

# weathering change

newsletter of the northern climate exchange summer 2002

## The Northern Climate ExChange Gap Analysis Project

An assessment of the current state of knowledge  
about the impacts of climate change in northern Canada

The substantial increase in climate change research in the past decade has made it difficult to keep track of all the various projects related to understanding, preventing, and mitigating climate change impacts. This situation has almost certainly led to overlapping research, unnecessary duplication of effort, and ineffective use of limited time and resources. In addition,

there has been no overall vision guiding the allocation of efforts and resources.

Communication has been limited among the various groups and organizations involved in and concerned about climate change: researchers, communities, indigenous peoples, non-government organizations, industry, and many levels of government. This has made it difficult to exchange information, to correlate scientific knowledge and local information, and to return the results of research to the people experiencing the effects of climate change most directly. Sharing information among all of these different parties and interest groups can be a challenge, but it is essential. When knowledge is not shared, everyone's understanding of climate change and its impacts is diminished.

*Sharing information among  
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Beginning in 1999 and carrying on into 2002, the Northern Climate ExChange (NCE) coordinated the Gap Analysis Project, aimed at assessing the current state of knowledge about climate change and its impacts in northern Canada. With Environment Canada as its main partner, and with consulting help from the University of Alberta, Ryerson University,

GeoNorth Limited and LegendSeekers Anthropological Research, NCE set out to meet several major objectives:

- Determine what is currently known

about climate change and its impacts in northern Canada, and incorporate this information into a database.

- Identify trends or patterns in the available information.
- Use this information to help identify research, monitoring, technological, and policy priorities.
- Improve collaboration and coordination among and between researchers, communities, governments, non-government organizations, and residents of northern Canada.

The overall goal of the project was to determine where information on climate

change is adequate and where there are gaps. Documenting existing knowledge will provide sound baseline information on what is known about climate change and its effects on northern Canada. This information will assist those attempting to establish priorities for climate change research, monitoring, technological development, policy development, and other matters in Canada's North. It will also help to facilitate links between different people and organizations working towards similar goals.

The NCE Gap Analysis Project has created several products that offer an

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## Welcome to the first edition of *Weathering Change*

Information dissemination is an essential part of Canada's strategy to meet its international climate change commitments, which include improving the knowledge base of climate change impacts and identifying appropriate adaptation measures. Information exchange is essential if we are to improve our understanding of what climate change means to us and how we can take action to reduce greenhouse gas emissions and adapt to a changing environment.

As part of the national strategy to meet these commitments, the National Climate Change Process established the Canadian Climate Impacts and Adaptation Research Network (C-CIARN) and the Public Education and Outreach (PEO) Hubs, which have offices across the country. The Northern Climate ExChange (NCE),

established in 2000 by the Government of Canada, Yukon Government, and Yukon College, delivers these programs in the Yukon. The mandate of the NCE is to provide an independent source of information, develop shared understanding, and promote action on climate change in northern Canada.

This newsletter is a joint initiative of the NCE and its PEO Hub and C-CIARN North programs. These programs have a common objective: to improve information exchange and increase the visibility and understanding of climate change impacts and adaptation (I&A) issues.

YUKON GOV'T PHOTO



*Permafrost makes building in the North tricky.*

Our work on the Gap Analysis Project, which is summarized in this inaugural edition of *Weathering Change*, first brought to our attention the need for a vehicle to summarize the latest in research and technical information. *Weathering Change* was designed with this in mind. Each

issue will feature articles on a selected I&A topic that is of relevance to northern communities and environments.

Please contact Aynslie Ogden at [aogden@yukoncollege.yk.ca](mailto:aogden@yukoncollege.yk.ca) or 867-668-8735 with your comments and suggestions on the newsletter. Your feedback is appreciated!

### weathering change

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assessment of the state of knowledge on climate change in northern Canada:

- The Infosources Database.
- The Directory of Contacts.
- The Matrix Maker.
- The report of a workshop on climate change research and priorities.
- Two reports assessing the level of documented local and traditional northern knowledge about climate change.
- Two reports assessing the completeness and value of the Infosources Database.
- The NCE Knowledge Site, an Internet resource containing most of these products, and more.
- An overview report.

All products are available on the Internet through the Northern Climate ExChange web site at [www.taiga.net/nce](http://www.taiga.net/nce).

In general, the NCE Gap Analysis Project revealed:

- Inequalities in the amount of existing information across systems.
- Greater knowledge and confidence concerning baseline information and predicted temperature changes than for other climate components.
- Strong regional trends for compiled information, with some regions well studied and others barely touched.
- Relatively little documented local and traditional knowledge about climate change.

More information about climate change impacts on biological systems with an economic component than for those without obvious economic significance.

Many individuals and organizations contributed to the Gap Analysis Project by sharing their knowledge and their ideas about how to proceed. The breadth of knowledge and diversity of perspectives represented by these different groups greatly strengthened the overall assessment.

## Reports assess climate change information

The first step in the NCE Gap Analysis Project was to review available documented information about climate, climate change, and its potential impacts in northern Canada.

Since the initial literature review identified a bias towards information from scientific sources, independent reviews of the availability of documented local and traditional knowledge about climate change and its impacts were commissioned.

In addition, two independent reviews of the information contained in the Infosources Database were commissioned from respected academics, one evaluating the completeness of data on climate change and human activity in northern Canada and the second addressing data related to the biophysical aspects of climate change.

### DOCUMENTED TRADITIONAL AND LOCAL KNOWLEDGE

People living in the North are already noticing differences in their environment related to climate change. These direct observations add an important dimension to our understanding of climate change. However, two separate groups of researchers concluded that very little of this information has been documented.

GeoNorth Limited of Yellowknife examined information from Nunavut, the Northwest Territories, Labrador, and the northern regions of Alberta, Manitoba, Ontario, and Quebec. Whitehorse-based LegendSeekers analyzed documented sources from the Yukon and northern British Columbia.

The reports' compilers searched the Internet, as well as sources such as existing databases, academic publications, conference papers, and video archives. As well, they contacted a number of northern experts for information.

Both reports emphasize the lack of documented local and traditional knowledge about climate change,

indicating a need for further research on local and traditional knowledge.

There is so little documented information, in fact, that it is difficult to assess whether specific areas of concern are understood poorly or adequately. Also, much of the existing documentation comes from larger sources, general reports, or publications focussing on other issues entirely, and is incidental or descriptive rather than specific.

### INDEPENDENT REVIEWS OF DATABASE

The NCE Gap Analysis Project included two independent reviews of the contents of the Infosources Database. Frank Duerden of Ryerson University in Toronto addressed the completeness of references to human activity. David Hik of the University of Alberta in Edmonton looked at biophysical aspects.

Duerden defined human activity broadly as economy and land use, dividing the relevant entries into various activities involving land use, economic impacts, infrastructure/community, or hazards and extreme events.

He found the database a relatively good inventory of available information. He concluded, however, that quality information relating human activity and climate change impacts in northern Canada is decidedly lacking. Duerden also noted that almost nothing in the reviewed

literature explicitly addressed the question of strategies for dealing with uncertainty.

David Hik's review related to biophysical systems and looked at whether the database is representative of available information, the extent to which it provides information for assessing specific climate change impacts, and whether the information sources are regionally representative. He also provided some recommendations for future action.

Hik noted particularly that the amount of data available varies widely by region. Regions with a longer history of access from southern Canada tend to have a more complete set of baseline information. Most of the regional knowledge gaps are in areas that are either difficult to access or where no research infrastructure exists.

Secondly, Hik reported, information about climatological, physical, and biological processes is poorly integrated with socio-economic aspects of the northern environment. As a consequence, even where potential climate change impacts are reasonably well understood, the implications for human activities and well-being are not obvious.

The full texts of all four reports are available on the CD-ROM accompanying the NCE Gap Analysis Project overview report.

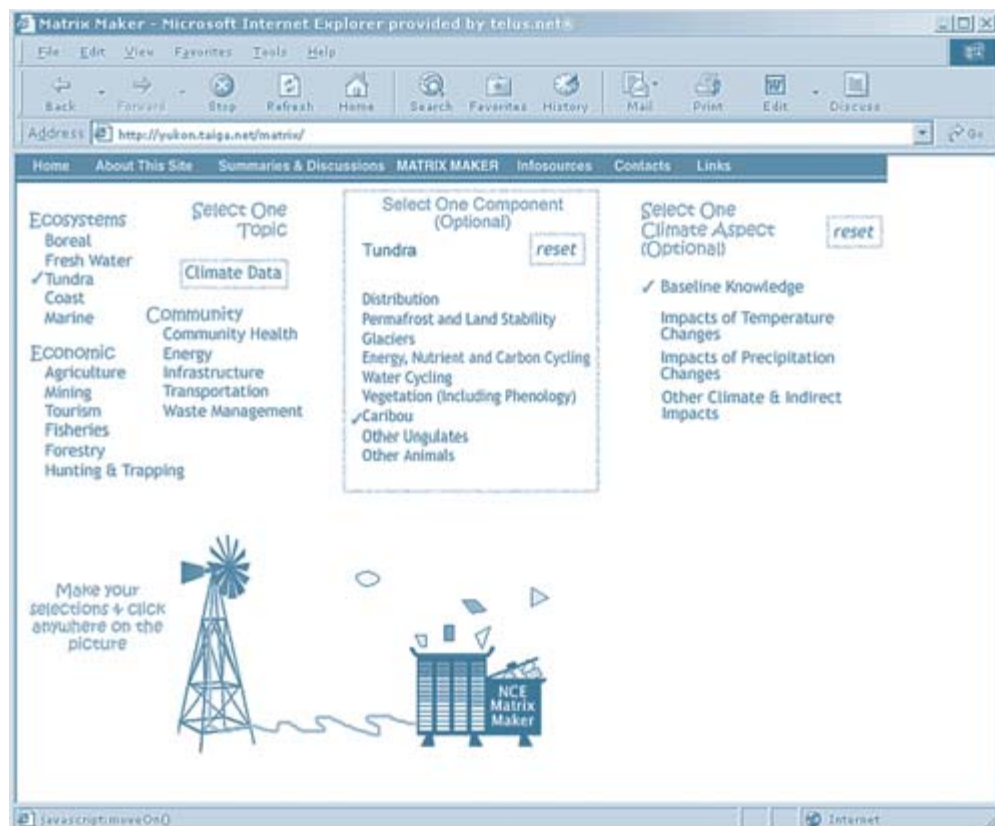
*Scientists are monitoring the rate of glacial melt.*

YUKON GOV'T PHOTO





## How to use the Matrix Maker



Do you want to find out what's known about the impacts of climate change on caribou, what baseline information is available on aquatic invertebrates in the North, or how well we can predict the impact of climate change on forest fires?

The Matrix Maker is for you!

The Northern Climate ExChange (NCE) Matrix Maker is a graphical Internet interface to the matrices prepared for the NCE Gap Analysis Project. It's reached by a link on the NCE home page ([www.taiga.net/nce](http://www.taiga.net/nce)) or by going directly to <http://yukon.taiga.net/matrix>.

Once there, you'll find a set of topics, representing the 17 matrices, or tables, set up to analyse the state of knowledge about climate change in northern Canada. At the bottom of the screen, a climate-friendly windmill is blowing bits of coloured paper into the NCE Matrix Maker's analysis bin.

When you pick a topic, more options will appear, allowing you to focus your query more closely by choosing one component of the matrix and one aspect of climate change.

For example, if you're interested in the boreal ecosystem, you can choose to focus your question on mammals and, more specifically, on the impact of temperature changes on mammals. Alternatively, you can choose to stay with the less-focussed query and get a broad picture of the state of knowledge about one of the 17 original categories.

Once you've made your selections, click on the busy windmill to execute the search. If you chose the focussed question about mammals in the boreal ecosystem, the result of your query will look like the screenshot on this page.

The results box starts with a rating of the state of knowledge in the category. In this case, the rating is Fair. Below the rating is a set of points briefly summarizing where research has been done.

The numbers in parentheses after each point indicate the source of the information. To see a citation for the source, click on the References link at the left of the screen and enter the number in the search box that appears onscreen.

*Climate change is altering weather patterns in northern Canada*

YUKON GOV'T PHOTO



### contributors this issue

Claire Eamer  
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## Building the Knowledge Matrices MIKE GILL, ENVIRONMENT CANADA, WHITEHORSE

### *What are the Knowledge Matrices?*

The Knowledge Matrices are a set of tables representing 16 natural, economic, and community systems (and one baseline information system) important to northern Canada. Each matrix contains organized information concerning our current state of knowledge on the impacts of climate change in northern Canada.

The matrices form a central tool of the Northern Assessment of the Impacts of Climate Change Project and were developed to facilitate the assessment of the quality of existing information on climate and climate change and the identification of gaps in our current knowledge.

### *Who was involved in their creation?*

The Knowledge Matrices were developed collaboratively by Anne Munier, a research assistant with the Northern Climate ExChange; Joan Eamer, head of Ecosystem Health with Environment Canada's Environmental Conservation Branch in Whitehorse, Yukon; Aynsle Ogden, director of the Northern Climate ExChange; and Mike Gill, a wildlife ecologist also with Environment Canada's Environmental Conservation Branch in Whitehorse.

### *How were the matrices created?*

A number of steps were involved in developing the Knowledge Matrices. Anne Munier conducted an extensive review of what has been documented about climate, climate change, and its potential impacts in northern Canada. This involved identifying, accessing, synthesizing, and organizing existing information related to climate and climate change in northern Canada.

Information sources included journal articles, conference proceedings, databases, public lectures, researcher/expert surveys, research licence compendiums, Internet sites, and experts from governments, universities, and communities. Compiled information

involved documented scientific, local, and traditional knowledge, although methods yielded a bias in finding scientifically derived information. As a result, documented local and traditional knowledge regarding climate change and its impacts was identified, organized and analyzed utilizing a different approach.

The huge amount of information gathered from the review was then organized into the 17 systems. The natural systems were boreal, freshwater, tundra, coastal, and marine ecosystems. The economic systems were agriculture, fisheries, forestry, mining, tourism and recreation, and hunting and trapping. The community systems were community health, energy development, infrastructure, transportation, and waste management. Each system formed a separate matrix (table).

Main components of each of the systems were identified and listed in the table rows. Listed in the columns are three aspects of climate change—temperature change, precipitation change, and other

climate and indirect impacts—as well as “baseline knowledge,” which does not take climate change into account.

We examined the cross-relationship between these components and the general climate change projections, assessing the current state of knowledge for each of them. Information supporting the assessment for each cross-relationship was entered into the cells of the matrix.

This information included the type of knowledge, location of studies, and time span of research as well as current deficiencies in knowledge. It did not include information on how system components will be impacted by the predicted climate changes.

Each cell was also assigned a ranking of “good,” “fair,” or “poor” to denote the current state of knowledge of the specific topic/relationship. Rankings were assigned systematically based on a series of questions concerning the quality and quantity of existing information.

Matrix Maker Results - Microsoft Internet Explorer provided by telus.net

Address: <http://yukon.taiga.net/matrix/results.cfm?sTopic=Boreal&Component=c&Aspect=temperature>

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State of Knowledge for Northern Canada: Climate Change Impacts & Adaptations

Matrix Maker

Summaries & Discussions

References

COMPONENT	CLIMATE ASPECT: Impacts of Temperature Changes
Mammals	<p><b>State of Knowledge: FAIR</b></p> <ul style="list-style-type: none"> <li>- Study of marten, red fox and lynx in Mackenzie Basin under different fire regimes; relevant to predicting impacts of climate change (33)</li> <li>- Some study of forest fire effects on moose and snowshoe hare (26)</li> <li>- Observation by biologists and locals of species expanding their range northward in Yukon - (i.e. mule and white-tailed deer, elk and cougar) (65)</li> <li>- Some information on winter tick range moving north; much information for northern Alberta and B.C., less for Yukon (42); fair bit of study in Alberta on how they respond to temperature; range of tick surveyed in late 80s to determine temperature controls (8,37,65)</li> </ul>

## Infosources Database holds a wealth of information

In a sense, the *Database of Climate Change Information Sources for Northern Canada* (the Infosources Database) pre-dates the Northern Climate ExChange.

It began as a project under the 1995 Canada Country Study. At that time, it was modest in size—fewer than 150 entries—

reflecting the relatively small amount of research that had been published on climate change in northern Canada.

Since the Northern Climate ExChange took over maintenance of the online database in 2000, research on climate change in the North has burgeoned, and so has the

database. The Infosources Database now contains more than 1,800 entries, including journal articles, books, conference proceedings, data sets, videotapes, websites, and online resources.

Currently the database is maintained and updated by the North region of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN North). C-CIARN North, hosted by the Northern Climate ExChange, is part of a national network of researchers and stakeholders involved in impacts and adaptation research.

The Infosources Database is accessible over the Internet. To search it directly, go to the home page of the Northern Climate ExChange ([www.taiga.net/nce](http://www.taiga.net/nce)) and click on the “Database of Climate Change Information Sources” link at right, or go directly to <http://yukon.taiga.net/infosources/>.

The Infosources home page provides a graphical interface, in the form of a map of the regions covered by the database. Clicking on a region will bring up a search screen for that region. Alternatively, it’s possible to search all regions at once. There is also a text version of the search page, which bypasses the map.

The entries can be searched by category, format, words within the title, author name, summary, and agency. You can also call up a full listing of all entries within a region or a full listing of the complete database.

The Infosources Database can also be searched through the national search engine of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN). The national search engine, at [www.c-ciarn.ca/database.asp](http://www.c-ciarn.ca/database.asp), offers a more limited set of search criteria but simultaneously searches several other climate change databases from other C-CIARN regions and sectors.



*Open water during calving season causes problems for caribou.*

YUKON GOV'T PHOTO

## Directory of Contacts builds linkages

The Directory of Contacts for Climate Change in the Canadian North is an online listing of people interested in a variety of aspects of climate change in the North.

It’s not a comprehensive listing. Individuals voluntarily submit their contact information for posting on the site. The Northern Climate ExChange does not add contacts, nor does it verify the information.

The Directory of Contacts allows people to announce their interests and get in touch with each other. So far almost 120 people have taken advantage of the opportunity.

To find the Directory of Contacts, go to the Northern Climate ExChange home

page at [www.taiga.net/nce](http://www.taiga.net/nce) and click on the “Directory of Contacts” link at right. Alternatively, go directly to the Directory of Contacts at <http://yukon.taiga.net/contacts/>.

The Directory’s home page offers three options: adding your own name to the Directory, viewing the complete list, or searching the Directory. The Directory is an online database, searchable by last name, field of interest, and region of interest.

The Directory of Contacts is intended to be a service for the climate change community. Suggestions about how to increase its usefulness are welcome.



## Taking the next step on the Gap Analysis: C-CIARN North

Climate change impacts and adaptation (I&A) research is a relatively new field, based on understanding that our climate is changing, with impacts on the natural and built environment. We need to adapt, both to minimize impacts and to maximize gains.

Governments, industry, and others involved in developing adaptation strategies need impacts and adaptation research and monitoring to assist decision making, planning, and priority setting. There is also a growing need to exchange the results of research and monitoring.

The NCE Gap Analysis Project created several tools intended to provide an information base for identifying research, monitoring, technological, and policy priorities, and to assist those developing adaptation strategies for northern organizations.

Ongoing work will be needed to keep these tools up to date. For example, when the Matrix Maker was developed, the Infosources Database contained about 500 records. It now contains more than 1,800 entries, which must be incorporated into the Matrix Maker. Further maintenance will be necessary each time the database is updated. The Directory of Contacts requires ongoing promotion to expand its use and, therefore, usefulness.

A new research network, established in the fall of 2001, will assume some of the responsibilities for carrying on this work. Coordinators for C-CIARN North (the northern section of the Canadian Climate Impacts and Adaptation Research Network) are Claire Eamer at the NCE in Whitehorse, Michelle Crossfield at Aurora Research Institute in Inuvik, and Rick Armstrong at the Nunavut Research Institute in Iqaluit.

The coordinators will also promote interaction among scientists involved in impacts and adaptation studies, raise the

visibility of this research, and provide opportunities for researchers to interact with other groups that have a stake in climate change in northern Canada.

Given the current state of knowledge and limited resources, what should the priorities be for research on climate change in Canada's North? In this issue of *Weathering Change*, Frank Duerden identifies the need for a community-scale database on vulnerability of human activity to climate change, and David Hik argues for a network of high-quality monitoring and research sites across northern Canada. The Gap Analysis Project itself revealed a need for information to guide communities, industries, and governments incorporating climate change into management and planning activities.

What else can and should be done? C-CIARN North has developed a multi-pronged approach to setting research priorities for the North, using a survey and sector-based virtual workshops to examine research gaps and priorities.

In May 2002, the Joint Ministers of Energy and the Environment approved a National Climate Change Adaptation Framework, and directed officials to:

- Raise awareness of adaptation
- Facilitate and strengthen capacity for coordinated action on adaptation
- Incorporate adaptation into government planning processes
- Promote and coordinate research on adaptation
- Support networks to share knowledge; and
- Provide methods for adaptation planning

Finally, the three territorial C-CIARN North working/advisory groups, with broadened participation, will review the priorities in light of regional differences and concerns. The process will result in a report on priority research topics for the North.

### Climate Change. Are you doing your bit?



**Tip:** *Trees are natural sinks of CO<sub>2</sub>. Planting evergreen trees to the northwest of a house can make an effective wind break; leafy deciduous trees on the south side provide shade in summer; and allow sun in through the winter.*

For more tips from the NCE's Bob and Dog Mackenzie go to [www.taiga.net/nce/doyourbit.html](http://www.taiga.net/nce/doyourbit.html)



## ExChanging VIEWS

### Bringing climate change impact assessment to the human scale

FRANK DUERDEN, PROFESSOR, SCHOOL OF APPLIED GEOGRAPHY, RYERSON UNIVERSITY

The message the NCE Gap Analysis delivers about our understanding of the impacts of climate change on human activity is not very reassuring because it tells us that much of the information is not very useful for application at the scale at which people live.

Changes in the physical environment cannot be translated into local impacts without consideration of conditions on the ground in places that are affected, community histories and economies, and the attitudes of local populations and decision makers.

Information deficiencies are compounded by the fact that, while it is widely recognized that the importance of information lies in reducing uncertainty by pointing decision makers towards the most probable futures, relatively little is known about who is listening and who is using the information.

The Gap exercise indicates a need to develop a rigorous community-scale database focused on vulnerability of human activity to climate change. Such a pan-northern endeavour would assist in making difficult decisions about allocation of resources, provide more balanced assessments of possible impacts, and enable local decision makers to assess threat, vulnerability, and opportunity as a basis for formulating responses.

The Mackenzie Basin Impact Study (MBIS) and the current Gap Analysis were very cost-effective research undertakings, exemplifying the real value added through cooperation among governments, universities and communities. While they only provided glimpses of a much larger picture—MBIS exemplifying the type of research that needs to be done across the North, and the Gap Analysis telling us what we need to know—they pointed the way towards the future.

Climate change has the capacity to fundamentally change life in the North, but the transition to a warmer world would be a much less uncertain process if this rich nation, which prides itself on its “northern” image, were to commit itself to supporting a systematic pan-northern assessment of community vulnerability.



### My number one priority? Developing a network of northern research observatories

DAVID HIK, ASSOCIATE PROFESSOR AND CANADA RESEARCH CHAIR IN NORTHERN ECOLOGY, UNIVERSITY OF ALBERTA

One of the greatest problems identified by the NCE Gap Analysis was the paucity of good information from baseline monitoring and experimental studies against which to assess natural variability and change.

Unless a concerted effort is made to establish and/or maintain a network of high quality monitoring and research sites across northern Canada, it will remain very difficult to accurately assess the impacts of climate change and variability. Consequently, science will be unable to provide useful information for communities and governments to plan for the future.

To provide this information, it is essential to observe ecological and physical phenomena over many years at large spatial scales. A network of research observatories would promote comparative research across northern ecosystems, and help to ensure a synthesis of these results in a national and international context.

I recommend the development of a network of integrated ecological, physical, and climatological research observatories. There are a number of long-term research efforts in northern Canada, all struggling to secure adequate funding, that could easily fall under this program—for example, the Canadian Arctic Shelf Exchange Study (CASES) and the Kluane Ecosystem Monitoring Project (KEMP).

Models for such programs include the US and International Long-term Ecological Research Programs (LTER and ILTER). More generally, these research programs are sometimes referred to as “Integrated Regional Impact Studies” (IRIS). A good example in northern Canada was the Mackenzie Basin Impact Study during the 1990s.

Long-term commitments to monitoring and research in northern Canada are not impossible to imagine, but success will depend on engaging communities, governments, and scientists in collaborative efforts. Such collaborations occur already, but are often sporadically or poorly funded.

Stable baseline funding is a prerequisite, but even more important is the recognition that only coordinated efforts will provide the information that is required for developing practical, sensible, and sustainable adaptation strategies in the face of unprecedented environmental change in the North.