

## Climate-and-cryosphere challenges in Canada

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Much of Northern Canada is covered by snow and ice for 7 to 10 months of the year, and below that: seasonally frozen ground and permafrost. The area stretching between 60°W and 141°W longitude encompasses the Yukon Territory, Nunavut and the Northwest Territories.



Canada's Arctic is sparsely populated with only about 100,000 people living in a vast area larger than the size of Western Europe. A large proportion of these residents are northern aboriginal peoples, who depend heavily on a firm and persistent ice cover on rivers, lakes and coastal areas and snow covered land as transportation routes to get around in the wintertime so they can carry out their daily activities, including traditional hunting. Their traditional knowledge on the arctic environment is many generations old. But the increasingly earlier

break-up of the ice during spring, the later onset of freezing during autumn, the overall unstable ice and snow conditions pose new challenges to local communities.

In an intensive dialogue with residents living in the Canadian Arctic, scientists working at Environment Canada and Canadian universities seek to learn from traditional knowledge about the past and present changes in arctic snow and ice cover. "This knowledge, combined with scientific ground and space-based observations, will help to provide reliable information to the people about how snow and ice is changing, maybe why it's changing, and get them better prepared for what the future may bring" said Environment Canada researcher Anne Walker.

Walker leads a major research project on 'Variability and Change in the Canadian Cryosphere (Snow and Ice)' which is the Canadian contribution to the large International Polar Year (IPY) activity 'State and Fate of the Polar Cryosphere', a project run under the auspices of the WCRP Climate and Cryosphere (CliC) project.

### *Today's snapshot in historical context*

The 'Variability and Change in the Canadian Cryosphere' initiative investigates the current state and past change of snow, lake and river ice, sea ice, frozen ground, glaciers and ice caps providing new satellite information for a variety of users, including northern communities and water resource management and operations. During extensive field campaigns within the Northern territories, Walker and her team collect a vast amount of data on snow and ice conditions and properties. The data will then be used to compare today's snapshot in the

context of the historical record to document the magnitude of changes over the 50 years since the last International Polar Year (IGY 1957-1958).

Over 30 investigators from government, academia and the private sector are involved in this snow-and-ice project. Several research teams out in the field measured snow depth, snow water equivalent and other snow cover properties or conducted lake ice measurements. In addition, aircraft collected airborne data in order to improve satellite-based retrievals of snow water equivalent which is the amount of water contained within the snow-pack. "The field and aircraft-based teams braved extreme winter conditions with -40° to -50°C wind chills to acquire the first-ever extensive field measurements of snow cover properties over such an expansive and remote area" reported Walker.

Eventually, all data combined will help to characterize and explain the observed variability and changes and will improve the representation of the cryosphere in Canadian land surface and (global) climate models. An accurate representation of the cryosphere is essential for current and future climate simulations – and to better prepare northern communities for the expected changes.

### ***IPY and social responsibility***

Environment Canada, the Canadian federal government department responsible for weather and climate, is leading five large International Polar Year projects and has scientists involved in 14 other projects looking at a wide breadth of critical northern issues.

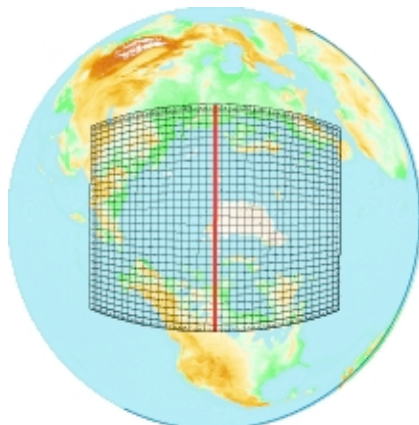
The International Polar Year is a large scientific programme organized through the International Council for Science (ICSU) and the World Meteorological Organization (WMO). To capture the full arctic and Antarctic seasonal cycle the programme runs from March 2007 until March 2009. Thousands of scientists from over 60 nations are involved in over 200 endorsed projects which examine a wide range of physical, biological and, for the first time: social research topics.

The Government of Canada supports with over \$150 million Canadian polar research during the ongoing International Polar Year 2007/2008 and beyond. Canadian science and research activities address two priority areas: science for climate change impacts and adaptation, and health and well-being of Northern communities. In fact, all IPY-endorsed Canadian research projects had to meet strict criteria to promote Northern participation, including skills training to build long-term Northern research capacity and foster a new generation of Northern scientists. The arctic environment is changing – IPY research efforts will help to increase the sustainability of arctic communities.

### ***Tomorrow's weather for small regions***

In addition to understanding future climate in the far North, Canada's natives also will benefit from more accurate weather and environmental prediction. "Our main concern is to improve Arctic weather forecast for time scales of one day to two weeks – this is far beyond climate studies which look at seasonal to centennial time scales" said Ayrton Zadra, Atmospheric

Scientist at Environment Canada and leader of the 'Arctic Weather and Environmental Prediction Initiative (TAWPEI)', another International Polar Year project.



Zadra and his team of ten principal investigators and six young scientists will develop a regional numerical weather prediction model of 10 to 15 km horizontal resolution. The Arctic is, however, highly under-observed and meteorological data to feed such a model are sparse. There are surface and radiosonde observations taken every several hundred kilometres or so apart, some reporting more than 90% of the time while some others deliver less

complete reports. The use of satellite data may help to close (temporal and spatial) data gaps. However, this is not as straightforward as it sounds, as satellite retrievals in polar regions are difficult, owing to the snow- and ice-covered land surface, as well as cold, low-level clouds consisting mainly of ice crystals. "The scarcity of data is limiting scientists' ability to accurately model small-scale processes such as Arctic storms and their associated hazardous conditions like blizzards and severe wind-chill" explained Zadra. The team will use data obtained during field campaigns conducted by other IPY projects and collaborators. "We need these data on snow, sea-ice, ozone layer and polar clouds to correctly initialize our models and to evaluate the quality of the forecast issued by the models!" Field experiments are conducted on Baffin Island, Ellesmere Island, and Greenland – "...sometimes at conditions that allow to study Arctic storms with every cell of your body!"

"In order to develop an improved model for numerical weather prediction over the Arctic requires improvements in our numerical methods ('numerical' basically means 'computer') and in our understanding of physical processes in polar regions" said Zadra. The research will also enhance science's understanding of the Arctic and its influence on world weather. The project is still in its early stages, research activities started in April 2007 and will continue until March 2010. [C Arndt]

### **Links & references**

Environment Canada <http://www.ec.gc.ca/>

EnviroZine [http://www.ec.gc.ca/envirozine/english/home\\_e.cfm](http://www.ec.gc.ca/envirozine/english/home_e.cfm)

International Polar Year <http://www.ipy.org>

TAWEPI project <http://collaboration.cmc.ec.gc.ca/science/rpn/tawepi/en/index.html>

Variability and Change in the Canadian Cryosphere project  
<http://classic.ipy.org/development/eoi/details.php?id=644>

WCRP <http://wcrp.wmo.int>

WCRP Climate and Cryosphere (CliC) project <http://clic.npolar.no>

WMO Bulletin (2007) <http://www.wmo.int/pages/publications/bulletin/>