weathering change

High tech opens new lines of communication for the North

One of the jobs of the North region of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN North) is to bring people together to discuss issues related to climate

change—how it is likely to affect the North, how northerners will cope with change, and what research we need in order to prepare ourselves.

Sounds simple, but the logistics are anything but simple. Just bringing

northerners together is an expensive and time-consuming proposition. The sparse population of northern Canada is spread over an area seven times the size of France. Even with modern means of transportation, assembling people in one location for a meeting means subjecting them to several days of travel.

To add to the logistical nightmare, many people closely involved in the affairs of northern Canada actually live and work outside the North. Academic researchers are based at southern Canadian universities; many consultants and corporations work out of offices in southern Canadian cities; federal agencies and government departments are headquartered in Ottawa or other major southern centres. C-CIARN North and its host organization, the Northern Climate ExChange, decided to apply some new technology to this old problem. With the help of the Canadian Polar Commission's CPIN web service,

...we are convinced the online workshop is a useful tool for exchanging views among people widely separated by geography, culture, and profession. we organized two online workshops in the first two months of 2003.

Instead of using airplanes and hotels to bring people together, we used the Internet and email. The discussion took the form of

messages posted on a dedicated newsgroup on the CPIN system. Participants in the workshop received email notification of new contributions to the discussion. They could respond to earlier postings, start new discussion threads, and post background documents for others in the workshop to see or download.

The two online workshops—Climate Change and Infrastructure, and Climate Change and Resource Development were an experiment, and a successful one. Although there is plenty of room for improvement in organization and delivery, we are convinced the online workshop is a useful tool for exchanging views among people widely separated by geography, culture, and profession. Talking the high-tech way is not as good as talking face to face—but it beats not talking at all!



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A note from the editor

The Northern Climate ExChange (NCE) has devoted this issue of Weathering Change to summary reports from the first two online workshops run by the North region of the Canadian Climate Impacts and Adaptation Research Network (C-CIARN North), a program hosted by the NCE.

C-CIARN North is part of a national network of regional and sectoral offices. The network's purpose is to facilitate effective and efficient research into climate change impacts and adaptation by linking researchers with each other and with those who need the results of research. Central and Yukon operations are run from the Northern Climate ExChange office in Whitehorse, with regional offices at the Aurora Research Institute in Inuvik and the Nunavut Research Institute in Igaluit.

Most of the articles in this issue were written by C-CIARN Yukon coordinator Claire Eamer, but the ideas, information, and recommendations belong to the people who took part in the workshops. The two articles in the "ExChanging Views" column were contributed by workshop participants Peter Johnson and Christy Love.

Thanks to everyone for the good conversation and great ideas!

Claurie Eamon

And now a word for our sponsor...

C-CIARN North's online workshops could not have taken place without the generous support of the Canadian Polar Commission and its web service, the Canadian Polar Information Network (CPIN).

In particular, we wish to thank Jean-Marie Beaulieu, the Polar Commission's Manager

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Canada

of Polar Science and webmaster. Online workshops were a new experience for all of us at CPIN and C-CIARN North. Jean-Marie's enthusiasm for the idea and for the content of the workshops was refreshing and infectious. We encourage everyone interested in the North and, particularly, in northern science to check out the resources available on the Canadian Polar Commission's website (www.polarcom.gc.ca) and the CPIN site (www.polarcom.gc.ca/cpin).

Online workshops are still online

Even if you missed the C-CIARN North online workshops, you can see the full discussion on the C-CIARN North website.

For *Climate Change and Infrastructure*, go to www.taiga.net/c-ciarn-north/online1. Resources include:

- A transcript of the discussion.
- A list of participants.
- A graph showing the winter road season, over time, in the Northwest Territories.
- An approach to Cold Region Integrated Infrastructure Planning (CRIIP).
- A report on waste water recycling.
- An outlined approach to responding to climate change impacts on transportation.

For *Climate Change and Resource Development*, go to www.taiga.net/cciarn-north/online2. Resources include: • A transcript of the discussion.

• A list of participants.

If you're interested in following up on discussions that took place during the workshops, join C-CIARN North's Internet newsgroup. There, you'll find many of the people who participated in the workshops. To join the newsgroup, go to the C-CIARN North home page (www.taiga.net/c-ciarn-north) and select the link at the bottom of the page—the one that says "C-CIARN North: The Newsgroup."

Missed the online workshops?

Don't worry—there will be more!

Watch the C-CIARN North website for topics and dates.

www.taiga.net/c-ciarn-north

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Workshops develop recommendations for further action, research

C-CIARN North's online workshops were primarily venues for discussion, rather than vehicles for determining future directions. Nevertheless, when people get together to talk about issues that concern them deeply, ideas about future action and what is important are bound to arise. On this page are a number of recommendations that arose during the workshops. Some came from individuals, some from several people, and some drew even broader support. Although there was no formal approval process for recommendations, none of the ideas listed here was rejected by other members of the discussion group. To that degree, they represent the concerns and priorities of the online workshop participants.

Climate Change and Infrastructure: recommendations

TRANSPORTATION

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- Both mitigation and adaptation must be considered.
- Funding programs should be modified to suit the North, which relies heavily on government researchers and local research institutions.
- Research into changes in sea ice should be expanded.
- Data collection systems and monitoring networks should be restored and maintained.
- Research into alternate modes of transportation, such as hovercraft and airships, should be supported.
- Support should be given to research into alternate energy sources that would reduce the pressure on winter roads.
- Shipping regulations and insurance requirements should be reviewed if the navigation season in northern waters increases.

• An integrated, cross-sectoral approach to climate change planning is needed.

INFRASTRUCTURE

- Research is needed into the implications of climate change for community infrastructure.
- Local and traditional knowledge must be integrated with scientific knowledge in planning for climate change.
- Research networks and alliances should be developed to link the northern territories and northern provinces.

COSTS AND RESPONSIBILITIES

- Federal money will be needed to meet the costs of adapting to climate change in the North.
- The vulnerability of communities and systems to environmental change should be assessed as a starting point in developing adaptation strategies.

- The process of obtaining commitments to fund adaptation approaches should begin now.
- Northern governments, communities, agencies, and academic and research institutions should be engaged as full partners in the adaptation process.
- Monitoring networks must be adequate to meet both national and international obligations.

WHERE DO WE GO FROM HERE?

- Historic permafrost data should be located, collected, and preserved.
- Research associated with the communities of the North should be encouraged and facilitated.
- Increased resources should be sought to allow Northern Climate ExChange and C-CIARN North to expand their clearinghouse function for northern climate change research results and research needs.

Climate Change and Resource Development: recommendations

MINING AND MINERAL EXPLORATION

- A travelling exhibit on climate change should be developed for use at mining industry conferences to help build links between researchers and practitioners.
- To be useful, information for industry should be short and easily digestible.
- There is a need for consistent standards for climate modeling and recommendations for the use of models by environmental assessment practitioners and mining companies.
- Government should take responsibility for monitoring, collecting baseline information, and disseminating it to industry.

FORESTRY AND AGRICULTURE

- Research into ecosystem responses to climate variation should be supported.
- Collaborative networks should be developed to share resources and attack problems from many different perspectives, including the social sciences.

• Forest management techniques should be identified or developed to cope with changing conditions.

ENERGY

- Canada should commit to a broad "invest in the North's future" program, an equivalent of the national commitment that built the railways, the Trans-Canada Highway, and trans-Canada pipelines.
- Governments should nurture efforts currently underway to develop alternative and small-scale energy sources for northern communities.
- Governments should focus on small-scale local developments that are economically and environmentally sustainable, reduce costs to consumers in small communities, and keep revenues in the North.

RESEARCH NEEDS

• A long-term research plan should be developed by communities, scientists, and governance representatives in preparation

for the next few decades of resource industry development in northern Canada.

- Canada's monitoring system should be maintained and expanded, with long-term stable funding, to track change and improve models.
- A better understanding of Arctic food chains is required to address potential impacts of climate change on country food species.
- Research agendas developed in the northern territories, Nunavik, and Labrador should be used as a basis for planning.
- Southern researchers should partner with northern research institutes and colleges in order to build capacity in the North.
- Because of the limited resources of northern governments, federal funding is required to attract research to the North and researchers to northern studies.

C-CIARN North online workshop on Climate Change and Infrastructure: summary report

The Climate Change and Infrastructure workshop was organized around four themes: transportation, infrastructure, costs and responsibilities, and where we go from here.

TRANSPORTATION

The transportation sector is a major contributor to climate change, accounting for about 25 percent of greenhouse gas emissions nationally. At the same time, it is already feeling the impacts of climate change in the North. Several participants emphasized the need to look at both mitigation and adaptation in considering climate change in the North. Participants urged an integrated approach to climate change planning, spanning sectors and tying adaptation planning to regional development planning.

Records show the winter road and ice bridge seasons have become shorter in the Northwest Territories since 1996. Operating seasons for ice bridges and open water navigation are highly variable and may become more variable in a changing climate. This variability is a major challenge in planning for climate change.

Converting ice crossings to permanent bridges extends the operational window for winter roads. Replacing winter roads with all-weather roads is another option. Both solutions are expensive, and climate change makes planning roads and, especially, stream crossings more difficult. Cutbacks in the monitoring networks have added to the difficulties. Discharge estimates are vital for planning stream crossings, but the federal government has cut back substantially on

contributors this issue

Claire Eamer Peter G. Johnson Christy Love its water monitoring network, making it difficult to predict discharge levels.

Another option is to reduce the need for winter roads. Much winter road traffic consists of bulk fuel shipments. Shifting to other energy technologies, such as fuel cells, could substantially reduce traffic. However, eliminating winter roads would have social and economic consequences, particularly in the Northwest Territories where only eight of 34 communities have year-round highway access.

One mode of transportation often seen as a beneficiary of climate change is shipping. However, not enough is known yet about how the warming trend might affect northern sea ice. More drifting ice might, in fact, make summer navigation more difficult. In addition, the shipping season is determined by Transport Canada regulations and marine insurance practices. These would have to be reconsidered before the commercial shipping season could expand.

INFRASTRUCTURE

Lack of information about potential climate change impacts on community infrastructure was identified as a serious problem by several workshop participants. Regulatory frameworks and environmental assessment standards will have to change as conditions change, but we have little information on which to base these changes.

Local and traditional knowledge will be vital components in developing adaptation strategies for communities. Participants discussed the degree to which this kind of knowledge is currently integrated with traditional science. The Arctic Borderlands Ecological Knowledge Co-op (www.taiga.net/coop) was cited as an example of an effective approach.

Historical information is another underutilized resource. Integrating historical data such as Hudson's Bay Company records into traditional science can extend our records of environmental conditions, providing a longer timeline with which to assess change.

Some technology already exists for dealing with climate-sensitive factors that affect infrastructure. Thermal siphons, which prevent the melting of permafrost, are becoming increasingly common. Wastewater recycling was mentioned as an effective technology for reducing energy use and greenhouse gas emissions.

The northern territories and the northern regions of the provinces share similar climate change concerns. A participant from Quebec, where climate change



impacts are already apparent in Inuit communities south of Hudson Bay, urged developing networks and research proposals based on the broader geographical region of northern Canada in order to share common solutions to common problems.

COSTS AND RESPONSIBILITIES

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All levels of government in the North have current financial demands well beyond their means. Climate change impacts add a new demand. However, the high level of uncertainty about the nature and cost of adaptation makes discussing fiscal responsibility difficult. Nevertheless, there was broad agreement that the issue of responsibility for costs must be discussed, even while actual costs are being identified, particularly since the process of obtaining funding commitments takes so long.

Participants listed some potential costs, including adaptation measures for roads and bridges; introduction of new energy sources and new transportation methods; repair and maintenance costs; and the less quantifiable social, cultural, and environmental costs. In extreme cases, community relocation might be considered, but this is a very expensive alternative and one that cannot be imposed on a community.

Several participants referred to the vulnerability approach, in which the cost of change and the nature of adaptation will depend on the vulnerability of the community or system involved. Identifying communities and systems at greatest risk would allow a staged approach to adaptation and reduction of vulnerability that could meet other challenges as well as those of climate change.

The importance of engaging or ceding the lead to northerners and northern institutions was emphasized by several speakers. Many northern institutions and communities have developed research agendas or identified climate change issues. However, they still have difficulty linking southern institutions into northerndirected agendas. Part of the discussion focused on permafrost research and monitoring, particularly in areas like the western Yukon where warming has been very marked. Several sources of historic permafrost data were identified by participants. Permafrost vulnerability is also part of a two-year study being undertaken in the Nunavik region of northern Quebec, where expanding Inuit communities are built on ice-rich ground.

WHERE DO WE GO FROM HERE?

Several participants talked about the importance of locating and preserving historical data, particularly about permafrost. C-CIARN North committed to investigating further some of the sources mentioned in the discussion. Another issue is identifying the most useful historical data and transferring it into digital form for ease of use. This would require both funding and expertise.

In order to plan for the future, it's important to know what is being observed in the North now. Research associated with northern communities is also important for future planning and should be encouraged. The resulting information should be made widely accessible. C-CIARN North committed to developing a web-based clearinghouse for the exchange of information and the flagging of information needs related to climate change impacts and adaptation.

The Northern Climate ExChange and C-CIARN North were identified as the logical agents to coordinate making data more accessible. Several participants suggested trying to find increased resources for the NCE so that it can take on this role more effectively.

Another priority identified by the group was securing resources for communities to move ahead with some of their own priorities. The Canadian Polar Commission's Researchers Directory was offered as a means of identifying expertise on issues of concern to community groups. The Federation of Canadian Municipalities' Green Fund was suggested as a source of financial support.



Sensitivity to climate change will be a factor in planning new infrastructure.

A further suggestion was that northern stakeholders develop a decision-making framework based on the vulnerability or critical-thresholds approach to adaptation. The Climate Change Action Fund was cited as a source of funding for this project. One participant offered a sample outline of a similar approach developed in Manitoba for the transportation sector, although not yet carried beyond the proposal stage.

Online workshop: Climate Change and Infrastructure

JANUARY 8 - 9, 2003

The North region of the Canadian Climate Impacts and Adaptation Research Network convened this online workshop. Co-chairs were Karen Bergman, policy analyst with Transport Canada, and Karen Henry, engineer and project manager with the Government of the Northwest Territories. Technical support was provided by Jean-Marie Beaulieu of the Canadian Polar Commission and Claire Eamer of C-CIARN North.

A total of 67 people registered, including participants from Europe, the United States, and most regions of Canada. A list of participants is available on the C-CIARN North website at www.taiga.net/c-ciarn-north/online1. Posted at the same location is a full transcript of the workshop

C- CIARN North online workshop on Climate Change and Resource Development: summary report

The workshop was organized around four themes: mining and mineral exploration, forestry and agriculture, energy, and research needs.

MINING AND MINERAL EXPLORATION

A number of climate change impacts related to mining and mineral exploration were identified:

- Warming permafrost is likely to affect the minerals industry in a variety of ways. As air temperatures increase, permafrost will become more vulnerable to disturbance, affecting ground stability for roads, airstrips, and building. The stability of ice-cored structures such as tailings dams in a warming permafrost environment is already being studied.
- Changing groundwater patterns, particularly those linked with degrading permafrost, could affect the dispersal of contaminants through the soil.

Online workshop: Climate Change and Resource Development

FEBRUARY 5 - 10, 2003

The North region of the Canadian Climate Impacts and Adaptation Research Network convened this online workshop. Co-chairs were C-CIARN North coordinator Claire Eamer and the coordinator of the Northern Climate ExChange, Aynslie Ogden. Technical support was provided by Jean-Marie Beaulieu and John Bennett of the Canadian Polar Commission and by Claire Eamer of C-CIARN North.

A total of 61 people registered, representing a geographical range from Europe to Alaska and from Nunavut to Texas. A list of participants is available on the C-CIARN North website at www.taiga.net/c-ciarn-north/online2. Posted at the same location is a full transcript of the workshop.

- The shrinking season for winter roads has implications for the costs of exploration and development in the North.
- Changing run-off patterns and timing will affect development near streams. There will be changes to the timing and amount of water supply in glacierized basins as the storage component in glaciers is exhausted. Catastrophic events are possible in areas like the St. Elias Mountains, where glaciers have a pattern of causing damming and flooding.
- Climate change impacts will have to be factored into the environmental assessment process and into the assessment of cumulative effects.

Participants discussed how to deliver information related to climate change to the minerals industry and overcome perceived fear and denial within the industry. An industry member suggested that the more information comes from within the industry, the more acceptable it will be, and that practical suggestions about what action industry can take would be useful. Another participant suggested taking the vulnerability approach to climate change—that is, strengthening processes so that they are sufficiently resilient to withstand future change.

The quantity, quality, and consistency of information available to the assessment and planning processes are of concern. Cutbacks in government climate and water monitoring networks have devolved more responsibility to consultants and mining proponents, for whom this kind of data collection is not part of core business.

FORESTRY AND AGRICULTURE

Both forestry and agriculture are small industries in the North. However, they are important players in some regional economies. Potential climate change impacts identified during the discussion include:

- Changes in species ranges and growth rates of trees in the boreal forest.
- Possible increase in the number and severity of forest fires.
- Increased susceptibility of the boreal forest to diseases and insect pests that have been kept in check in the past by severe winters.
- Changes to the growing season, affecting both forestry and agriculture.

In discussing forestry, a participant from the research community said many climate change models predict shifts in species ranges and changes in growth based on very general assumptions, while actual changes might be dramatically different. The problem, he said, is huge gaps in our knowledge of ecosystem response to climate change. However, financial support for this kind of basic research is hard to find. He suggested linking the ecological questions with social questions as a way of making the best use of resources.

On the agriculture side, it was pointed out that changes to the growing season might have relatively little impact on the potential of agriculture in the North. In most areas, the capacity of soils to support agricultural production is very limited. However, some areas of the Yukon have productive soils and might see a change in agricultural capacity.

ENERGY

Energy development is a potential economic benefit in the North—particularly the development of hydrocarbon resources and pipelines to transport them. At the same time, energy is a major cost in the North, and hydrocarbon-based energy sources are factors in the rate of global climate change.

Although the North's contribution to Canada's greenhouse gas emissions is a small fraction of the total, the use of fossil fuels is locally significant. Diamond

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mines in the Northwest Territories, for example, haul millions of litres of diesel fuel annually up winter roads. Replacing most of this with hydropower would cut greenhouse gas emissions and provide ongoing infrastructure improvement.

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Climate change has implications for the expansion of hydroelectric power in the North. Nunavut might be able to use hydroelectric power generated in Manitoba. However, this would require construction of transmission lines and temporary roads through a discontinuous permafrost zone where rising air temperatures are likely to make the ground less stable, affecting the economic viability of the project.

The viability of developing northern hydroelectric resources was another topic of concern. One participant pointed out several constraints: long distances between customers, their distance from potential hydropower sites, limited availability of financing, small local markets. A recent Northwest Territories hydroelectric development was cited as an example of how the financing problem might be overcome. The project was a partnership involving NWT Power, a local First Nation group, and banks, with the First Nation group retaining ownership of the plant and receiving revenues from the project.

Several participants urged keeping power developments within the scale of local markets. Pumping natural gas over short distances is cost-effective; however, pumping it to distant markets vastly increases the cost and the capital investment. Smallscale hydro projects aimed at local markets may be more sustainable and more environmentally friendly than large, capital-intensive projects.

Power companies and communities in the North are currently investigating a variety of alternative energy options. One option is wind power as part of a hybrid system that includes hydrogen fuel production, storage, and reuse. Small, instream hydropower units are being used in communities along the Great Bear River. Other energy options include tidal power and Carnot cycle generators, which rely on temperature differentials to generate power.

RESEARCH NEEDS

Workshop participants talked not only about what research should be done and how it should be supported, but also about how the results of research can be transmitted to industry and how better linkages can be developed between the research community and the private sector.

A number of participants emphasized the importance of long-term planning and long-term funding commitments to track and prepare for global climate change. The predicted effects of climate change in the North already intersect the 10-to-30-year planning horizons for infrastructure and resource development, but most planning and funding programs work on short-term cycles in the range of three years.

The need for an extended monitoring system to track change and fine-tune climate models was also discussed. Several participants lamented the decline of government-supported monitoring networks during a period when evidence



Wind power is being considered in several northern communities.

of climate change impacts in the North has made monitoring increasingly important. Provincial and territorial governments, non-government agencies, and industry were urged to put pressure on federal cabinet ministers to restore and support the monitoring system.

Northern governments, communities, and co-management agencies have developed research agendas in the past few years, and several participants spoke of the importance of using these agendas as a basis for planning. Participants also recommended that southern-based researchers involve northern institutions in their projects as partners, sources of logistics support, and conduits for engaging northerners in research.

Climate Change. Are you doing your bit?



Tip: Replace your clothes dryer with a clothesline and save \$113 and 0.32 tonnes of CO₂ each year.

For more tips from the NCE's Bob and Dog Mackenzie go to www.taiga.net/nce/doyourbit.html



SH CLIMATE

Linking research and industry: a researcher's perspective

PETER G. JOHNSON, PROFESSOR, DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF OTTAWA

It is predicted that in the first half of this century, substantial changes in climate will occur within the time frame of many industrial and, particularly, mining projects. Later phases of operation and decommissioning will be in a totally different set of environmental conditions. The change is occurring faster than the current policy machinery can react, even if there were strong leadership from the political arena.

The mining industry is concerned with short-term projects. The engineering challenge is often seen as the major obstacle and the greatest risk, because in the past the environment has not changed fast enough to affect operations.

Risk is understood in economic terms but often not in social and environmental terms. A mine may stimulate training in certain fields, but how is that training applicable to the postmine economy, particularly one where the overarching environment has changed dramatically from start to finish of the project?

The Government of Canada's Innovation Strategy calls for a substantial percentage of the national increase in science investment to come from the industrial sector. In an era of unstable financial markets, it is proving difficult to increase investment even in product-related science. To convince some sectors of industry to listen to and invest in climate change scholarship, and to assess the potential effects on operations and profitability, are challenges.

The climate change science and scholarship community must strengthen its outreach activities to industry. Communicating science and scholarship to any community requires a strategy appropriate to that community. It requires knowledge of the community, why they need to know, why we want them to know, what they may use the knowledge for, and what other mechanisms exist for them to get the message. It does not mean we will change the message depending on the community, but how we communicate the message will change. We need to go to industry forums and conferences with a consistent message on how climate change science provides opportunities and reduces risks.

Linking research and industry: an engineer's perspective

CHRISTY LOVE, ENGINEER-IN-TRAINING, SUSTAINABILITY ENGINEER/ RESEARCHER, ASSOCIATION OF PROFESSIONAL ENGINEERS AND GEOSCIENTISTS OF BC

Many engineers, geoscientists, and their related associations are already rolling climate change adaptation into successful business strategies. The number of BC professionals with "green" building accreditation is growing daily. BC's

hydrogen fuel industry is a major player in the global industry. On the association side of things, the

Association of Professional Engineers and Geoscientists of BC has undertaken educational outreach to its members, while the Canadian Council for Professional Engineers recently organized a workshop to explore the role of the engineering profession in climate change adaptation.

Many engineers and geoscientists employed in municipal or other governments influence policy and the shape and selection of projects. Consultants in the private sector recommend solutions in their chosen fields of practice. These professionals need expertise and specialized knowledge to back up their decisions. However, they rarely have time or resources to invest in extensive research or to read 100-page reports on climate change. This is where, I suggest, researchers need to step in.

Engineers, geoscientists, and researchers are actually quite similar: they develop high levels of expertise in their chosen area, and they prefer to stay quietly behind the scenes. Researchers need to reach out to the professions. If you have something important to say and a compelling argument for doing things differently, package the information in a digestible manner and "sell" it to the practitioners who will put your ideas to work. So much information is out there that, if you want your message to be heard, you have to actively seek out your audience.

Some places to start:

- Present to engineering/geoscience students at universities and form connections across research and applied science faculties.
- Write to professional associations in your area and recommend specific actions.
- Initiate dialogues through online or in-person forums, websites, and participation in industry conferences.

Some of the federal and provincial funding programs created as a result of Canada's commitments to the Kyoto Protocol could surely aid these efforts.

Disclaimer: The views expressed in this article are those of the author and not necessarily those of the Association of Professional Engineers and Geoscientists of BC.

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