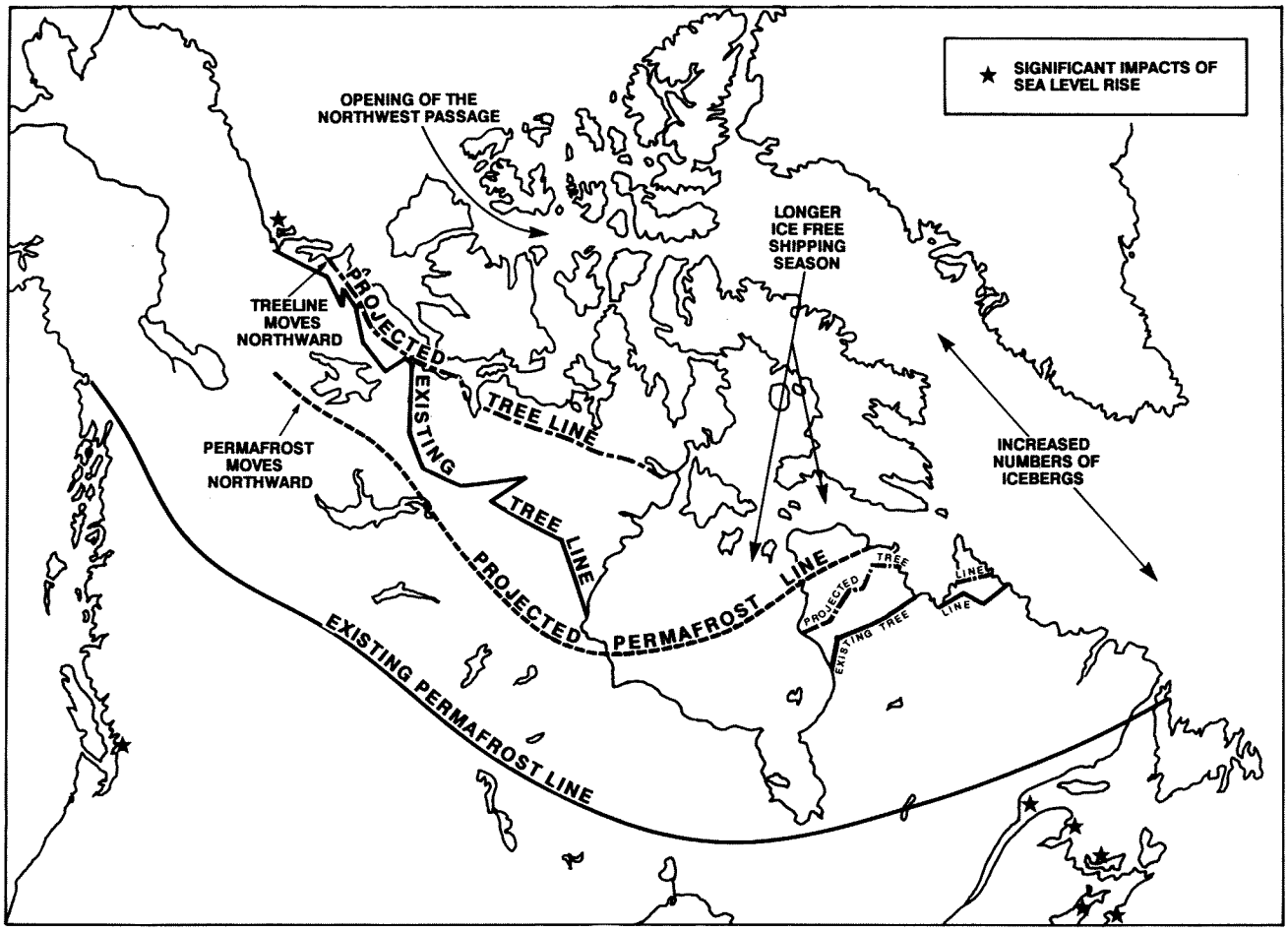
FACT SHEET

The Greenhouse Effect: Impacts on the Arctic



Climate warming, caused by the greenhouse effect, is expected to be the greatest in the earth's polar regions. Such change would have profound impacts on the northern way of life.

Over the next 50 years, scientists anticipate that human activities will substantially alter global climate, by enhancing the earth's natural greenhouse effect. Air pollution, the burning of fossil fuels, deforestation, and even agricultural practices have increased the amount of heat-trapping gases in the earth's atmosphere. Carbon dioxide, produced by the burning of fossil fuels, is the greatest concern, as the world's demand for energy is steadily increasing. These "greenhouse gases" are expected to change the earth's climate by increasing global temperatures and altering rainfall patterns. Climate change is expected to be the greatest in the polar regions.

Scientists suspect the first evidence of global warming will be found in the far north. At weather stations in the Arctic, such as this site at Mould Bay, Environment Canada takes daily observations, which will be important in the future detection of climate change.

Average global temperatures are anticipated to increase by 1.5 to 4.5 degrees C over the next 50 years. Although such temperature increases may not seem large, on a global scale even a one degree rise in average temperature could have major impacts. During the last ice age, average global temperatures were only 5 degrees cooler than today.

In the Arctic, the warming is anticipated to be less than the global average during the summer — perhaps as little as half a degree. However, during the winter a dramatic increase in temperature is expected — as much as 8 to 10 degrees C. This would be at least twice the global average. In addition, rainfall which presently falls in southern Canada is expected to shift northward, increasing Arctic precipitation by 20 to 30%.

The Thawing of the North

Such a major warming would melt much of the permanently frozen ground that underlies about half of Canada's land surface. In the Arctic, permafrost may extend to a depth of up to 300 m (1,000 ft). A major concern is that as it melts, permafrost releases methane — one of the gases which contributes to global warming. Thus widespread melting of permafrost could further increase the greenhouse effect.

Rising temperatures would also melt part of the permanently frozen northern oceans. During the summer, the Arctic Islands are expected to be ice-free. Mountain glaciers on the islands and the mainland would also decrease and, in some cases, melt entirely. The large Greenland Icecap would remain intact, with only a small amount of melting.

Such melting would contribute to the anticipated rise in global sea levels. This rise is likely to be as much as one metre, half of which would be caused by melting from sea ice, glaciers and ice caps throughout the globe. (The additional half metre rise would result from the ocean water expanding as it becomes warmer.) Such an increase in sea levels would threaten low-lying coastal regions throughout the globe.

Such major changes in climate would have profound impacts on both human activities and natural systems in the far north. At first glance, a warmer climate might seem beneficial to the Arctic — living conditions would be improved, and the north would be more open and accessible. Yet there would be negative effects as well, including the loss of those very characteristics that make the Arctic unique. The harsh climate has helped to isolate the far north, preserving its wildlife and allowing its native peoples and their culture to endure. Climate warming is likely to end this isolation by eliminating the Arctic's natural barriers.

Effects on Vegetation and Wildlife

Climate warming in the far north would slowly shift the tree-line north by 200 to 300 km, with the tundra shrinking back to the Arctic Islands. Such changes would occur gradually over a long period of time, but

would have a major effect on northern wildlife. Some species are expected to be able to adapt to changes in their habitat. Others, however, would decline — particularly those dependent on the tundra for survival.

The Arctic tundra is essentially a frozen desert — one of the driest regions in the world. Warmer, wet winters, which are expected as the climate changes, have been shown in the past to decimate populations of caribou and muskox. Heavier winter snowfall would bury the sparse tundra vegetation on which these animals depend for food. Open water between the Arctic Islands would also cut off the migration of caribou and the movements of other land-based wildlife, reducing their opportunity to find suitable habitat and new food sources.

Most marine life and migratory birds are expected to flourish. Warmer temperatures would increase fish populations in both inland lakes and the ocean. Seals, walruses, beluga and bowhead whales would increase in numbers and spread northward. Polar bears are also expected to survive as they have already demonstrated considerable ability to adapt to a broad range of habitats.

Impacts on Society and the Economy

Shipping and Offshore Oil Drilling

Sea ice and extreme winter cold have been traditional obstacles to northern shipping and the development of offshore oil resources. Reduced sea ice would mean less damage to ships and oil rigs, resulting in decreased design and construction costs and greater safety. The shipping season is expected to lengthen by six to eight weeks, and permanent ice would be greatly reduced. Such benefits would probably be tempered by other changes including an increase in ocean storms, stronger winds and higher waves.

Icebergs, a hazard in the eastern Arctic for both shipping and offshore oil platforms, are also expected to increase in frequency. Icebergs are produced as pieces of ice break off glaciers which are advancing into the sea. Increasing snowfall would cause the glaciers on Greenland and the Arctic Islands to advance more quickly, creating a significant increase in the number of icebergs.

Agriculture

The potential for agriculture would increase in a warmer climate, with the growing season lengthening by 30 to 40%. For example, growing conditions for Yellowknife and Whitehorse would be similar to those in Edmonton — 1,000 km further south. Yet most of the north would remain unsuitable for agriculture, as Arctic soils tend to be poor and infertile. Agriculture could become viable in limited areas on the Arctic mainland — in certain valleys of the Mackenzie District and Yukon. Even limited local agriculture would lower food costs.

Fishing and Hunting

Although most marine life and migratory birds should increase in numbers, their distribution and migratory patterns may alter in response to changed environmental conditions. Settlements chosen for their proximity to hunting or fishing grounds may no longer be well located for these activities.

Building on melting permafrost

The anticipated widespread melting of permafrost would damage roads, buildings, power lines and pipelines which are now resting on permanently frozen ground. Over much of the Arctic, existing structures would have to be reinforced to withstand the anticipated seasonal freezing and thawing, much like structures further south. Construction costs for new developments will increase accordingly.

Opening of the Northwest Passage

The melting of permanent sea ice between the Arctic Islands would open the Northwest Passage. This long-sought passage — the quickest route from Europe to Japan — would become a viable shipping route during the summer months. This would have implications for Canada's sovereignty over the Arctic, as the north would draw increased interest from foreign nations for scientific, military and commercial purposes.

Environment Canada keeps tabs on the gradual increase of gases contributing to the greenhouse effect in the high Arctic. Here a scientist takes an air sample outside the world's most northerly permanent research station, at Alert, on the northern tip of Ellesmere Island.

Increased Accessibility and Development

Warming in the Arctic would reduce the harsh living conditions and open new shipping lanes, leading to increased development in the north. The Arctic's natural resources, including its minerals, forests and sea ports, would be more easily utilized. Large reserves of oil, natural gas, lead, zinc and iron ore have already been discovered in the Arctic. Shipping and tourism would increase. Commercial fishing could become viable. Settlement would expand and spread northward among the Arctic Islands.

Impacts on the native people would be mixed as increased economic activity would bring increased and more diverse employment opportunity, but also greater pressure on traditional cultures and environmental values.

How certain is climate warming?

Scientists from around the world agree that significant climate warming now appears "inevitable". However, many uncertainties still remain about the timing and magnitude of this warming, and the specific regional impacts. Nevertheless, scientists strongly recommend that the probability of major change in climate be considered in the planning of future development, especially for large projects with anticipated life-spans of several decades. This is particularly important in the Arctic, as climate is a significant factor in virtually every northern activity.

Environment Canada's Role

We have only begun to understand the complexities of the earth's atmosphere and how it is being changed by human activities. Environment Canada is striving to learn more about global warming and its impact on the Arctic. Our Canadian Climate Program combines the efforts of governments and universities to further our understanding of this complex issue.

Many scientists feel the first evidence of global warming will be found in the Arctic, as climate change is expected to be greatest in the earth's polar regions. Environment Canada is well prepared to detect such a change. For decades, we have maintained a network of weather monitoring stations in the Arctic to keep tabs on current weather conditions. We also monitor sea ice conditions and the state of ocean waves. Such information is necessary for accurate weather forecasts and to ensure the safety of shipping lanes and offshore oil rigs. These records have already contributed to our understanding of Arctic climate, and will continue to be important in the future detection of global change.

Environment Canada also monitors the gradual increase of gases contributing to the greenhouse effect. We operate the world's most northerly research station — an air pollution measuring lab at Alert, on the northern tip of Ellesmere Island.

Canada is also working to reduce climate warming. Steps have already been taken to reduce CFCs (chlorofluorocarbons), industrial chemicals which threaten the ozone layer and are a major contributor to climate warming. Our nation played a key role in the development of the Montreal Protocol, an international agreement to reduce CFCs by 50% by 1999. The use of the most damaging CFCs has already decreased, and international action is underway to strengthen the Montreal Protocol and encourage further reductions.

In addition, Canada is studying ways to reduce carbon dioxide, the most serious of the greenhouse gases. As the global increase in CO_2 has been produced primarily by the burning of fossil fuels, Canada is considering ways to reduce our energy use, through conservation and improved efficiency.

Part of a series of fact sheets on Arctic air pollution. Other titles are:

- *Arctic Haze — Visible Air Pollution*
- *Toxic Chemicals in the Arctic*
- *Depletion of the Arctic Ozone Layer*

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Aussi disponible en francais
December/89

Published by Authority of the Minister of the Environment

Catalogue No. En57-29/5-1989E
ISSN 0847-3099
ISBN 0-662-17295-7

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