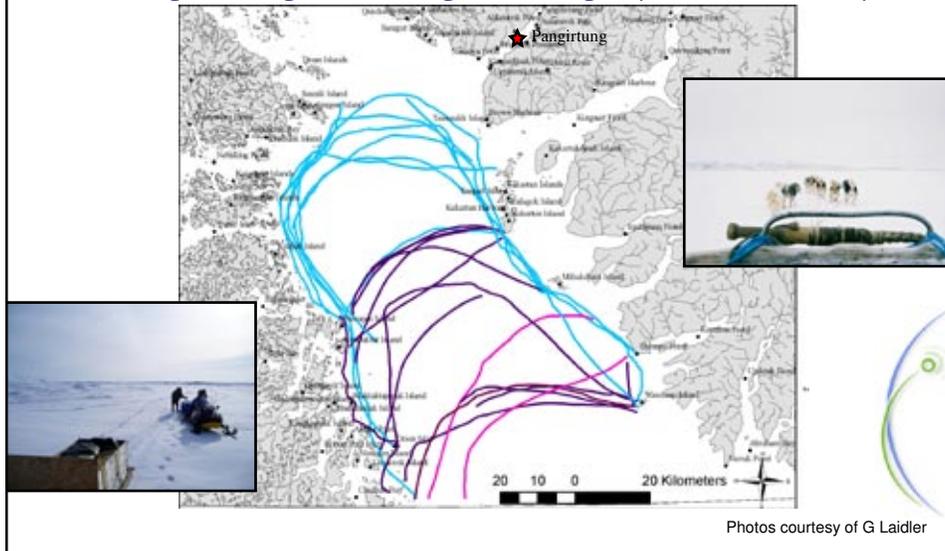
(Canadian Component of SIKU)



Photos courtesy of G Laidler

C-SIKU - ice processes, use and change

Pangnirtung Floe Edge Change (1960s - 2005)



Polar View Floe Edge Service

G Laidler, Carleton University

- implement the service
- community information sessions and workshops
- evaluate how the products are used
- tailor products to community needs
- evaluate ability of products to detect conditions of interest to communities to enhance travel safety



Photos courtesy of G Laidler

Canadian Investment in Vulnerability and Adaptation Research and Action



Environment
Canada

Environnement
Canada

Canada

[Home](#) > [Media Room](#) > Media Advisories

Backgrounder

Canada's Government Taking Action on Adaptation and Climate Change Issues

The Government of Canada is taking real action on climate change by investing \$85.9 million over four years to help Canadians increase their capacity to adapt to a changing climate. Environment Canada, in collaboration with Natural Resources Canada, Indian and Northern Affairs Canada, Health Canada and the Public Health Agency of Canada, will implement several new programs as part of the Government of Canada's new adaptation plan. New initiatives will enhance the scientific knowledge and tools needed to take further action against climate change and reduce the risks to Canadians.

The investment of \$85.9 million will complement the Government's [Turning the Corner Action Plan](#) by putting the following adaptation initiatives in place:

- **\$14 million for Northern and Aboriginal Communities to assess Key Vulnerabilities and Opportunities.** Aboriginal and northern communities are uniquely affected by an already changing climate with greater changes expected in the future. Indian and Northern Affairs Canada will build on current work to advance risk assessment, planning and community-based adaptation projects. A project undertaken could, for instance, address the need for community access to regionally-based climate change scenarios.
- **\$7 million to address Health Adaptation in Northern / Inuit communities.** Health Canada will work with Aboriginal communities, other key stakeholders and government departments to establish a community-based research program to assess key vulnerabilities and health impacts related to climate change in Northern / Inuit populations. The results will be used to develop innovative human health risk management plans and tools, including culturally sensitive educational and awareness materials, to improve decision-making regarding health adaptation in the North.

ArcticNet



Dr. Martin Fortier
Executive Director
Université Laval, Québec



CCGS AMUNDSEN
CANADIAN RESEARCH ICEBREAKER



www.amundsen.quebec-ocean.ulaval.ca



The CCGS *Amundsen* in the Northwest Passage, on transit to conduct the Canadian Arctic Shelf Exchange Study (CASES), its first scientific mission. Within the CASES project, the icebreaker will spend the entire year in the Mackenzie Shelf/Amundsen Gulf area.

Canadian Investment in Vulnerability and Adaptation Research and Action

- Adaptation now exists
- Local and regional scale activities
- Understanding vulnerability
- Awareness of Arctic health is on the rise
- Partnerships