CANADA'S GREEN PLAN

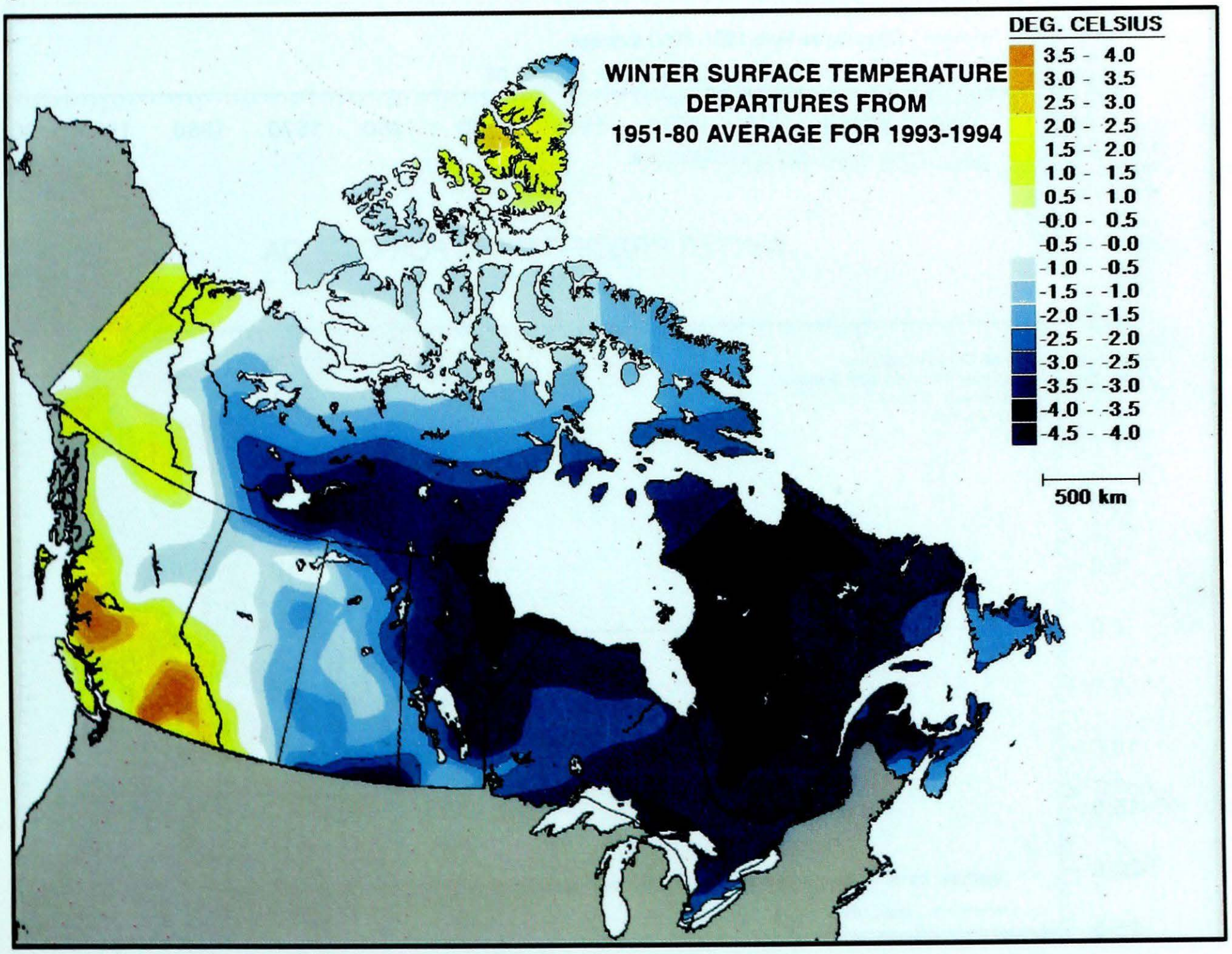
# Climatic Perspectives

*Monthly + Winter 1993/94 Review* **FEBRUARY - 1994** *Vol. 16*

## Winter 1993-1994

### A national summary

*Preliminary data for the December through February period indicate below-average temperatures and precipitation for Canada. The nationally-averaged winter temperature was 1.5°C colder and precipitation was 11% drier than the long-term reference average. Winter 1993-94 was the 20th coldest (80th warmest) since national temperature records began in 1895 and the 7th driest (40th wettest) since 1948. Nationally, it was the coldest winter since 1979. Nonetheless, the winter time-series still suggests a significant warming trend of 1.1°C over the 100-year period and in fact, 6 of the last 10 winters in Canada have actually been warmer than average.*




Environment Canada Environnement Canada

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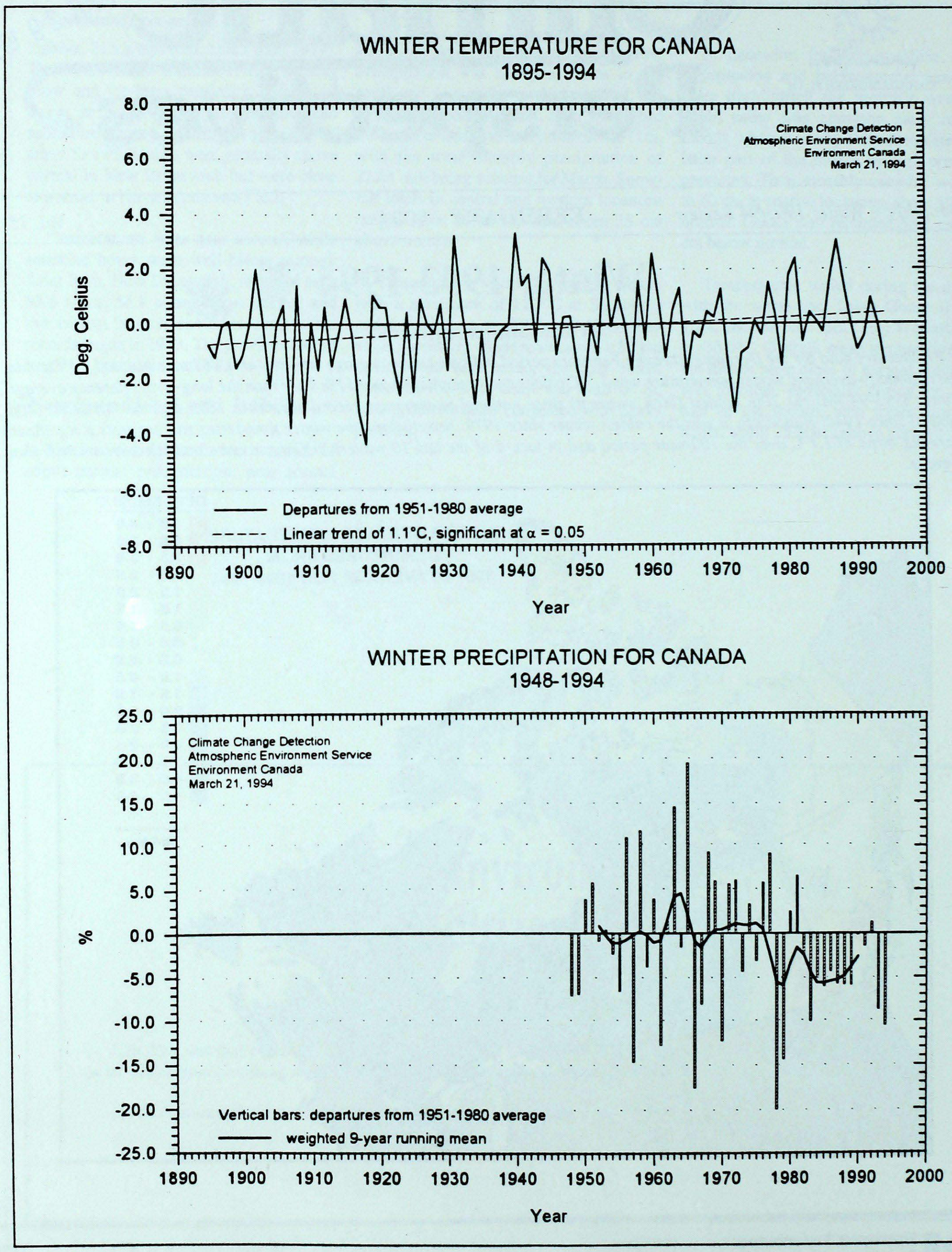
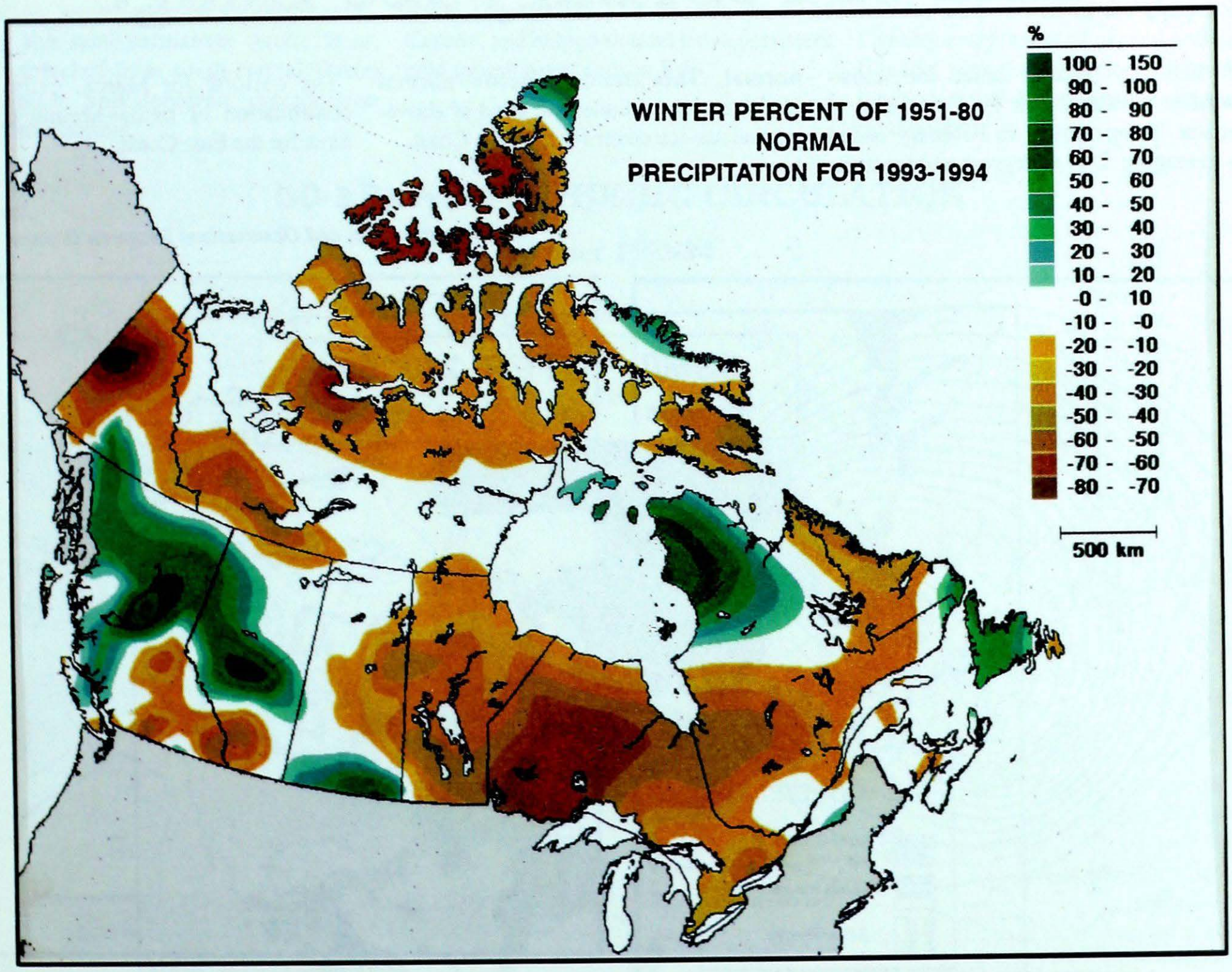

WINTER TEMPERATURE FOR CANADA
1895-1994
Climate Change Detection
Atmospheric Environment Service
Environment Canada
March 21, 1994
Deg. Celsius
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
Departures from 1951-1980 average
Linear trend of 1.1°C, significant at α = 0.05
1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year
WINTER PRECIPITATION FOR CANADA
1948-1994
Climate Change Detection
Atmospheric Environment Service
Environment Canada
March 21, 1994
%
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
Vertical bars: departures from 1951-1980 average
weighted 9-year running mean
1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year

An apparent decline in nationally-averaged winter precipitation since 1948 is suggested; however, the data are provisional at this time and the apparent trend may be somewhat exaggerated by certain observational biases.

The national temperature anomaly pattern for winter 1993-94 is not unlike that of the past autumn. Considerably below-average temperatures persisted in a broad area around Hudson Bay and extended from Great Bear Lake in the northwest, through Saskatchewan and Manitoba in the west, and throughout Ontario, Quebec and Atlantic Canada in the east. Temperatures here averaged as much as 2 to 4 degrees colder than the long-term reference averages. In the west, a narrow band of above-average temperatures persisted throughout the mountains of British Columbia and the Yukon Territory. In the Far North, a small area of above-average temperatures persisted over Ellesmere Island.

The national precipitation pattern for winter 1993-94 shows drier-than-average conditions throughout most of Canada for the 3-month period. Only small areas of above-average precipitation are evident for Newfoundland and southern Labrador, northern Quebec, coastal Baffin and northern Ellesmere Islands in the Far North, the Prairies of extreme southern Saskatchewan, and in a broad area extending through central and northern Alberta and British Columbia into the southern Yukon Territory, and southwestward along much of the West Coast. For these regions, winter precipitation totals were typically 30 to 60% above the long-term reference averages.

Atlantic Canada experienced its 11th coldest winter in the 100-year period making temperatures there colder-than-average for 10 winters in a row. Throughout Ontario and Quebec, winter 1993-94 was the 6th coldest in the 100-year period and the coldest since 1934. In the northern two-thirds of these provinces, 8 of the last 10 winters have all been colder-than-average but in the lower Great Lakes Basin only 3 of the last 10 were similarly colder, making this past season feel particularly chilly to residents.



The Prairie Provinces were also colder-than-average with considerable change from recent winters. Only 3 in the south and 2 in the north, of the last 10 winters, have been colder-than-average, while all others have been substantially warmer.

Most of the Far North, from the Mackenzie Mountains in the northwest to the mountains and fiords of coastal Baffin Island in the east, experienced colder-than-average winter temperatures this year. However, in the Mackenzie Basin, 7 of the last 10 winters have actually been warmer-than-average and a significant warming trend of 2.3°C is suggested over the 100-year period. Along the northeastern coastal perimeter of Canada, temperatures continued to decline this winter, with the last 6 in a row all exhibiting colder-than-average values.

British Columbia and the Yukon Territory were relatively mild during winter 1993-94, with all areas showing above-average values for the 3-month period. In the south, 7 of the last 10 winters in the interior and 6 along the coast, have all been warmer-than-average, while in the north, all 10 in a row have been warmer than the long-term reference averages. Even with these recent warm winters, no significant warming trends are suggested for British Columbia or the Yukon Territory, over the 100-year period.

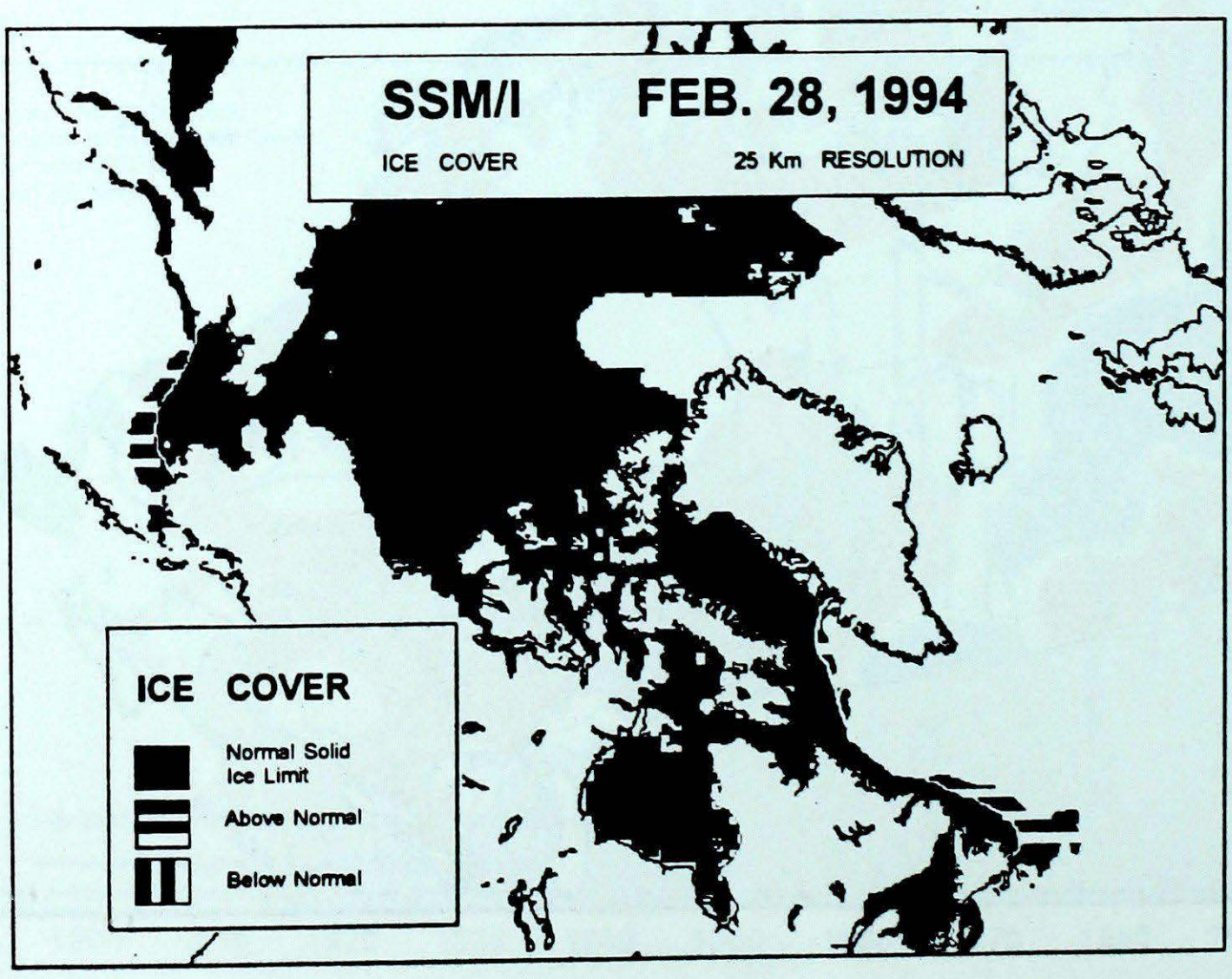
***Climate Change Detection Division***
***Downsview***

# End of February Ice Image

The February forecast called for below-normal temperatures for the East Coast of Canada. Temperatures in February ended up averaging 2 to 6 degrees colder-than-normal. This trend of below-normal temperatures continues the trend of above-normal sea-ice cover for the East Coast.

The outlook for March, calls for the continuation of below-normal temperatures for the East Coast.

***Arvids Silis***
***Climate Processes and Observations Research Division (Arctic)***



# Winter 1993-1994 Atmospheric Circulation

□ *Aaron Gergye*

Record-cold temperatures dominated the central and eastern parts of Canada, while most of British Columbia and the Yukon enjoyed a mild winter. The mean atmospheric circulation was remarkably similar to the winter of 1976-77. The pattern of cold weather in the east and warmer weather in the west was also similar to the winters of 1962-63, 1985-86, and 1987-88. Across many parts of central and eastern Canada, it was the coldest winter since 1929.

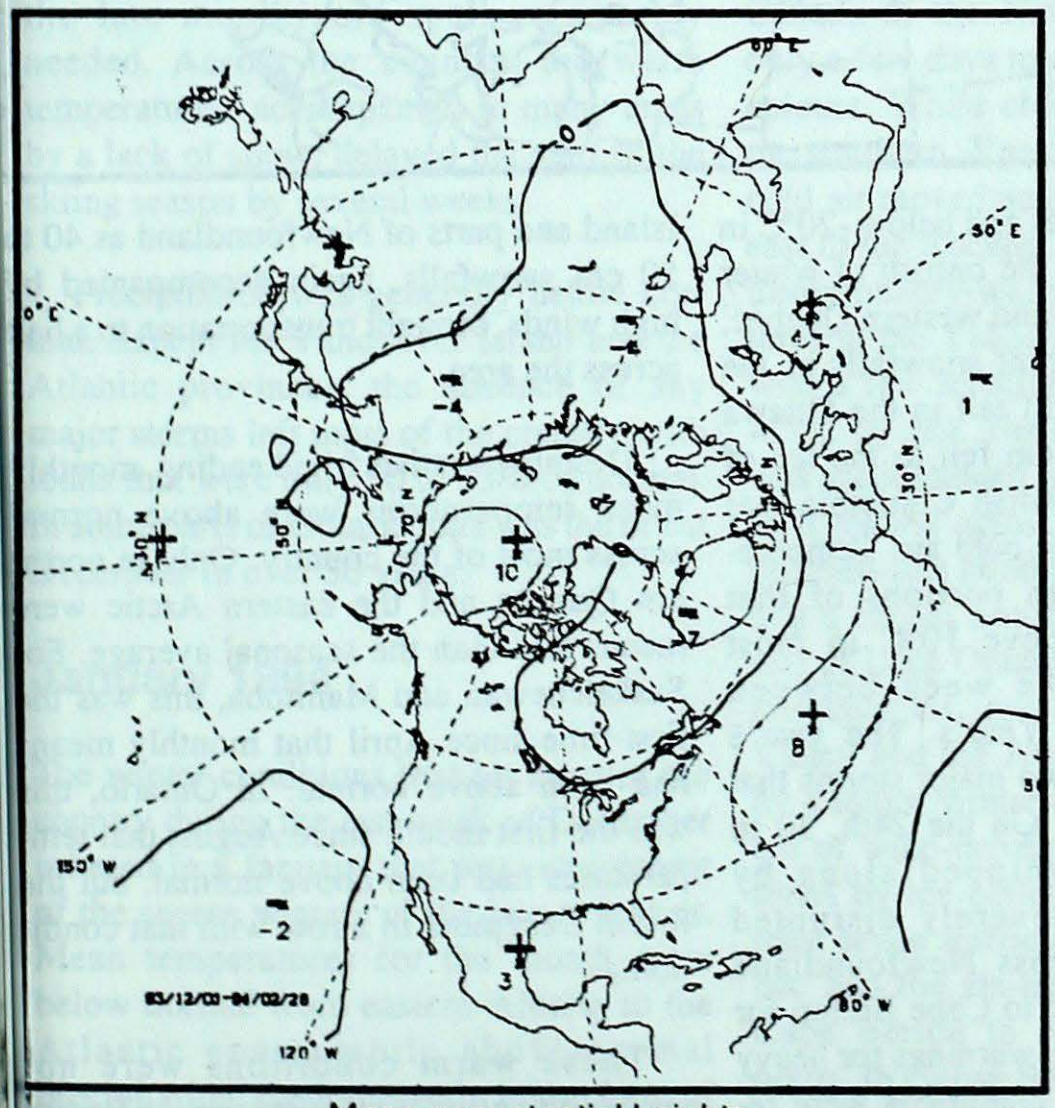
A ridge of high pressure extending from northern California to Alaska gave near to above normal temperatures across B.C. and the Yukon. Variable amounts of precipitation were recorded in these areas. Along the semi-permanent Arctic front, which stretched from south-central Yukon to southern Saskatchewan, precipitation was above normal.

The warm sea-surface temperatures in the Gulf of Alaska resulted in the formation of the persistent western ridge of high pressure. The warmer-than-normal sea surface temperatures in the Gulf was a remnant and an extension of the prolonged El-Niño event, which occurred during 1991-93. Warmer water from the tropical Pacific gradually moved northwards along the west coast of North America during that period. This pool of water gradually warmed the air above it and built a ridge of high pressure, which persisted for at least 6 months - from the fall of 1993 through the winter of 1993-94. East of the ridge, the general wind direction was from the northwest, which allowed Arctic air to flood the central and eastern parts of Canada, and helped to establish a persistent cold trough over Hudson Bay.

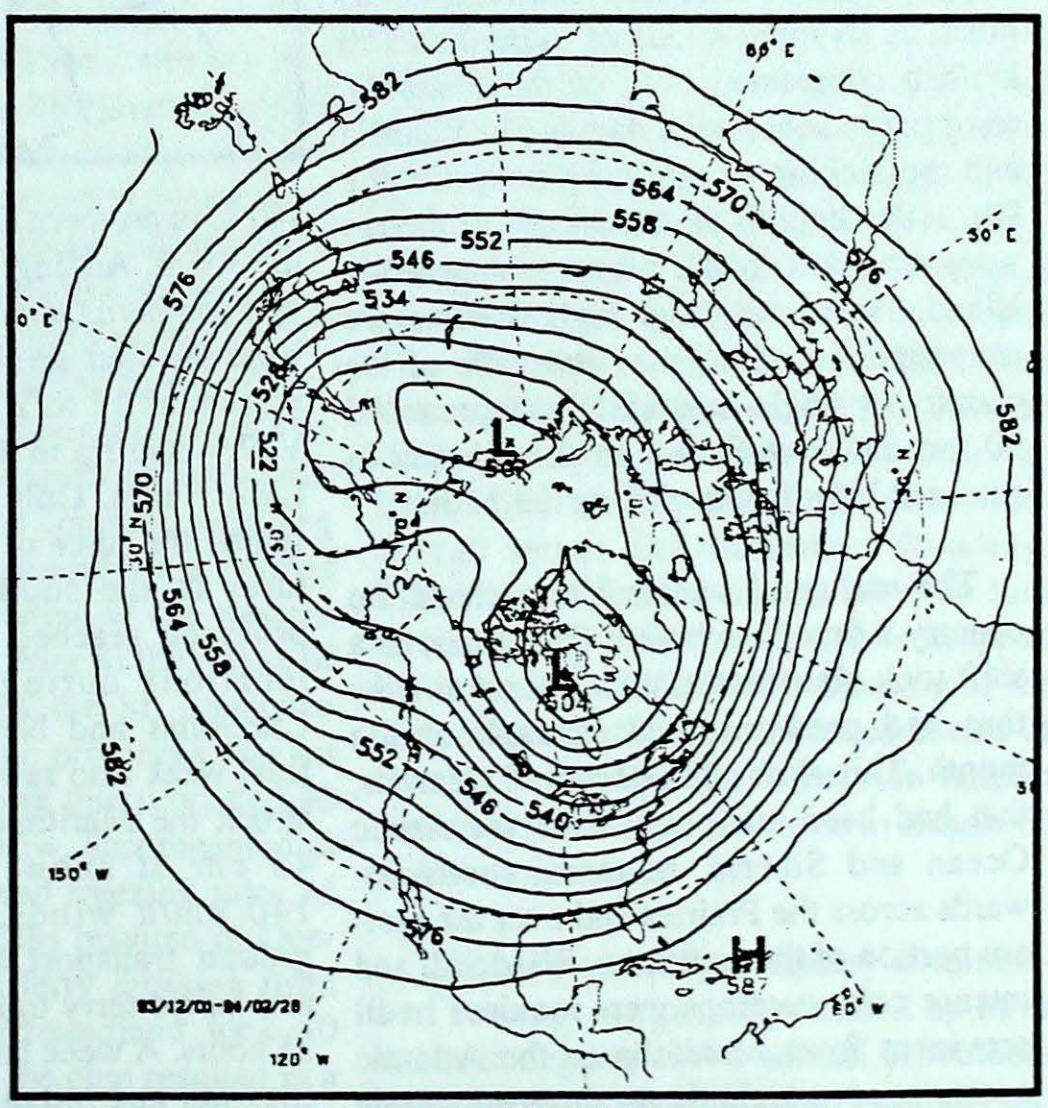
The pronounced trough of low pressure, stretching from the southernwestern tip of Baffin Island to Lake Ontario, resulted in a record-cold winter for most of eastern and central Canada. The stronger-than-normal ridge-trough pattern over Canada resulted in extended outbreaks of cold air over central and eastern Canada, producing cold northwest winds east of the ridge of high pressure. Except as noted earlier, precipitation was well-below-normal. The western ridge effectively blocked Pacific low pressure systems from penetrating western Canada. Also, the cold air associated with the stronger-than-normal trough of low pressure over the eastern half of Canada pushed low pressure systems farther south, into the eastern half of the United States. Consequently, most of central and eastern Canada, with the exception of Newfoundland, received below-normal amounts of precipitation.

## 50-kPa ATMOSPHERIC CIRCULATION

### Winter 1993-94



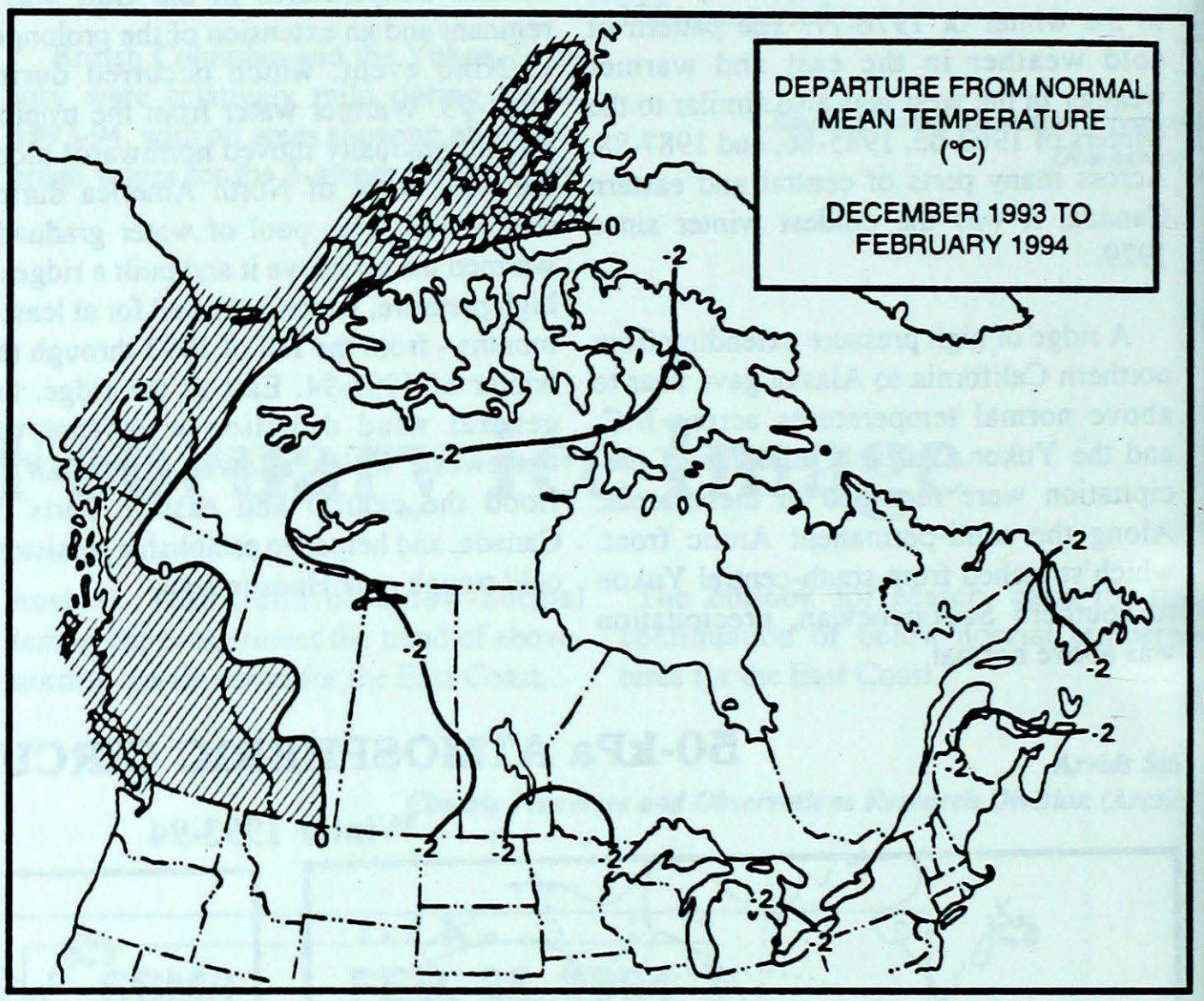

Mean geopotential heights
- 5 decametre interval -




Mean geopotential height anomaly
- 5 decametre interval -

# Winter 1993-1994

## December 1993

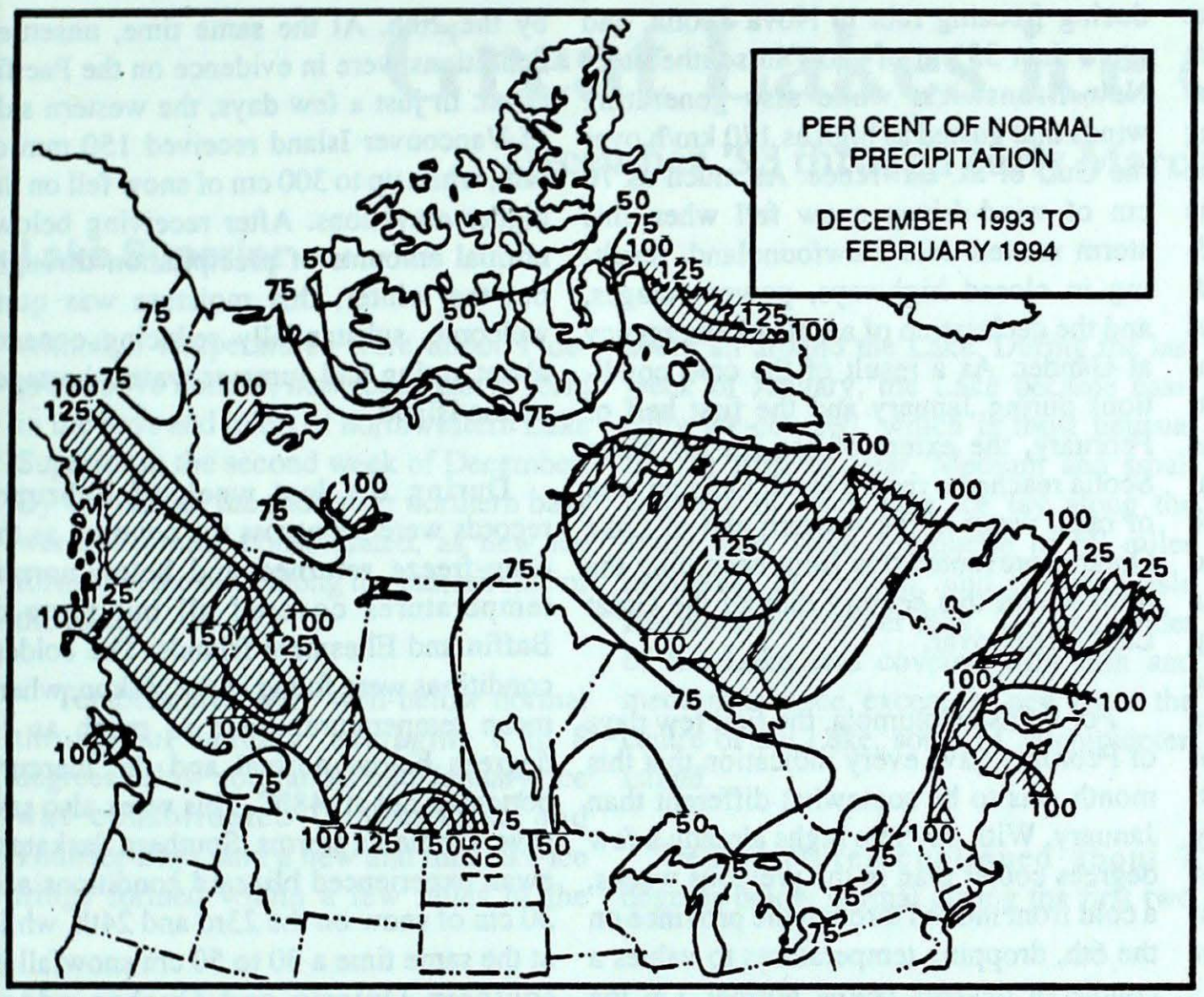



In contrast to December 1992, when winter conditions struck early, there was little significant winter weather across Canada in December 1993 until the last few days of the month. As December began, very warm conditions prevailed across the entire country, with temperatures as much as eight to ten degrees above normal over the western Prairies. As well, daytime highs frequently rose to the low to mid-teens in all four Atlantic Provinces and eastern Quebec. There was very little change in this situation as the mid-point of the month passed. Only in the high Arctic were below-normal temperatures observed. During this period there was little in the way of precipitation, as only the coastal areas experienced any significant storms. Some flooding occurred on Vancouver Island when two storms, on the 9th and the 12th, produced one-day rainfalls of as much as 88 mm. Winds of more than 150 km/h accompanied both of these storms, resulting in some wind damage in Victoria and the sinking of a fishing boat. On the 9th, wave heights in excess of 30 metres were recorded to the west of Vancouver Island. Heavy rain and high winds were also experienced on the other side of the country as single-day rainfalls approached 90 mm in Nova Scotia on the 5th and in southern New Brunswick on the 11th.

The reality of winter hit much of the country a few days before Christmas, as a shift took place in the west to east airflow that had predominated throughout the month. This shift allowed a cold air mass, that had been stationary over the Arctic Ocean and Siberia, to move southeastwards across the Prairies and over the eastern portion of the continent. Windchill and intense cold warnings were required in all provinces from Manitoba to the Atlantic coast, as overnight lows dropped below -40°C in northern areas and below -20°C in the south. Adding to the onrush of winter into southern Ontario and western Quebec, were the first significant snowfalls of the season, as 15 to 20 cm fell in the Ottawa Valley and up to 40 cm fell to the lee of Lake Huron. Only British Columbia was spared the force of the cold air. Temperatures in the southern portions of that province reached above 10°C in most locations during the week between Christmas and New Year's. The year's final week also saw two major storms that struck the Maritimes. On the 24th, 30 to 45 cm of snow, whipped along by 140 km/h winds, severely disrupted ground transport across Newfoundland and halted ferry traffic to Cape Breton for 35 hours. A week later, warnings for heavy snowfall and blizzard conditions were required for Nova Scotia, Prince Edward Island and parts of Newfoundland as 40 to 50 cm snowfalls, again accompanied by high winds, brought transportation to a halt across the area.

Despite its rather frigid ending, monthly mean temperatures were above normal across most of the country. Only in northern Quebec and the eastern Arctic were means less than the seasonal average. For Saskatchewan and Manitoba, this was the first time since April that monthly means had been above normal. In Ontario, this was the first month since August that temperatures had been above normal, but the fourth December in a row with that condition.

These warm conditions were not viewed favourably by everyone. In British Columbia, oil and forest industries in the




north were disrupted due to an inability to construct ice roads. For southern Ontario's ice-wine industry, which requires well-frozen grapes for the production of its wine, the late month cold spell was sorely needed. Across the country, the warm temperatures, accompanied in many areas by a lack of snow, delayed the start of the skiing season by several weeks.

Precipitation was generally below normal. Except for Vancouver Island and the Atlantic provinces, the absence of any major storms left most of the country with totals that were only 50 to 75% of normal. In some parts of Ontario, this was the driest December in over 50 years.

## January 1994

The winter conditions that hit most of the country during the last week of December ushered in a January that was reminiscent of the severe winters of the late seventies. Mean temperatures for the month were below normal from eastern Alberta to the Atlantic coast, while above-normal precipitation, predominantly in the form of snow, was recorded across the Prairies, over the lower Great Lakes, and throughout the Atlantic provinces.

Although mild air covered much of Canada as the New Year began, it took only a few days to establish January's true colours. While cherry blossoms bloomed on southern Vancouver Island, frigidly cold air moved across most of the country east of the Rockies. After several weeks of unseasonably-warm conditions, temperatures in the Yukon dropped to near -50°C, with a few locations failing to rise above -45°C by day. The advance of this cold air was accompanied by significant snowfalls, as it moved across the country, including blizzard-like conditions across the Prairies and a 50 cm accumulation at the western end of Lake Ontario. Prior to the influx of this cold air, much of the St. Lawrence Valley and the Atlantic provinces was hit by a major winter storm that produced 30 cm of wind-driven snow, accompanied at times by ice pellets and freezing rain. At least seven traffic deaths resulted in Quebec and the six-hour ferry crossing from Cape Breton to Newfoundland took 40 hours. In Goose Bay, the cold resulted in a water shortage, as taps had to be kept open to prevent pipes from freezing.

With the approach of the mid-point of the month, the cold air was well entrenched across much of the country. At Fort Good Hope, a low of -53°C established the country's coldest temperature of the winter. The mercury at Yellowknife failed to rise any higher than -40°C for several days in a row and most Prairie locations saw daytime highs that were more in keeping with their normal overnight minimums. In southern Ontario on the 19th, Windsor recorded its lowest temperature since 1885, as the mercury dropped to -29°C; the high on the same day reached only -21°C, the coldest ever for that location. In contrast, southern British Columbia saw very little sign of winter and temperatures frequently reached above 10°C throughout the month. For the rest of January, there was little significant change in this pattern, although a few areas did manage some minor temperature changes as warm air made some brief forays northward. On the 18th, several records were broken as daytime highs reached 11°C in Nova Scotia and 9°C in Newfoundland, before the cold air roared back behind a storm that produced 20 to 40 cm of snow and 90 km/h winds. The 28th and 29th saw a strong, but short-lived wedge of warm air that pushed temperatures several degrees above freezing in an area extending from the lower Great Lakes through southern Quebec and into the Atlantic Provinces. The change in air mass was particularly noticeable in the Halifax area, where a high of 9°C on the 29th came only three days after an all-time low of -29°C had been reached. Unfortunately, this resulted in considerable snow melt and, when combined with rainfalls of 25 to 35 mm, widespread street and basement flooding. These same flooded streets were to turn into ice rinks when temperatures dropped by as much as 25°C by the morning of the 30th. The rapid freeze produced sheets of ice that forced Toronto's Pearson Airport to shut down for the first time in almost 60 years of operation.

This was certainly a January to remember. Average temperatures ended up three to seven degrees above normal in southern British Columbia, with a few locations setting new marks for the month. From

Ontario to the Atlantic coast, this was the coldest January in over a hundred years; in several places it was colder than any other month on record. As well, most observing sites in Eastern Canada set at least one daily temperature record during this January, and a few experienced their coldest-ever values. Despite the cold, record-high snowfalls occurred in east-central British Columbia, central Alberta, southern Saskatchewan, and New Brunswick. As a result of January's severity, the upcoming summer's peach crop in southern Ontario has already been hard hit, with 40% of the buds in the Niagara area and 100% of those in the Windsor area destroyed. Auto insurance claims were up by 50% from the year before, while the costs resulting from frozen water pipes were double 1993's amount. Retailers of cough and cold remedies benefited from the winter chill, as sales increased by almost 10%. In Toronto, the number of parking tickets issued was down by almost 100,000, largely because of the effect of the cold.

## February 1994

For most of Canada east of the Rockies, the first half of February saw a continuation of the conditions that had prevailed through most of January. Temperatures were several degrees below normal and for some areas snowfall was a frequent occurrence. With extremely cold air entrenched over the Prairies, temperatures on the 7th and 8th dropped to some of their lowest values of the winter. At Edmonton, the overnight minimum reached -44°C, the area's coldest temperature since 1977; Lloydminster's -43°C reading was its lowest since 1968. However, the nippiest value was found at Scott, Saskatchewan, where the temperature of -48°C was colder than anything recorded in the previous 44 years. Chinook winds a few days later provided some relief, pushing daytime highs up to 6°C in Alberta and 2°C in Saskatchewan on the 12th. The country's first major snowfall of the month occurred on the 3rd, with 20 cm in Newfoundland and 34 cm over Cape Breton. Ten days later a vicious storm blasted through the Maritimes, producing freezing rain in Nova Scotia, and more than 35 cm of snow in southeastern New Brunswick, while also generating winds that gusted as high as 170 km/h over the Gulf of St. Lawrence. As much as 70 cm of wind-driven snow fell when this storm moved over Newfoundland, resulting in closed highways, power outages, and the declaration of a state of emergency at Gander. As a result of the cold conditions during January and the first half of February, the extent of sea ice off Nova Scotia reached a record level. Only an area of open water at the western end of Lake Ontario prevented this from becoming the third winter this century that all the Great Lakes froze over.

For British Columbia, the first few days of February gave every indication that this month was to be somewhat different than January. With daytime highs already a few degrees cooler than in the previous weeks, a cold front moved through the province on the 6th, dropping temperatures to values a couple of degrees below normal. On the night of the 8th, southwestern British Columbia received its first snowfall of the season, just over a centimetre at Victoria and almost 9 cm at Vancouver, where there were numerous traffic accidents and schools had to be closed. The snow cover was short-lived, as high temperatures struggled up to 4°C on the 9th, melting most of it.

On the 19th, the persistent cold spell that had begun shortly before Christmas finally broke in Ontario. Temperatures rose above the freezing mark in all areas, with many locations reaching double digit values. Kapuskasing's high of 11°C was the second warmest ever recorded in the January-February period. As the mild air reached Quebec and the Maritimes the next day, the temperature reached 20°C in southwestern New Brunswick. A reading of 18°C at Halifax was the highest ever in 122 years of December to February records. As this warm air was moving into eastern Canada, much of the west was seeing a return to extreme cold. After reaching temperatures of almost 10°C in Alberta on the 15th, a cold front moving southwards brought overnight lows down below -30°C by the 20th. At the same time, unsettled conditions were in evidence on the Pacific coast. In just a few days, the western side of Vancouver Island received 150 mm of rain, while up to 300 cm of snow fell on the higher elevations. After receiving below-normal amounts of precipitation throughout the winter, this moisture was quite welcome, substantially reducing concern about spring and summer water shortages on the Island.

During the last week of February records were set across the country, as the deep-freeze returned and below-normal temperatures covered all but parts of Baffin and Ellesmere Islands. The coldest conditions were found in the Yukon, where mean temperatures were as much as 16 degrees below normal and the mercury bottomed out at -48°C. This week also saw several notable storms. Southern Saskatchewan experienced blizzard conditions and 30 cm of snow on the 23rd and 24th, while at the same time a 30 to 50 cm snowfall in southern Ontario and Quebec added further to already over-budget snow removal expenses. Another storm on the 24th closed schools and businesses in parts of New Brunswick with a mixture of heavy snow, ice pellets, and freezing rain. Even the West Coast was not immune to winter precipitation, as daffodils in Victoria were covered by 17 cm of snow on the 24th and 25th.

Despite the profusion of storms, there were few areas of the country that ended the month with significantly above-average precipitation totals. Only British Columbia, the northern Prairies, and a few isolated locations in eastern Canada had higher than normal amounts. Except for the high Arctic, mean temperatures for all of Canada were substantially below the seasonal average. The greatest departures were found in a band from the southern Yukon to northwestern Alberta, where means were 9 degrees below normal.

The winter season saw record snowfall amounts in Alberta at Whitecourt (175.6 cm, old record of 155.4 in 1981-82) and Cold Lake (115.8 cm, old record 114.1 cm in 1957-58).

# Great Lakes ice cover

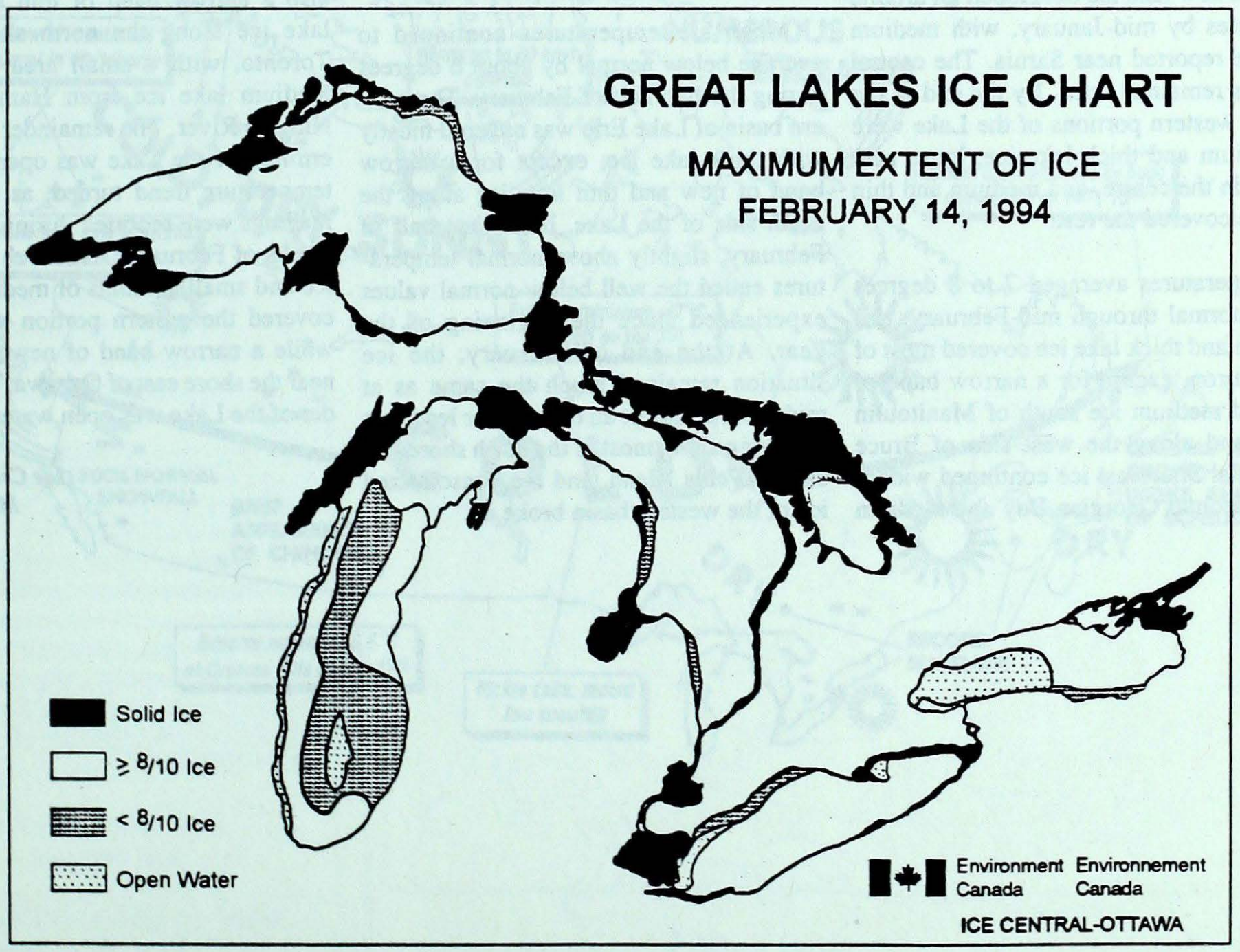
## December '93 through early March 1994

### Lake Superior

Although temperatures were about 1 degree above normal, new ice began to form in the bays and inlets of northwestern Lake Superior in the second week of December. By Christmas, the shallower northern bays were becoming consolidated, as new ice formed in the bays along the eastern side of the Lake.

Temperatures were well-below normal throughout January, averaging 6 to 8 degrees below normal. At mid-January, ice was consolidated in Whitefish and Thunder Bays, and a new and thin lake ice fringe formed within a few miles of the shore all around the Lake. During the last week of January, the Lake became basically ice-covered, which is most unusual for the time of year. Medium and small amounts of thick lake ice lay along the south side, from Marquette to 60 miles northeast of Duluth, and between Isle Royale and Thunder Bay. The remainder of the Lake was covered with thin and medium lake ice, except for new ice in the centre of the Lake, south of Michipicoten Island.

Temperatures continued about 7 degrees below normal during the first two weeks of February. These cold temperatures produced medium and thick ice cover, which is unusual for this time of year, although there were patchy new ice leads along the north shore. Near-normal temperatures in the last half of February brought an end to the well-below-normal temperature regime. In early March, medium and thick lake ice still prevailed, with a band of mostly thin lake ice along the north side from Isle Royale around to the consolidated ice in Whitefish Bay. There were also patchy new ice leads along the north shore.



## Lake Huron and Georgian Bay

On Lake Huron and Georgian Bay, December had near-normal temperatures. Around Christmas, new ice began to form in the North Channel and by New Year's, the St. Marys River was mostly ice covered and Georgian Bay sported a fringe of new and thin ice along the eastern side.

Temperatures averaged 6 to 7 degrees below normal for all of January. Before mid-January the North Channel consolidated and shorefast ice also lay in a narrow band along the northeast shore of Georgian Bay. At mid-month, the remainder of Georgian Bay had medium and thin lake ice cover. In late January, there was medium and thick lake ice in northern Georgian Bay and medium and thin lake ice in the rest of the Bay. Near the end of the month, a wide area from the Bruce Peninsula to the northern shore consolidated, a first since 1979. In Lake Huron, thin and new lake ice developed all around the shores by mid-January, with medium lake ice reported near Sarnia. The central portions remained open. By the end of the month, western portions of the Lake were in medium and thick lake ice, loose new ice lay in the centre, and medium and thin lake ice covered the rest.

Temperatures averaged 7 to 8 degrees below normal through mid-February, and medium and thick lake ice covered most of Lake Huron, except for a narrow band of thin and medium ice south of Manitoulin Island and along the west side of Bruce Peninsula. Shorefast ice continued widening all around Georgian Bay and medium and thick ice covered the centre. After mid-February, temperatures averaged near normal but the ice pattern persisted into March.

## Lake Erie and Lake St. Clair

Near-normal temperatures prevailed in December and as the month drew to a close new ice began to form in shallow Lake St. Clair and in the western basin of Lake Erie, west of Point Pelee.

Mean air temperatures averaged 4 degrees below normal during the first half of January, and about 6 degrees below in the second half. This consolidated Lake St. Clair by mid-month, while thin to medium lake ice cover formed over most of Lake Erie. The ice grew to medium and thick lake ice by the end of the month, as the western basin of the Lake also consolidated. A narrow band of new ice persisted along the north side of the Lake.

Mean air temperatures continued to average below normal by about 6 degrees during the first half of February. The eastern basin of Lake Erie was covered mostly with thick lake ice, except for a narrow band of new and thin lake ice along the north side of the Lake. In the last half of February, slightly above-normal temperatures ended the well below-normal values experienced since the beginning of the year. At the end of February, the ice situation remained much the same as at mid-month, except an open water lead was widening along most of the north shore and east of Pelee Island, and the consolidated ice of the western basin broke up.

## Lake Ontario

Mean air temperatures were near normal in December, but about 4 to 5 degrees below normal during January. By New Year's, the ice consolidated in the Bay of Quinte and in the entrance to the St. Lawrence Seaway. At mid-January, new ice in an 8 to 10-mile wide band lay along the north shore of the Lake with open drift new ice along the south side, west of Rochester. East of the Bay of Quinte, the Lake was covered with mostly thin lake ice. At the end of the month, a narrow band of new and medium lake ice lay all along the north side of the Lake. There was a large area of thin and medium lake ice east of Trenton, and open water in the centre of the Lake.

Mean air temperatures were 5 to 6 degrees below normal during the first two weeks of February, making this year one of the coldest on record. Near mid-February, the eastern half of the Lake was covered with thin and medium lake ice. There was also a narrow band of thin and medium lake ice along the north shore, east of Toronto, with a small area of thin and medium lake ice from Hamilton to the Niagara River. The remainder of the western half of the Lake was open water. The temperature trend turned, as near-normal readings were reported during the last two weeks of February. As March began, new ice and small amounts of medium lake ice covered the eastern portion of the Lake, while a narrow band of new lake ice lay near the shore east of Oshawa. The remainder of the Lake was open water.

***Ice Central-Ottawa***
***March 7, 1994***

CANADA'S GREEN PLAN

# Climatic Perspectives

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## CLIMATIC HIGHLIGHTS




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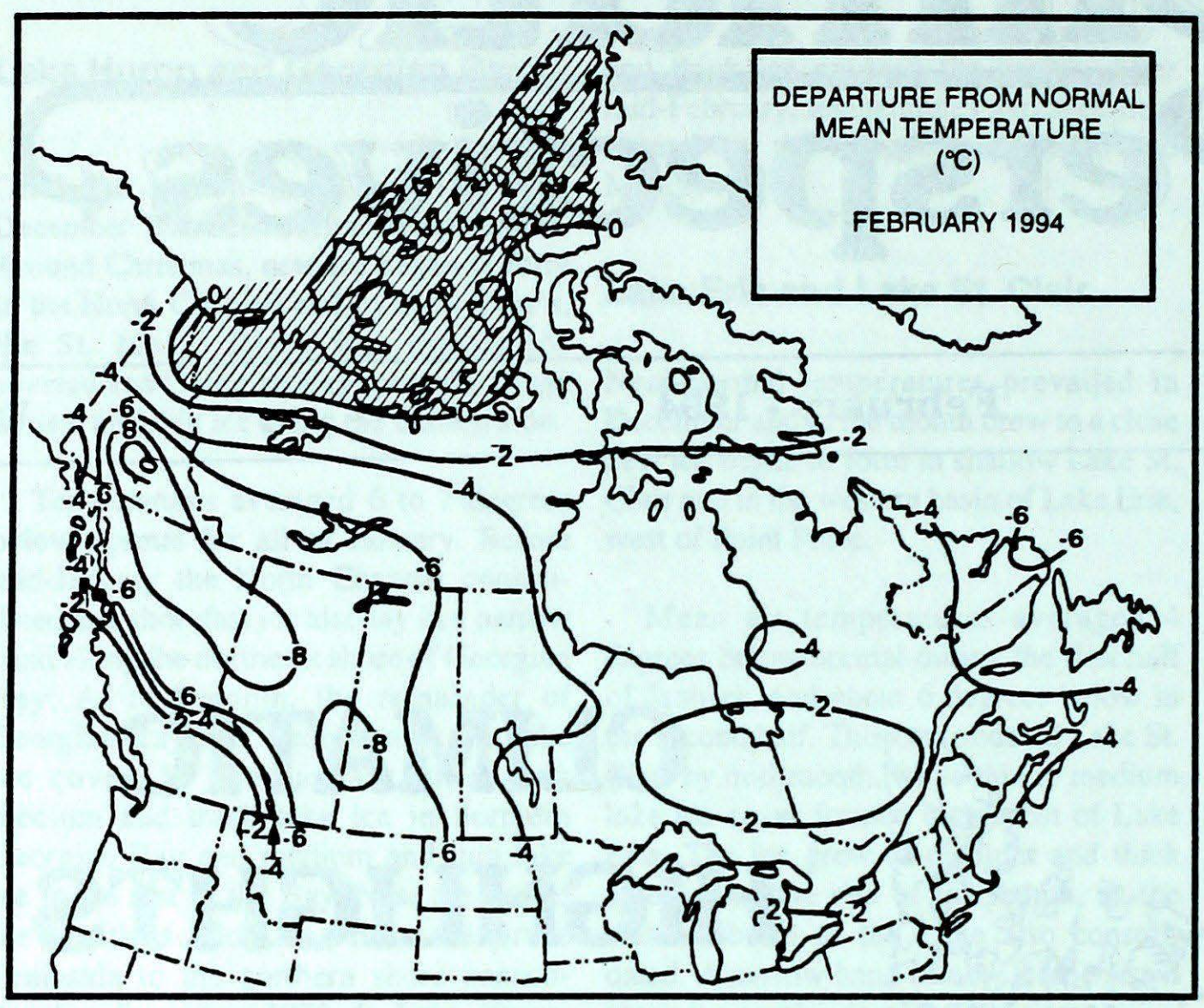


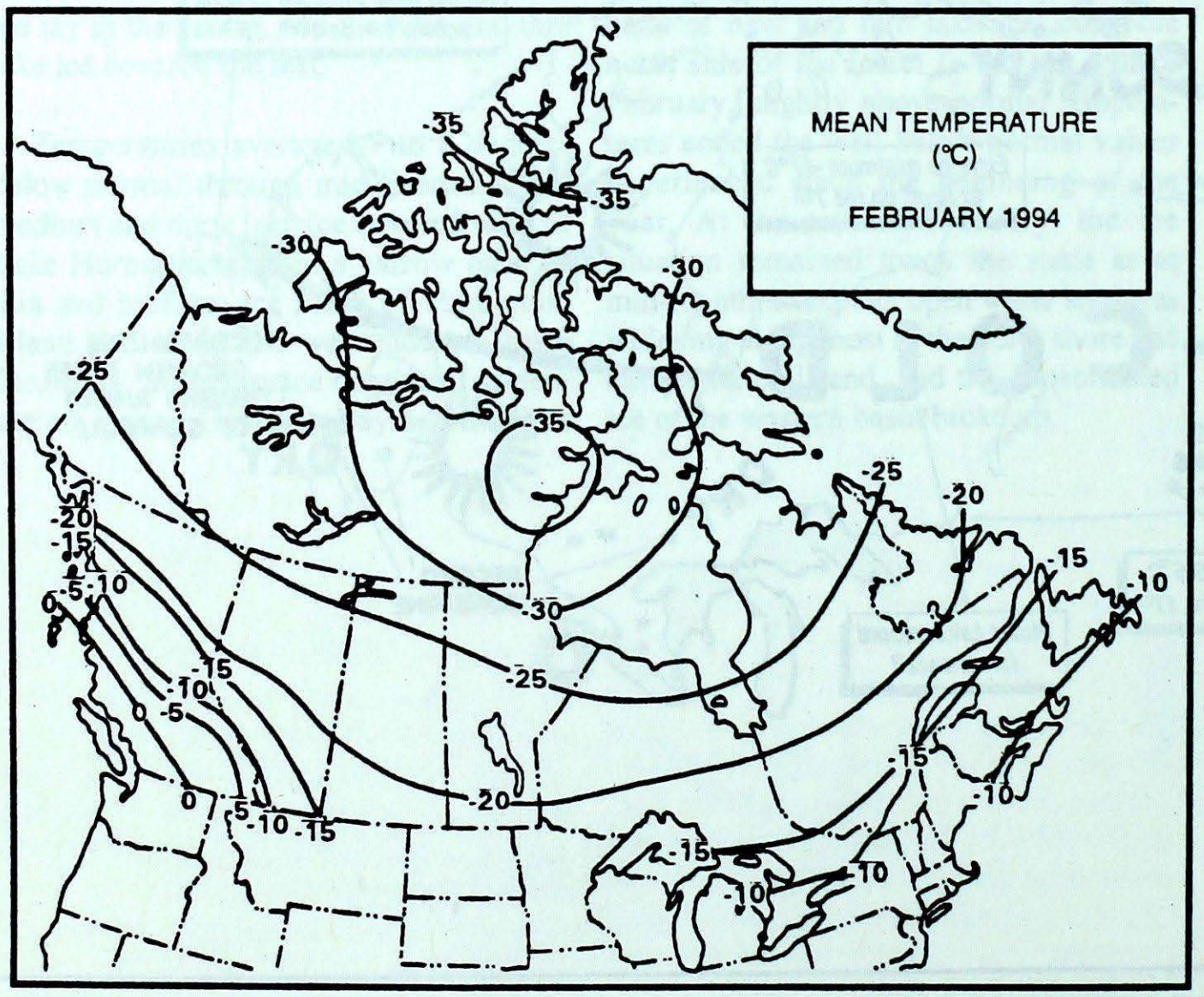


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# Across the country

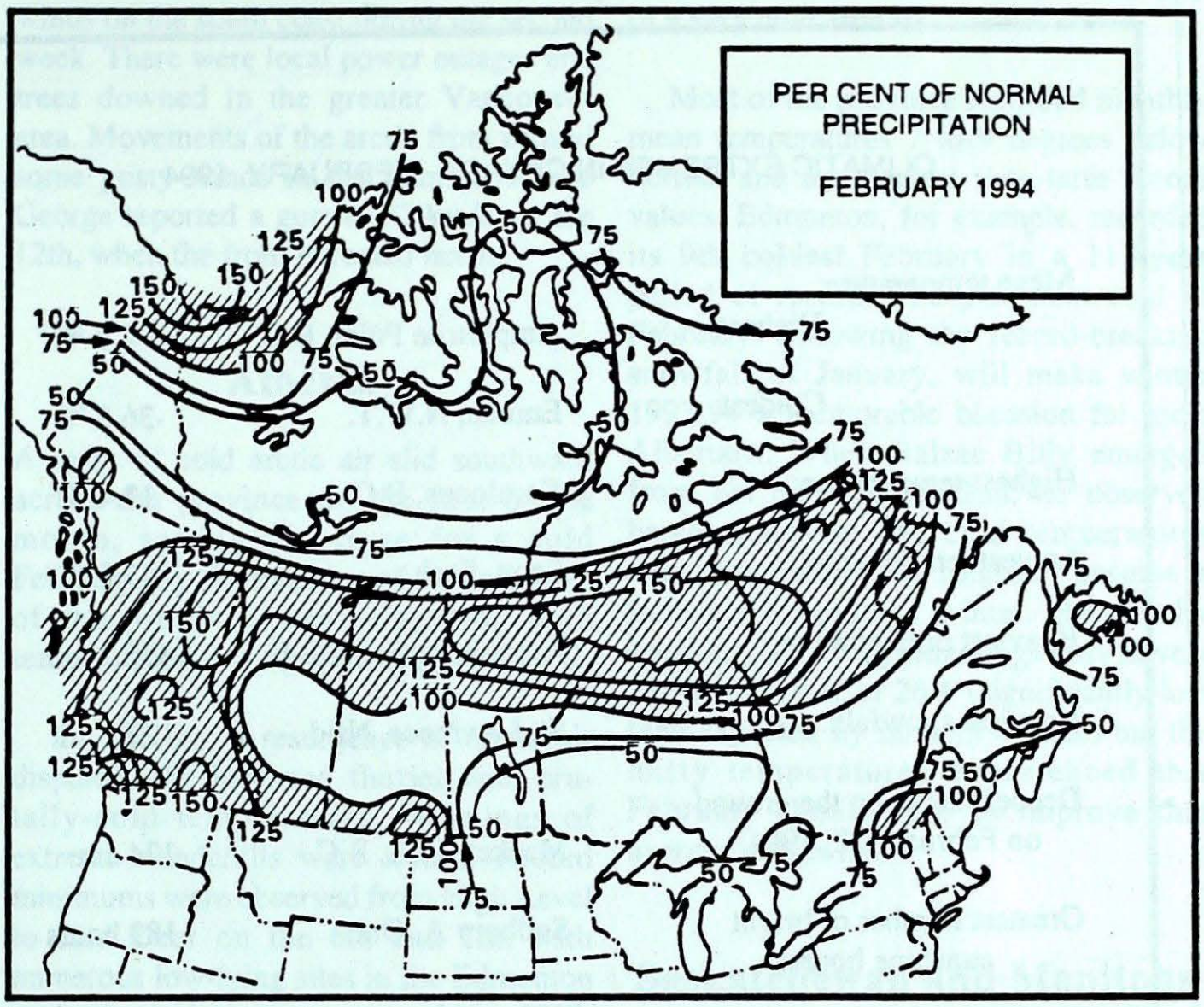
## Yukon

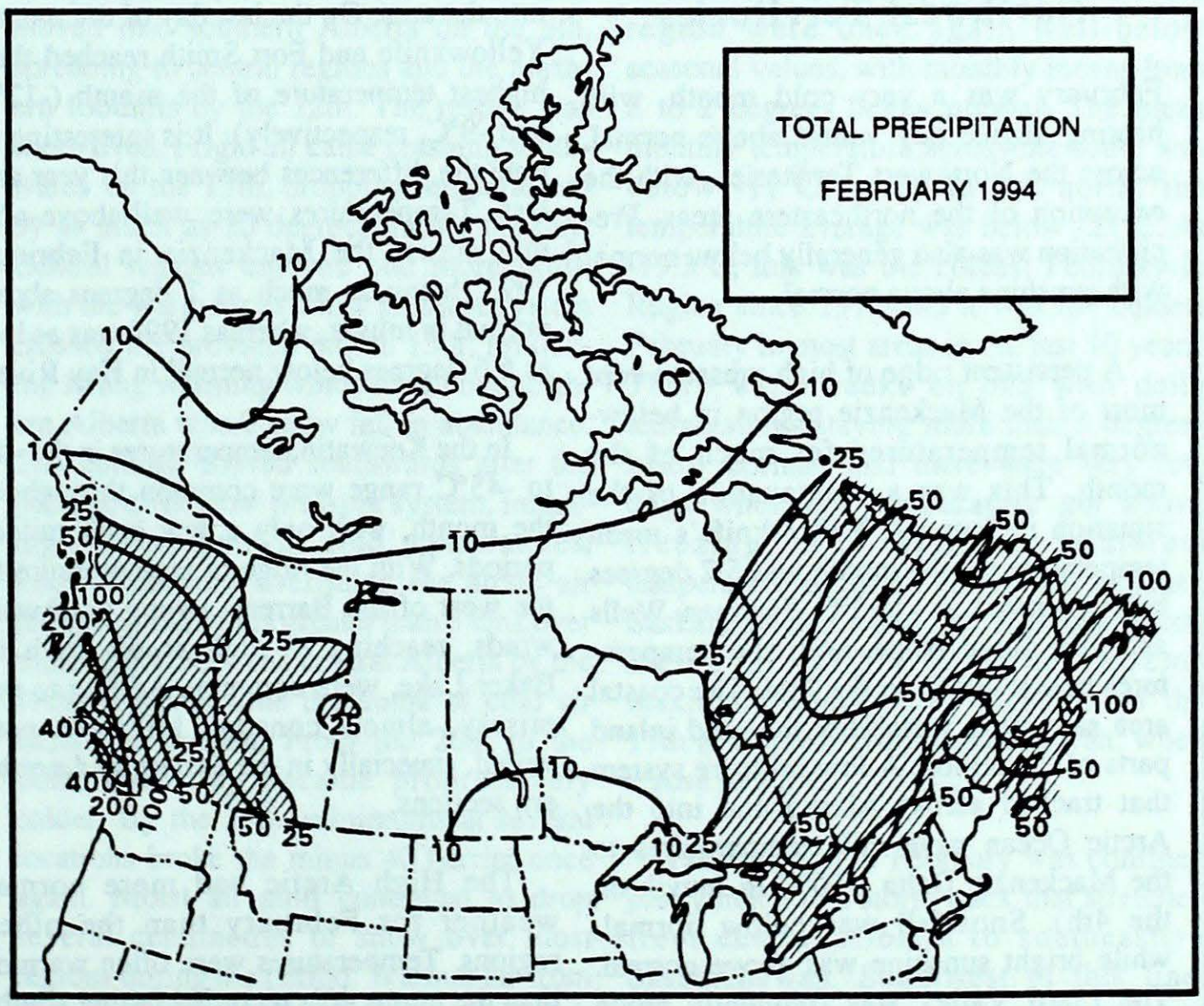
After a fairly mild start to the winter, the Yukon plunged into an Arctic deep freeze. Mainly dry conditions prevailed.

Of all Yukon reporting stations, only Eagle Plains had temperatures above normal while south of the Ogilvie Mountains almost all stations were four degrees below normal. Coldest was Stewart Crossing, at 13.5 degrees below normal. The next coldest was Swift River, at 10.1 degrees below normal.

The month started with temperatures slightly below normal. The warmest spot in the Yukon, and the only one with an above-freezing maximum temperature, was Blanchard, with 2°C on the 1st. By mid-month a large ridge of high pressure dominated the territorial weather. Under clear skies, temperatures plunged into the minus 40's. The only stations not recording -40°C were Blanchard (-34), Eagle Plains (-37), Swift River (-37), Teslin (-38) and Klondike (-39). The coldest recorded temperature was at Ogilvie, with a -48°C reading on the 22nd. At the end of the month, the ridge started to break down and a number of communities in the southern half of the territory reported their highest temperatures of the month on the 28th.

Along with the cold, it was also dry in most areas. The only station reporting above-normal precipitation was Whitehorse, with 139% of normal. Whitehorse also had the greatest snowfall of all Yukon stations, with 22.8 cm. Central areas had less than 50% of normal precipitation, with Klondike only recording a trace for the month, while Ogilvie had 14% of normal and Dawson and Stewart Crossing, 19%. The coastal passes were also extremely dry with Blanchard showing 9% of normal and Fraser 25%.



CLIMATIC EXTREMES IN CANADA - FEBRUARY, 1994

| | | |
|---|---|---|
| Mean temperature: | | |
| Highest | Amphitrite Point, B.C. | 4.9 ℃ |
| Coldest | Eureka, N.W.T. | -36.3 ℃ |
| Highest temperature: | Kamloops, B.C. | 13.4 ℃ |
| Lowest temperature: | Scott, Sask. | -47.5 ℃ |
| Heaviest precipitation: | Amphitrite Point, B.C. | 436.2 mm |
| Heaviest snowfall: | St. Lawrence, Nfld | 127.1 cm |
| Deepest snow on the ground on February 28, 1994 | Mackenzie A, B.C. | 124 cm |
| Greatest number of bright sunshine hours: | Sudbury A, Ont. | 189 hours |

## Northwest Territories

February was a very cold month, with heating degree day values above normal, across the Northwest Territories, with the exception of the northeastern areas. Precipitation was also generally below normal with sunshine above normal.

A persistent ridge of high pressure kept most of the Mackenzie region in below-normal temperatures for much of the month. This was a continuation of the situation in January. Yellowknife's mean temperature for the month was 5.7 degrees below normal at -30.2℃. Norman Wells and Fort Good Hope, both saw temperatures below -45℃ on the 21st. The coastal area saw more variability than did inland parts of the region. A low pressure system that tracked across Alaska and into the Arctic Ocean gave mild temperatures to the Mackenzie Delta (-10℃ in Inuvik on the 4th). Snowfall was below normal, while bright sunshine was above normal. The Liard Valley was frequently much milder than the rest of the southern Mackenzie, as warm air over B.C. intruded into the area. On the last day of the month, Yellowknife and Fort Smith reached their highest temperature of the month (-17℃ and -9℃, respectively). It is interesting to note the differences between this year and last. Temperatures were well-above-normal across the Mackenzie in February 1993, being as much as 7 degrees above normal in Inuvik, whereas 1994 was as low as 6.6 degrees below normal in Hay River.

In the Keewatin, temperatures in the -40 to -45℃ range were common throughout the month, with only a few brief milder periods. With the ridge of high pressure to the west of the Barrens, strong northwest winds, reaching as high as 60 km/h in Baker Lake, were common. Adding to the misery, almost constant blizzards prevailed, especially in the eastern and northern sections.

The High Arctic had more normal weather for February than the other regions. Temperatures were often warmer than the minus 40's recorded farther south. Resolute experienced a few blizzards but they were not as frequent as those in the Keewatin. At the end of the month, an intense storm, that gave heavy snow to the Maritimes, gave Iqaluit a blizzard and strong winds to most other areas on Baffin Island.

## British Columbia

February was very cold in northern and central British Columbia. Arctic air also moved into southern sections a few times during the month. Cold, wet, dull and windy sums it up for the coastal areas.

Mean temperatures were below average throughout the province. In the north, much of the month passed in a deep freeze while arctic outbreaks were less extreme further south. In the northern third of B.C., temperatures were 7 to 10 degrees below average. Germansen set a new record for February, reporting a mean temperature of -17.2℃, breaking the old record of -15.7℃ set in 1989. Toad River, on the Alaska Highway, west of Fort Nelson, recorded a minimum of -45.0℃ on the 25th. Temperatures began to moderate near month's end. Central sections were 3 to 6 degrees below average. Prince George recorded its coldest temperature of the winter on the 24th, -36.8℃. Southern interior and south coastal areas experienced a couple of minor arctic outbreaks, which were a little more severe on the north coast. Temperatures were 0.5 to 2 degrees below average.

In the northern half of the province, western sections reported 70 to 100% of average precipitation increasing to the east to 175 to 200 %of average in the Peace River area. Precipitation was more variable in the southern half. Most areas reported 120 to 170% of average but amounts varied widely. Vancouver, Williams Lake and Princeton reported near 90% while the central Chilcotins reported near 300%. There were some heavy rains, such as 74.8 mm at Port Alberni on the 14th. No new precipitation records were reported.

Snowfall was below average in the northwest corner of the province and in a narrow band from Quesnel to the Fraser

Canyon as well as central Vancouver Island and the extreme southern Okanagan. From the north coast eastward to the Prince George region and north to the Peace River, snowfall was 150 to 200% of average. Many southern interior areas reported 110 to 140% of average, except the northern Vancouver Island/Chilcotins/Whistler area where snowfall was near 300% of average. South coastal regions varied widely from near average to 300% of average.

Several areas reported very heavy snowfall during mid-month. The Terrace/Kitimat area reported 75 to 150 cms of snow from the 8th to the 15th. The South Coast Mountains received from 100 to 300 cms in mid-month, greatly improving ski conditions. Southern interior ski areas were happy to see heavy snowfalls of 60 to 90 cms in the third week of the month. The Peace River area has had two consecutive months of well-above-average snowfall. Snowpack conditions are reported above normal in the upper and middle Fraser, the Peace and the Liard. Elsewhere, snowpack is near or below normal.

Sunshine was above average in the far north, running from 100% in the west to 150% in the east. Sunshine dropped off rapidly to the south to 50 to 80% of average in central section, improving to 70 to 85% of average in the south, except for local areas such as Revelstoke, which reported only 49% and Princeton which reported 115% of average. Fort Nelson reported a new record-high sunshine value for February, of 99.6 hours, breaking the old record of 79.7 hours set in 1987. On the other end of the scale, Whistler set a record low of 58.9 hours of sunshine, breaking the old record of 59.5 hours in 1991.

Fog plagued the south coastal area for several days in the first week of the month, causing some travel delays for airline passengers.

It was a windy month, with many coastal areas reporting outflow, or squamish winds associated with arctic outbreaks as well as the more typical winds associated with Pacific weather systems. B.C. ferries reported some difficulty with winds on the south coast during the second week. There were local power outages and trees downed in the greater Vancouver area. Movements of the arctic front caused some gusty winds in the interior. Prince George reported a gust to 82 km/h on the 12th, when the front retreated north.

## Alberta

A mass of cold arctic air slid southward across the province on the first of the month, setting the stage for a cold February. By the morning of the 3rd, most of the province was struggling with temperatures ranging from -30°C to -20°C.

On the 6th, a resurgence of arctic air displaced the localized flurries with brutally-cold temperatures. Warnings of extreme windchills were issued. Record minimums were observed from High Level to Red Deer on the 6th and 7th, with numerous low-lying sites in the Edmonton region reporting values approaching -50°C. Extreme cold gave way to above-freezing temperatures, as chinook conditions moved into southern Alberta on the 8th, spreading to central regions and the northern foothills by the 12th. The respite was short-lived. Frigid air came crashing southwards on the 13th, dropping temperatures by as much as 20 degrees during the day. Central regions enjoyed one more brush with the warm air as a low pressure system crossed the province on the 15th, producing strong warming winds for all but northern Alberta where snow fell in abundance. The cold air moved southwards after the passage of the low pressure system, initiating another bout of cold temperatures. Pacific moisture overriding the arctic air produced snowfalls greater than 5 cms over most of northern and central Alberta by the 19th, at which time the dome of cold air started to deepen. From the 20th to the 26th, each day became progressively colder. By the 25th, minimums at several locations broke the minus 40 barrier once again. Moist air aloft continued to drop several centimetres of snow over most regions during the period. Warmer air from the west slowly eroded the dome of cold air in the foothills on the 27th and in areas further east on the 28th, ending the icy grip of a very cold airmass.

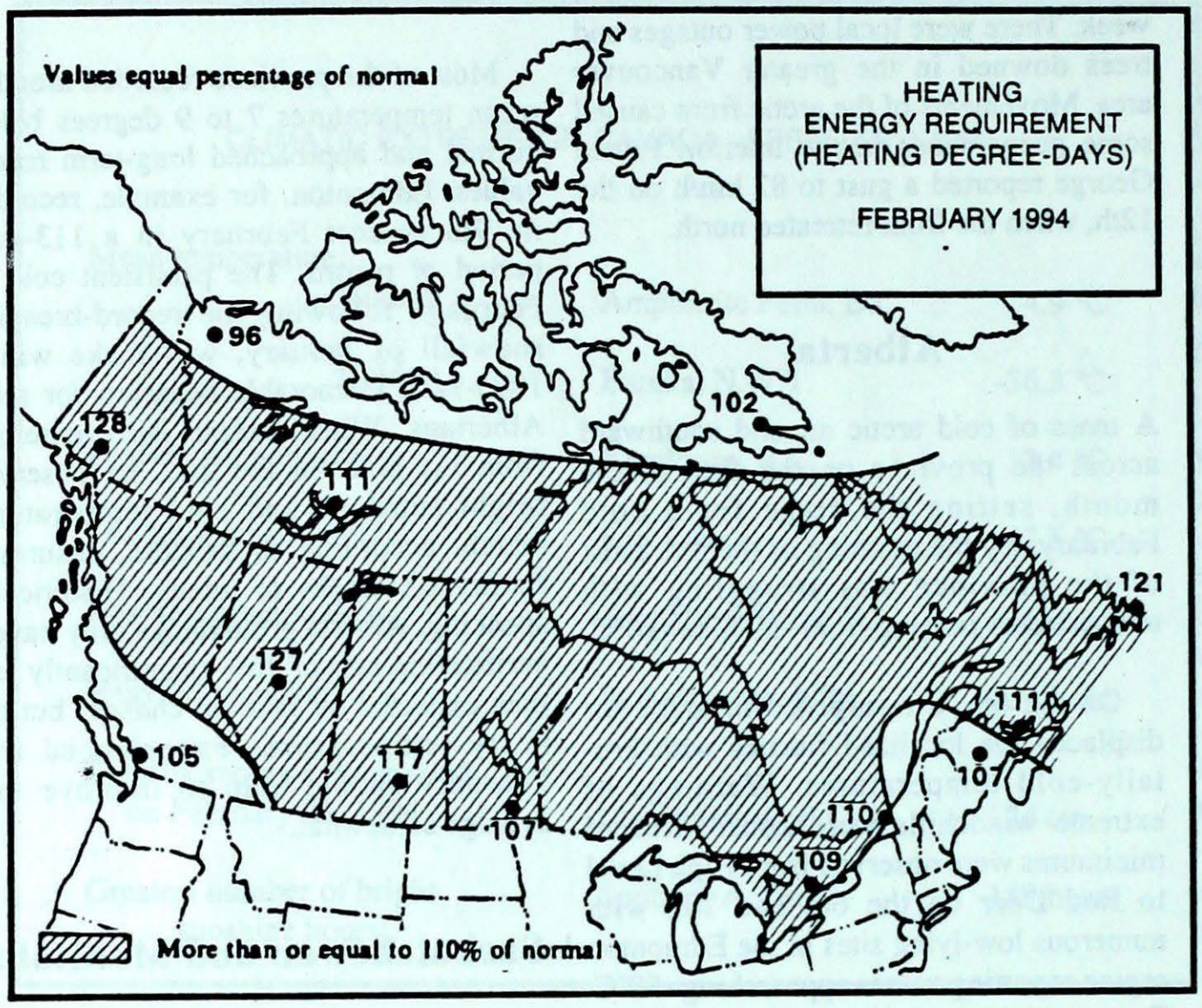
Most of the province recorded monthly mean temperatures 7 to 9 degrees below normal and approached long-term record values. Edmonton, for example, recorded its 9th coldest February in a 113-year period of record. The persistent cold of February, following the record-breaking snowfall of January, will make winter 1993-94 a memorable occasion for most Albertans. When Balzac Billy emerged from his hole on the 2nd, he observed bright sunshine and cold temperatures which, according to folklore, ensures a further six weeks of winter. Historically speaking, Alberta groundhogs only have a verification rate of 26% (significantly less than expected by random chance) but the nasty temperatures experienced this February should help to improve that average somewhat.

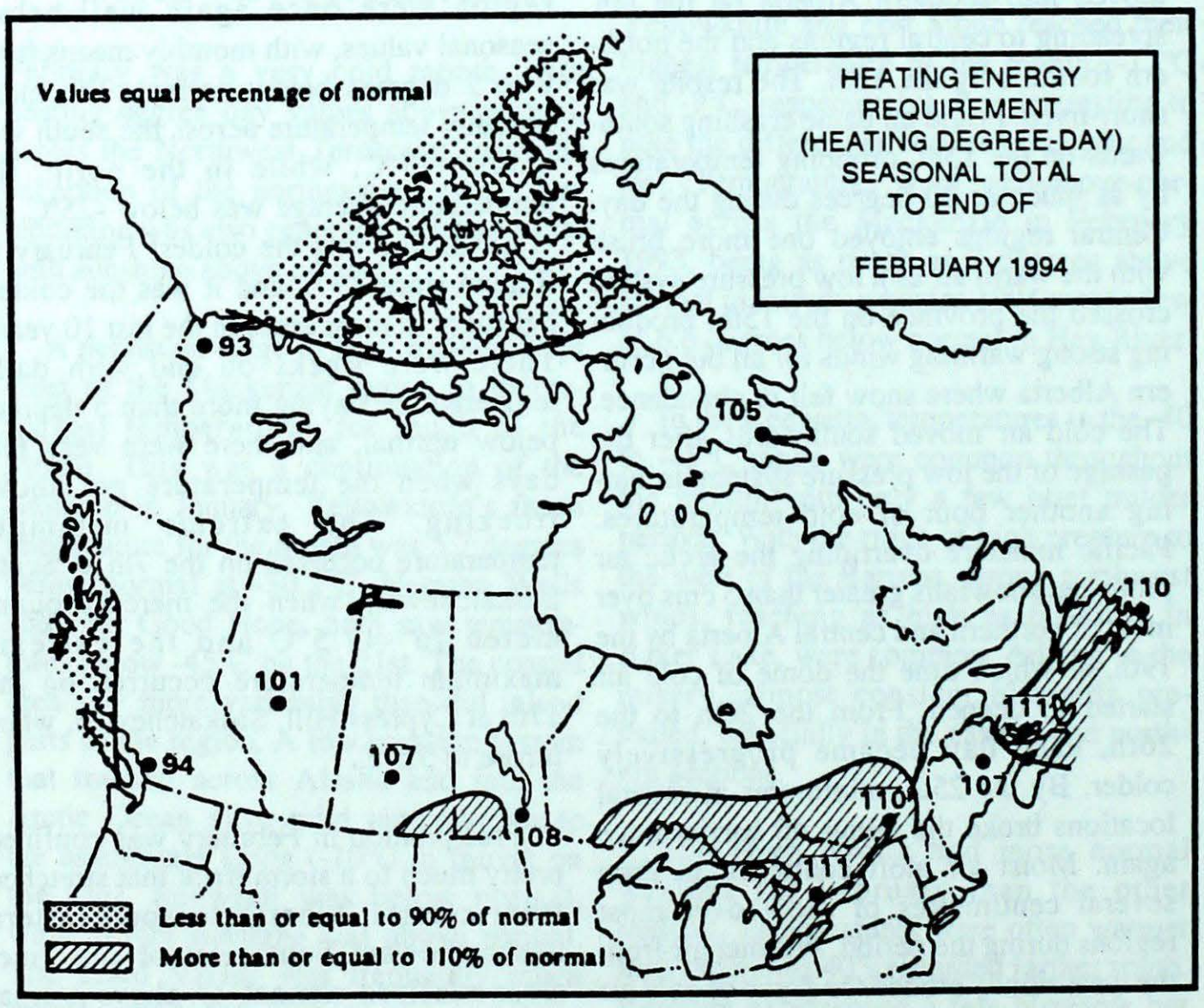
## Saskatchewan and Manitoba

February continued the way January ended...COLD. Temperatures across the region were once again well-below seasonal values, with monthly means from 8 to 2 degrees below normal. The mean monthly temperature across the south was below -17°C, while in the north, the temperature average was below -25°C. At -19.3°C, this was the coldest February in Regina since 1979 and it was the coldest February in most areas in the last 10 years. There were weeks on end with daily temperatures staying more than 5 degrees below normal, and there were very few days when the temperature got above freezing. The extreme minimum temperature occurred on the 7th at Scott, Saskatchewan, when the mercury plummeted to -47.5°C and the extreme maximum temperature occurred on the 17th at Cypress Hill, Saskatchewan, when it rose to 5.5°C.

Precipitation in February was confined pretty much to a storm track that stretched from central Alberta to southeastern Saskatchewan. Southwest of this line, areas received normal or above-normal precipitation, while the remainder of the

*...continued on page 26*



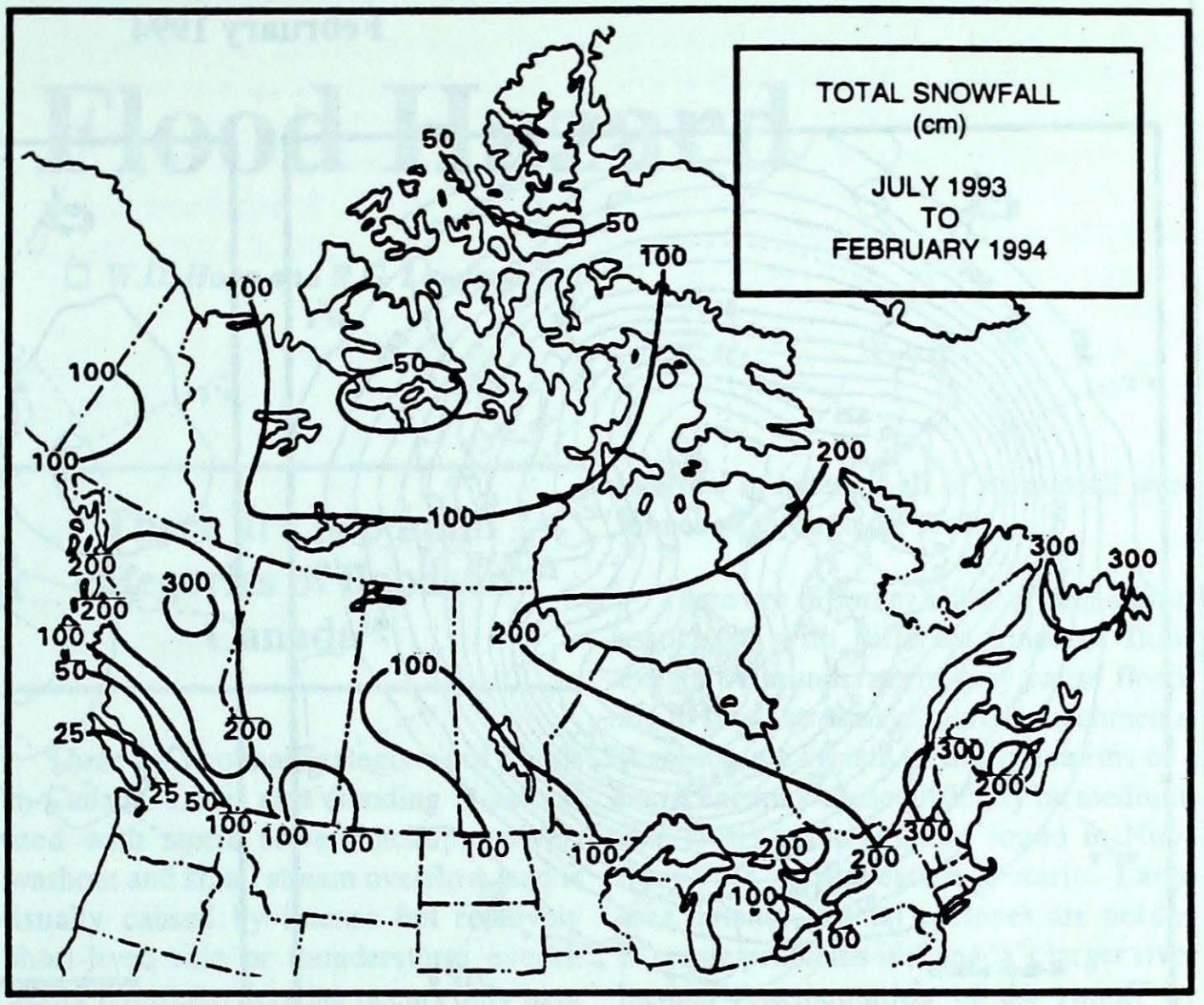



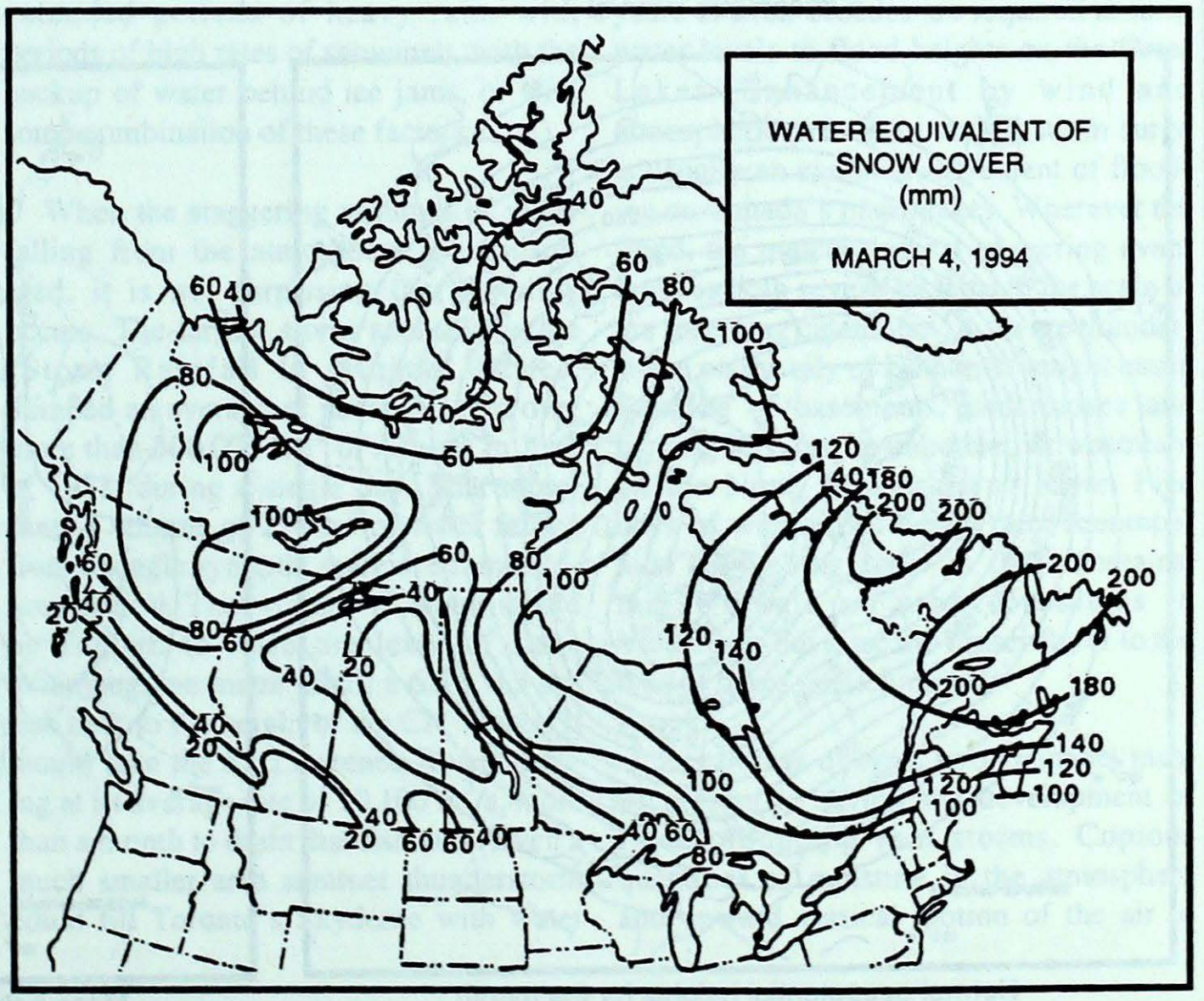

**SEASONAL TOTAL OF HEATING DEGREE-DAYS TO END OF FEBRUARY**

| | 1994 | 1993 | NORMAL |
|---|---|---|---|
| **BRITISH COLUMBIA** | | | |
| Kamloops | 2586 | 3173 | 2820 |
| Penticton | 2423 | 2769 | 2545 |
| Port Hardy | 3994 | 4005 | 3910 |
| Vancouver | 1941 | 2151 | 2974 |
| Victoria | 1986 | 2178 | 2117 |
| **YUKON TERRITORY** | | | |
| Whitehorse | 4765 | 5077 | 5099 |
| **NORTHWEST TERRITORIES** | | | |
| Iqaluit | 6901 | 7217 | 6591 |
| Inuvik | 6499 | 6563 | 6975 |
| Yellowknife | 6247 | 5696 | 6040 |
| **ALBERTA** | | | |
| Calgary | 3816 | 3979 | 3797 |
| Edmonton Mun. | 4034 | 4027 | 3990 |
| Grande Prairie | 4393 | 4667 | 4487 |
| **SASKATCHEWAN** | | | |
| Estevan | 4584 | 4350 | 3987 |
| Regina | 4571 | 4410 | 4254 |
| Saskatoon | 4781 | 4653 | 4417 |
| **MANITOBA** | | | |
| Brandon | 4922 | 4714 | 4447 |
| Churchill | 6679 | 6211 | 6170 |
| Dauphin | 5314 | 4820 | 4904 |
| Winnipeg | 4667 | 4468 | 4306 |
| **ONTARIO** | | | |
| Kapuskasing | 4991 | 4675 | 4558 |
| London | 3161 | 2964 | 2898 |
| Ottawa | 3723 | 3494 | 3387 |
| Sudbury | 4327 | 3988 | 3845 |
| Thunder Bay | 4551 | 4167 | 4078 |
| Toronto | 3210 | 2961 | 2899 |
| Windsor | 2851 | 2568 | 2593 |
| **QUEBEC** | | | |
| Baie Comeau | 4461 | 4446 | 4175 |
| Montréal | 3595 | 3417 | 3270 |
| Québec | 4025 | 3826 | 3663 |
| Sept-Îles | 4668 | 4671 | 4273 |
| Sherbrooke | 3887 | 3779 | 3726 |
| Val-d'Or | 4887 | 4656 | 4361 |
| **NEW BRUNSWICK** | | | |
| Fredericton | 3559 | 3519 | 3317 |
| Moncton | 3551 | 3516 | 3236 |
| **NOVA SCOTIA** | | | |
| Sydney | *** | 3184 | 2880 |
| Yarmouth | 2779 | 2956 | 2686 |
| **PRINCE EDWARD ISLAND** | | | |
| Charlottetown | 3421 | 3366 | 3093 |
| **NEWFOUNDLAND** | | | |
| Gander | 3674 | 3783 | 3296 |
| St. John's | 3362 | 3381 | 3053 |

**SEASONAL SNOWFALL TOTALS (cm)**
**TO END OF FEBRUARY**

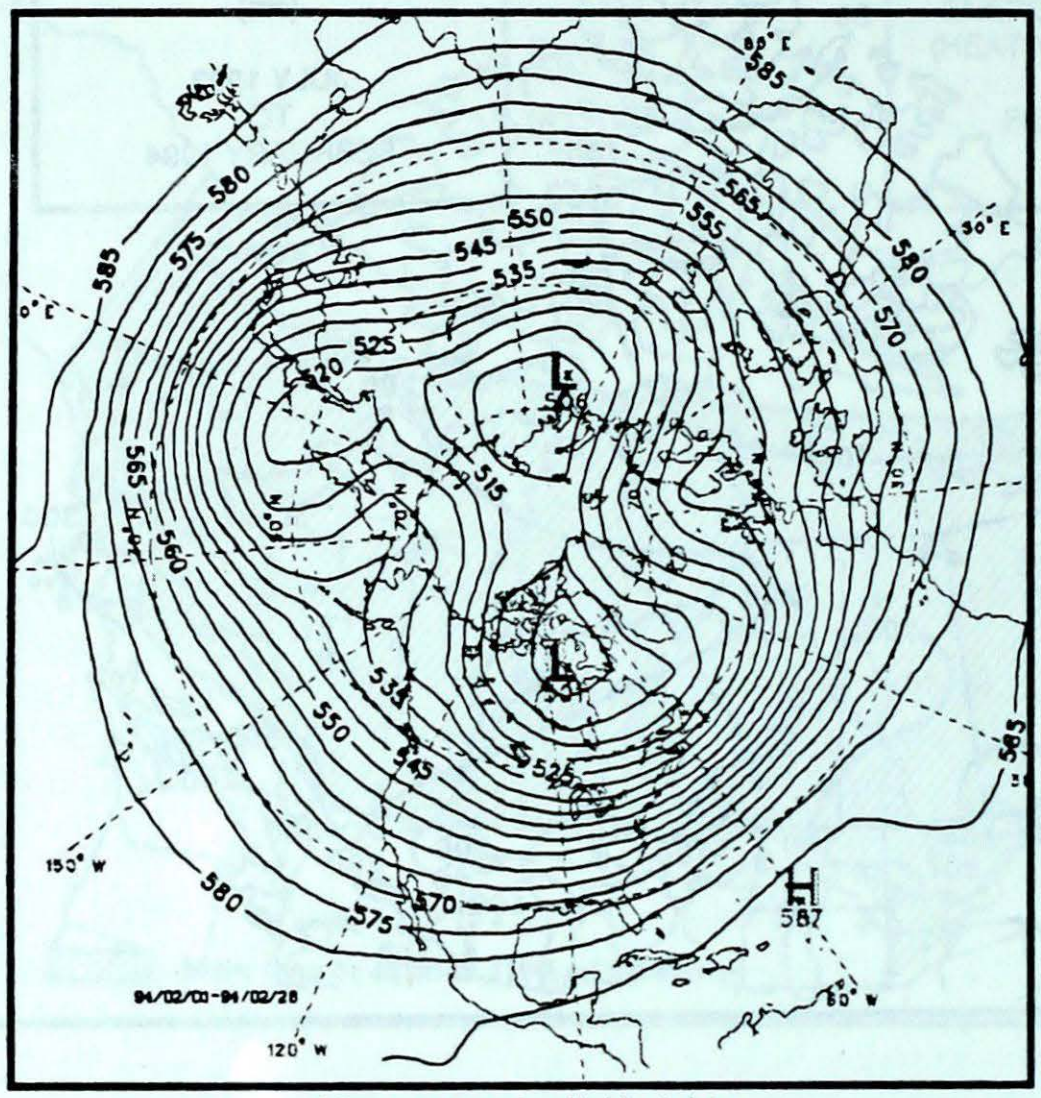
| | 1994 | 1993 | NORMAL |
|---|---|---|---|
| **BRITISH COLUMBIA** | | | |
| Kamloops | 41 | 90 | 87 |
| Port Hardy | 37 | 37 | 60 |
| Prince George | 228 | 223 | 200 |
| Vancouver | 12 | 68 | 54 |
| Victoria | 19 | 46 | 44 |
| **YUKON TERRITORY** | | | |
| Whitehorse | 142 | 179 | 106 |
| **NORTHWEST TERRITORIES** | | | |
| Iqaluit | 130 | 133 | 168 |
| Inuvik | 116 | 178 | 130 |
| Yellowknife | 111 | 105 | 107 |
| **ALBERTA** | | | |
| Calgary | 59 | 109 | 96 |
| Edmonton Mun. | 134 | 81 | 100 |
| Grande Prairie | 195 | 88 | 141 |
| **SASKATCHEWAN** | | | |
| Estevan | 153 | 78 | 81 |
| Regina | 101 | 70 | 83 |
| Saskatoon | *** | 62 | 83 |
| **MANITOBA** | | | |
| Brandon | 63 | 72 | 84 |
| Churchill | *** | 112 | 132 |
| The Pas | 97 | 83 | 117 |
| Winnipeg | 69 | 101 | 90 |
| **ONTARIO** | | | |
| Kapuskasing | 175 | 235 | 237 |
| London | 96 | 174 | 172 |
| Ottawa | 202 | 210 | 182 |
| Sudbury | 189 | 168 | 194 |
| Thunder Bay | 103 | 150 | 158 |
| Toronto | 76 | 108 | 101 |
| Windsor | 111 | 88 | 93 |
| **QUEBEC** | | | |
| Baie Comeau | 233 | 223 | 277 |
| Montréal | 210 | 132 | 188 |
| Québec | 360 | 158 | 272 |
| Sept-Îles | 294 | 249 | 318 |
| Sherbrooke | 313 | 202 | 236 |
| Val-d'or | 218 | 167 | 237 |
| **NEW BRUNSWICK** | | | |
| Fredericton | 171 | 134 | 219 |
| Moncton | 228 | 215 | 243 |
| **NOVA SCOTIA** | | | |
| Sydney | 258 | 244 | 223 |
| Yarmouth | 255 | 165 | 168 |
| **PRINCE EDWARD ISLAND** | | | |
| Charlottetown | 272 | 250 | 240 |
| **NEWFOUNDLAND** | | | |
| Gander | 376 | 256 | 270 |
| St. John's | 260 | 193 | 247 |



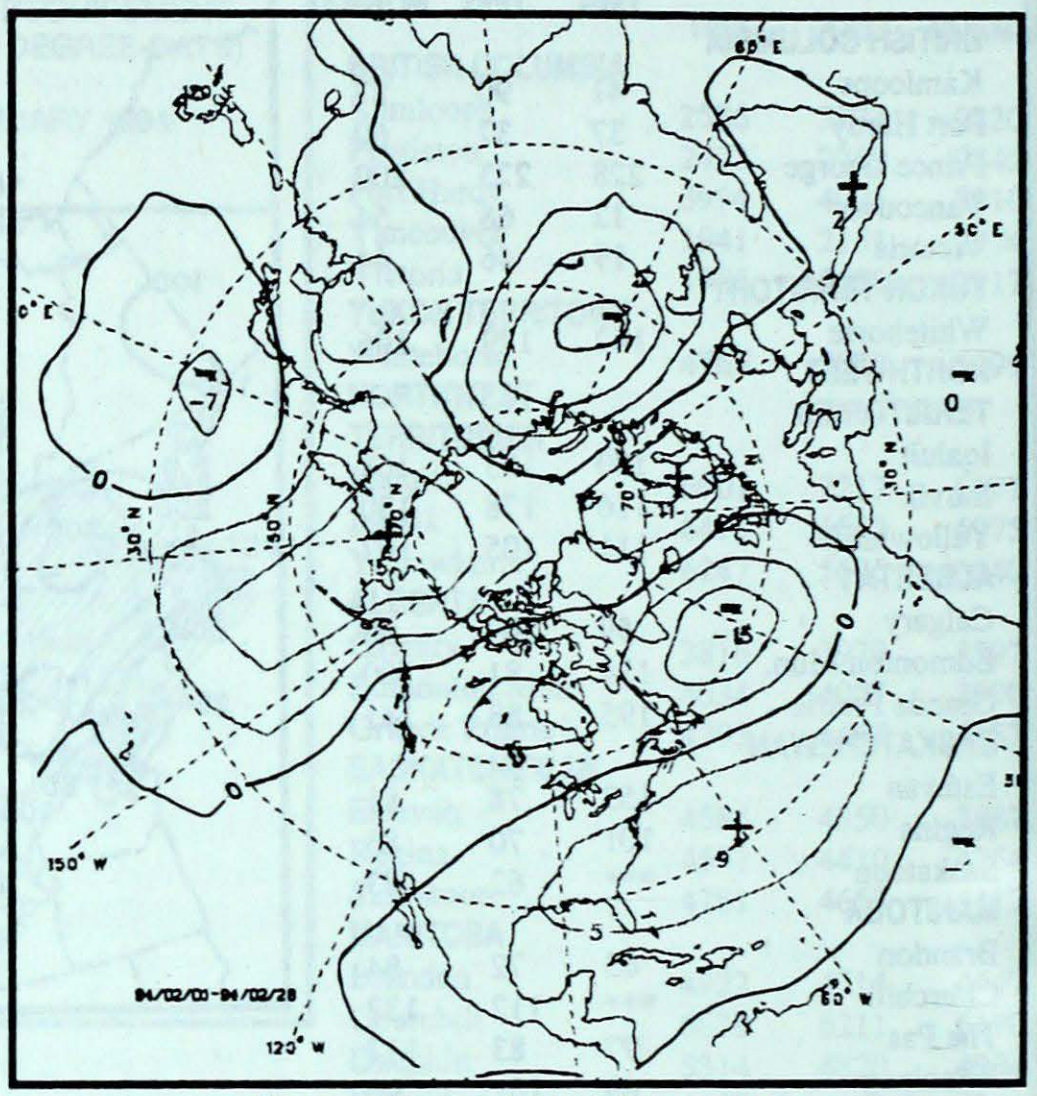



# 50-kPa ATMOSPHERIC CIRCULATION

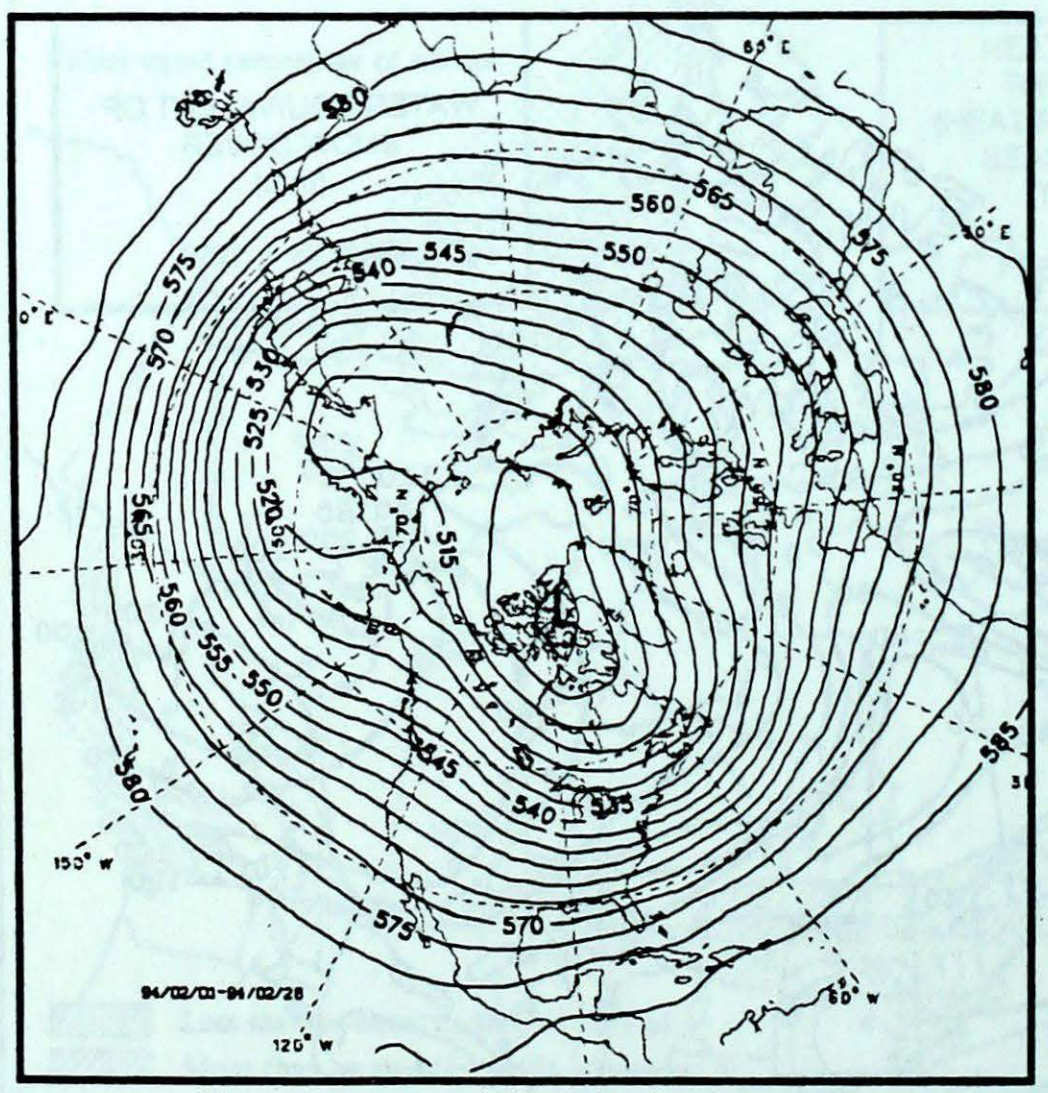
## February 1994



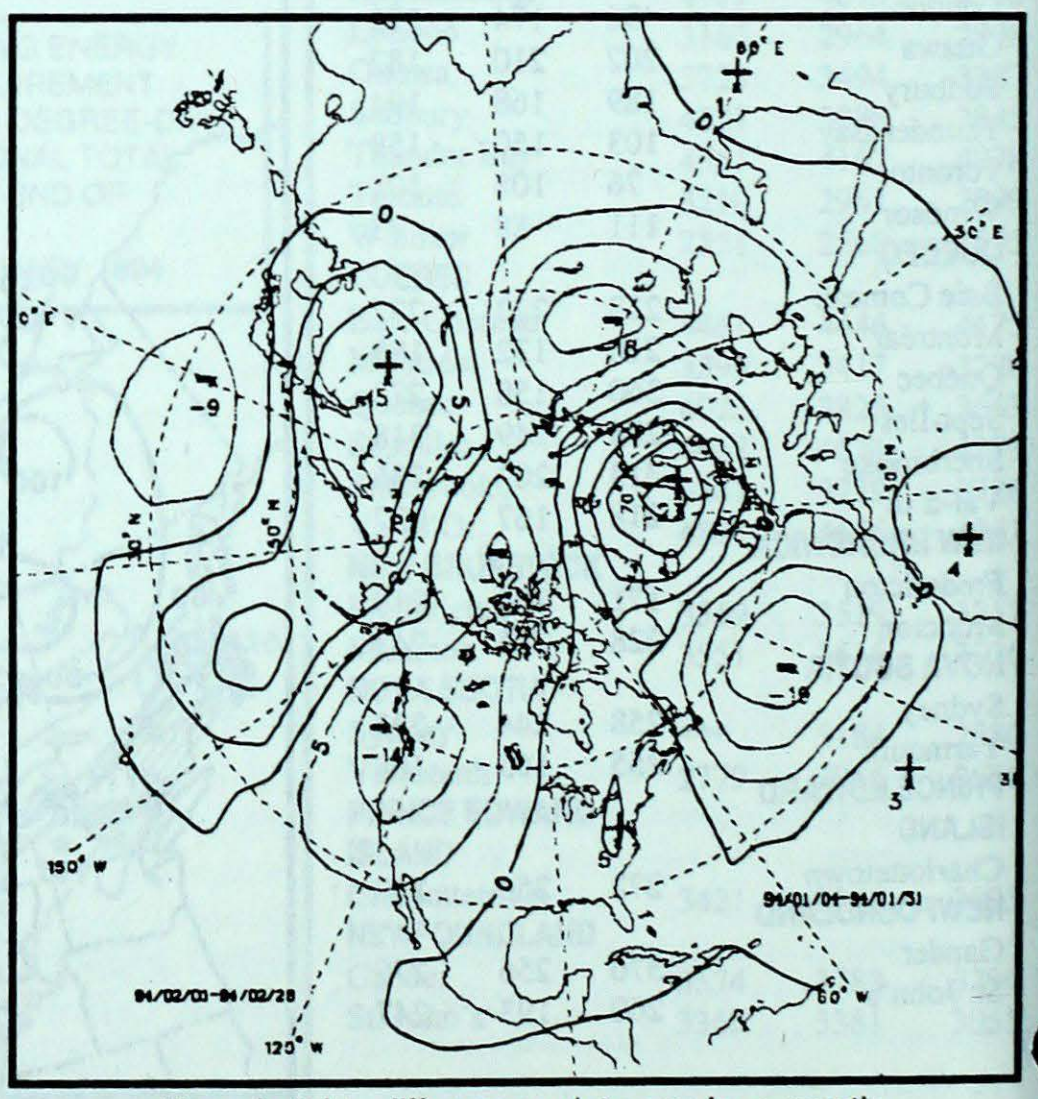

Mean geopotential heights
- 5 decametre interval -




Mean geopotential height anomaly
- 5 decametre interval -




Normal geopotential heights for the month
- 5 decametre interval -




Mean heights difference w/r to previous month
- 5 decametre interval -

# The Flood Hazard

□ *W.D. Hogg and R.G. Lawford*

*Historically, floods around the world have led to extensive damage and great human tragedy. In November, 1977, a cyclone and accompanying flood left 7,000 to 10,000 dead in India. One of the worst events in recorded history occurred in August 1931, when the Huang He River in China flooded, killing an estimated 3,700,000 people. In Canada, the most devastating flood was Hurricane Hazel in October, 1954. It resulted in the deaths of 79 people and did an estimated $133.3 million damage (1991 dollars).*

Floods are still both big business and the cause of huge losses in Canada. Flood losses are often at least partial justification for the construction of major dams costing hundreds of millions of dollars each. Spillways, to safely pass floods around these dams, cost additional tens of millions. An estimated $5 billion per year is spent on urban storm sewer and culvert construction across the country. The summer of 1993 was a good example of the losses possible in North America due to floods. Most of the vast Mississippi River System suffered widespread flooding, which caused an estimated $12 billion in damages. A number of Canadian communities also experienced extensive flooding in 1993. In the city of Winnipeg alone, claims for flood damage and clean-up are expected to total $170 million. In other years, different parts of the country have borne the brunt of flood damages, but virtually no region is immune.

**"There are two main categories of floods in Canada"**

There are two main categories of floods in Canada. Local area flooding is associated with storm sewer backup, culvert washout and small stream overflow, and is usually caused by intense but relatively short-lived rain or thunderstorm events. Major river/lake flooding occurs only in or near the flood plains of major rivers or lakes. Such events can be associated with extended periods of heavy rain, with periods of high rates of snowmelt, with the backup of water behind ice jams, or with some combination of these factors.

When the staggering volumes of water falling from the atmosphere are considered, it is not surprising that flooding occurs. The largest storm analyzed in the "Storm Rainfall In Canada" Series, dumped an average of nearly 80 mm over more than 300,000 $km^2$ of Alberta in June of 1973, during a single day. That represents a volume of 25 $km^3$ of water falling from a single synoptic scale event in a 24-hour period. That volume of water would be enough to raise the level of Lake Winnipeg one metre or fill a 6.5 x 6.5 km fish tank to the height of the CN Tower. It would take the St. Lawrence River, flowing at its average rate of 10,100 $m^3/s$, more than a month to drain that fish tank. Even a much smaller area summer thunderstorm could fill Toronto's Skydome with water in a few minutes, if all of its rainfall were funnelled through the roof.

There are different kinds of rain storms associated with different kinds of flood events. A thunderstorm may cause flooding in small streams and urban catchments. A mesoscale system of thunderstorms or a hurricane may cause difficulty on medium-size rivers such as those found in Nova Scotia or southwestern Ontario. Large area, intense, frontal cyclones are needed to create problems in Canada's larger river basins. Augmentation of the runoff by melting snow is usually a contributing factor in floods on these larger rivers. Wet years or even decades are required to raise water levels to flood heights on the Great Lakes. Enhancement by wind and atmospheric-pressure-induced storm surge is usually an essential ingredient of flooding on Canada's major lakes. Wherever the flood, the meteorological triggering event must be both severe and match the scale of the receiving catchment. A severe thunderstorm on the city of Edmonton might cause flooding of basements, underpasses and parking lots, but be unnoticed downstream on the North Saskatchewan River. Five days of widespread heavy rain, accompanied by melting snow in the mountains, might create no urban problems in Vancouver but raise the Fraser River to the tops of dikes in Richmond.

Regardless of type, two elements must be present to permit the development of flood-producing rain storms. Copious quantities of moisture in the atmosphere and upward vertical motion of the air to

cool and condense the water vapour into rain drops, are needed. Atmospheric moisture capacity varies directly according to temperature, and hence, reaches a maximum in summer in all parts of the country. Fortunately, widespread upward vertical motion does not usually coincide with maximum moisture availability. Large areas of ascending air are associated with synoptic-scale cyclones in regions of strong temperature gradients. Strong temperature gradients are associated with the presence of both warm and cold airmasses and hence with the transition seasons.

This tradeoff between ascent and moisture means that the peak in large-area rain storms occurs at different times of the year in different regions of the country. Autumn through early winter is the critical time for B.C., although spring is also critical for the interior of the province. Late spring is the critical time in the Alberta foothills but autumn and early spring events are the biggest as we move eastwards across the Prairies and into Ontario and Quebec. Major rain storms are possible through all of the colder months in Atlantic Canada.

Of course, convective instability (the cause of local thunderstorms) is the source of vigorous ascent on a smaller spatial scale, during the warm season. This ascent, combined with a maxima in atmospheric moisture, produces the highest rainfall intensities, but for shorter durations and smaller areas than at other times of the year.

**Table 1** shows the highest-recorded rainfall for both one hour and one day, as measured at Environment Canada stations in each province and territory, along with the corresponding coefficient of variation ($C_v$). Typical values of $C_v$, which is the standard deviation of annual extremes divided by the mean annual extreme, were extracted from "Rainfall Frequency Atlas For Canada".

The one hour record rainfall reflects the high intensity, short duration, summer thunderstorms. The pattern indicates minima on both coasts, rising to a peak intensity in the central part of the continent. This suggests that vertical motion, as controlled by the degree of instability, not moisture availability, is the controlling factor in severe thunderstorm events in Canada.

The one day records show the reverse. Maximum provincial values tend toward maxima on both coasts and decrease northwards and toward the centre of the continent. This implies that moisture availability is the limiting factor for sustained, large-area rain events, which generally occur in the colder months.

Approximately 36% of the mean annual precipitation in Canada occurs as snow, most of which accumulates over three to six months. Typically, this accumulation melts in a matter of days or weeks which can lead to flood situations. In northern Canada, spring melt is the major hydrologic event of the year. It can also be a significant source of flooding in more temperate latitudes, even where summer rainstorms dominate total runoff. Snowmelt flood potential depends both on the magnitude of the snow accumulation and the rate at which the snow is melted. Concurrent rainstorms often significantly contribute to the flood event by both adding water through rain and increasing melt rate because of the warmth of the rain.

## Table 1

| Province/Territory | Maximum 1-hr rain (mm) | | Maximum 1-day rainfall (mm) | |
|---|---|---|---|---|
| | Value | $C_v$ | Value | $C_v$ |
| British Columbia | 48.8 | 0.4 | 489 | 0.3 |
| Yukon/NWT | 27.9 | 0.4 | 91 | 0.35 |
| Alberta | 63.3 | 0.6 | 213 | 0.45 |
| Saskatchewan | 81.5 | 0.55 | 179 | 0.35 |
| Manitoba | 96.3 | 0.5 | 217 | 0.4 |
| Ontario | 86.9 | 0.5 | 188 | 0.3 |
| Quebec | 84.0 | 0.35 | 172 | 0.35 |
| New Brunswick | 54.6 | 0.4 | 180 | 0.4 |
| Nova Scotia | 55.5 | 0.3 | 239 | 0.35 |
| Prince Edward Island | 42.6 | 0.3 | 164 | 0.35 |
| Newfoundland | 46.2 | 0.3 | 173 | 0.25 |

**Table 1**. *Maximum-recorded rainfall at AES stations for each province and territory in Canada. $C_v$ is the coefficient of variation (standard deviation /mean) of the annual maximum values for selected recording rain gauge locations in the* province.

## "...mitigate damage due to flooding"

Of course, society does not meekly accept that damage due to flooding is unavoidable. There are at least four techniques used in Canada to mitigate damage due to flooding. Complex gutter, culvert and storm sewer systems rush water away from urban streets and basements. Extensive dam, dyke and floodway systems protect major centres like Montreal, Winnipeg, Vancouver and others, which are in close proximity to flood-prone rivers. Flood plain zoning is used to discourage the construction of vulnerable structures in areas likely to flood. Finally, meteorologists and hydrologists co-operate to produce streamflow and flood forecasts for major rivers, saving lives and reducing losses during flood events.

## Trends In Precipitation And Flood Patterns

The design and construction of almost all water-carrying structures is based upon the analysis of historic climate data. We are assuming that future climate conditions will be similar to what has been observed in the past. This is obviously a very dangerous assumption given the evidence and information currently available on global climate change.

Information on trends in extreme rainfall is inconclusive - even more inconclusive than temperature. Time series of annual extreme of daily rainfall for a selection of long period of record stations have been examined to investigate the possibility of trends. **Figure 1** shows time series of extreme rainfall for a selection of stations on Canada's Prairies. No trend is obvious. Similarly, trends in large-area storm rainfall are inconclusive.

There is no indisputable evidence that extreme rainfall events in Canada are either increasing or decreasing in magnitude or frequency. Chance plays a role in the coming together of the critical causative factors of extreme events. General circulation models are not particularly accurate at reproducing precipitation, especially extremes. It will be years, maybe decades, before we are confident that trends in rainfall extremes have been identified.

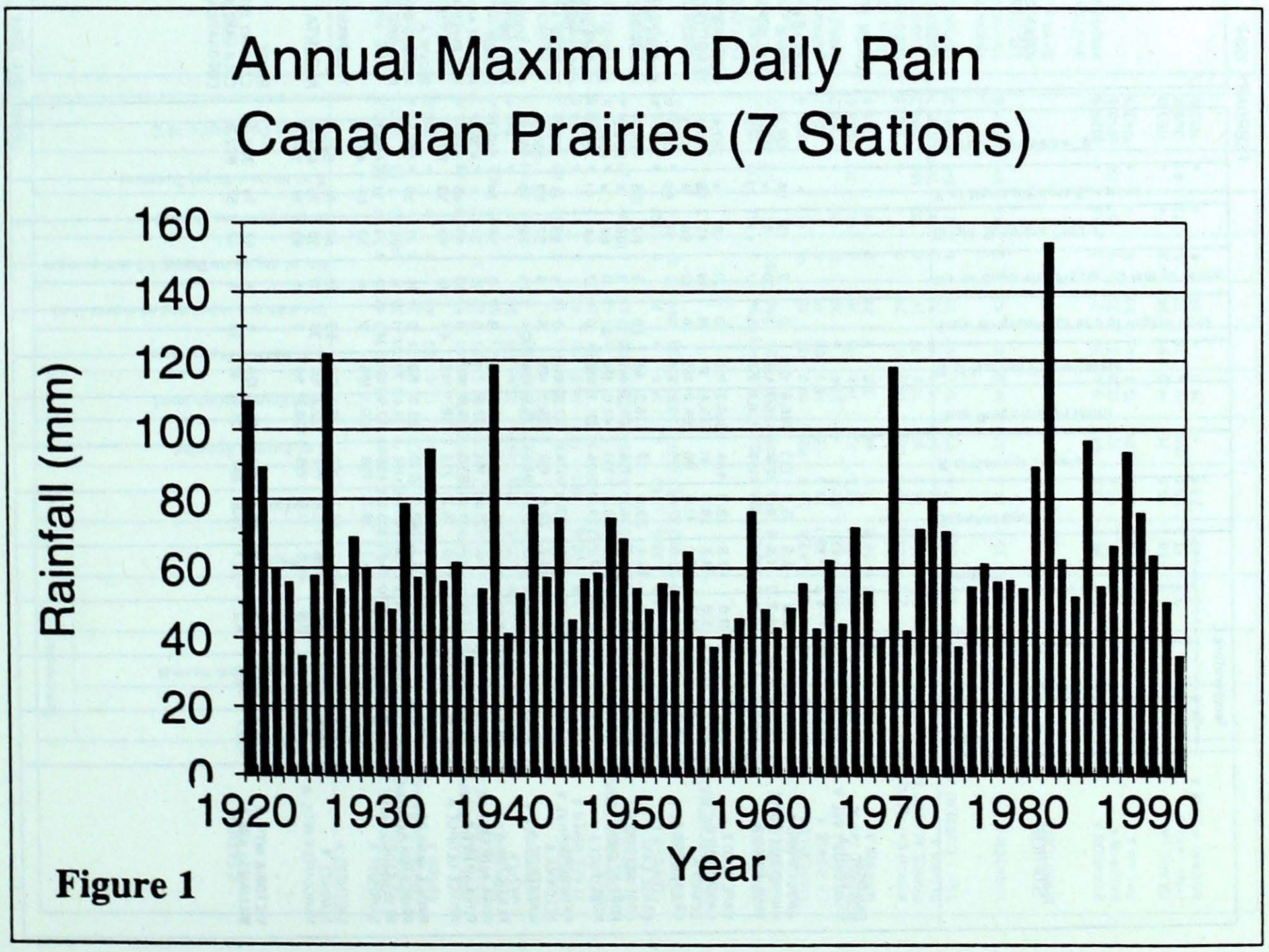



**Figure 1**

FEBRUARY 1994

| STATION | Temperature C | | | | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Difference from Normal | Maximum | Minimum | | | | | | | | | |
| BRITISH COLUMBIA | | | | | | | | | | | | | |
| ABBOTSFORD A | 2.7 | -1.7 | 12.0 | -6.6 | 15.8 | 133 | 196.6 | 123 | 0 | 17 | 73 | 94 | 427.2 |
| AMPHITRITE POINT | 4.9 | -1.2 | 11.3 | -1.4 | 8.5 | 274 | 436.2 | 126 | 0 | 20 | 0 | * | 365.7 |
| BLUE RIVER A | -7.7 | -3.0 | 7.6 | -30.6 | 103.5 | 168 | 100.1 | 158 | 95 | 17 | 43 | 73 | * |
| CAPE SCOTT | 4.2 | -0.9 | 11.0 | -2.8 | 38.8 | 404 | 269.2 | 109 | 0 | 21 | 0 | * | 387.4 |
| CASTLEGAR A | -1.5 | -0.9 | 5.0 | -14.6 | 39.8 | 91 | 65.4 | 111 | 8 | 18 | 45 | 66 | 547.2 |
| COMOX A | 3.1 | -0.9 | 12.2 | -3.2 | 12.8 | 88 | 206.0 | 165 | 0 | 12 | 60 | * | 416.3 |
| CRANBROOK A | -6.0 | -2.2 | 6.2 | -26.8 | 32.0 | 125 | 30.2 | 139 | 8 | 7 | 91 | 89 | 670.7 |
| DEASE LAKE | -21.8 | -8.9 | 2.7 | -39.4 | 20.8 | 67 | 16.2 | 66 | 60 | 5 | 112 | 105 | 1114.2 |
| FORT NELSON A | -23.3 | -6.4 | -2.5 | -38.4 | 36.2 | 156 | 28.3 | 145 | 75 | 8 | 100 | * | 1156.2 |
| FORT ST JOHN A | -21.0 | -9.6 | 7.3 | -36.3 | 58.2 | 191 | 49.0 | 179 | 87 | 11 | 64 | * | 1091.1 |
| HOPE A | 1.9 | -1.5 | 7.3 | -7.2 | 33.2 | 106 | 211.3 | 108 | 0 | 17 | 44 | 91 | 451.6 |
| KAMLOOPS A | -2.6 | -1.3 | 13.4 | -16.9 | 22.1 | 174 | 22.8 | 142 | 2 | 6 | 69 | 74 | 576.2 |
| KELOWNA A | -1.9 | 0.1 | 8.7 | -18.2 | 23.8 | 159 | 35.3 | 145 | 6 | 9 | 57 | 83 | 555.3 |
| MACKENZIE A | -16.0 | -5.7 | 6.0 | -38.5 | 107.4 | 208 | 75.8 | 134 | 124 | 20 | 36 | 49 | 952.2 |
| PENTICTON A | -0.4 | -1.0 | 9.5 | -17.8 | 9.4 | 82 | 37.2 | 188 | 0 | 8 | 56 | 74 | 513.7 |
| PORT ALBERNI A | 2.4 | -1.0 | 12.0 | -7.4 | 25.9 | 101 | 427.8 | 171 | 0 | 15 | 37 | * | 437.3 |
| PORT HARDY A | 3.0 | -0.9 | 11.5 | -4.7 | 35.3 | 336 | 236.0 | 148 | 0 | 18 | 49 | 66 | 419.5 |
| PRINCE GEORGE A | -11.8 | -5.7 | 8.0 | -36.8 | 76.2 | 213 | 58.1 | 148 | 44 | 16 | 46 | 53 | 834.5 |
| PRINCE RUPERT A | -0.1 | -2.7 | 10.0 | -14.1 | 48.7 | 210 | 185.0 | 80 | 0 | 14 | 32 | 50 | 507.5 |
| PRINCETON A | -3.1 | -0.1 | 8.5 | -22.5 | 29.1 | 119 | 21.4 | 72 | 11 | 6 | 105 | * | * |
| REVELSTOKE A | -3.6 | -0.8 | 4.0 | -19.8 | 105.8 | 138 | 113.9 | 131 | 43 | 20 | 29 | 51 | 605.7 |
| SANDSPIT A | 1.9 | -1.6 | 8.7 | -5.7 | 30.7 | 198 | 120.1 | 106 | 0 | 16 | 52 | 64 | 445.4 |
| SMITHERS A | -11.5 | -6.2 | 9.5 | -29.2 | 46.7 | 152 | 39.1 | 124 | 63 | 12 | 62 | 74 | 825.9 |
| TERRACE A | -6.4 | -5.0 | 5.2 | -17.8 | 110.6 | 154 | 132.2 | 107 | 33 | 11 | 55 | 76 | 684.0 |
| VANCOUVER INT'L A | 3.7 | -0.9 | 11.6 | -6.5 | 11.6 | 155 | 108.2 | 94 | 0 | 16 | 65 | 74 | 399.8 |
| VICTORIA INT'L A | 4.1 | -0.7 | 12.9 | -4.8 | 18.7 | 231 | 118.9 | 120 | 0 | 14 | 67 | 79 | 389.3 |
| WILLIAMS LAKE A | -10.7 | -6.5 | 8.2 | -30.1 | 26.4 | 104 | 21.9 | 91 | 35 | 9 | 62 | 57 | 802.8 |

| STATION | Temperature C | | | | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Difference from Normal | Maximum | Minimum | | | | | | | | | |
| YUKON TERRITORY | | | | | | | | | | | | | |
| DAWSON A | -28.8 | * | -12.0 | -44.9 | 3.6 | * | 3.4 | * | * | * | * | * | * |
| MAYO A | * | * | -12.6 | 46.3 | 5.8 | 32 | 3.8 | 23 | * | * | * | * | * |
| WHITEHORSE A | -22.2 | -9.0 | -3.5 | -40.5 | 22.8 | 150 | 16.5 | 124 | 0 | 6 | 93 | 102 | 1124.5 |
| NORTHWEST TERRITORIES | | | | | | | | | | | | | |
| BAKER LAKE A | -35.1 | -2.5 | -25.0 | -44.4 | 1.6 | 30 | 1.6 | 33 | 28 | 1 | 136 | 127 | 1487.5 |
| CAMBRIDGE BAY A | -32.9 | 1.5 | -22.9 | -41.2 | 2.4 | 52 | 2.2 | 55 | 20 | 0 | 66 | 128 | 1425.2 |
| CLYDE A | -28.6 | -0.9 | -16.0 | -43.9 | 8.0 | 127 | 6.2 | 100 | 48 | 2 | 52 | 130 | 1304.6 |
| COPPERMINE A | -29.6 | 1.5 | -25.6 | -33.5 | 1.5 | 23 | 1.7 | 27 | 23 | 0 | 79 | 103 | 1334.6 |
| CORAL HARBOUR A | -32.2 | -2.8 | -18.8 | -42.6 | 6.0 | 65 | 6.0 | 68 | 29 | 3 | 53 | 46 | 1406.0 |
| EUREKA | -36.3 | 1.7 | -15.8 | -45.3 | 1.6 | 62 | 1.6 | 67 | 4 | 0 | 0 | * | 1521.1 |
| FORT SIMPSON A | -27.9 | -5.4 | -7.8 | -41.2 | 9.4 | 50 | 6.9 | 43 | 30 | 4 | 146 | 152 | 1285.8 |
| FORT SMITH A | -27.8 | -6.0 | -9.0 | -42.0 | 19.6 | 107 | 13.2 | 83 | 62 | 4 | 143 | 126 | 1286.2 |
| IQALUIT | -27.1 | -1.2 | 14.0 | -40.5 | 11.8 | 48 | 11.8 | 51 | 25 | 6 | 89 | 92 | 1262.9 |
| HALL BEACH A | -32.4 | -0.3 | -19.4 | -43.8 | 4.0 | 47 | 3.8 | 46 | 28 | 2 | * | * | 1410.2 |
| HAY RIVER A | -28.3 | -6.6 | -12.1 | -42.8 | 5.8 | 30 | 5.0 | 28 | 60 | 3 | * | * | 1295.2 |
| INUVIK A | -27.3 | 1.6 | -9.8 | -44.1 | 29.4 | 233 | 21.2 | 202 | 45 | 6 | 46 | 70 | 1267.2 |
| NORMAN WELLS A | -30.0 | -3.8 | -10.1 | -45.5 | 23.0 | 133 | 14.2 | 88 | 40 | 3 | 97 | 128 | 1344.1 |
| RESOLUTE A | -33.4 | -0.2 | -21.4 | -42.3 | 1.2 | 39 | 1.2 | 40 | 19 | 1 | 2 | 9 | 1437.2 |
| YELLOWKNIFE A | -30.2 | -5.1 | -17.2 | -41.3 | 9.7 | 74 | 8.4 | 75 | 26 | 3 | 141 | 138 | 1350.0 |
| ALBERTA | | | | | | | | | | | | | |
| BANFF | -11.6 | -5.3 | 7.5 | -38.0 | 40.6 | 124 | 27.0 | 97 | 28 | 8 | * | * | |
| CALGARY INT'L A | -13.5 | -6.2 | 11.4 | -32.5 | 13.4 | 70 | 9.6 | 62 | 3 | 3 | 125 | 98 | 881.3 |
| COLD LAKE A | -21.1 | -7.5 | -1.6 | -40.2 | 38.0 | 210 | 19.1 | 121 | 59 | 8 | 112 | 89 | 1100.7 |
| CORONATION A | -20.2 | -8.5 | 4.8 | -41.3 | 25.4 | 127 | 10.9 | 64 | 30 | 4 | 127 | 96 | 1069.6 |

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| STATION | Temperature C | | | | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Difference from Normal | Maximum | Minimum | | | | | | | | | |
| EDMONTON INT'L A | -18.9 | -7.5 | 3.0 | -43.9 | 19.1 | 89 | 18.1 | 103 | 42 | 8 | 117 | 98 | 1020.3 |
| EDMONTON MUNICIPAL | -17.1 | -7.5 | 4.7 | -36.5 | 19.7 | * | 17.1 | 91 | 36 | 9 | 113 | 97 | 983.1 |
| EDMONTON NAMAO A | -18.4 | -7.5 | 4.3 | -37.0 | 25.8 | 121 | 15.4 | 74 | 39 | 9 | * | * | * |
| EDSON A | -14.4 | -4.1 | 9.0 | -41.5 | 15.0 | 50 | 13.4 | 82 | 40 | 5 | * | * | 950.5 |
| FORT MCMURRAY A | -23.1 | -7.7 | -2.4 | -39.9 | 47.0 | 215 | 26.4 | 140 | 52 | 5 | 102 | 79 | 1204.8 |
| GRANDE PRAIRIE A | -20.4 | -8.3 | 5.2 | -44.0 | 60.7 | 229 | 48.7 | 205 | 62 | 14 | 80 | * | 1073.3 |
| HIGH LEVEL A | -24.1 | -5.8 | -5.6 | -41.4 | 24.1 | 117 | 23.0 | 143 | 50 | 8 | 133 | 106 | 1225.0 |
| JASPER | -12.8 | -6.3 | 7.8 | -35.5 | 33.2 | 153 | 22.6 | 110 | 38 | 6 | 107 | * | 861.4 |
| LETHBRIDGE A | -12.5 | -7.1 | 9.9 | -36.6 | 26.3 | 123 | 19.6 | 104 | 6 | 5 | 124 | 101 | 854.9 |
| MEDICINE HAT A | -15.1 | -7.4 | 5.0 | -37.1 | 24.6 | 134 | 18.8 | 113 | 18 | 5 | 100 | 82 | 928.3 |
| PEACE RIVER A | -22.3 | -8.8 | 5.8 | -38.8 | 20.1 | 78 | 18.8 | 90 | 42 | 6 | * | * | 1128.8 |
| RED DEER A | -17.9 | -7.2 | 6.1 | -42.2 | 10.0 | 51 | 9.5 | 54 | 26 | 4 | * | * | 1011.8 |
| ROCKY MTN HOUSE A | -14.8 | -7.4 | 12.3 | -43.9 | * | * | * | * | 40 | * | * | * | * |
| SLAVE LAKE A | -19.9 | -7.4 | 4.6 | -42.5 | 30.4 | 139 | 23.8 | 118 | 43 | 6 | 92 | 81 | 1061.4 |
| SUFFIELD A | -16.0 | * | 4.9 | -38.0 | 21.2 | * | 14.6 | * | 19 | 5 | 102 | * | 950.4 |
| WHITECOURT A | -17.8 | -7.6 | 3.8 | -40.2 | 45.7 | 172 | 30.7 | 128 | 44 | 10 | * | * | 1002.2 |
| **SASKATCHEWAN** | | | | | | | | | | | | | |
| BROADVIEW | -20.0 | -5.1 | 0.3 | -38.4 | 20.6 | 137 | 17.2 | 141 | 34 | 7 | 166 | 122 | 1064.2 |
| ESTEVAN A | -19.4 | -7.4 | -0.3 | -37.8 | 46.8 | 266 | 39.4 | 230 | 50 | 80 | 153 | 113 | 893.6 |
| KINDERSLEY | -20.2 | -7.7 | 3.1 | -43.4 | 23.4 | 150 | 18.2 | 113 | 38 | 4 | 113 | * | 1069.9 |
| LA RONGE A | -23.2 | -5.6 | -4.8 | -38.1 | 18.3 | 78 | 16.9 | 108 | 45 | 4 | * | * | 1153.7 |
| MEADOW LAKE A | -23.4 | * | -0.1 | -42.7 | 30.4 | * | 21.4 | * | 38 | 11 | 118 | * | 1158.2 |
| MOOSE JAW A | -18.0 | -6.5 | 2.2 | -39.1 | 13.6 | 72 | 11.6 | 75 | 30 | 3 | 140 | 112 | 1006.6 |
| NIPAWIN A | -22.2 | * | -3.5 | -38.8 | 7.6 | * | 3.8 | * | 36 | 2 | 127 | * | 1126.9 |
| NORTH BATTLEFORD A | -21.3 | -7.2 | 2.3 | -44.1 | 18.3 | 118 | 16.5 | 114 | 29 | 7 | * | * | 1101.2 |
| PRINCE ALBERT A | -21.6 | -5.1 | 0.5 | -39.7 | 16.0 | 97 | 11.4 | 77 | 24 | 4 | 122 | 100 | 1109.2 |
| REGINA A | -19.3 | -5.7 | 1.1 | -40.6 | 12.6 | 69 | 9.9 | 61 | 32 | 3 | 142 | 118 | 1045.7 |
| SWIFT CURRENT A | -17.9 | -7.6 | 3.3 | -37.7 | 17.0 | 95 | 17.0 | 99 | 35 | 4 | 123 | 108 | 985.2 |
| YORKTON A | -20.4 | -4.9 | -0.3 | -39.7 | 14.8 | 77 | 14.8 | 82 | 42 | 3 | 148 | 114 | 1074.8 |
| **MANITOBA** | | | | | | | | | | | | | |
| BRANDON A | -19.9 | -4.2 | -3.0 | -38.4 | 12.6 | 64 | 9.4 | 50 | 21 | 3 | 168 | * | 1028.9 |
| DAUPHIN A | -19.5 | -3.9 | -0.5 | -34.6 | 13.4 | 72 | 10.0 | 57 | 15 | 3 | 157 | 116 | 1050.6 |
| GILLAM A | -26.8 | -3.5 | -10.5 | -40.2 | 44.8 | 201 | 25.4 | 140 | 50 | 6 | * | * | 1243.3 |
| ISLAND LAKE | -24.6 | -4.7 | -6.3 | -40.3 | 16.0 | 76 | 14.0 | 89 | 56 | 3 | * | * | 1193.0 |
| LYNN LAKE A | -27.4 | -5.7 | -9.0 | -42.3 | 25.0 | 166 | 20.4 | 136 | 30 | 5 | 123 | 93 | 1269.8 |
| NORWAY HOUSE A | -24.6 | * | -8.1 | -42.2 | 23.6 | * | 16.0 | * | 39 | 4 | * | * | 1192.6 |

| STATION | Temperature C | | | | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Difference from Normal | Maximum | Minimum | | | | | | | | | |
| THE PAS A | -22.9 | -4.9 | -7.7 | -37.3 | 21.6 | 104 | 14.0 | 91 | 26 | 4 | 131 | 99 | 1143.9 |
| THOMPSON A | -26.9 | -5.1 | -10.3 | -42.8 | 21.6 | 193 | 17.7 | 158 | 40 | 4 | 138 | 96 | 1257.0 |
| WINNIPEG INT'L A | -17.8 | -2.2 | 3.6 | -35.2 | 5.6 | 30 | 5.2 | 30 | 12 | 1 | 156 | 109 | 1002.5 |
| **ONTARIO** | | | | | | | | | | | | | |
| EARLTON A | -16.7 | -2.6 | 10.3 | -39.9 | 22.0 | 47 | 34.0 | 72 | 8 | 7 | * | * | 970.3 |
| GERALDTON A | -20.1 | * | 6.6 | -40.6 | 8.8 | * | 9.0 | * | 5 | 2 | * | * | 1068.1 |
| HAMILTON RBG | -7.3 | * | 13.0 | -25.0 | 65.4 | * | 51.0 | * | 17 | 9 | 146 | * | * |
| HAMILTON A | -8.7 | -2.4 | 10.8 | -26.7 | 71.8 | 239 | 45.7 | 95 | 17 | 11 | * | * | 747.2 |
| KAPUSKASING A | -17.7 | -1.5 | 10.6 | -35.9 | 14.4 | 33 | 11.8 | 27 | 24 | 8 | * | * | 994.1 |
| KENORA A | -16.6 | -2.2 | 7.0 | -37.5 | 5.0 | 20 | 5.7 | 25 | 6 | 2 | * | * | 969.2 |
| KINGSTON A | -9.9 | -2.0 | 7.2 | -25.1 | 57.0 | 160 | 54.2 | 95 | 35 | 8 | 149 | 116 | 781.0 |
| LONDON A | -8.7 | -2.6 | 11.1 | -27.3 | 38.2 | 98 | 36.3 | 60 | 15 | 7 | 109 | * | 747.1 |
| MUSKOKA A | -12.2 | -2.6 | 10.6 | -33.6 | 33.3 | 65 | 30.0 | 48 | 34 | 7 | * | * | 846.0 |
| NORTH BAY A | -13.8 | -2.5 | 11.0 | -31.2 | 59.8 | 118 | 54.7 | 97 | 48 | 9 | 111 | 89 | 891.8 |
| OTTAWA INT'L A | -11.8 | -2.3 | 9.7 | -26.2 | 67.8 | 135 | 55.8 | 93 | 49 | 7 | * | * | 833.4 |
| PETAWAWA A | -14.7 | -2.6 | 16.2 | -34.9 | 43.6 | 96 | 27.8 | 54 | * | 7 | * | * | 916.4 |
| PETERBOROUGH A | -11.7 | -2.9 | 10.4 | -33.4 | 25.0 | 79 | 24.2 | 51 | 9 | 6 | * | * | 831.8 |
| PICKLE LAKE | -20.3 | -1.6 | 5.0 | -39.2 | 4.2 | 15 | 7.6 | 30 | 17 | 2 | * | * | 1071.2 |
| RED LAKE A | -20.0 | -3.2 | 4.5 | -39.0 | 8.0 | 35 | 6.2 | 31 | 33 | 3 | 156 | * | 1063.8 |
| ST CATHARINES A | -6.2 | -1.2 | 14.4 | -18.5 | 48.6 | 215 | 43.7 | 96 | 9 | 8 | 141 | * | 678.1 |
| SARNIA A | -7.4 | -1.5 | 13.2 | -25.4 | 37.0 | 156 | 30.2 | 69 | 10 | 7 | 121 | 114 | 710.1 |
| SAULT STE MARIE A | -14.3 | -2.8 | 8.6 | -33.2 | 12.7 | 20 | 23.1 | 42 | 4 | 5 | 107 | 95 | 904.3 |
| SIOUX LOOKOUT A | -18.5 | -2.8 | 6.8 | -38.7 | 9.4 | 33 | 10.6 | 38 | 30 | 4 | * | * | 1032.9 |
| SUDBURY A | -14.9 | -2.4 | 7.6 | -31.9 | 36.2 | 81 | 40.0 | 85 | 43 | 7 | 189 | 144 | 921.3 |
| THUNDER BAY A | -16.1 | -3.1 | 9.5 | -33.6 | 7.8 | 25 | 7.6 | 27 | 8 | 3 | 145 | 99 | 953.3 |
| TIMMINS A | -16.9 | -1.3 | 11.7 | -37.0 | 23.3 | 44 | 22.6 | 50 | 27 | 8 | * | * | 976.6 |
| TORONTO | -6.0 | * | 9.9 | -20.0 | 33.2 | * | 28.2 | * | 6 | 5 | * | * | 672.4 |
| TORONTO INT'L A | -8.2 | -2.1 | 12.5 | -23.5 | 25.0 | 94 | 20.2 | 44 | 5 | 6 | * | * | 737.5 |
| TORONTO ISLAND A | -6.7 | * | 8.8 | -19.0 | 40.2 | 161 | 29.2 | * | 5 | 6 | * | * | 689.9 |
| TRENTON A | -9.8 | -3.3 | 9.0 | -26.8 | 38.8 | 110 | 29.5 | 52 | 12 | 6 | * | * | 779.1 |
| WATERLOO WELLINGTON | -9.6 | -1.7 | 10.2 | -28.0 | 30.8 | 99 | 38.6 | 75 | 11 | 10 | * | * | 774.2 |
| WAWA A | -16.7 | * | 9.5 | -38.1 | 39.2 | * | 37.0 | * | 37 | 10 | * | * | 968.0 |
| WIARTON A | -11.3 | -3.8 | 10.4 | -31.9 | 59.7 | 99 | 44.0 | 69 | 26 | 11 | 104 | 101 | 819.6 |
| WINDSOR A | -5.5 | -1.7 | 14.2 | -21.0 | 42.8 | 188 | 45.6 | 91 | 12 | 6 | * | * | 658.5 |

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| STATION | Temperature C Mean | Difference from Normal | Maximum | Minimum | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| QUEBEC | | | | | | | | | | | | | |
| BAGOTVILLE A | -16.1 | -2.3 | 13.5 | -34.9 | 26.5 | 43 | 28.0 | 47 | 50 | 8 | * | * | 956.1 |
| BAIE COMEAU A | -15.3 | -2.2 | 5.0 | -35.3 | 42.8 | 58 | 37.6 | 53 | 47 | 6 | 149 | 124 | 933.6 |
| BLANC SABLON A | -17.5 | -7.5 | -5.0 | -34.1 | 59.8 | 59 | 59.8 | 55 | 21 | 9 | 120 | * | 995.9 |
| CHIBOUGAMAU CHAPAIS | -20.6 | * | 7.6 | -41.3 | * | * | 24.1 | * | 0 | 9 | * | * | 1080.0 |
| GASPE A | -14.7 | * | 1.1 | -30.1 | 51.0 | * | 42.7 | * | 0 | 5 | 155 | * | 894.3 |
| KUUJJUAQ A | -26.0 | -3.6 | -8.2 | -37.3 | 44.0 | 130 | 44.0 | 132 | 33 | 8 | 137 | 126 | 1233.6 |
| KUUJJUARAPIK A | -26.8 | -4.2 | -9.1 | -42.4 | 45.0 | 186 | 42.8 | 182 | 28 | 7 | 136 | 110 | 1254.1 |
| LA GRANDE IV A | -25.1 | * | 4.1 | -45.9 | 58.4 | * | 57.8 | * | 62 | 11 | 113 | * | 1207.8 |
| LA GRANDE RIVIERE A | -24.7 | * | 3.9 | -40.2 | 28.6 | * | 35.0 | * | 66 | 7 | 120 | * | 1248.9 |
| MONT JOLI A | -12.7 | -2.2 | 10.4 | -26.8 | 50.8 | 67 | 46.8 | 63 | 25 | 9 | 131 | 115 | 859.3 |
| MONTREAL INT'L A | -11.8 | -2.8 | 10.0 | -27.9 | 69.8 | 130 | 65.4 | 100 | 9 | 9 | 157 | 122 | 834.6 |
| MONTREAL MIRABEL 1/ | -13.3 | * | 12.6 | -32.6 | 62.4 | * | 63.6 | * | 33 | 8 | 187 | * | 876.8 |
| NATASHQUAN A | -16.6 | -5.3 | -0.3 | -35.6 | 63.4 | 112 | * | * | 70 | 8 | 137 | * | 958.9 |
| QUEBEC A | -13.4 | -2.6 | 8.4 | -31.5 | 59.4 | 85 | 39.2 | 50 | 86 | 6 | 147 | 130 | 879.6 |
| ROBERVAL A | -16.6 | -1.9 | 10.6 | -35.5 | 44.5 | 74 | 37.9 | 64 | 8 | 6 | 153 | * | 967.5 |
| SEPT-ILES A | -16.8 | -4.3 | 1.5 | -35.1 | 52.2 | 71 | 50.0 | 63 | 45 | 7 | 134 | 97 | 973.3 |
| SHERBROOKE A | -12.5 | -1.0 | 14.3 | -32.4 | 91.6 | 163 | 63.2 | 105 | 60 | 10 | 132 | * | 852.6 |
| ST HUBERT A | -11.7 | -2.7 | 10.2 | -27.9 | 64.8 | * | 67.0 | 93 | 50 | 10 | 149 | * | 831.2 |
| VAL D'OR A | -18.2 | -3.3 | 12.3 | -41.5 | 21.6 | 43 | 29.4 | 58 | 27 | 7 | 138 | 102 | 1013.6 |
| NEW BRUNSWICK | | | | | | | | | | | | | |
| CHARLO A | -14.0 | -2.6 | 11.1 | -30.2 | 50.2 | 68 | 37.8 | 59 | 46 | 5 | 164 | 120 | 89.0 |
| FREDERICTON A | -10.5 | -2.1 | 18.6 | -25.5 | 47.4 | 75 | 40.5 | 45 | 10 | 4 | * | * | 796.9 |
| MONCTON A | -10.4 | -2.7 | 15.3 | -24.6 | 75.3 | 110 | 60.9 | 62 | 10 | 5 | 166 | 135 | 795.8 |
| SAINT JOHN A | -9.8 | -2.3 | 13.3 | -24.7 | 38.0 | 60 | 29.2 | 25 | 8 | 5 | 162 | 129 | 779.3 |

| STATION | Temperature C Mean | Difference from Normal | Maximum | Minimum | Snowfall (cm) | % of Normal Snowfall | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | % of Normal Bright Sunshine | Degree Days below 18 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NOVA SCOTIA | | | | | | | | | | | | | |
| GREENWOOD A | -7.3 | -1.9 | 13.7 | -21.0 | 32.4 | 52 | 29.3 | 33 | 13 | 5 | * | * | 709.5 |
| HALIFAX INT'L A | -7.7 | -1.6 | 17.5 | -22.1 | 64.4 | 98 | 56.9 | 43 | 6 | 10 | * | * | 718.4 |
| SABLE ISLAND | -2.7 | -1.7 | 8.1 | -12.7 | 27.7 | 87 | 91.5 | 77 | 11 | 12 | 96 | 131 | 579.7 |
| SHEARWATER A | -6.3 | -1.8 | 16.2 | -20.3 | 55.0 | 106 | 41.8 | 34 | 1 | 8 | 146 | 114 | 681.6 |
| SYDNEY A | -9.9 | -4.0 | 11.8 | -27.3 | 84.6 | 123 | 82.2 | 67 | 19 | 8 | 139 | 127 | 781.8 |
| YARMOUTH A | -4.3 | -1.1 | 6.5 | -17.5 | 69.4 | 129 | 56.2 | 49 | 2 | 14 | 108 | 116 | 647.7 |
| PRINCE EDWARD ISLAND | | | | | | | | | | | | | |
| CHARLOTTETOWN A | -10.5 | -3.0 | 10.3 | -24.6 | 73.0 | 111 | 55.4 | 57 | 10 | 7 | * | * | 797.1 |
| NEWFOUNDLAND | | | | | | | | | | | | | |
| BONAVISTA | -10.4 | -5.2 | 2.8 | -24.7 | 83.2 | 184 | 80.4 | 93 | 71 | 10 | * | * | 794.5 |
| BURGEO | -10.2 | -4.5 | 3.0 | -25.9 | 87.6 | 172 | 87.4 | 68 | 64 | 13 | * | * | 792.1 |
| CARTWRIGHT | -18.3 | -5.7 | 0.8 | -34.5 | 46.8 | 71 | 48.8 | 72 | 123 | 8 | 146 | 138 | 1015.5 |
| COMFORT COVE | -13.4 | -5.7 | 3.0 | -27.7 | 100.2 | 137 | 80.6 | 98 | 92 | 10 | * | * | 878.3 |
| DANIELS HARBOUR | -13.1 | -5.4 | 2.0 | -29.5 | 53.6 | 72 | 55.2 | 68 | 32 | 15 | 110 | 146 | 870.2 |
| DEER LAKE A | -13.8 | -4.6 | 2.9 | -27.4 | 92.7 | 142 | 76.2 | 109 | 72 | 15 | * | * | 889.3 |
| GANDER INT'L A | -12.5 | -5.7 | 3.2 | -27.6 | 125.4 | 165 | 111.3 | 112 | 60 | 13 | 144 | 146 | 853.5 |
| GOOSE A | -19.9 | -5.4 | -6.8 | -33.1 | 48.8 | 81 | 37.4 | 62 | 52 | 8 | 153 | 131 | 1060.2 |
| MARY'S HARBOUR | -16.9 | -6.8 | -4.3 | -31.2 | 30.4 | 48 | 30.4 | 39 | 55 | 5 | * | * | 975.7 |
| PORT AUX BASQUES | -10.0 | -4.3 | 2.6 | -24.0 | 110.5 | 159 | 116.3 | 99 | 100 | 21 | * | * | 783.9 |
| ST ANTHONY | -15.3 | -4.1 | -2.0 | -30.5 | 88.6 | 146 | 74.2 | 90 | 77 | 11 | * | * | 932.6 |
| ST JOHN'S A | -9.5 | -5.0 | 1.9 | -22.4 | 103.6 | 139 | 103.6 | 74 | 63 | 15 | 110 | * | 770.1 |
| ST LAWRENCE | -7.9 | -3.4 | 4.0 | -19.2 | 127.1 | 263 | 129.5 | 119 | 85 | 17 | * | * | 724.9 |
| STEPHENVILLE A | -11.5 | -5.3 | 3.0 | -24.4 | 80.1 | 105 | 88.7 | 99 | 58 | 18 | 91 | * | 826.8 |
| WABUSH LAKE A | -23.9 | -3.1 | 3.4 | -44.8 | 61.9 | * | 55.7 | 116 | 64 | 8 | 107 | * | 1172.5 |

AGROCLIMATOLOGICAL STATIONS FEBRUARY 1994'

| STATION | Temperature C Mean | Difference from Normal | Maximum | Minimum | Snowfall (cm) | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | Degree days above 5 C This month | Degree days above 5 C Since jan. 1st |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BRITISH COLUMBIA** | | | | | | | | | | | | |
| AGASSIZ | 2.5 | -2.0 | 10.0 | -6.0 | 18.2 | 201.3 | 114 | 0 | 16 | 68 | 57.8 | 57.8 |
| SUMMERLAND | -2.5 | -2.6 | 9.0 | -16.0 | 6.0 | 16.6 | 88 | 0 | 5 | 69 | 2.8 | 2.8 |
| **ALBERTA** | | | | | | | | | | | | |
| BEAVERLODGE | -19.2 | -9.0 | 6.5 | -40.0 | 44.4 | 44.4 | 175 | 66 | 13 | 81 | 0.0 | 0.0 |
| LACOMBE | -17.8 | -7.3 | 8.5 | -44.0 | 6.3 | 6.5 | 36 | 24 | 4 | 107 | 0.0 | 0.0 |
| **SASKATCHWAN** | | | | | | | | | | | | |
| INDIAN HEAD | -20.1 | -6.3 | 1.5 | -39.0 | 28.1 | 33.1 | 185 | 62 | 4 | ** | 0.0 | 0.0 |
| MELFORT | -21.1 | -4.8 | 0.5 | -38.0 | 9.8 | 9.8 | 60 | 43 | 3 | 119 | 0.0 | 0.0 |
| SCOTT | -21.6 | -7.2 | 0.0 | -47.5 | 27.2 | 21.8 | 168 | 50 | 8 | 119 | 0.0 | 0.0 |
| SWIFT CURRENT | -17.2 | -6.8 | 3.5 | -37.5 | 19.4 | 12.3 | 82 | 38 | 2 | 107 | 0.0 | 0.0 |
| **MANITOBA** | | | | | | | | | | | | |
| BRANDON | -19.7 | -4.5 | -1.5 | -41.8 | 8.7 | 8.7 | 43 | 20 | 3 | ** | 0.0 | 0.0 |
| MORDEN | -17.3 | -0.9 | 4.0 | -34.0 | 12.8 | 14.4 | 53 | 17 | 4 | 162 | 0.0 | 0.0 |
| GLENLEA | -19.0 | -5.6 | 4.0 | -39.0 | 7.2 | 7.2 | 38 | 22 | 3 | 136 | 0.0 | 0.0 |
| **ONTARIO** | | | | | | | | | | | | |
| DELHI | -7.8 | -2.4 | 13.0 | -30.0 | 45.4 | 45.4 | 80 | 10 | 9 | ** | 6.1 | 6.1 |
| ELORA | -10.4 | -3.1 | 8.3 | -27.3 | 21.6 | 25.3 | 52 | 11 | 8 | ** | 1.6 | 1.6 |
| HARROW | -3.0 | 0.8 | 12.0 | -21.0 | 25.7 | 34.1 | 64 | 6 | 7 | 113 | 5.5 | 5.5 |
| KAPUSKASING | -18.0 | -1.7 | 10.0 | -37.5 | 5.6 | 8.9 | 22 | 12 | 4 | 99 | 0.0 | 0.0 |
| OTTAWA | -11.8 | -2.3 | 9.8 | -27.5 | 43.9 | 37.2 | 68 | 18 | 7 | 140 | 2.7 | 2.7 |
| SMITHFIELD | -9.2 | -2.6 | 10.0 | -25.5 | 44.5 | 48.0 | 67 | 13 | 8 | ** | 0.2 | 0.2 |

Courtesy of Agriculture Canada

| STATION | Temperature C Mean | Difference from Normal | Maximum | Minimum | Snowfall (cm) | Total Precipitation (mm) | % of Normal Precipitation | Snow on ground at end of month (cm) | No. of days with Precip 1.0 mm or more | Bright Sunshine (hours) | Degree days above 5 C This month | Degree days above 5 C Since jan. 1st |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **QUEBEC** | | | | | | | | | | | | |
| LA POCATIERE | -11.7 | -1.5 | 11.0 | -29.5 | 51.4 | 46.1 | 65 | 50 | 7 | 162 | 3.5 | 3.5 |
| NORMANDIN | -19.7 | -3.6 | 10.9 | -41.3 | *.* | 31.4 | 58 | 28 | 14 | 148 | 0.0 | 0.0 |
| **NEW BRUNSWICK** | | | | | | | | | | | | |
| FREDERICTON | -9.9 | -1.6 | 19.0 | -25.5 | 38.8 | 31.5 | 36 | 6 | 2 | 191 | 10.0 | 10.0 |
| **NOVA SCOTIA** | | | | | | | | | | | | |
| KENTVILLE | -7.0 | -1.8 | 14.5 | -20.5 | 34.2 | 35.6 | 33 | 9 | 7 | 123 | 5.4 | 5.4 |
| NAPPAN | -9.2 | -2.3 | 11.0 | -27.0 | 57.6 | 57.6 | 65 | 10 | 8 | 151 | 4.5 | 4.5 |
| **PRINCE EDWARD ISLAND** | | | | | | | | | | | | |
| CHARLOTTETWN | *.* | *.* | *.* | *.* | *.* | *.* | ** | *** | *** | ** | 0.0 | 0.0 |
| **NEWFOUNDLAND** | | | | | | | | | | | | |
| ST.JOHN'S WEST | -9.3 | -5.0 | 2.0 | -26.0 | 97.3 | 107.5 | 65 | 70 | 17 | 108 | 0.0 | 0.0 |

Courtesy of Agriculture Canada

...continued from page 15

region saw less-than-normal snowfall in February. The only exception was northern Manitoba, which continued to have greater-than-normal snowfall, with some areas getting over 25 cm. Some major storms during February crossed southern regions, giving blizzard conditions in open areas.

## Ontario

February 1994, ran both "hot and cold" across Ontario. While the first 2 weeks continued the frigid weather entrenched during January, a brief taste of spring-like weather provided a short rest before the cold settled back into the province for the final week of the month. Statistically, the cold weather easily prevailed over the mild, dragging monthly-mean temperatures well-below-normal for the 2nd month in succession. In fact, the combined January-February 1994 mean temperature was the coldest recorded, in Toronto for example, since 1920.

Around the province, February monthly mean temperatures ranged from 2 to 4 degrees below the long-term average. February 1994 ranked as the coldest February since 1982 in southwestern Ontario and the coldest since 1979 in, and to the west of, Sault Ste. Marie.

Most of the province experienced less snow than usual. At Pickle Lake, 120 km northwest of Lake Nipigon, only 4 cm of snow fell - the lowest for any February since records began there in 1939. Generally, snowfall totals north and west of a line from Sault Ste. Marie to Sudbury ranged from 4 to 10 cm in the extreme northwest and 10 to 35 cm in the northeast. These totals are well below the 20 to 50 cm normal. In central and southern regions, snowfall was close to normal. However, in eastern Ontario, the Hamilton-Niagara area and southwestern Ontario, snowfall was above normal by 20 to 40 per cent, mainly due to lake-effect snow in easterly winds over Lake Ontario. Hamilton, at 72 cm, established a new high for any February in the last 35 years.

Given the cold, rainfall was scarce and generally non-existent in Ontario during February. In Hamilton, for instance, despite the 72 cm of snow, only a trace of rain fell (25 mm is normal February rain) leaving them with only 80% of their usual February total precipitation. Most areas had precipitation totals lower-than-normal.

If temperature and precipitation were lacking, sunshine was not, in most of Ontario. Both Sudbury, with 189 hours of sunshine (normal 132 hours), and St. Catharines 141 hours (normal 102), set records for their sunniest February.

## Quebec

February, just like January, had below-normal temperatures across the entire region. Although February departures were not as remarkable as the previous month, each and every station ended up with monthly mean temperatures 2 to 7 degrees below normal.

Wabush was the cold spot, with a monthly mean temperature of -27.4°C (7.0 degrees below normal), followed closely by Kuujjuarapik, with -26.8°C. Blanc Sablon was 6.8 degrees below normal, with -16.7°C as a monthly mean temperature.

On the other hand, most of the province finally enjoyed a period of above-zero temperatures from the 19th to the 21st. Sherbrooke ended up being the big winner, with a 'balmy' 14.3°C. From Val-d'Or to Lac St.-Jean to Mont Joli, temperatures broke the 10.0°C mark. Even La Grande IV managed to reach 4.1°C during this period.

Precipitation was below normal across all regions, except in the extreme north and the extreme south, where precipitation was above normal. One major snow storm dumped from 35 to 50 cm of snow over southern Quebec from the 23rd to the 25th.

Conditions for skiing were exceptionally good in February, despite the cold. From a tourism standpoint, skiing attendance was up 30%. There had been adequate snow since mid-December and the depth of the ski bases were averaging 45 cm greater than they had been in the past five years.

The only spot wih less sunshine than normal was Wabush (77% of the normal). Other areas of Quebec received from 101 to 144% of the normal amount of sunshine.

## Maritimes

February was very cold, sunny, and dry. Mean temperatures for the month were generally 2 to 3 degrees below normal in New Brunswick, Prince Edward Island and areas of Cape Breton, Nova Scotia. In mainland Nova Scotia, mean temperatures were 1 to 2 degrees below normal.

A break in the cold weather arrived on the 20th and 21st, when some extremely mild air poured into the Maritimes, smashing some long-standing record-high maximum temperatures. Not only were daily records broken, but records for the month were also established at a number of locations; Halifax (CFB Shearwater) (16.2°C on the 20th), Halifax International Airport (17.5°C on the 20th), Fredericton (18.6°C on the 20th), Moncton (15.3°C on the 20th), and Saint John (13.3°C on the 21st).

Sunshine hours were generally well-above normal, particularly in New Brunswick and Prince Edward Island, where both Fredericton and Charlottetown recorded new record-high sunshine hours for the month, with readings of 191.3 hours and 165.1 hours, respectively. The previous record at Fredericton was 173.6 hours, set in 1978, with records dating back to 1914, and at Charlottetown, 165.0 hours, set in 1923, with records dating back to 1910.

Precipitation totals were well-below normal, ranging from 82% of normal at Sable Island, Nova Scotia, to 28% of normal at Saint John, New Brunswick. The total of 29.2 mm recorded at Saint John, was only 3.3 mm away from tying the record for the lowest February precipitation. Most of the precipitation fell in the form of snow, with very little rainfall. Snowfall totals were generally below

normal in New Brunswick, except for the Moncton area, where they were slightly above normal. Totals in Nova Scotia and Prince Edward Island, ranged from 48% below normal at Kentville, Nova Scotia, to 40% above normal at Yarmouth, Nova Scotia.

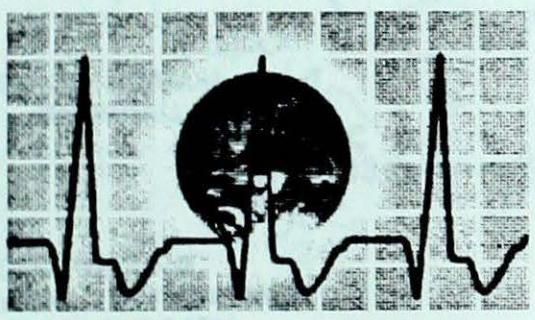
## Newfoundland and Labrador

Newfoundland experienced mainly sunny conditions and cold temperatures for the first two weeks of February. This was interspersed with some snowfall on the 3rd and 6th of the month. Mean temperatures for the month were 5 degrees below normal, with the coldest days being the 9th and 10th. Many minimum temperature records were set on these days with Gander's -27.6°C on the 9th, being the lowest.

Valentine's Day and the 15th yielded one of the worst snowstorms this decade. Snowfall amounts were in the 30 to 50 cm range, peaking with Gander's 71 cm. Wind gusts exceeded 100 km/h, while Twillingate on the northeast coast reported 141 km/h. Many highways were closed and power outages were frequent. The town of Gander issued a state of emergency on the 15th.

The remainder of the month consisted of alternating days of sun and flurries with freezing rain affecting the Island on the 21st. Generally, sunshine and snowfall were above normal for the month, with the bulk of the snow falling on the 15th. Temperatures recovered slightly towards the end of the month and actually broke the freezing mark at most locations on the 22nd; St. Lawrence reported 4.0°C on that date. The insistent cold temperatures resulted in ice growth being three weeks ahead of schedule around coastal areas. This had dramatically interrupted ferry service to many communities around Newfoundland.

Labrador was sunny and very cold for most of the month. Snow blanketed the area on the 3rd, 20th and during the Valentine's Day storm. Snowfall was 20 cm below normal. Most of Labrador experienced at least 30 hours more sunshine than usual, while western sections remained under more cloud. Wabush Lake reported the coldest temperature of -44.8°C on the 8th and the highest temperature of 3.4°C on the 21st.



## Municipal Water Use and Wastewater Treatment Environmental Indicator Bulletin

Canada's per capita water use is the second highest in the world according to Environment Canada's most recent environmental indicator bulletin: Water - Municipal Water Use and Wastewater Treatment.

### Some of the key findings are:

- Residential water use accounted for over one-half of all municipal water use in 1991 - an increase of 21% between 1983 and 1991.
- Canadian households that paid volume-based water rates in 1991 used nearly 40% less water than those charged a flat rate.
- Canadian municipalities are improving their wastewater treatment systems.

Environmental indicators are designed to provide a profile of the state of Canada's environment and measure progress towards sustainable development.

*Copies of Municipal Water Use and Wastewater Treatment are available from the Environment Canada Enquiry Centre by phoning (819) 997-2800.*