

ICE STORM

JANUARY 4 - 10, 1998

'98

Was El Niño to blame
for the storm?

The worst ice storm
in Canadian history?

What about
climate change?

Environment Canada
Environment Canada
Environment Canada



Environment
Canada

Environnement
Canada

Canada

Table of Contents

● Introduction	1
● History of the Storm	2
● Cause of the Storm	5
● Affected Areas	6
● Forecast and Warnings	7
● Damage	8
● Human Suffering	10
● Commercial Activities	11
● Aftermath of the Ice Storm / Media	12
● Frequently Asked Questions	14

Introduction

Ice storms are no stranger to the eastern provinces of Canada. They occur about 15 times a year and can last from a few hours to more than a day. Usually these systems fade away or are followed by a warming trend which melts the ice and alleviates any cause for icing concern.

There is no question that the ice storm of January 1998 was the worst ever to hit Canada, based on the criteria of (a) the amount of ice accumulation, (b) the duration of the storm, and (c) the population affected. The areas affected by the storm were eastern Ontario, southern Québec, southern New Brunswick and some districts in Nova Scotia. During the six days of the storm, January 4-10, the water equivalent of freezing rain and ice pellets exceeded 100 mm in many areas, more than double the yearly average.

The freezing rain coated every exposed surface with such a large layer of ice, that tree branches snapped off, trees fell down, hydro wires and towers (pylons) were destroyed and all types of transportation and travel were seriously affected. The storm claimed at least 25 lives and severely inconvenienced millions of people. At the height of the storm, nearly three million people were without electricity or heat. Thousands had to take refuge in shelters. Falling temperatures and additional snowfall continued to hamper relief efforts after the storm. A week after the storm ended, nearly one million people were still without light or heat. Storm related costs are estimated to be close to two billion dollars.

History of the Storm¹

The operational involvement of units of the Atmospheric Environment Program spanned the period from January 3-10. This history attempts to portray a chronological history of events associated with the storm. (see Fig. 1 & Fig. 2)

Saturday, January 3 Both the Ottawa and Montréal forecast offices mention freezing precipitation in their afternoon forecasts for the next day. These are carried on subsequent public forecasts.

Sunday, January 4 At 4:00 a.m., the Montréal *Bureau de services météorologiques et environnementaux* (BSME) issues the first warning of freezing rain. This warning was renewed on subsequent forecasts. The Ottawa Regional Centre (RCNC) also issues a warning of freezing rain at 3:38 p.m. for the eastern Ontario region. Spotty freezing rain is reported at Kingston and Trenton shortly after 3:00 p.m. and becomes more widespread after midnight.

Monday, January 5 Freezing precipitation begins shortly after midnight in the Ottawa and southern Québec areas and lasts until the late evening on the following Tuesday. Freezing rain is forecast to begin on Tuesday in southern New Brunswick, with expected accumulations of 10-15 mm. At 1:00 p.m., the Montréal BSME advises the *Direction générale de la sécurité et de la prévention* (DGSP) in Québec City that another freezing rain episode will begin on Wednesday. Arrangements are made for the BSME to provide regular briefings thereafter to DGSP. The Ottawa Regional Forecast Centre has freezing rain in the public forecast for Wednesday. Total accumulations ranging from 10 to 25 mm.

Tuesday, January 6 Freezing precipitation continues throughout the day in the eastern Ontario and southern Québec areas. At 5:00 a.m., freezing rain begins in the Saint John area. The Montréal BSME begins providing the first of what will turn out to be more than 500 media interviews over the

next five days. At 11:30 a.m., the Québec DGSP urgently requests a forecaster for an in-person briefing that afternoon. The Québec City BSME seconds two forecasters to provide dedicated 18 hours a day support to the DGSP over the next 5 days. Cornwall hydrological office of the Ontario Region begins operating on a 24 hours a day emergency basis in support of the International Joint Commission's St. Lawrence River water level and flow operations. The Canadian Meteorological Centre (CMC) experiences the first in what will be a total of 107 emergency power starts between January 6-14. The Montréal BSME upgrades its computer and communications support to 24 hours a day to ensure rapid response to computer and communications problems. Monitoring personnel are called to de-ice wind equipment at airports around Montréal. Freezing rain ends at 5:00 a.m. in Petawawa and in the afternoon and late evening for the rest of eastern Ontario and southwestern Québec. More freezing rain is in the public forecasts for Wednesday with the possibility of changing to rain in the afternoon. Weather warnings from Montréal BSME call for more freezing rain on Wednesday. At 2:00 p.m. the Ottawa office issues a special weather statement indicating that 34 mm of freezing rain had fallen and that more periods of freezing rain are expected on Wednesday. More than 750,000 Québeckers are without power. Total accumulations on Tuesday: 10-15 mm.

Wednesday, January 7 Autostations require human intervention to de-ice anemometers and rain gauges. Data is lost at L'Assomption, Ste-Chlothilde, Île Charron, McTavish, St-Anicet, Mont Orford, Ste-Anne-de-Bellevue and L'Acadie autostations. At St-Hubert and

¹ Assessment of the January 1998 ice storm in Eastern Canada by R.B. Saunders, March 1998

Sherbrooke, where automatic observations are taken overnight, a 24 hours a day manned program is instituted to maintain the integrity of the data. At 4:00 a.m., the second round of freezing rain begins at Petawawa and spreads eastward throughout the morning. Weather observing sensors around Montréal are de-iced again. Power failures begin to affect the area. A weather warning is issued for freezing rain in the Saint John area on Thursday, with 20-30 mm expected. At 6:00 p.m., the Ottawa Regional Forecast Centre issues an updated weather warning indicating that an additional 20-40 mm of freezing rain is expected by midday Thursday. Montréal schools, universities, and businesses close. More than one million Québécois are without electricity. Tens of thousands of eastern Ontario homes are blacked out. 5-10 mm of freezing rain fall over the Montréal area with 10-20 mm further south and east over the Montérégie region.

Thursday, January 8 Freezing precipitation begins at Saint John at 5:00 a.m. Anemometers at St. Stephen, Saint John, Point Lepreau, Moncton and Fredericton are iced up, as are the precipitation gauges at St. Stephen, Point Lepreau and Saint John. Power outages occur at the Fundy Shore areas. The weatheradio antenna at Mégantic ceased transmission because of ice coating and power failure. Freezing rain warnings forecast this episode to diminish Thursday but for another one, the third and last, to begin Friday. Freezing rain warnings are continued for southern New Brunswick. Montréal BSME staff begin daily briefings to the emergency centre comprising of the Montréal Urban Community Emergency Measures Office, Hydro-Québec, DND, DGSP Montréal, Québec Provincial Police and the municipal police. Armed forces begin deployment in Montréal. States of emergency are declared for the regional municipality of Ottawa-Carleton and for eastern Ontario. The Gatineau Receiving Station goes down causing the loss of processed RADARSAT data. Freezing rain ends in the late evening at Kingston, Ottawa and Dorval. The

last round of freezing rain begins at 3:00 p.m. at Trenton and at 9:00 p.m. at Moncton. Accumulations on Thursday up to 20 mm in Ottawa-Outaouais area; 5-20 mm in Montréal; up to 40 mm in the Montérégie region and locally in the Eastern Townships region; up to 20 mm in the Saint John area, and up to 30 mm in the St. Stephen area.

Friday, January 9 WSC Trenton issues special forecasts four times per day for the eastern Ontario and southwestern Québec areas and TAFs for Petawawa in support of military assistance operations. At 6:00 a.m. freezing rain begins at Kingston and by 10:00 a.m. the area has extended to all of eastern Ontario, southeastern Québec and southern New Brunswick. Special alternative arrangements are made to load ATADs and weatheradio messages from the Québec Ministry of Transport. CMC also implements special alternative procedures to ensure that forecast information is delivered to their Québec and BC hydro clients. The Kingston ATAD and Weatheradio plus the weatheradio repeaters at Sandringham, Lavant and Pembroke failed. Power outages extend to St-Hubert, Sherbrooke, and St. Stephen. Modem data communications are lost at Sherbrooke. The Québec region Scientific Services Division begins preparing storm summaries for the media in order to relieve the pressure on operational staff. The New Brunswick Weather Centre makes ten special media broadcasts during the day. McGill radar is out from 7:00 p.m. to 11:00 p.m. due to the generator running out of gas. The power grid is near collapse. The number of homes without power peaks at 1.4 million, affecting three million people. Ten more millimetres of freezing precipitation fell during the day, ending in the evening.

Saturday, January 10 Freezing rain has ended but forecasts call for falling temperatures as an Arctic airmass approaches. Daily briefings to Montréal DGSP Emergency Centre discontinued. Cold threatens 1,400,000 Québec households still without electricity.

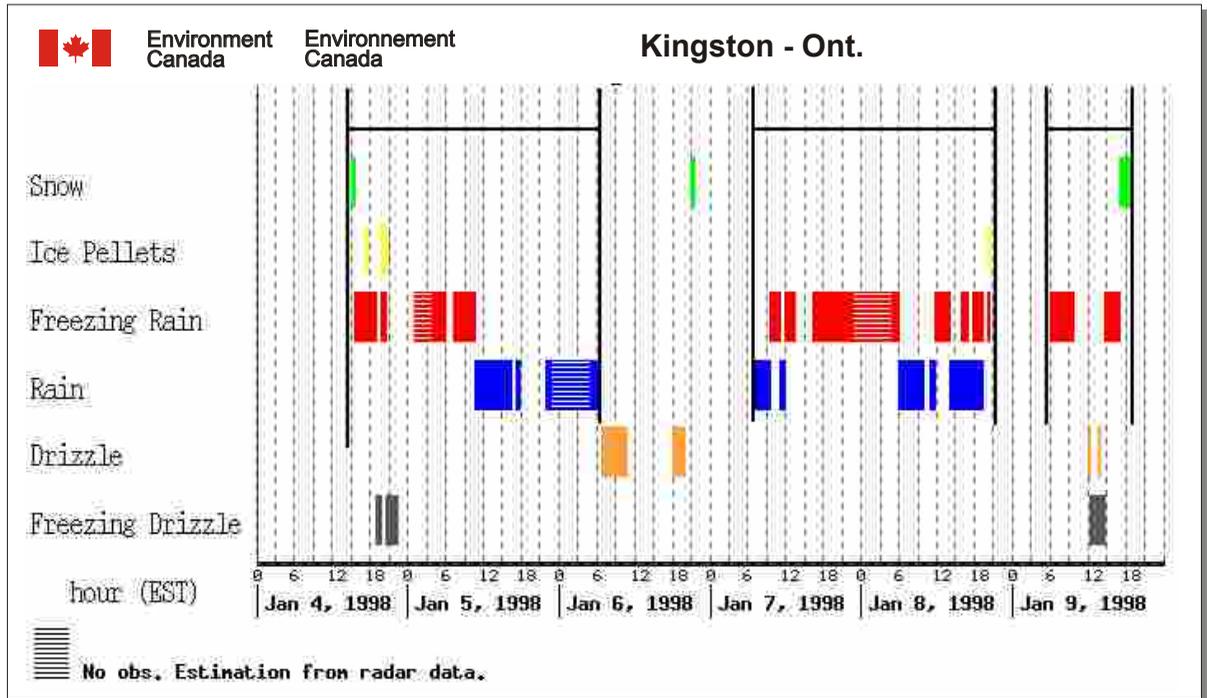


Fig. 1 During the period January 4-9, Kingston experienced about 41 hours of freezing rain, 4 hours of freezing drizzle, 6 hours of snow, and 30 hours of rain

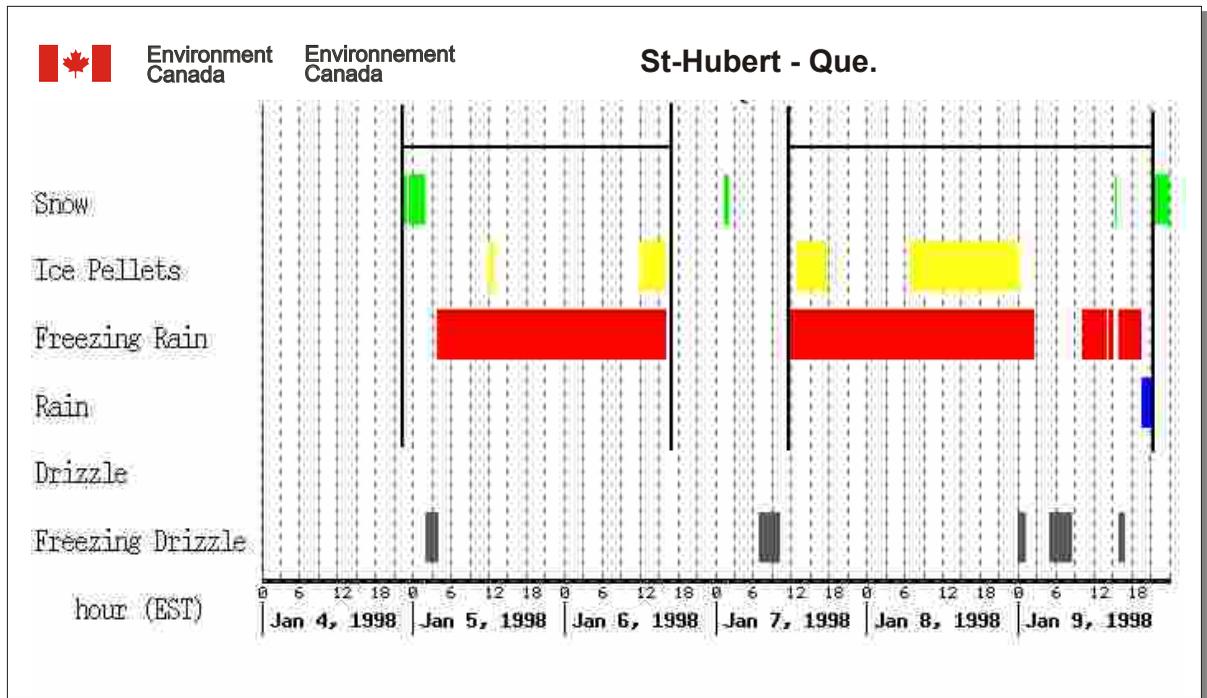


Fig. 2 During the period January 4-10, St-Hubert experienced about 82 hours of freezing rain, 26 hours of ice pellets, 10 hours of freezing drizzle, and 6 hours of snow

Cause of the Storm

The ice storm that gripped Québec and eastern Ontario during the week of January 4-10, 1998 produced a significant amount of freezing rain.

A northeasterly outflow of air, with temperatures below zero degree celsius, from a high pressure over Hudson Bay and northern Québec pushed southward to lie north of Lake Ontario by January 5. At the same time a weak southerly flow of warm air was being pushed into southern Ontario and southern Québec. (Fig. 3 & Fig. 4)



Fig. 3 Surface analysis 00Z Jan 6, 1998

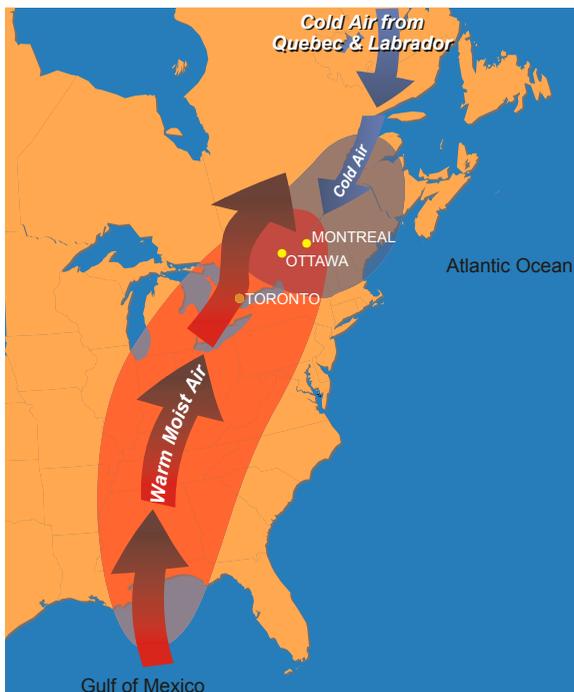


Fig. 4 Warm air masses move up from the Gulf of Mexico, taking moisture north to Ontario and southern Québec. Cold air moving slowly southward from Québec forces the warm air to rise, causing regions in the cold air to experience freezing rain and ice pellets

This pattern is a model setup for freezing rain, as the warm air is forced to rise gently over the denser cold air. The rain falling out of this warm airmass is cooled below the freezing point as it passes through the cold air below. The super-cooled raindrops which are produced freeze on contact with any cold surface in the cold airmass and ice begins to accumulate. (Fig. 5)

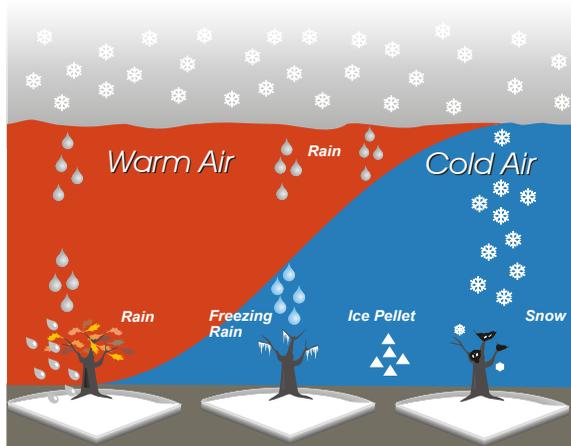
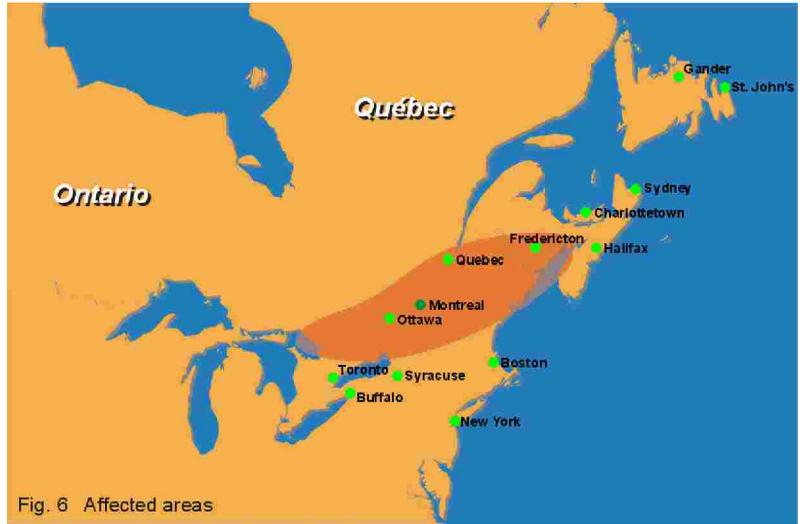


Fig. 5 Formation of freezing rain

The weather situation remained virtually unchanged throughout the remainder of the week. The main low pressure system which was located just south of the Great Lakes, generated small impulses which rippled along the boundary of the cold and warm airmasses, bringing additional bands of freezing rain to eastern Ontario, southern Québec and the Maritimes. The pattern broke down on January 9, as the low pressure system moved towards the northeast. This movement allowed the colder air and light snow to move in the already stricken districts, further aggravating the serious situation.

Affected Areas

In eastern Ontario the area which was significantly affected was bounded by the region east of a line from near Petawawa to Kingston and eastwards to the St. Lawrence River. In southern Québec and the maritimes, the area was bounded by the region south of a line from Petawawa to just south of Québec City to Fredericton to Truro. Figure 6 is the outline of the districts which experienced major damage during the period of the storm.



The greatest devastation was centred in the area near Saint-Jean-Sur-Richelieu. Figure 7 shows the isohyets of freezing precipitation (mm) for the duration of the storm. Figure 8 shows the total precipitation in millimetres for the duration of the storm.

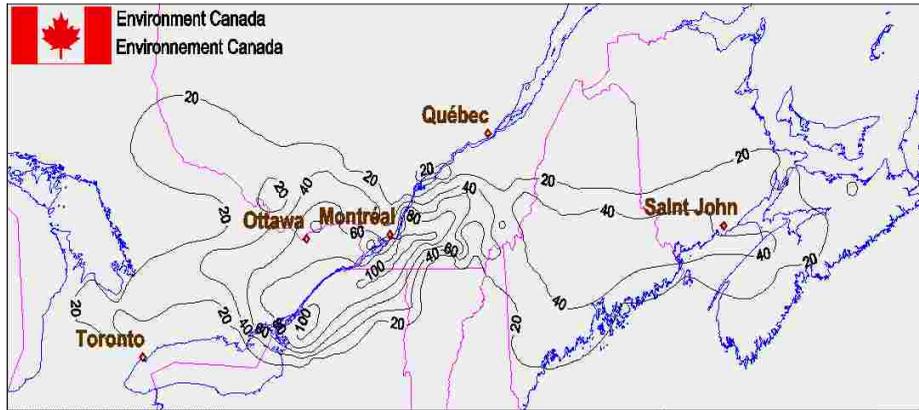


Fig. 7 Preliminary map of freezing rain accumulations in mm, January 4-10, 1998



Fig. 8 Preliminary map of total precipitation accumulations in mm, January 4-10, 1998

Forecast and Warnings

The daily public forecasts included freezing rain for portions of eastern Ontario and southern Québec on Saturday, January 3. This gave a lead time of 24 hours to these communities. The first band of freezing precipitation occurred late Sunday evening January 4 in the Kingston area, and spread northeast into southern Québec Sunday night. Below is the special weather statement issued by RCTO on the morning of January 4.

WOCN10 CWTO 040952
SPECIAL WEATHER STATEMENT
ISSUED BY ENVIRONMENT CANADA. REGIONAL CENTRE TORONTO
ONTARIO.
4:52 A.M. EST SUNDAY, JANUARY 4, 1998.

PATCHY FREEZING RAIN IS EXPECTED TO MOVE THROUGH PARTS OF SOUTHERN ONTARIO THIS MORNING. HOWEVER A LARGER AREA OF FREEZING RAIN IS FORECAST TO DEVELOP TONIGHT AND INTO MONDAY OVER SOME REGIONS OF SOUTHERN AND EASTERN ONTARIO. PRESENT INDICATIONS ARE THAT THE PRECIPITATION WILL LIKELY START AS SNOW THIS EVENING IN A BAND FROM LAKE HURON THROUGH COTTAGE COUNTRY AND TO THE NORTH OF TORONTO THEN INTO THE OTTAWA VALLEY. THE SNOW IN SOME OF THESE AREAS WILL CHANGE TO FREEZING RAIN OVERNIGHT AND THEN TO RAIN ON MONDAY. HOWEVER IT IS LIKELY THAT THE FREEZING RAIN WILL PERSIST IN THE OTTAWA VALLEY THROUGHOUT THE DAY ON MONDAY WITHOUT CHANGING TO RAIN.

AT THE MOMENT IT LOOKS AS THOUGH SOUTHWESTERN ONTARIO WILL BE WARM ENOUGH BY THIS EVENING TO ESCAPE THE WORST WEATHER AND END UP WITH JUST RAIN.

FOR MORE DETAILS PLEASE REFER TO THE PUBLIC FORECASTS.
STAY TUNED FOR UPDATES AND UPGRADES.

END

This earlier statement was followed by an updated statement Sunday evening.

WOCN10 CWTO 041924
SPECIAL WEATHER STATEMENT
UPDATED BY ENVIRONMENT CANADA. REGIONAL CENTRE TORONTO
ONTARIO.
2:24 P.M. EST SUNDAY, JANUARY 4, 1998.

PATCHY FREEZING RAIN OR FREEZING DRIZZLE CONTINUES TO PLAGUE SOUTHERN AND EASTERN ONTARIO ALONG A CORRIDOR NORTH OF SARNIA TO GODERICH EASTWARD ACROSS THE NIAGARA PENINSULA AND JUST NORTH OF LAKE ONTARIO.

KITCHENER TORONTO NIAGARA AND PETERBOROUGH WERE REPORTING FREEZING PRECIPITATION AROUND 2 PM.

THESE CONDITIONS WILL PERSIST AND SPREAD EASTWARD ALONG LAKE ONTARIO UNTIL THE NEXT ORGANIZED AREA OF FREEZING RAIN. THIS NEXT SHOT OF FREEZING RAIN PROMISES TO BE EVEN MORE SIGNIFICANT THAN THE LAST AND WILL AFFECT REGIONS VICINITY TO JUST NORTH OF GEORGIAN BAY AND LAKE HURON AND NORTH OF LAKE ONTARIO INCLUDING MOST OF EASTERN ONTARIO BY MONDAY MORNING.

FOR MORE DETAILS PLEASE REFER TO THE PUBLIC FORECASTS.
STAY TUNED FOR UPDATES AND UPGRADES.

END

By Tuesday January 6, residents in the affected communities were warned that 30 to 40 mm of ice had formed in many districts and another wave of freezing rain was expected during the following two days. The warning indicated that an additional 20 to 40 mm of ice accumulation was possible. Discussion between the weather offices and the appropriate provincial and municipal bodies were ongoing at this time. A state of emergency was declared in eastern Ontario at 10:00 a.m. on Thursday, January 8. The warnings finally ended on the evening of Friday, January 9.

Environment Canada played an important role in the wide range of federal support related to the ice storm. Throughout the crisis, Environment Canada was able to provide Canadians with accurate and timely weather warnings and information on a 24-hour basis. The department also provided utilities, municipalities, provincial authorities, other federal departments and emergency response officials with extensive specialized weather support, as well as advice and assessments on a broad range of environmental issues related to the storm damage. Meteorologists and climate experts handled about 1,000 media calls, and visits to the department's national website, the Green Lane (<http://www.ec.gc.ca>) increased by 50% to more than 300,000 hits per day.

Damage

Eastern Ontario

In Ontario, damage was generally east of a line from Petewawa to Kingston and included the National Capital Region. During the week of the storm, most areas had accumulated a coating of 50 mm of ice with higher amounts in those areas bordering the St. Lawrence River. A state of emergency was declared on January 8 for over 30 municipalities in the affected area. At the height of the storm there were over 120,000 customers affected. By January 9, 80,000 customers were without power. There were damages to 1,000 wooden poles and many steel transmission towers. Tree damage was extensive in this area. (Figures 9 and 9a) In Ontario there were a total of 232,000 customers affected with 300 towers and 11,000 poles downed.

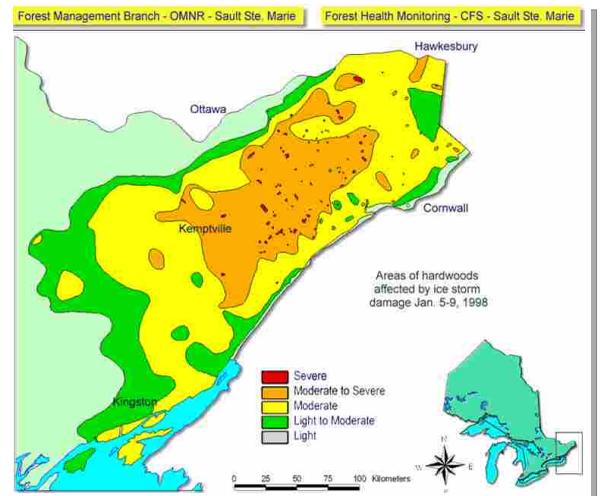


Fig. 9 Areas of hardwoods affected by ice storm damage January 5-9, 1998

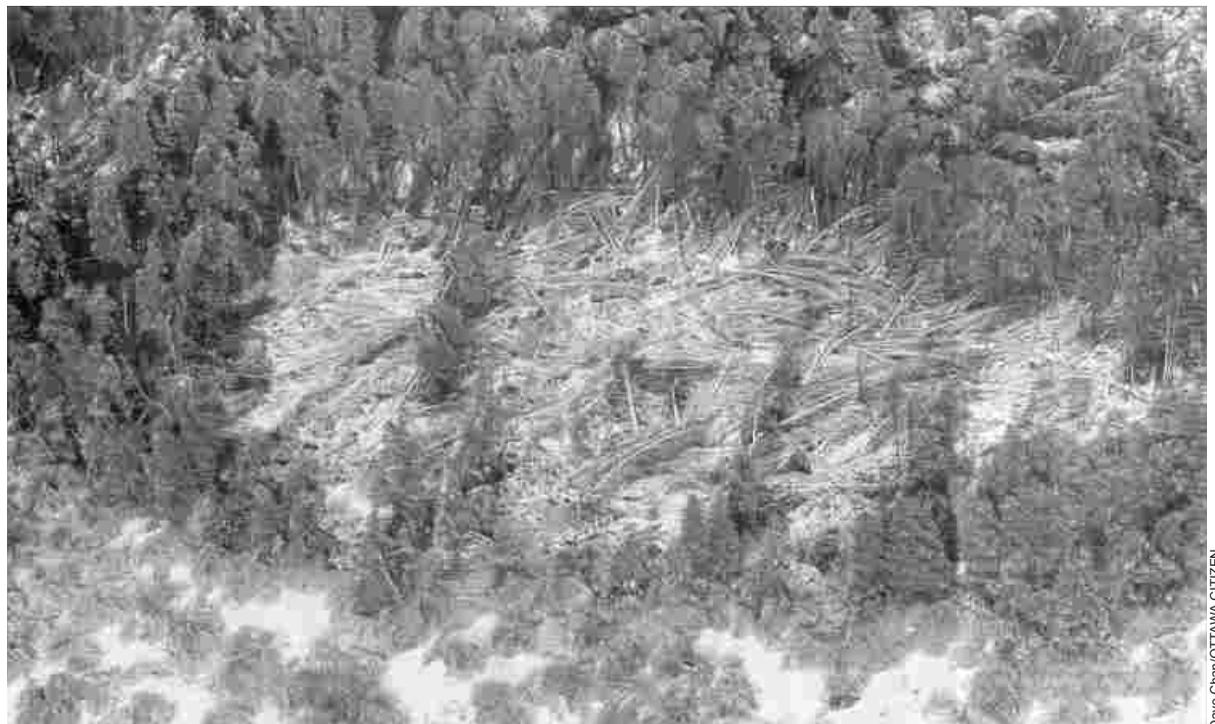


Fig. 9a Downed trees in a forested area

Dave Chan/OTTAWA CITIZEN

Damage

Quebec

Figure 10 shows Québec's transmission power grid before the storm.

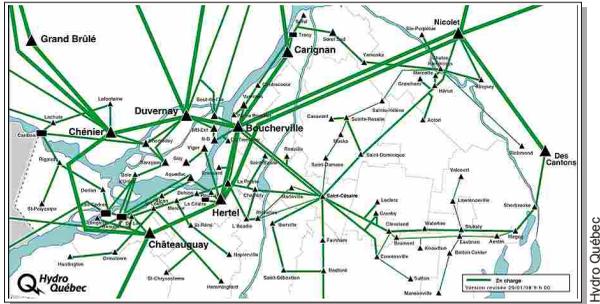


Fig. 10 Québec's transmission grid before the storm

The entire transmission system experienced significant disruption. About 1,000 towers and over 100 transmission lines were affected. (Fig. 11)

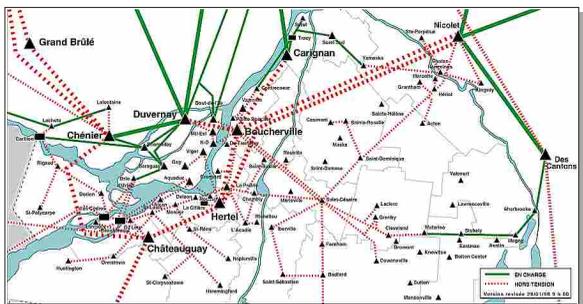


Fig. 11 Québec's transmission grid after the storm. Red areas show damaged power lines

There were 16,000 wooden transmission poles, 4,000 transformers and 1,000 pylons destroyed. This type of damage caused considerable electric-service interruption in southern Québec. There were prolonged power failures and substantial damage to the electrical system and to customers. As a result, the lives of more than 3 million people in Québec were disrupted for a number of weeks. The power supply reached a critical peak on January 9 when the entire Montréal and vicinity districts were reduced to one single high voltage

line from Laval. (Fig. 12) This brought about a slow down in the economic, social and community activities. Temporary breakdowns in the city's water supply system caused drinking water shortages for thousands of residents. The agricultural and business communities were disrupted for several days, causing considerable loss of revenue. The total damage showed that in Québec there were 1,393,000 homes affected.

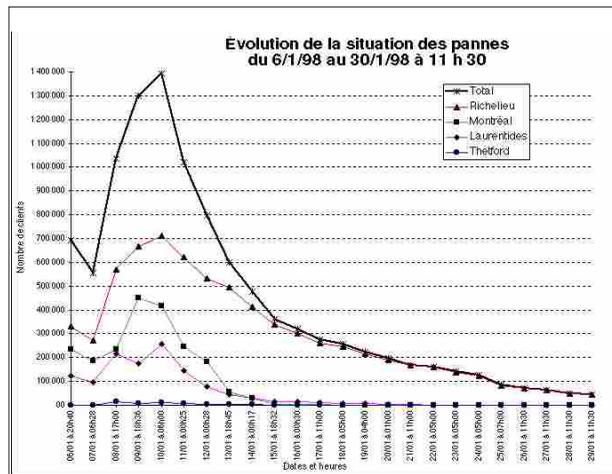


Fig. 12 The rate at which power returned to customers during January 6-30, 1998

Maritimes

From January 6-10, 1998, total water equivalent precipitation amounts near 80 mm fell over many southern New Brunswick locations. There were two main freezing rain events. The first freezing rain event was on January 6, where accumulations were generally light. The second and more significant freezing rain and ice pellet period began on January 7 and ended on January 9. Damage was not as extensive as in Québec and eastern Ontario. By the end of the storm there were 28,000 customers affected in New Brunswick and 20,000 in Nova Scotia.

Human Suffering

Human suffering continued in the affected area as the power grid was repaired. Power was off in entire districts, or fluctuated. Those persons without electricity flooded to the shelters. Trees and power lines were falling and roads were blocked, which made traveling hazardous. Officially there were more than 22 deaths directly attributed to the ice storm. As people were reluctant to vacate their homes, many were stricken with hypothermia. For those who tried alternate heating, toxic fumes from some heating devices may subsequently caused health problems.



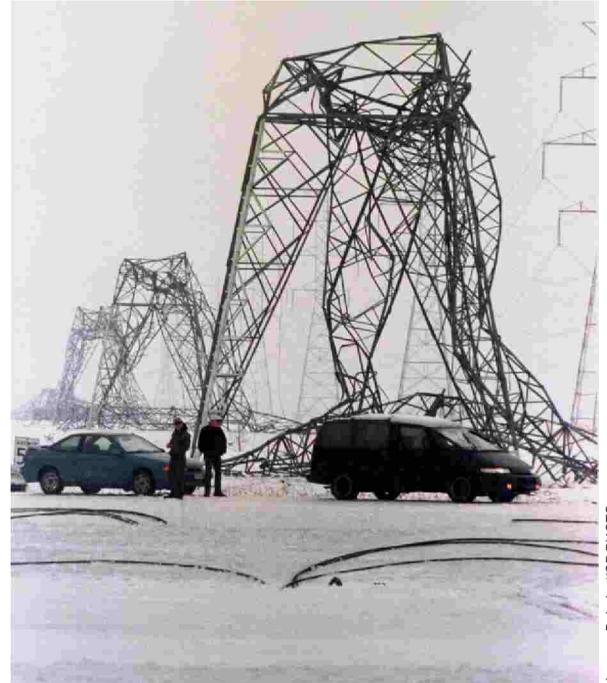
Rob Cellbreith/CP PHOTO

Residents get out the shovels in Montréal to get rid of five days worth of freezing rain and snow



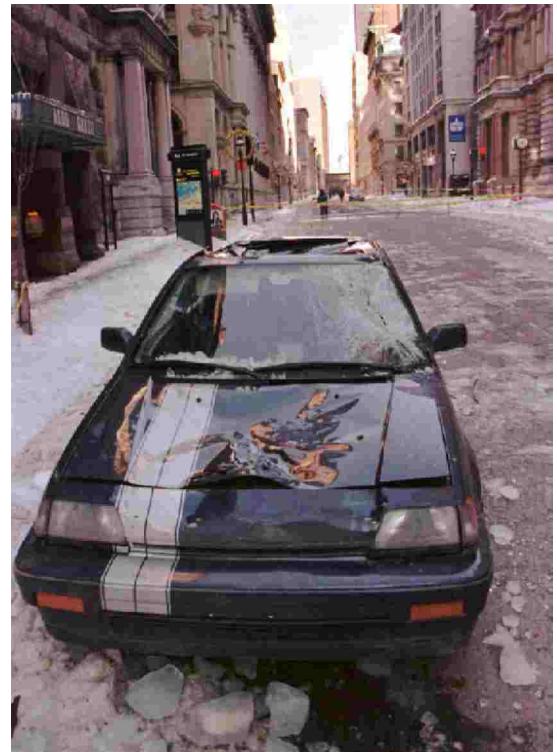
Tony Catwell/Ottawa Sun

In Ottawa, wise pedestrians like Alice Conway on Wellington St. keep an eagle eye out for falling ice and branches, many of them at the breaking point



Jacques Boissinot/CP PHOTO

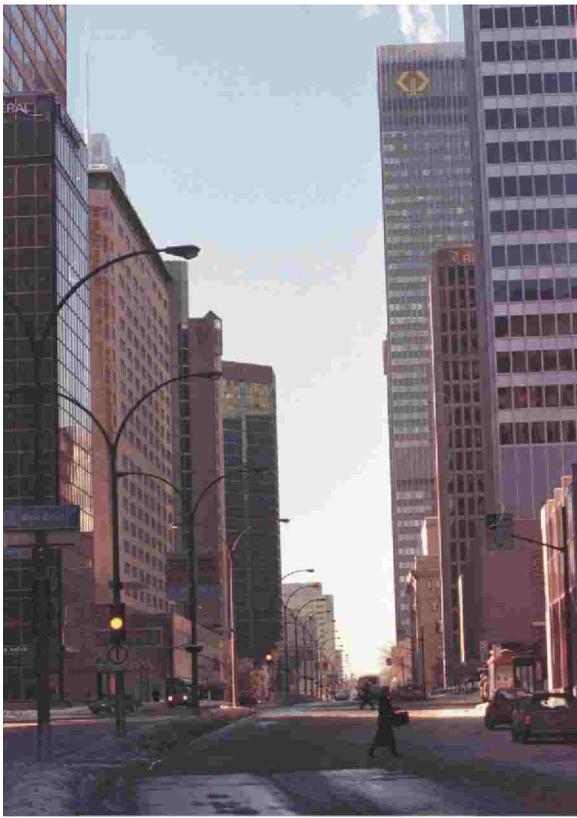
A series of Hydro-Québec high voltage towers that collapsed near St-Bruno, Québec, south of Montréal. The storm has left over one million households out of electricity



CP PHOTO

A car that was crushed by falling ice sits on the deserted streets of downtown Montreal Monday, January 12, 1998. Authorities have asked companies and pedestrians to stay off the streets to facilitate the cleanup of the ice storm

Commercial Activities



CP PHOTO

The deserted streets of downtown Montréal, Monday, January 12, 1998

Many offices in downtown Montréal were closed by the third day of the storm to save electricity for the rest of the province. There was a lack of power, no telephone service and little or no communications. With more and more buildings losing power, generators, flash lights, batteries and other such utensils were fast being sold in the stores. The agricultural area was severely affected as cattle, pigs and chickens were suffering from the lost of power even to feed them. For those persons who were able to obtain a generator, there was a lack of fuel as service stations quickly ran out of fuel. In the stores and supermarkets, spoilage and security was an ever increasing worry.



CP PHOTO

Motorists line up for gas as they stocked up when the pumps were working in west-end Montréal



CP PHOTO

Dead cattle are being piled up outside a processing plant in St. Albert, Ontario, a farming area east of Ottawa



Peter Cutler/Ottawa Sun

More than 1,000 shoppers were waiting in line for generators as homeowners struggle with power outages after the ice storm

Aftermath of the Ice Storm

A number of additional studies are being carried out on this ice storm and will be distributed as they become available. Some of the reports are of a meteorological nature and are aimed at the more technical person. Other reports addressed topics and issues related to the media participation in the event, how the Emergency Measures Organization (EMO) performed in the crisis and the economic impact to the affected areas. A post-event public opinion survey has revealed some interesting results.

Media

The January 1998 eastern Canada ice storm put significant pressure on the resources of several Environment Canada offices having responsibilities for delivering atmospheric and hydrologic programs. In general, there were no serious problems encountered by the Atmospheric Environment Program (AEP) during the storm. Products and services, including special services to support EMO's and the media, were delivered on time with no degradation in quality.

Data disruptions, workload increases, the need for special products and services and staff who were personally affected by the storm were the primary contributors to this pressure. On the whole, the organization's facilities, systems, and personnel performed well and provided all routine, and many special products and services during the storm and its aftermath without interruption or degradation.

Good support was supplied to emergency measures organizations and to the media. Following the first

freezing rain event, and with more freezing rain in the forecast, provincial and municipal emergency measure organizations became more involved. The *Direction générale de la sécurité et de la prévention* (DGSP) in Québec city was briefed daily as was the Regional Municipality of Ottawa-Carleton (RMOC), and all other municipalities. The AES Interagency Services Branch (ISB) provided special support to the military in support of their operations in the affected areas. WSC Trenton issued special forecasts four times per day for the affected areas.

Several offices were fortunate not to suffer any power or communication failures as some systems were close to the breaking point. Feedback indicated that the public was well satisfied with the weather service provided by Environment Canada.

Data Monitoring

Observations are especially important in severe freezing rain situations. While manned stations continued to operate with little loss of data during the storm, autostations did not fare as well.

Service Delivery

It was in the area of service delivery that most of the pressure on the AEP was sustained. Each of the affected offices, the Regional Centre National Capital (RCNC), the *Bureaux de services météorologiques et environnementaux* (BSME)-Montréal and Québec City, and the New Brunswick Weather Centre (NBWC) had significant increases in workload during and immediately after the storm. This additional workload consisted of special briefings to emergency organizations, power and telephone

companies, and commercial customers, as well as a large number of media briefings, many of which were broadcast live. The BSME Québec City seconded two meteorologists to the DGSP to provide 18 hour a day support. Dissemination systems worked fairly well with only occasional interruptions. All regular products and services were provided on time as well as good support.

Weatheradio and Weathercopy

In Québec, all weatheradio and weathercopy facilities worked throughout the period with few interruptions except for the Mégantic weatheradio transmitter which was without power for two weeks. In Ontario, while the Ottawa weatheradio and weathercopy transmitter broadcast throughout the ice storm, the three repeaters which are fed from this transmitter were off-air for a considerable period of time. In Kingston, the weatheradio transmitter failed on January 9. Power and restoration of broadcasts did not return until January 13.

Telecommunications

All telecommunication lines to the Canadian Meteorological Centre (CMC) and regional centres were functional for the duration of the ice storm. If the Québec region St-Laurent office had lost power or telecommunications, it would have been difficult to collect and distribute any observations from the rest of the Québec regional offices.

This office is provided with a Uninterruptible Power Supply (UPS) to prevent loss of power. During and immediately following the storm, Environment Canada (EC) forecasts and updates involving measurements of freezing precipitation were featured

extensively in the French and English media. Several print and broadcast journalists sought climatic and historical perspectives from EC officials in an attempt to explain the cause and severity of the storm and EC spokespersons were interviewed extensively in this regard.

Public Survey¹

A public survey was conducted to evaluate how people perceived Environment Canada's performance before, during and after the storm where 1,253 interviews were conducted.

Before the storm. Seventy-nine percent of respondents indicated that they had heard about the impending storm but almost half (48%) said that they did not receive adequate notice for a significant amount of freezing rain.

During the Storm. Eighty six percent of respondents said that they received enough information to make decisions for themselves and their families.

After the Storm. The percentage of people who got their weather information from television rose after the storm to 62%. Over 60% of respondents said that they would do things differently if they heard a forecast of a freezing rain warning again.

¹ Evaluation of Environment Canada's weather service performance during the January 1998 ice storm, administered by Goldfarb Consultants, March 1998.

The worst ice storm in Canadian history?



David Phillips

While freezing rain is not an uncommon Canadian experience, the ice storm that hit eastern Ontario, Québec, and New Brunswick was exceptional. Environment Canada senior climatologist and resident climate expert David Phillips, provides us with his analysis of how Ice Storm '98 stacks up in the record books.

Ice storms are often winter's worst hazard. The ice is more slippery than snow. Freezing rain is tenacious, clinging to every object it touches. A little can be dangerous, a lot can be catastrophic.

Ice storms are a major hazard in all parts of Canada except the north, but are especially common from Ontario to Newfoundland. The severity of ice storms depends largely on the accumulation of ice, the duration of the event, and the location and extent of the area affected. Based on these criteria, Ice Storm '98 was the worst ever to hit Canada in recent memory.

From January 5-10, 1998, the total water equivalent of precipitation, comprising mostly of freezing rain and ice pellets and a bit of snow, exceeded 70 mm in Ottawa, 73 mm in Kingston, 100 mm in Cornwall and 90 mm in Montréal. Previous major ice storms in the region, notably December 1986 in Ottawa and February 1961 in Montréal, deposited between 30 and 40 mm of ice which is about half the thickness from the 1998 storm event!

The extent of the area affected by the ice was enormous. Freezing precipitation is often described as "a line of" or "spotty occurrences of". At the peak of the storm, the area of freezing precipitation extended from Muskoka and Kitchener in Ontario through eastern Ontario, western Québec and the eastern Townships to the Fundy coasts of New Brunswick and Nova Scotia. In the United States, icing coated northern New York and parts of New England.

What made the ice storm so unusual, though, was that it went on for so long. On average, Ottawa and Montréal receive freezing precipitation on 12 to 17 days a year. Each episode generally lasts for only a few hours at a time, for an annual average total between 45 to 65 hours. During Ice Storm '98, it did not rain continuously; however, the number of hours of freezing rain and drizzle was in excess of 80 - again nearly double the normal annual total. Unlucky too! The storm brutalized one of the largest populated and urbanized areas of North America leaving more than three million people freezing in the dark for hours, if not days. Without question, the storm directly affected more people than any previous weather event in Canadian history. Into the third week following the onset of the storm, more than 700,000 people were still without electricity. Had the storm tracked 100 km farther east or west of its main target, the disruptive effect would have been far less crippling.

How the storm affected Canada:

- ◆ at least 25 deaths, many from hypothermia
- ◆ about 1,400,000 households were without power in Québec; 100,000 in Ontario
- ◆ about 100,000 people took refuge in shelters
- ◆ residents were urged to boil water for 24 to 48 hours
- ◆ airlines and railways discouraged travel into the area
- ◆ 13,000 troops (including 2,300 reservists) deployed to help with clean up, evacuation and security
- ◆ millions of residents forced into mobile living, visiting family to shower and share a meal or moving in temporarily with a friend or into a shelter
- ◆ prolonged freezing rain brought down millions of trees, 120,000 km of power lines and telephone cables, 1,300 major transmission towers each worth \$100,000 and about 27,000 wooden utility poles costing \$3,000 each

The damage in eastern Ontario and southern Québec was so severe that major rebuilding, not repairing, of the electrical grid had to be undertaken. What took human beings a half century to construct took nature a matter of hours to knock down.

What about climate change?

Environment Canada's science advisor on climate change, Henry Hengeveld, helps us out with the question that comes to mind whenever we hear of unusual severe weather. Was this a sign of climate change and things to come?



Henry Hengeveld

As with all individual extreme events, it is impossible to tie this specific event directly to a specific global force such as climate change. And given the evidence regarding El Niño's possible contribution to this ice storm, there is interest in understanding the link between El Niños and climate change.

While a number of recent research studies have suggested linkages between climate change and intense El Niños, these results are still under debate. This means that although 1997 was the warmest year on record and such linkages are possible, the current El Niño may be unrelated to climate change.

As winters become warmer due to climate change, temperatures close to the freezing level are likely to occur more frequently during winter months in southern Canada. Furthermore, results from climate models generally agree that the flow of moisture into southern Canada, and the resulting precipitation, will increase in winter seasons. These factors suggest that the frequency of ice storms could increase as the climate warms. The effect on the intensity of such storms is still unknown.

Was El Niño to blame for the ice storm?

Environment Canada scientists have been tracking the strongest El Niño in a century and a half and the phenomenon has been blamed in recent months for playing havoc with the world's weather. We've asked Environment Canada's Amir Shabbar, an expert on El Niño, to answer the question on many minds, "Was El Niño to blame for the ice storm?"



Amir Shabbar

There is no evidence that ice storms in eastern Canada are more frequent during El Niño winters. Instead, we might say that this ice storm had an "El Niño signature." Here's why: The sub-tropical jet stream in the southern United States, whose association with El Niño is well established, in combination with a stagnant ridge of high pressure in the Atlantic and a shallow layer of cold air in the St. Lawrence Valley, helped set the stage for prolonged periods of freezing rain in central and eastern Canada.

Other factors, however, controlled the conversion of the precipitation to freezing rain. For five continuous days, this jet stream was diverted towards southern Québec, bringing an abundant amount of rain northward. Meanwhile, a steady stream of northeasterly flow at the lower levels in the atmosphere, in the St. Lawrence Valley and the Ottawa Valley, maintained a shallow layer of cold air at the surface. The overrunning of warm moist air over the cooler air helped produce super-cooled water droplets which froze on impact on trees, hydro wires, and other objects.

Not all El Niños bring extensive freezing rain to central and eastern Canada. Major freezing rain events have occurred in non El Niño winters, for example, the 1961 record-setting two-day ice storm in Montréal.



Environment
Canada

Environnement
Canada

Environment Canada

General Inquiries: **1 800 668 6767**

Weather Information: **<http://www.weatheroffice.com>**

Environment Canada website: **[http:// www.ec.gc.ca](http://www.ec.gc.ca)**

The Green Lane (Atmospheric Environment Service):

<http://www.msc-smc.ec.gc.ca>

e-mail: **enviroinfo@ec.gc.ca**

Mailing address:

Environment Canada

National Weather Service Directorate

4905 Dufferin Street

North York, Ontario

M3H 5T4

Environment
Canada



Your window
on the weather

SINCE 1871