Section 1: Background

CLIMATE CHANGE: AN OVERVIEW

Introduction

Climate influences where we live, our growth, and our well-being. Each species of plant and animal has adapted to live within a specific climatic niche. Humans have adapted and expanded into more climatic niches than most other species have. Throughout history, human adaptability has been evident in customs, shelter, clothing, food preferences, agricultural practices, transportation, and settlement patterns. It is also reflected in industrial strategies, recreation, and economic policies. This is why the potential climate change due to global warming is a source of concern for all Canadians.

> We are a land of seasons: spring, summer, fall, and winter flowing in a natural rhythm. The weather of our seasons can vary dramatically from region to region. The unpredictability of our weather brings its share of searing droughts, blinding blizzards, crop-killing frosts and hail, and the destructive wrath of tornadoes and avalanches. (Environment Canada, 1995, 11)

A Brief Explanation of Climate Change

Climate change can be defined as "…a change in the average weather that a given region experiences" (Environment Canada, 1995, 11). Average weather includes elements such as temperature, wind patterns, and precipitation. In the media, the terms *global warming* and *climate change* are often used interchangeably; however, they are not the same thing. Climate change refers to general shifts in climate, including the weather elements already mentioned. These shifts may vary from region to region. Global warming (as well as global cooling) refers specifically to any change in the global average surface temperature. In other words, global warming or cooling is ONE type of planetary scale climate change.

When describing climate change, it is important to distinguish long-term from short-term change. Climate processes are influenced by a complex array of interacting elements. These include the sun, the atmosphere, the oceans, and even volcanic activity and changes in topography. The interconnectedness of these elements results in a system that can be hard to predict. In any location, temperatures, rainfall, and other climatic elements can naturally vary a great deal from one year to the next and still be considered within the bounds of normal climate variability. Therefore, one abnormally cool summer occurring after a series of warm summers does not necessarily indicate a reversal of a trend. Similarly, one unusually hot season does not by itself prove global warming is taking place. It is critical—though often difficult—to distinguish an important emerging long-term trend from an insignificant short-term irregularity in the climate pattern.

A common misconception is that global warming will cause the world to warm uniformly. In fact, an increase in average global temperature will also cause the circulation of the atmosphere to change, resulting in increased warming in some areas of the world and a less than the average warming in others. Some areas can even cool.

The question on everyone's mind is, "Has the world warmed?" The answer is, "Yes!" The average global temperature at the earth's surface has warmed by about 0.6°C since the late 19th century. Because this is an average temperature rise we know that this means the warming has been several times greater than the global average in some places, while in a few areas temperatures have actually cooled. In Canada, for example, there has been an increase in the average annual temperature of about 1°C over the period from 1895 to 1992. According to recent research results for the northern hemisphere, the 20th century is now likely the warmest century, the 1990s the warmest decade, and 1998 and 2001 the hottest years.

Issues Related to Climate Change

The natural regulating system for the temperature on the earth is known as the *greenhouse effect*. This refers to the atmosphere's role in insulating the planet from heat loss, much the way a blanket on our beds insulates our bodies from heat loss. Human activities have the potential to disrupt the balance of this natural system. As human societies become more dependent on technology, the amount of heat-trapping CO_2 and CH_4, among other gases (often referred to as greenhouse gases), in the atmosphere increases. By increasing the amount of these greenhouse gases, humankind has enhanced the warming capability of the greenhouse effect. This human influence on the natural warming function of the greenhouse effect has become known as the *enhanced greenhouse effect*. It is the human-induced enhanced greenhouse effect that causes concern. It has the potential to warm the planet at a rate that has never been experienced.

Human activity has had a direct impact on the amount of CO_2 and CH_4 released into the atmosphere. This activity includes the production and burning of fossil fuels such as coal, oil, and natural gas, and the clearing of forests for building and agricultural land. In particular, since the Industrial Revolution of the 1800s, fossil-fuel burning machines have done work that was previously done by hand and by animal power. Meanwhile, trends such as increased rice production and growing numbers of domestic animals have resulted in increased emissions of CH_4. During this time, the concentrations of CO_2 and CH_4 have increased faster than at any other time in recorded history.

Both local and global consequences are expected with rapid climatic change. In Canada, the shift in climate zones may affect the distribution of plant and animal species. Globally, a rise in sea level, which will threaten coastal cities and settlements all over the world, is possible. Another disturbing consequence of anthropogenic (human-caused) climate change is that it may permanently affect the earth's climate system. We do not fully understand the complex ways in which the elements that influence the climate such as oceans, forests, and clouds interact. "Once interrupted by the initial effects of global warming, they may not easily be restored and, therefore, may not be able to provide the same temperature regulating functions to which life on Earth has become accustomed" (Environment Canada, 1995, 13).

Future Perspectives

As stated in an earlier section, Canada has warmed by 1°C over the timespan of 1895 to 1992. However, the warming trend has not been consistent throughout this entire time. Three distinct phases are apparent in the national temperature record. These include a warming from the 1890s to the 1940s, a cooling from the 1940s to the 1970s, and a resumption of warming from the late 1970s on. The 1980s was indisputably the warmest decade on record in Canada. "The warming that has been observed in Canada over the past century is unquestionably real and significant though its intensity has varied from decade to decade, from region to region and from season to season" (Environment Canada, 1992, 4).

In 2001, the Intergovernmental Panel on Climate Change (IPCC) concluded that without coordinated global action to reduce greenhouse gas emissions, the global average surface temperature relative to 1990 is expected to rise by between 1.4 and 5.8ºC by the year 2100. Even if greenhouse gas emissions from human activities were to stop immediately, temperatures will continue to rise because the effects of past emissions will persist for centuries. It is important to note that temperature changes will occur unevenly around the world and the effects will be far from uniform. In Canada, the annual mean temperature could increase between 5 and 10ºC over the next century (IPCC, 2001, Chapter 11).

The Impact of Climate Change on the Arctic

Rapid climate change has the potential to influence climates directly all around the world, with disturbing and immeasurable environmental consequences. This is particularly true for plants and animals that do not have the ability to adapt to sudden climate changes.

One problem Canadians may have to face is land instability in the North due to the decay of the permafrost layer. Other problems may include the loss of some favourite winter sports, increased disease, pest infestations, urban smog, and summer heat stress. Shifts in global wind and rainfall patterns could affect the timing and frequency of extreme events such as droughts, forest fires, and intense storms. Lower lake levels and changes to river flow could also affect water quality. In the end, it is the unprecedented rate of change and the uncertainties associated with a new climate that make adaptation a challenge.

The "frozen North" will be less frozen as winter temperatures may rise as much as 10°C in northern latitudes. The season for heavy pack ice will be shortened and the ice will be thinner, leading to earlier spring break-up. These changes could cause problems for Aboriginal Canadians dependent on subsistence hunting as wildlife reacts to altered migration routes and habitat. In the eastern Arctic, increased glacial flow off the land will likely result in more icebergs. Reduced sea ice cover may cause problems for marine mammals, including seals, walruses, and polar bears. Fish that are dependent on ice cover and cold water would also be affected. The Arctic region is a key regulator of global climate, and reduction in sea ice and snow extent will affect not only Arctic regions, but also global climate.

Canada's vast wetlands provide important wildlife habitat for waterfowl and a host of other species. Coastal wetlands and marshes, which occur in many river estuaries and bays along both coasts, could be at risk from rising sea levels. The prairie wetlands, so important to migrating and nesting waterfowl, will be in danger of drying out. Their loss will threaten the immediate survival of many North American waterfowl species. There is also the possibility (although remote) of some new wetland habitats being created in the North as permafrost under the tundra melts.

With climate change, there will likely be more precipitation, especially in fall and winter. Snow seasons will be shorter, but the build-up of snow could bury food for northern wildlife and also result in heavy spring flooding along many northern rivers. The slow melting of the permafrost layer that underlies much of the Arctic tundra could turn the ground into a quagmire. This could affect northern transportation, since in many areas, surface travel is possible only when the ground is frozen solid. Buildings and other structures such as pipelines built directly on permafrost may become unstable as well. The way of life of tens of thousands of northern Canadians could be affected.

The Kyoto Protocol

The Kyoto Protocol is a binding agreement between industrialized countries to limit their greenhouse gas emissions by a total of 5% from 1990 levels in the five-year period from 2008 to 2012.

A global concern regarding climate change was articulated in 1988 when the World Meteorological Organization and the United Nations (UN) Environment Programme established the Intergovernmental Panel on Climate Change (IPCC). The idea of creating an agreement among industrialized countries on reducing greenhouse gas emissions to slow down the effects of these gases on climate change was first introduced in 1990. The first framework agreement on reducing greenhouse gas emissions was developed in New York in May 1992 and opened for signature at the Earth Summit in Rio de Janeiro, Brazil, in June of the same year. Canada signed and ratified this agreement, along with 50 other countries.

Conference of Parties (CoPs): Beyond the Kyoto Protocol

The countries that signed the original agreement to reduce greenhouse gas emissions then began meetings to create a document that would outline the requirements for each country on their commitment to the reduction of greenhouse gas emissions. The following timeline describes the major activities related to the Kyoto Protocol between 1995 and 2002.

- The countries first met in 1995 in Berlin, Germany, where it was decided that the original agreement was not adequate to fulfill the greenhouse gas emission target. It was decided that a new document should be created to implement the goal of a reduction in greenhouse gas emissions by a total of 5% of 1990 levels.

- The third Conference of Parties (CoP3) was held in 1997 in Kyoto, Japan, where leaders adopted the Kyoto Protocol, a binding agreement among industrialized countries to limit greenhouse gas emissions by a total of 5% from 1990 levels in the five-year period from 2008 to 2012. For the Protocol to come into effect, 55% of the countries with 55% of the emissions were required to ratify it.
- The sixth Conference of Parties (CoP6) met in The Hague, Netherlands, in 2000 to set goals for implementing the Kyoto Protocol; however, the parties were unable to come to any agreement. The source of the disagreement was the extent to which countries can obtain emission credits for activities that create greenhouse gas "sinks" such as reforestation projects and soil management practices in agriculture. The disagreement was among a group of countries that included Canada, the United States, and the European Union, called the CoP6a.
- The sixth conference was extended to a second meeting in Bonn, Germany, in 2001, but prior to the meeting, the United States, under a new presidency, announced that it was pulling out of the Kyoto Protocol; at this conference (CoP6a) a new agreement was reached that did not include the United States.
- The seventh Conference of Parties (CoP7) was held in October 2001, where parties in Marrakesh, Morocco, agreed to many of the rules under the Kyoto Protocol and the Marrakesh Accords were approved by all parties.
- The eighth Conference of Parties (CoP8) was held in October 2002 in New Delhi, India, where the discussion emphasized adaptation to climate change.

Because the study of climate change is such a rapidly developing area, it is important to stay abreast of the latest information, including developments related to the Kyoto Protocol. The following websites can assist in keeping up to date:

- Climate Change Connection (Manitoba)
  <http://www.climatechangeconnection.org/>
- International Institute for Sustainable Development (IISD)—Linkages
  <http://www.iisd.ca/linkages/climate/>
- Manitoba Energy, Science and Technology—Climate Change
  <http://www.gov.mb.ca/est/climatechange/>