PEOPLE

People and their activities are greatly influenced by climate. How we earn our living, how we build our homes and communities, and how we spend our leisure time all depend on the kind of weather we expect.

As with natural ecosystems, it is not often easy to separate the influence of climatic changes on human activities from other influences. And unlike other species, we humans have a greater ability to lessen the impacts of such changes by using technology and by modifying our behaviour.

To consider some of the ways in which a changing climate may be affecting the daily lives of Canadians, this section examines the following six indicators:

- Traditional Ways of Life
- Drought
- Great Lakes–St.Lawrence Water Levels
- Frost and the Frost-free Season
- Heating and Cooling
- Extreme Weather

As Canadians learn more about trends in climate, they may want to know more about potential economic impacts. For example, how might changes in climate affect shipping seasons, construction methods, insurance requirements, and tourism opportunities? They may also wish to consider climate changes in evaluating potential health and social impacts, such as the spread of insect-borne diseases, injuries due to cold and heat extremes, and weather-related traffic accidents.

The lives of many Canadians are closely tied to the land. This is especially true for aboriginal communities, who get much of their food from hunting and fishing and the harvesting of edible plants and berries. These traditional activities are also an important part of aboriginal culture, which contains a large amount of knowledge about climate and how it affects these activities and the environment that supports them.

The North's climate is changing, however, and it is changing faster than in most other parts of Canada. These changes are affecting many aspects of the northern environment, such as ice and terrain conditions and the supply of game, wild plants, and fresh water. As a result, native peoples are finding it harder to rely on the traditional knowledge and practices they have used for so long to survive in a region that is usually frozen for more than half the year.

FOCUS: Western Nunavut

Follow the line of the Alberta-Saskatchewan border north to the Arctic Ocean and you come to Coronation Gulf. The gulf and Bathurst Inlet to the east are the heart of a region known as West Kitikmeot. This region is home to the Bathurst caribou herd whose range extends across West Kitikmeot and south into the Northwest Territories.

In recent years, the Kitikmeot Inuit, who inhabit the region, have noticed dramatic changes in the local climate and environment. Winters and summers have become warmer, and sea and lake ice have been melting earlier in the spring. Fall freeze-up – an August or September event just a few decades ago – now happens mostly in October or November. The weather has also become more variable, and short-term temperature swings that cause repeated thawing and freezing have become more common. With a more variable climate, weather and ice conditions have become harder to predict, and that has made it more difficult and dangerous for hunters and others travelling on the land and ice.

The changing climate has affected plants and wildlife too. Summer vegetation is richer, and birds and animals rarely seen before are appearing more frequently. Because the Kitikmeot Inuit get much of their food from hunting, fishing, and sealing, they are affected by all of these changes.

They are particularly concerned, though, about the impacts on caribou. More plentiful vegetation can support a larger herd, but hotter summers put more stress on the animals, while the more rapid appearance of large expanses of open water in the spring forces them to alter their migration routes. More frequent thawing and freezing of the snow cover can result in starvation, because it leaves a thick layer of ice that the caribou can't dig through to reach the vegetation below. Thin ice is also a hazard. Two snowmobilers travelling in the Coronation Gulf area discovered stark evidence of this in 1996, when they suddenly encountered hundreds of antlers sticking through the ice – an "antler forest" that marked the site of a mass caribou drowning.

A caribou herd crosses an expanse of water.

THE BIGGER PICTURE

Climate change is a major concern throughout Canada's arctic and subarctic regions, and many communities have begun to record their observations of how it is affecting their environments and their lives. From the Yukon to central Nunavut most local observers agree that the climate is getting warmer. In eastern Nunavut, however, opinions are mixed as to whether it is warming or cooling, while in Nunavik (northern Quebec) residents have noticed warmer summers but more extreme cold in the winter. In northern Labrador, the perception is again one of general warming. In all regions, however, it is agreed that the weather has become more variable, stormier, and harder to predict.

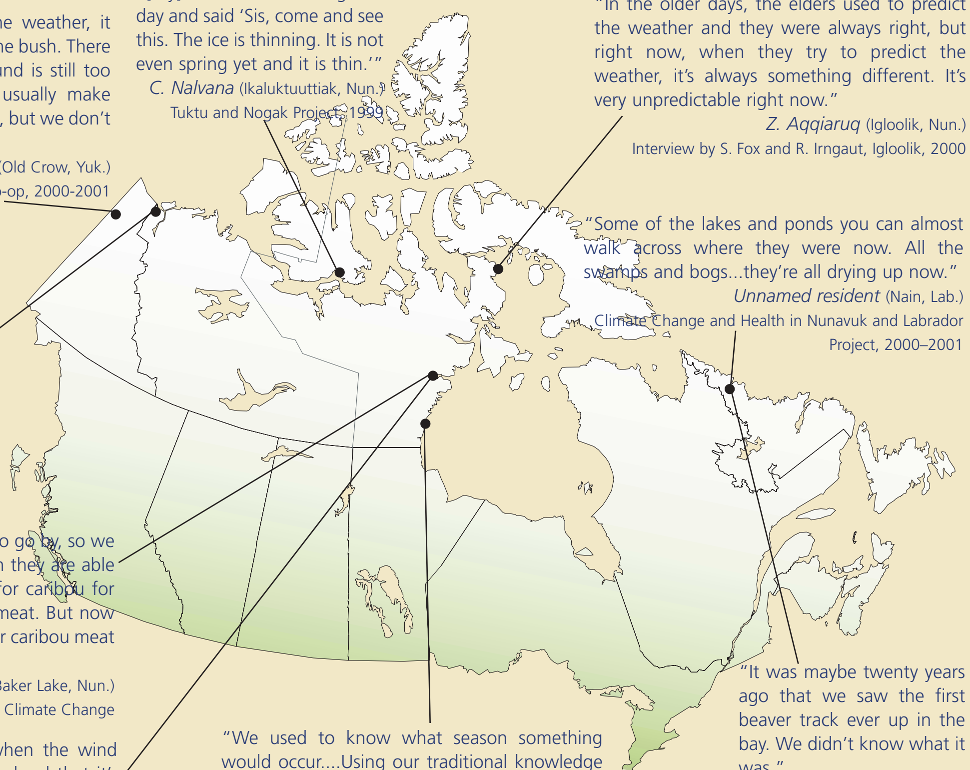
These observations generally agree with the scientifically measured trends, although the scientific record gives a stronger impression of cooling in the eastern Arctic than the reports of local observers do. This may be because local observers have given more emphasis to recent years, which have been unusually warm. The scientifically measured trends, on the other hand, cover a span of 50 years and include a greater number of cold years. But that could be changing. Parts of northern Quebec, at least, have been warming since the mid-1990s.

As a result of changes in climate, familiar environments are becoming less familiar. As in Kitikmeot, people in most parts of the North are noticing the arrival of birds, fish, and animals that have not been seen in their regions before. They are also noticing more unusual weather and more storms. Thunder and lightning, once very rare in the Arctic, are now being experienced more often, and in 2001 the Mackenzie Delta got its first tornado warning.

In coastal areas, people can no longer hunt, fish, or travel on the ice as often or as long as they used to, and thinning ice is making these activities more dangerous. Changing wind patterns are also making it more difficult to apply traditional navigational techniques like following the direction of snow drifts. Survival on the ice is more difficult as well, because stronger winds are often packing the snow harder and making it unsuitable for building igloos. Getting drinking water by melting sea ice is harder too, because old multiyear ice, which is mostly fresh water, is no longer as easy to find, and the more plentiful new ice is salty. In inland areas, problems such as melting permafrost and the drying of lakes and rivers are adding to the difficulties of tending traplines or travelling to hunting and fishing grounds in some areas.

Northerners are adapting to these changes in a number of ways – changing the timing of hunting and fishing activities, going to different locations, harvesting different types of fish and game, and being more cautious when travelling on the ice. Some changes also offer advantages. Extremely harsh winters are fewer and more time can be spent on the land in the summer. What is most endangered though is a way of life that has been based on a long relationship with the cold polar climate, a way of life that is very much a part of the identity of northern people.

CLIMATE CHANGE – THE NORTHERN EXPERIENCE



"Because of too much change in the weather, it makes it hard for people to go out in the bush. There is not much permafrost and the ground is still too soft under the snow. The grounds usually make cracking noises when it gets really cold, but we don't hear that anymore."
Shirley Kakfwi (Old Crow, Yuk.)
Arctic Borderlands Ecological Knowledge Co-op, 2000-2001

"[My] brother was sealing one day and said 'Sis, come and see this. The ice is thinning. It is not even spring yet and it is thin.'"
C. Nalvana (Ikaluktuuttiak, Nun.)
Tuktu and Nogak Project, 1999

"In the older days, the elders used to predict the weather and they were always right, but right now, when they try to predict the weather, it's always something different. It's very unpredictable right now."
Z. Aqqiaruq (Igloolik, Nun.)
Interview by S. Fox and R. Irngaut, Igloolik, 2000

"Some of the lakes and ponds you can almost walk across where they were now. All the swamps and bogs...they're all drying up now."
Unnamed resident (Nain, Lab.)
Climate Change and Health in Nunavuk and Labrador Project, 2000–2001

"The snow melted in April. Usually the snow stays until June and waters the ground."
Unnamed resident
(Aklavik, N.W.T.)
Arctic Borderlands Ecological Knowledge Co-op, 1998–1999

"Traditionally we didn't have calendars to go by, so we observed the nesting of the birds. When they are able to fly that is the time to start hunting for caribou for clothing skins and to start caching the meat. But now in the month of August you can't do your caribou meat caching. It's too warm."
Eugene Niviatsiak (Baker Lake, Nun.)
From Inuit Knowledge of Climate Change

"The wind blows a lot harder and when the wind blows that hard it packs the snow…so hard that it's almost like ice and it's not good now. You can't make igloo shelters with it."
M. Aqigaaq (Baker Lake, Nun.)
Interview by S. Fox and M. Kaluraq, Baker Lake, 2001

"We used to know what season something would occur....Using our traditional knowledge you would know what was going to happen when, but you can't predict anymore."
Donald Uluadluaq (Arviat, Nun.)
From Inuit Knowledge of Climate Change

"It was maybe twenty years ago that we saw the first beaver track ever up in the bay. We didn't know what it was."
Unnamed resident (Nain, Lab.)
Climate Change and Health in Nunavuk and Labrador Project, 2000–2001

Is drought becoming more frequent and severe? It's too soon to tell.

For farmers, drought means poor crops, more damage from insect pests, a greater risk of soil erosion by the wind, and possibly the need to sell off herds of cattle that can't be watered and fed. But drought can have many other impacts as well – water usage restrictions in cities, poorer water quality, higher food prices, lower power outputs from hydro dams, more forest fires, shrinking wetlands, and more stress on fish and waterfowl.

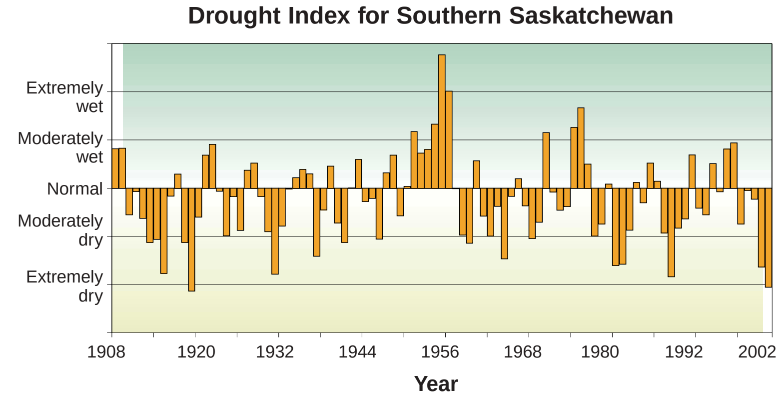
Although a warmer world is likely to be wetter overall, droughts could happen more often or be worse as a result of climate change. Why? In some areas it is because higher temperatures and a longer warm season could cause more moisture to be lost through evaporation than is gained from any increase in precipitation. Changes in weather patterns could also cause some places to get less rain than they used to while others get more. Or less rain might fall during the growing season (when it's needed) and more during the harvest season (when it's not).

FOCUS: The Prairies

The Prairies are one of Canada's most drought-prone regions. Their climate has also changed more over the past century than that of most other parts of the country, so it is here that we might expect an early indication of more frequent or more severe drought.

Climate records for the Prairies, however, do not show droughts happening more often than they did in the past. Nor is there any evidence yet that Prairie droughts are becoming more severe. Droughts that occurred 3–4 thousand years ago, for example, appear to have been worse than any in modern times.

Still, the most recent droughts on the Prairies have been quite severe. In fact, for some areas, 2001 and 2002 were drier than the driest years of the 1930s, when the region was devastated by the most destructive drought in Canadian history.



Source: *Adapted from R. Hopkinson, Environment Canada*

The index estimates the severity of drought on the basis of precipitation, the amount of moisture in the soil, evaporation, and other factors. It shows a number of droughts in the region over the past 100 years but no clear tendency towards either more severe or more frequent drought.

THE BIGGER PICTURE

Next to the Prairies, southern Ontario and the B.C. interior are the regions of Canada most affected by drought. Droughts also affect eastern Canada, but do not occur as often or last as long.

Although precipitation has generally increased in Canada during the twentieth century, there are some signs that severe dryness is occurring more often. The country as a whole, for example, has seen more extreme summer dryness – though not necessarily full-blown drought – in the second half of the century than in the first. Since the 1960s more of the country has also experienced unusually warm and dry spring weather. Two of the most severe and widespread droughts in Canadian history have occurred in the past 15 years. The drought of 1988 affected Ontario, Quebec, and the B.C. interior as well as the Prairies, while the drought of 2001 affected almost all of southern Canada and continued across the central and northern Prairies in 2002.

Could these recent events mark the beginning of a shift towards a more drought-prone climate? Perhaps. But more time will be needed to see if drought patterns in Canada are actually changing.

DROUGHT 2001

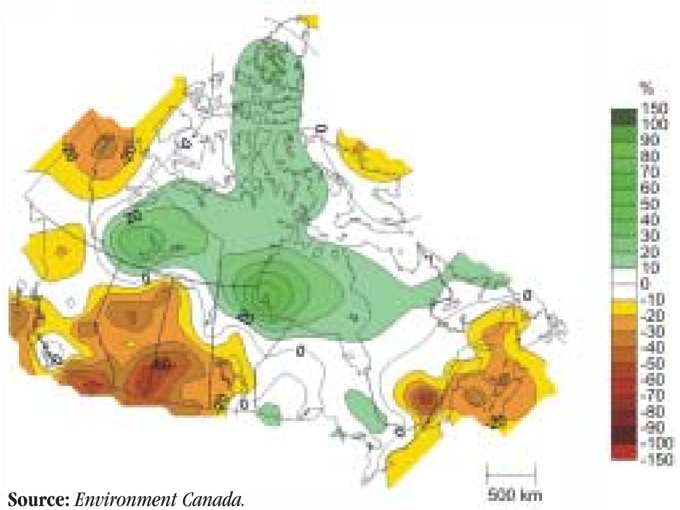
The drought of 2001 was one of the most intensive and widespread in Canadian history, affecting almost every farming region in the country. As so often before, it was worst on the Prairies, where wheat and canola yields fell by 43% from the previous year.

In the Great Lakes–St. Lawrence region, it was the driest summer in 54 years. Montreal's Dorval weather station recorded its driest April ever as well as a record 35-day rainless spell in the summer. Atlantic Canada had its fourth dry summer in five years, and both Charlottetown and Moncton reported their driest July and August ever. Most parts of B.C., in contrast, had a wetter than normal summer, but the preceding winter saw only about half the average levels of precipitation along the coast and in the southern interior.

While 2002 brought a return of normal conditions to the rest of the country, the drought lingered in many parts of central and northern Alberta and Saskatchewan. Failure of the hay crop forced many farmers to sell off their herds. Others more fortunate were able to keep going with surplus hay donated by eastern farmers. The soft wheat harvest was the smallest in 28 years, while barley yields hit a 34-year low. Canola fared poorly too, as output fell 35% below the already weak yields of the previous year.

Farmers felt the effects most directly, but the impacts rippled through every level of the economy – from small-town merchants serving cash-strapped farming communities to consumers across the country facing higher prices at the supermarket.

Differences from Normal Precipitation, 2001



Source: *Environment Canada.*

In 2001 rain and snowfall totals for the year were below normal for much of Canada. During the summer, dry conditions affected almost every farming region in the country.

The St. Mary reservoir channel near Spring Coulee, Alberta, after 66 days with no rainfall, summer 2001.

Do recent drops in lake levels indicate a new trend or are they part of a natural cycle?

Water levels in the Great Lakes are the result of a balance between water entering the system (through inflows from rivers, rain, snowfall, snowmelt and runoff) and water leaving it (through outflows to rivers, evaporation to the air, and withdrawals for various human uses). Natural seasonal and yearly variations in these factors can result in temporary changes in lake levels, but more permanent changes could come about as a result of climate change.

Changes in the climate of the Great Lakes–St. Lawrence region have brought more rainfall to replenish lake waters, but they have also brought higher temperatures, a longer warm season, and a shorter ice season, all of which increase evaporation and water loss. If the increases in rainfall and evaporation balance each other, climate change may have little effect on lake levels. There are concerns, however, that continued warming will increase evaporation rates more than precipitation and cause lake levels to fall.

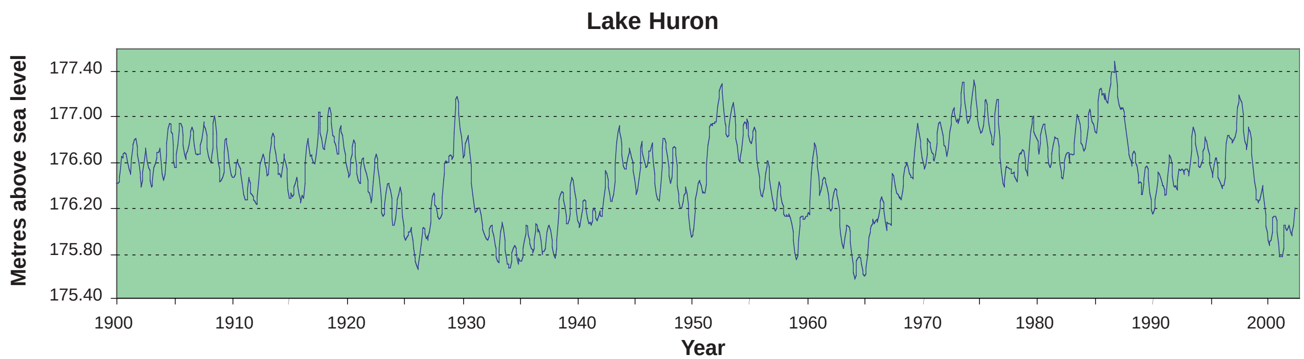
A significant lowering of lake levels could reduce the output of hydroelectric power, force ships to carry lighter loads, require cottagers to relocate docks, boathouses, and water intakes, and shrink or dry up wetlands that are important food sources and breeding grounds for fish and waterfowl. Extensive dredging would be needed to deepen channels and keep the connecting rivers between Lakes Huron and Erie navigable for commercial shipping. Similarly, the St. Lawrence River below Montreal might have to be totally transformed by the addition of dredged channels, locks, and dams to keep it open for large ships.

FOCUS: Lake Huron

Located in the middle of the Great Lakes system, Lake Huron is perhaps the most suitable of the lakes to use as an indicator of the effect of climate change on water levels. Lake Huron also reflects the influence of natural forces more directly than Lakes Superior and Ontario, where water levels are regulated to some extent by Canadian and U.S. authorities.

Over the past century, water levels in Lake Huron have not shown a consistent long-term trend. Instead, they have alternated irregularly every couple of decades between higher and lower phases. Extreme low water levels on the lake occurred in the mid-1960s, while the longest period of low-water levels was in the hot, dry years of the 1930s. Through the 1970s, 1980s, and most of the 1990s, lake levels were actually higher than the long-term average.

In the late 1990s, however, low water levels, similar to those of the 1960s, returned. It remains to be seen whether these signal the beginning of a longer trend or are just another phase in the lake's periodic swings between low and high water phases.



Source: *Environment Canada*

The graph shows changes in the average monthly lake level between 1900 and 2002. The level is given in metres above sea level. Although water levels in Lake Huron have varied considerably from decade to decade, no long-term change is yet apparent.

THE BIGGER PICTURE

Water levels in each of the Great Lakes and the St. Lawrence River are influenced to some extent by local climate and drainage conditions. Consequently, they do not always change in exactly the same way. Nevertheless, the long-term picture for Lake Huron is fairly representative of the system as a whole. Water levels in the Great Lakes have fluctuated within a range of about 1.8 metres over the past century, but no long-term trends have been apparent in any of the lakes or in the St. Lawrence River. Temperature changes in the region have been fairly small – about 0.5°C over 100 years – and that may be one reason why long-term changes in water levels have not yet appeared.

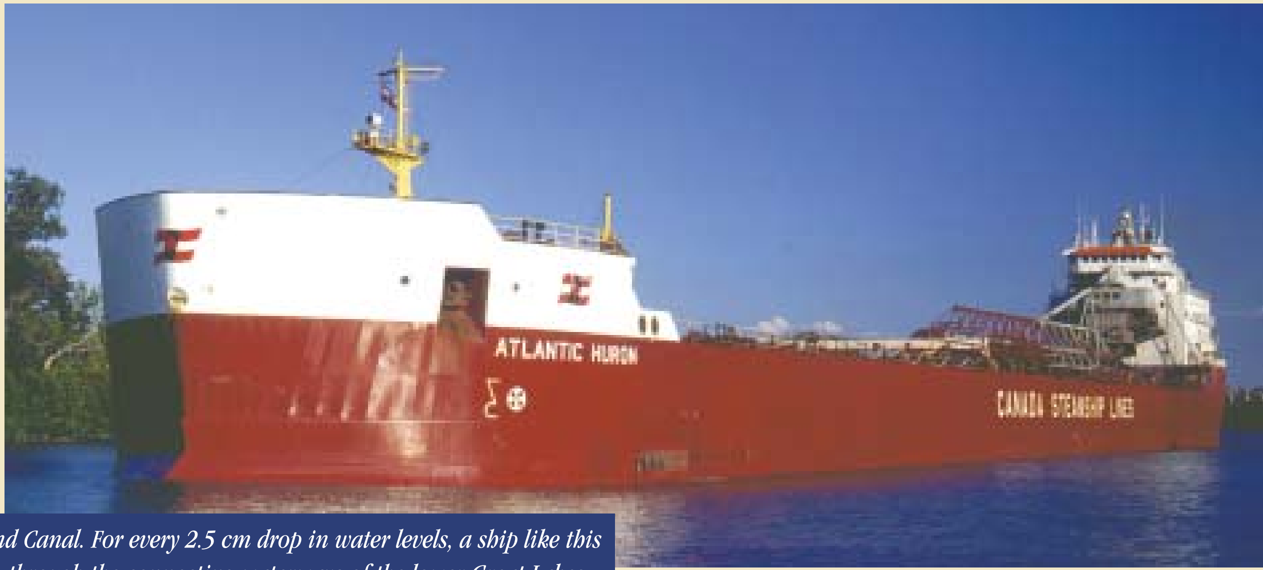
Still, concerns about low water levels remain, and one good reason is that the economic costs they impose are so high. Between 1988 and 1991, for example, when water levels at Montreal were 30 cm below average, the tonnage of goods passing through the port fell by 15%.

LOW WATER BLUES

After nearly three decades of high water levels, the rapid drop in lake levels in the late 1990s came as a sharp surprise to many. By 1999 the levels of all of the Great Lakes and the St. Lawrence River were below their long-term averages, and the system had lost almost as much water as flows over Niagara Falls in two and a half years.

In spite of above-average spring and early summer rains, water levels continued to drop in 2000. Cottagers found their docks on dry land and marina owners were forced to call in dredges to dig channels so they could keep their businesses open. Ships had to run lighter and higher in order to pass through canals and shallow channels, and hydroelectric power production was down substantially at both Niagara and Sault Ste. Marie.

The following year was not much better. In August, water levels in Montreal harbour were a record 95 cm below average. In late October, sustained high winds in Lake Erie pushed large volumes of water toward the lake's eastern end. This short-term effect caused already low water levels to fall a further 1.5 metres at the lake's western end and in the Detroit and St. Clair rivers. That was enough to make the link between Lakes Erie and Huron impassable for large vessels, and shipping traffic came to a halt until water levels rose two days later.



The Atlantic Huron transits the Welland Canal. For every 2.5 cm drop in water levels, a ship like this must travel 100 tonnes lighter to pass through the connecting waterways of the lower Great Lakes.

A longer frost-free season is bringing new opportunities – and some problems.

The frost-free season begins on the first day in spring when temperatures remain above freezing and ends on the first day in fall when freezing temperatures return. The earlier the frost-free season starts or the later it ends, the longer the growing season will be. A longer frost-free season is of interest to farmers and home gardeners alike because it gives them more choice in what they can grow and a better chance of seeing their annual crops and flowers survive to maturity.

The flip side of a longer frost-free season is a shorter frost season, and that is a benefit to governments that have to keep roads ice-free and for individuals and transportation companies that have to deal with ice hazards. It also means a longer season for construction. It is a disadvantage, however, to northern communities and to businesses like logging and oil and gas exploration that rely on frozen ground and waterways for moving goods and heavy equipment.

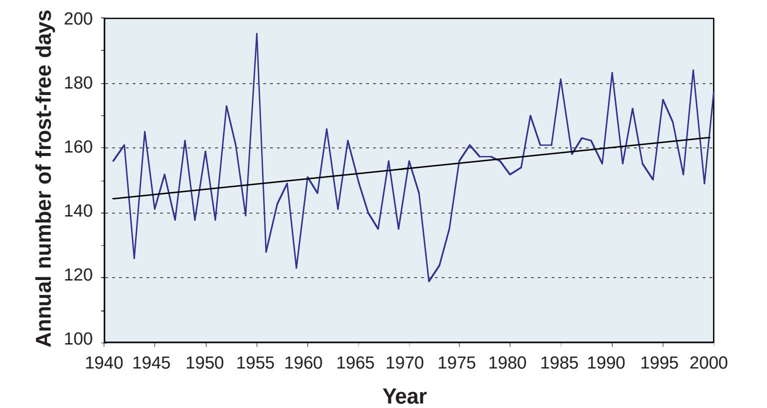
A number of factors can affect the persistence of frost. These include elevation, exposure to sunlight, vegetation, and proximity to water bodies or cities. As a result, even locations that are quite close to each other can have very different frost seasons. Air temperature, particularly the overnight low, is the dominant force, however, and regions that are becoming warmer can also expect to see shorter frost seasons.

FOCUS: Southwestern Ontario

Southwestern Ontario, with its mild climate and rich soils is prime farming country. Over the past century, it has warmed by about 0.5°C, somewhat less than the national average. Still, this has been enough to have a noticeable impact on the length of the frost-free period.

Temperature records for London airport, in the centre of the region, show that the average length of the frost-free season has increased by more than 18 days since the 1940s. The increase reflects a strong rise in winter and spring temperatures and especially in overnight lows.

Length of Frost-Free Period at London Airport, Ontario



Source: *J. Klaassen, Environment Canada*

A new soybean crop is off to a good start on this farm near London.

THE BIGGER PICTURE

The frost-free season has been getting longer in most other parts of Canada too. The biggest increases over the past 100 years have been seen in B.C. and on the Prairies. For most of Canada, spring has warmed more than any other season. Not surprisingly, then, the frost-free season has been getting longer largely because the last spring frosts are happening earlier.

While the frost-free season is getting longer on average, it can still vary considerably from one year to another, and unusually late spring or early fall frosts can still occur. While farmers thus face a smaller risk of losing a crop to frost, they still have to be cautious about planting too early or shifting production to varieties that require a longer growing season.

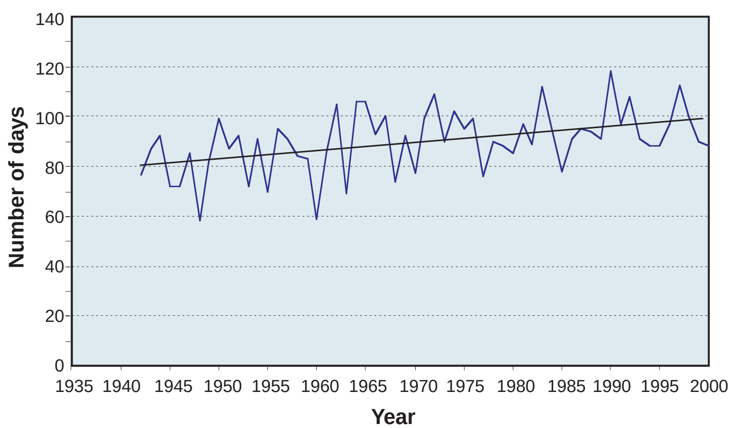
THE THAW-FREEZE-THAW-FREEZE SEASON

The transition from the frost to the frost-free season and back again is neither smooth nor sudden. As spring temperatures warm or fall temperatures cool, days with temperatures above freezing typically alternate with nights when temperatures are below the freezing point. Repeated cycles of thawing and freezing can be hard on trees and plants, especially in late winter or early spring. Large herbivores like deer and caribou suffer too, because refreezing puts a hard, icy crust on the snow that makes moving about and feeding difficult. When they occur in combination with rain and snow, thaw-freeze cycles also contribute to the weathering of building materials.

Preliminary studies indicate that in much of Canada thaw-freeze cycles are happening more often. Most of the stronger trends have been found in southern Ontario. The weakest have been in British Columbia. At Trenton, Ontario, thaw-freeze events have been increasing at the rate of 3.2 days per decade. At Swift Current, Saskatchewan, the rate is 3.9 days per decade. An interesting exception is the city of Toronto, where thaw-freeze cycles have been decreasing, possibly because of warming effects related to the city's growth.

Since the early 1980s, the construction industry has noticed that materials such as bricks and concrete are not lasting as long as expected in some parts of the country. Faster weathering as a result of more frequent thaw-freeze cycles is believed to be contributing to this problem, and because of it, building owners and taxpayers are facing added maintenance costs for buildings and other structures that use these materials.

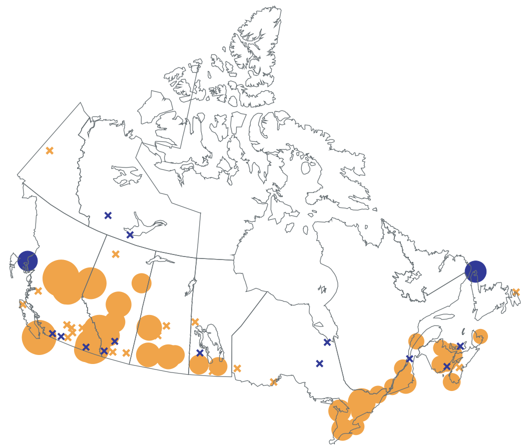
Number of Thaw-Freeze Days per Year at Trenton, Ontario



Source: *J. Klaassen, Environment Canada*

A day with a thaw-freeze cycle is one in which the daily high is above freezing and the overnight low is below freezing. In the 1940s Trenton averaged about 80 days with thaw-freeze cycles. By the 1980s and 1990s that number had climbed to about 95.

Trends in Length of Frost-free Period (days/100 years)



Source: *Environment Canada*

Orange dots indicate a longer frost-free season, blue dots a shorter. The larger the dots, the greater the change in the length of the season. The x's indicate changes that are not statistically significant. The largest increase (about 50 days per century) has occurred in central B.C. The largest decrease (about 30 days per century) has been in St. Anthony's, Newfoundland.

The amount of energy needed to heat a home for a year depends on how many cold days there are in the year and on how cold it gets on each of those days. When the weather is slightly cool, a little bit of heat might be needed for a few hours in the evening or early morning to stay comfortable. On a very cold day, a lot of heat will be needed all day and all night. A day's average temperature gives some idea of how much heat will be needed on that day.

Climatologists use a measurement known as heating degree-days (HDDs) to estimate heating needs more precisely. They assume that people will use at least some heat on any day that has an average outdoor temperature of less than 18°C. They then calculate the heating needs for each day by subtracting the day's average temperature from 18. The result is the number of heating degrees for that day or HDDs.

Cooling requirements, known as cooling degree-days or CDDs, can be measured in much the same way. The assumption this time is that there is some need for cooling on days when the average temperature is above 18°C. Subtracting 18 from the day's average temperature thus gives the number of cooling degrees for that day or CDDs.

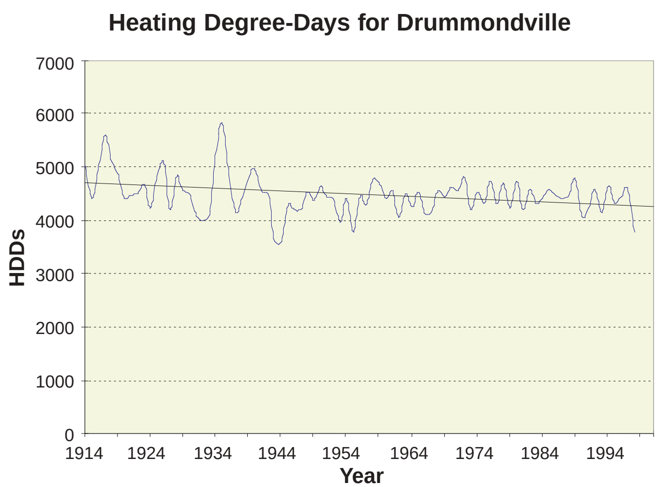
When the heating or cooling degrees for each day are added up for a season or year, the result is a very useful statistic that indicates how much demand there is for heating or cooling as a result of different climate conditions. The amount of energy actually needed to heat or cool a particular building will, of course, depend on many other factors, such as how well the building is insulated and the temperature that it is kept at.

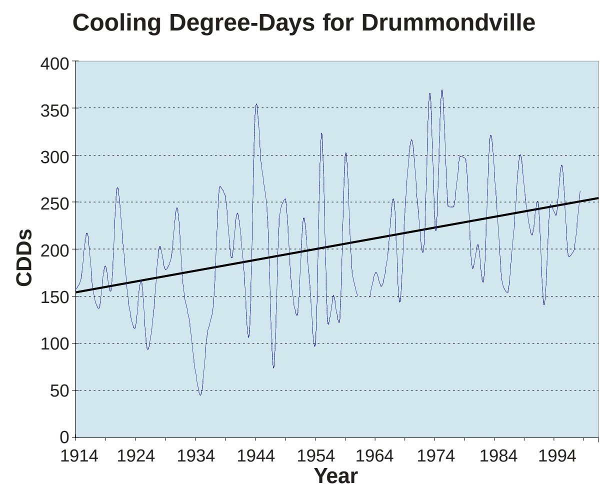
FOCUS: Drummondville, Quebec

In Canada, heating is always a bigger concern than cooling, and Drummondville is no exception. The city, 100 km northeast of Montreal, averages about 4500 HDDs a year, but with 250 CDDs a year (about the same as Montreal and Toronto) it still has plenty of hot summer days when air conditioning is welcome.

Over the past century, the average annual temperature in the Drummondville area has warmed by about 0.5°C – less than in some other parts of Canada but still enough to have had a noticeable impact on heating and cooling needs. At the beginning of the twenty-first century, Drummondville now averages 445 fewer heating degree-days per year than it did in the early twentieth century and has 100 more cooling degree-days. Those figures amount to a 9.5% decrease in HDDs and a 65.5% increase in CDDs.

Because the need for heating is much greater than the need for cooling, the energy savings from lower heating requirements are still more significant to the average person than any additional energy costs from higher cooling requirements. In fact, cooling becomes a significant cost only when people switch from electric fans to air conditioning to meet their cooling needs. As the cooling degree-day trend rises, however, more people may be inclined to make that change, and at that point cooling degree-days will begin to have an important impact on their budgets.





Source: *Environment Canada*

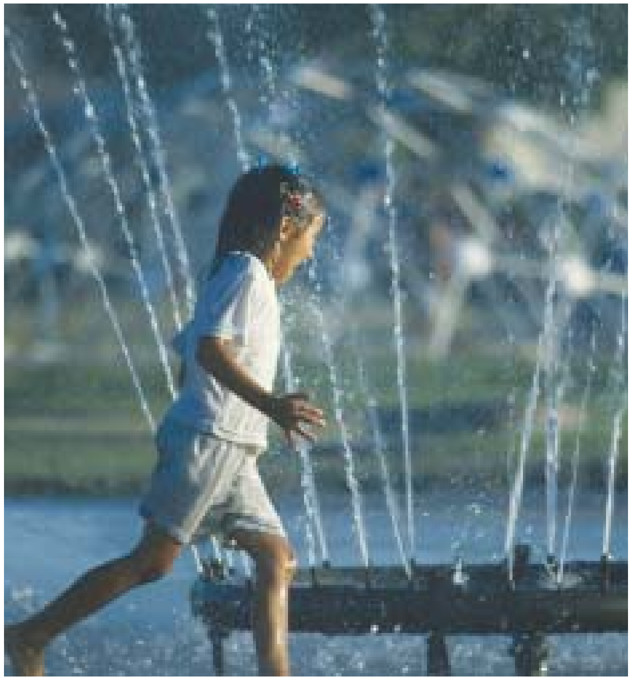
Because it is a large change in a small number, the increase in CDDs looks more important than the decrease in HDDs. However, the decrease in HDDs has had a greater impact on people's energy needs in Drummondville, simply because heating needs there are much greater than cooling needs.

THE BIGGER PICTURE

Heating degree-days in Canada vary from about 3,000 a year in balmy Victoria to about 13,000 in the Far North. Over the past century, HDDs have declined significantly in most of Canada.

Cooling degree-days range as high as 400 per year in the Windsor area of southwestern Ontario but average fewer than 100 in many parts of the country. Increases in cooling degree-days have been smaller and less widespread than the decreases in heating degree-days. Nevertheless, significant increases have occurred over the past century in southern B.C. and parts of the Prairies as well as in southern Quebec and the Maritimes. These trends are consistent with the way that our climate is changing – that is, both winters and summers have been getting warmer, but winters have warmed more.

In cities, these trends may also be affected by what is known as the heat island effect. City surfaces, like roads, buildings, and rooftops, absorb large amounts of heat from the sun during the day and then release it at night as they cool. Cars, furnaces, air conditioners, and other heat-producing equipment also add warmth to city air. As a result, temperatures within a city, especially a densely built downtown core, are often noticeably warmer than temperatures recorded on the city's outskirts. As a city grows, the heat island effect grows with it. Consequently, heating needs can decrease and cooling needs increase simply because a place is becoming more urbanized. It is a difficult task, however, to determine just how much of the warming in our cities is due to the heat island effect and how much is due to climate change.



HEATING AND COOLING DEGREE-DAYS ACROSS CANADA

The table gives heating and cooling needs for locations in each of the ten provinces and three territories. Heating needs in Vancouver are about half those in Winnipeg, although differences between other cities in southern Canada are less dramatic. Cooling needs, on the other hand, differ much more widely across the country.

Heating and Cooling Degree-Days for Selected Canadian Cities (Average Annual Totals, 1971–2000)

	HEATING DEGREE-DAYS	COOLING DEGREE-DAYS
St. John's, Newfoundland & Labrador	4,881	32
Charlottetown, Prince Edward Island	4,715	100
Halifax, Nova Scotia	4,367	104
Saint John, New Brunswick	4,754	37
Montreal, Quebec	4,575	235
Toronto, Ontario	4,066	252
Winnipeg, Manitoba	5,777	186
Regina, Saskatchewan	5,661	146
Edmonton, Alberta	5,708	28
Vancouver, British Columbia	2,926	44
Yellowknife, Northwest Territories	8,256	41
Whitehorse, Yukon	6,811	8
Resolute, Nunavut	12,526	0

Source: *Environment Canada*

Some of Canada's worst weather disasters occurred in the past decade. Do they signal a trend?

Extreme weather is weather that is unusual and often destructive. It includes events such as heat waves and cold spells, floods, droughts, severe thunderstorms, blizzards, ice storms, hurricanes, and tornadoes. For some kinds of events, however, what is considered extreme for one location may be quite normal for another. A 20 cm snowfall may be exceptional in Victoria, but not in Quebec City or St. John's.

Because different weather extremes have different causes, climate change could affect these extremes in a variety of ways. Although climate change could moderate some extremes, there are also concerns that it could lead to an increase in some of the most dangerous and destructive weather extremes. Some of these concerns are based on scientific arguments about how the processes that cause these extremes will be affected by a warmer climate. One such argument, for example, suggests that heavy rainstorms could become more common because a warmer atmosphere can hold more moisture to fuel these storms.

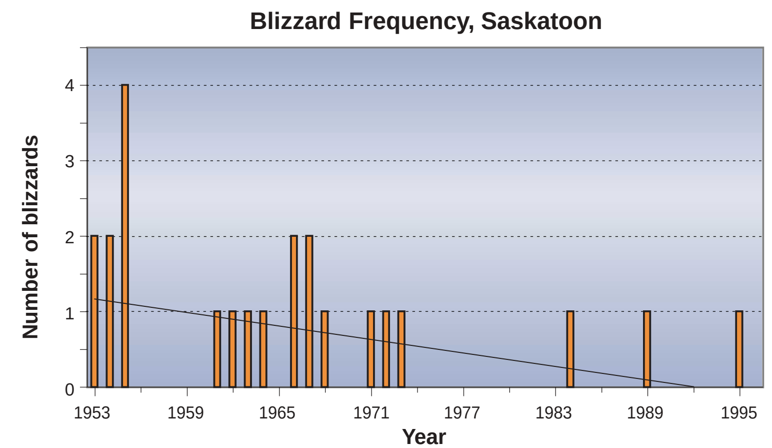
What is generally accepted, however, is that the warm season will get longer in most parts of Canada and that warm conditions will extend farther northwards. As a result, the risk of severe hot weather events such as heavy thunderstorms, hail, and tornadoes would extend over a longer period and affect a wider area. On the other hand, the time span in which severe winter weather may occur is likely to become shorter. Nevertheless, winter storms could still be quite intense.

Weather phenomena are very complicated, and unusually destructive events in particular are often the result of chance combinations of several factors. Consequently, there is still much to learn about how these events might be affected.

FOCUS: Prairie Blizzards

Blizzards combine bone-chilling temperatures, strong winds, and dense, blowing snow to pack one of winter's heaviest punches. They occur in almost every part of Canada, but Prairie blizzards are legendary for their ferocity. One that struck the Regina area in 1947 lasted 10 days and buried an entire train in a kilometre-long snowdrift.

Climate change could affect the intensity and frequency of these storms as well as the paths that they follow. As a result, blizzard patterns may be changing. In fact, a recent study shows that the number of blizzards has decreased significantly in southern Saskatchewan over the past half century. In Manitoba, however, there has been no change in blizzard frequency – possibly because the storm systems that affect Saskatchewan are not entirely the same as those that affect Manitoba.



Source: *Adapted from Lawson, 2003*

In Alberta, Saskatchewan, and Manitoba, a winter storm is a blizzard if it lasts at least 4 hours and has winds of 40 km/hour or more, a wind chill of –24.4°C or lower, and blowing snow with visibility less than 1 km. Over the past half century, the number of blizzards hitting Saskatoon has declined significantly. Regina has shown a similar trend, but Winnipeg has had no change in blizzard frequency.

THE BIGGER PICTURE

The 1990s witnessed a clustering of unusually severe weather events in both Canada and other parts of the world, including such disasters as the 1996 Saguenay flood in Quebec, the 1997 Red River flood in Manitoba, and the 1998 ice storm in Ontario, Quebec, and New Brunswick. The pattern continued in 2000, when the village of Vanguard, Saskatchewan, was flooded by 333 mm of rain in 10 hours – one and half times as much as it normally receives in a year.

Economic losses from weather events have also climbed sharply in recent years. However, the size of these losses also mirrors the growth of our society and economy: an extreme event today will affect more people and more property than it would have a few decades ago. That makes it harder to determine how much of the increase in losses is actually due to an increase in severe weather.

A similar problem also makes it difficult to judge whether tornadoes are occurring more frequently. Although the number of tornadoes reported over the past century has increased, climatologists note that the increase closely tracks the growth of the country's population. That makes it difficult to conclude whether more tornadoes are actually occurring or whether more are simply being reported.

We are on more solid ground in dealing with widely measured climate variables such as temperature and precipitation, and here, so far, there is little evidence of an increase in extremes. Canadian temperature records show that most of the country, except for the eastern Arctic, has seen a significant decrease in extremely cold weather over the past half century. At the same time, there has been no consistent increase in extremely hot weather.

There has also been no trend towards more frequent heavy rainfalls in Canada, even though precipitation has increased across the country during the past century. Since the 1940s most weather stations in southern Canada have recorded fewer heavy rainfalls, but the number of rainy days has increased. In some other parts of the world, however, such as the United States, Japan, and Australia, there has been a trend towards more intense precipitation.

It is hard to tell, therefore, whether many kinds of extreme weather events are becoming more common or not. Since extreme events are usually rare, it could take decades to detect a pattern of change.

THE GREAT ICE STORM OF 1998

Episodes of freezing rain are common in most of Canada, and occasionally they develop into major ice storms that are notable both for their sparkling beauty and the crushing weight of ice they leave on power lines and trees. But none had ever been as persistent or destructive as the storm that struck much of eastern Canada in January 1998.

Over a period of six days, freezing rain fell intermittently over an area extending from central Ontario to Prince Edward Island. Millions of trees, including valuable sugar maples, were toppled or damaged, and downed power lines left more than 4 million people without electricity. The Montreal area was affected the worst. Up to 100 mm of freezing rain fell south of the city, and some localities were without power for as long as five weeks. More than 600,000 people in Quebec and eastern Ontario sought refuge in emergency shelters, while 16,000 troops worked with utility crews from six provinces and eight American states to restore power and clean up the damage.

The storm was blamed directly for 28 deaths, and with damage estimated at over $5 billion, it was by far the costliest weather disaster in Canadian history. It is impossible to say that a single event such as this is the result of climate change. However, it does represent the kind of extreme event that some fear could become more common as climate change continues.