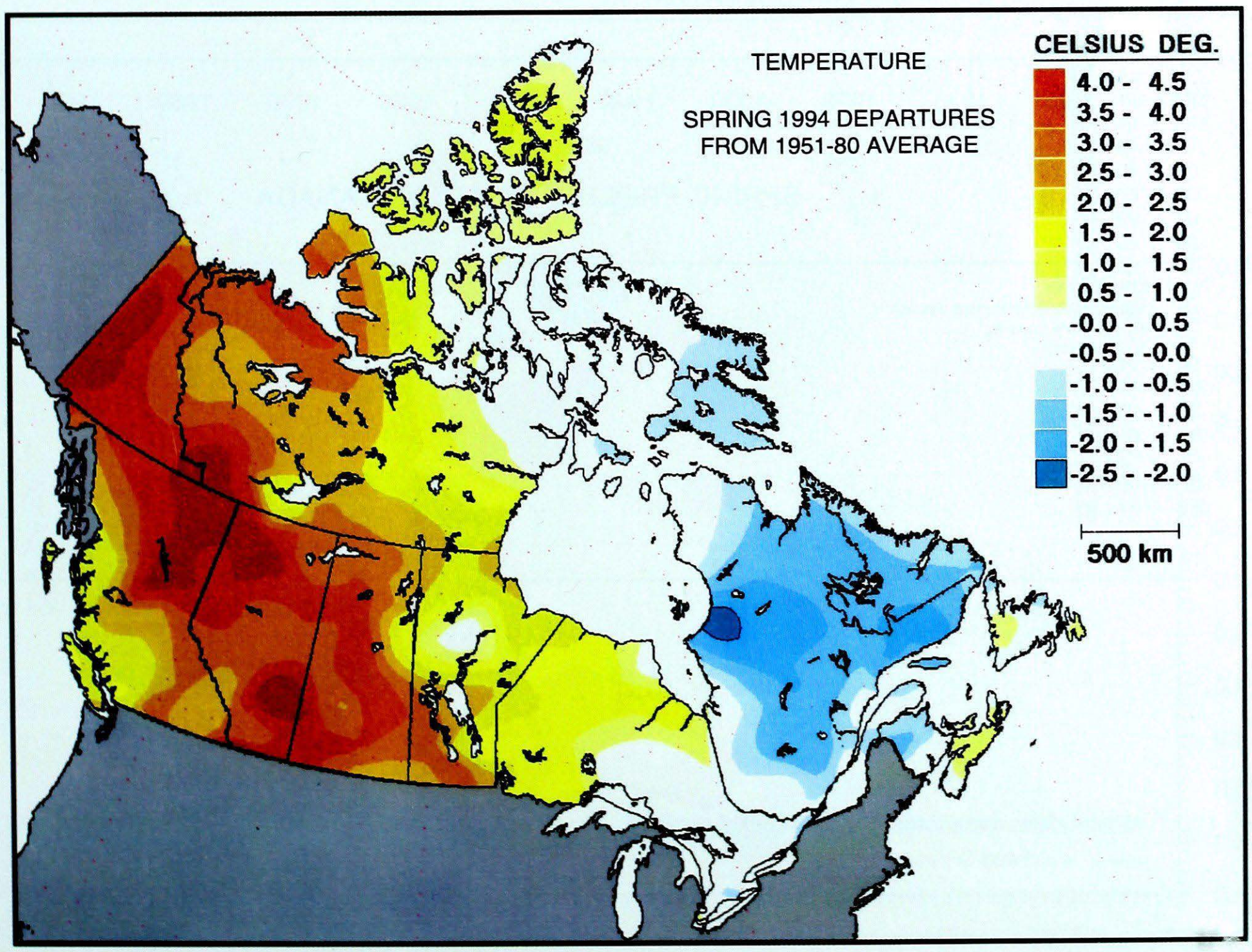
Climatic Perspectives

March to May 1994 **Seasonal review of Canadian climate and water** *vol. 16*

Spring 1994 National Summary

Preliminary data, averaged across the country for the March through May 1994 period, indicate above-average temperature and precipitation for Canada. The national spring temperature was 1.2 degrees warmer and precipitation was 13% wetter than the corresponding long-term average. Spring 1994 was the 16th warmest (85th coldest) and the 3rd wettest (45th driest) nationally since suitable temperature and precipitation records began in 1895 and 1948 respectively. Each spring since 1985, with the exception of 1989, has been warmer than average and each since 1986 has been wetter. The national spring temperature series indicates a warming trend of 1.4 degrees over the 100-year period since 1895, while the comparative precipitation series suggests increasing precipitation amounts since the 1948 start date.

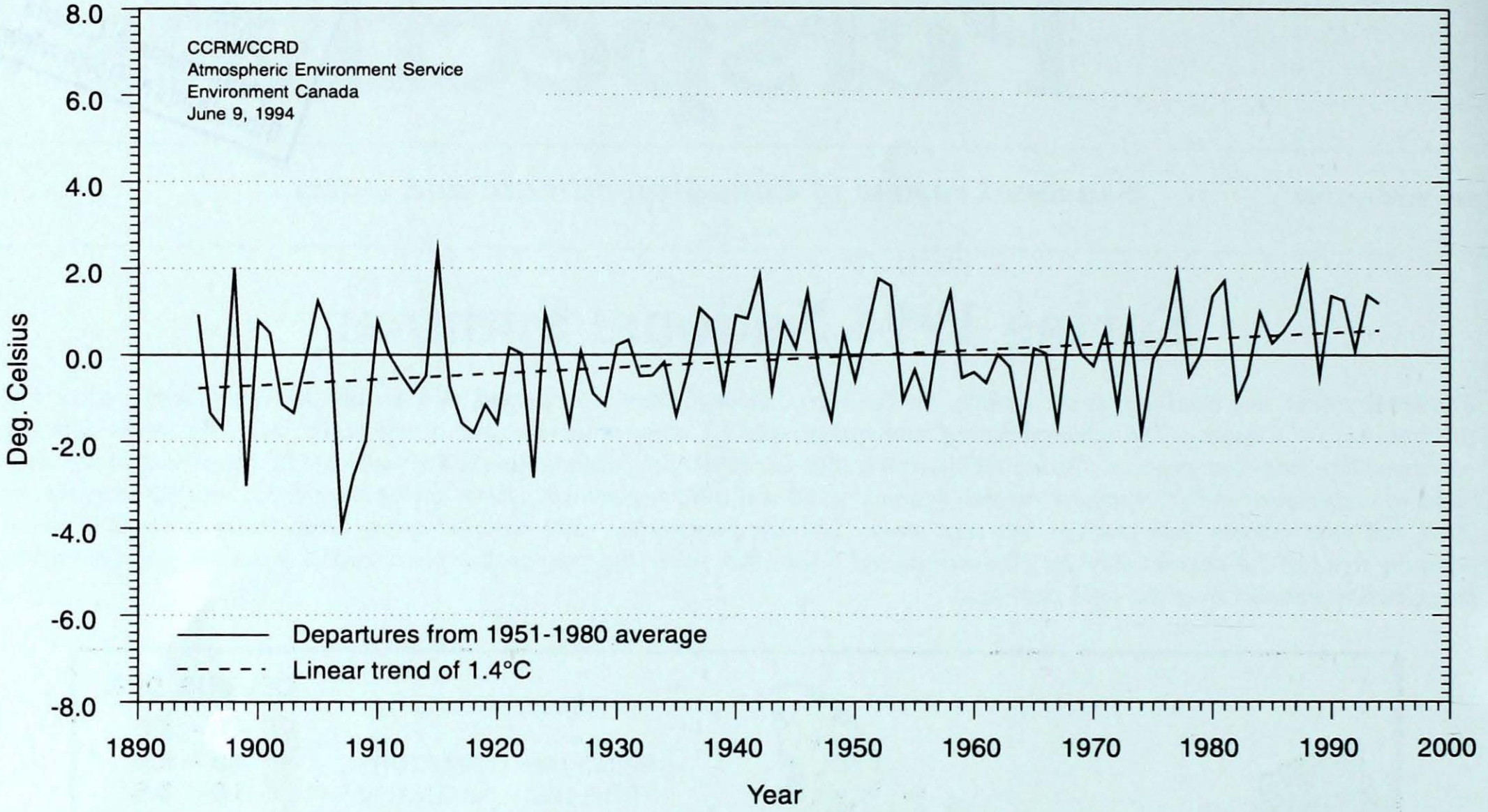


Environment Canada Environnement Canada

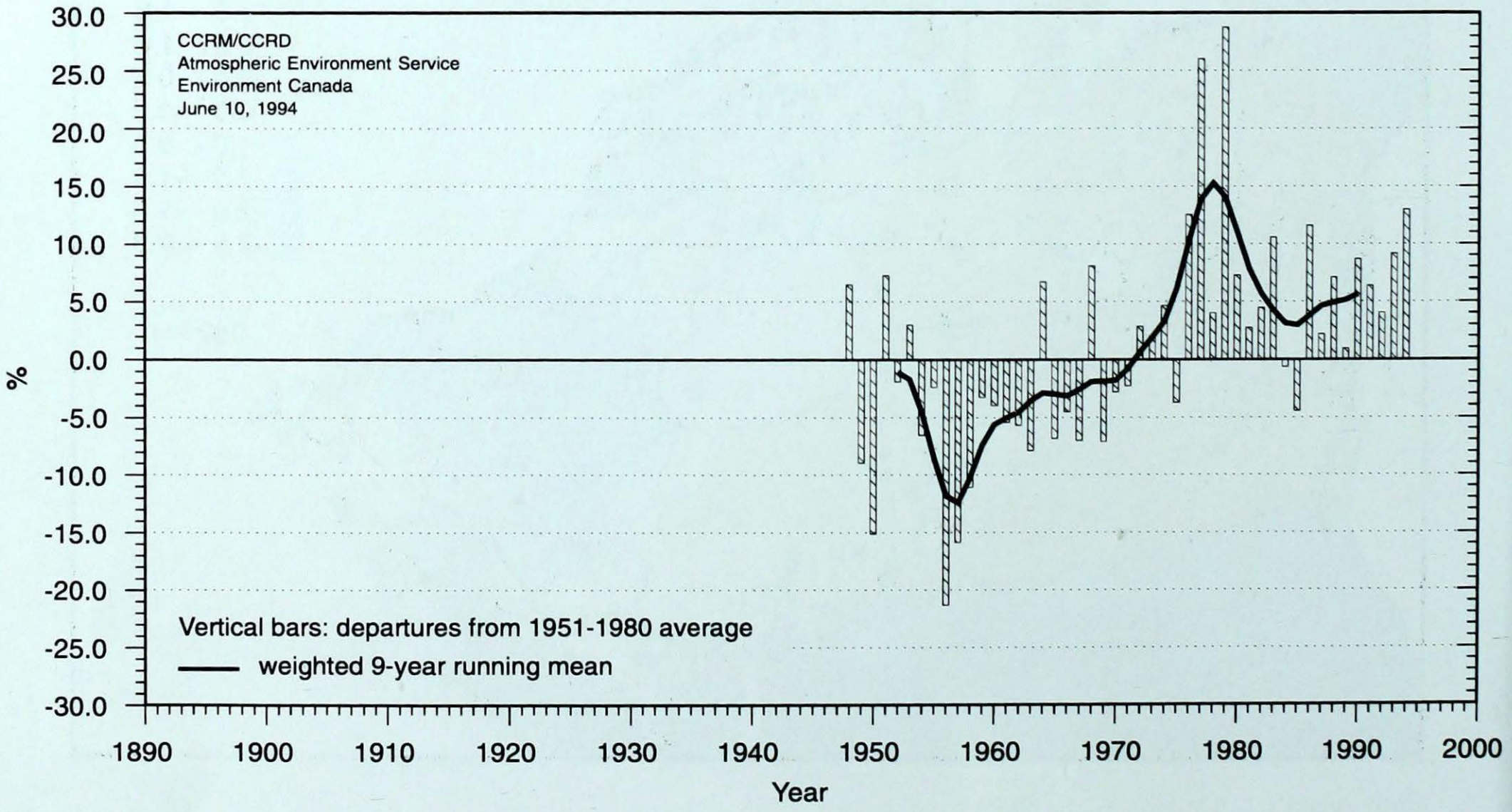
Canada

CANADA

SPRING TEMPERATURE
1895-1994



SPRING PRECIPITATION FOR CANADA
1948-1994



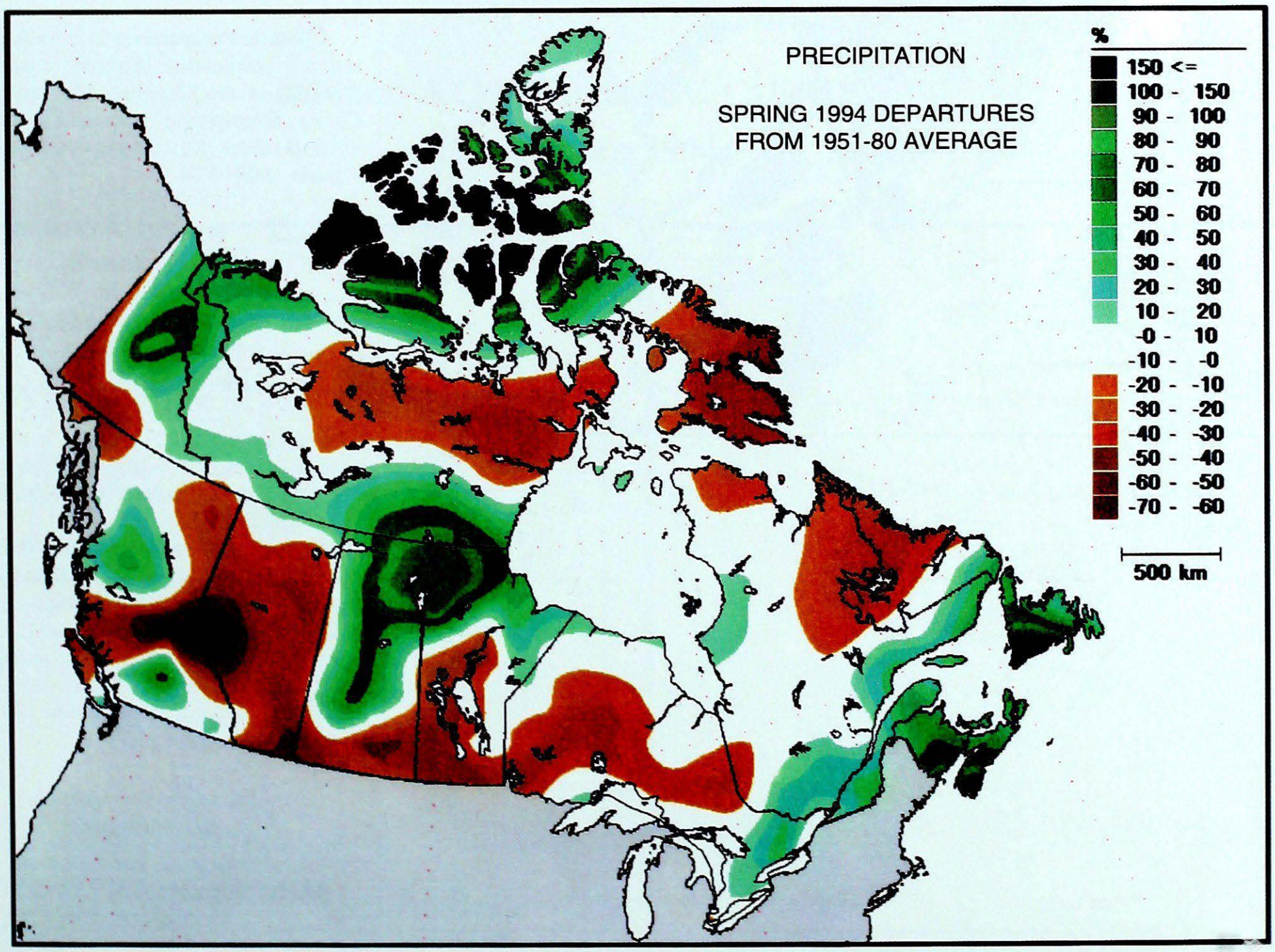
The national temperature departure pattern for spring 1994 is similar in many respects to that of a year ago, with above-average temperatures in central, western, and northwestern Canada and generally below-average values in eastern Canada, particularly in north-central Quebec. In the west, spring 1994 values were typically 2 to 4 degrees warmer than average, while in the east, they were generally 0.5 to 2 degrees colder than average.

The national precipitation departure pattern for spring 1994 indicates wetter-than-average amounts (up to 50 to 100% wetter) occurring across Newfoundland and all of Atlantic Canada, northern Manitoba and Saskatchewan, northern British Columbia, central Yukon Territory and the Mackenzie Delta, and across the High Arctic islands. On the other hand, drier than average precipitation amounts (typically 20 to 40% drier) occurred across much of northwestern Ontario, southern Manitoba and Saskatchewan, most of Alberta, central British Columbia, the central areas of Mackenzie and Keewatin Districts of the Northwest Territories, and southern Baffin Island-northern Labrador in the northeast.

Most regions of eastern Canada, from the Great Lakes to Newfoundland and Labrador experienced average spring temperatures that were near to below the long-term averages for the 3rd consecutive year. Over this vast region, the 100-year temperature trends indicate only very slight warming during the spring season. All regions of western and northwestern Canada, on the other hand, were in sharp contrast with long-term warming trends varying from 0.7 degrees along the Pacific coast, to 1.5 degrees in the southern Prairies, to as much as 2.6 degrees in the District of Mackenzie. In these regions, nine (eight in the Mackenzie) of the last ten springs have all been warmer than average, and in southern British Columbia, all 12 springs since 1983 have been warmer. Spring 1994 was among the warmest 5% of springs throughout much of British Columbia and Yukon Territory since 1895. Along the Pacific coast, it was the warmest spring since 1915. Across the central and high Arctic, a slight warming trend of 0.4°C, over the 1922-1994 period (73 years) was observed, while along northeastern Baffin Island a decreasing trend of 1.2°C was observed over the 1946-1994 period (49 years).

Spring 1994, throughout most of the Great Lakes Basin-St. Lawrence Lowlands region was among the wettest 25% of springs there since 1895. Across much of Atlantic Canada it was the wettest since 1895. At higher latitudes, the District of Mackenzie, and the tundra region of north-central Canada, experienced their 4th and 6th consecutive springs respectively, with wetter-than-average precipitation. Elsewhere, regional precipitation averages varied from just below to much below the long-term values

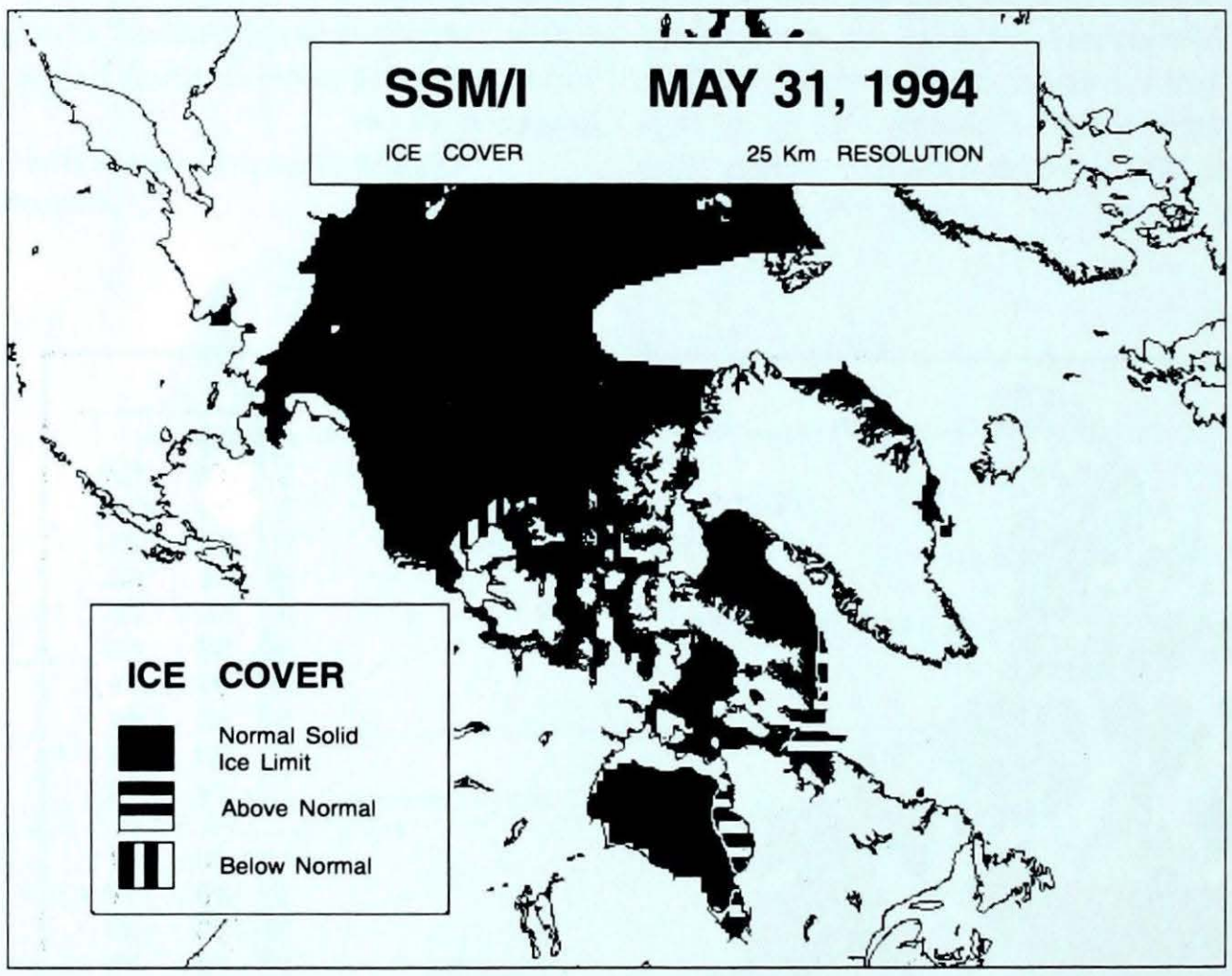
Climate Change Detection Division, Downsview



End of May Ice Image

Warmer-than-normal air temperatures in the western Arctic, northern Yukon and Northwest Territories have resulted in the Beaufort Sea opening up somewhat earlier. The ice cover to the west of Banks Island is less than normal for this time period. Due to slightly colder-than-normal air temperatures over James Bay and southern Hudson Bay, the normal pattern of break-up in Hudson Bay has been disrupted. Normally the east coast of Hudson Bay and James Bay open up first, but at the end of May these areas were still experiencing slightly more ice than normal. The Davis Strait area is experiencing slightly-above-normal ice cover also.

Arvids Silis
Climate Processes and Observations
Research Division



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The purpose of the publication is to make topical information available to the public concerning the Canadian climate and its socio-economic impact.

The data in this publication are based on unverified reports from approximately 225 Canadian synoptic weather stations. Information concerning climatic impacts is gathered from AES contacts with the public and from the media. Articles do not necessarily reflect the views of Atmospheric Environment Service.

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1994 Spring In Review

Cooler-than-normal temperatures dominated the northeastern parts of Canada, while the western half of the country enjoyed a warmer-than-normal spring.

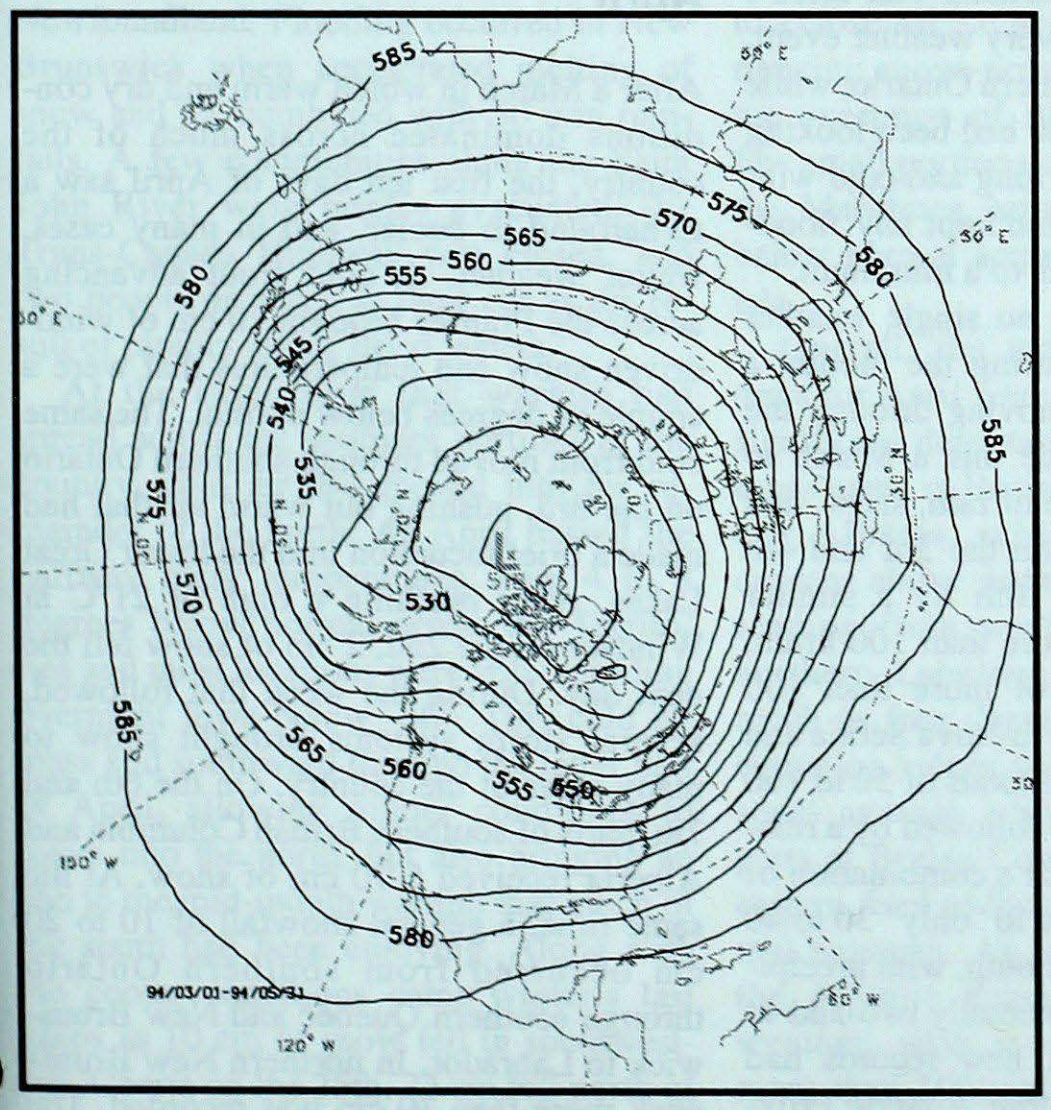
An amplified ridge extending from Montana to the Beaufort Sea gave above-normal temperatures to the Territories, B.C., and most of the Prairies. West of, and in the vicinity of the ridge, precipitation was above normal for most of B.C., the Arctic islands, northeastern Alberta and northern Saskatchewan. Warmer-than-normal sea surface temperatures in the Gulf of Alaska apparently transferred energy to the air above the water, resulting in a persistent upper ridge over western Canada. This ridge was also present during the past winter.

An amplified upper trough of low pressure stretching from Davis Strait to western Nova Scotia resulted in a cool spring across Labrador and central Quebec. The record-cold winter of 1993-94 which yielded above-normal ice and snow cover over the Northwest Territories, including Hudson Bay, remained above normal during the spring. As a result, Arctic air moving southeastward was kept refrigerated as it passed over the ice and snow-covered areas farther south. As well, extensive ice off the east coast of Canada hindered shipping operations. At the base of the trough, where the upper level winds were west-southwesterly, precipitation was above normal across the Atlantic Provinces and the Gaspé peninsula. Winds from the southwest are usually associated with above-normal precipitation amounts as moisture is pushed up from the warm, moist, subtropical regions.

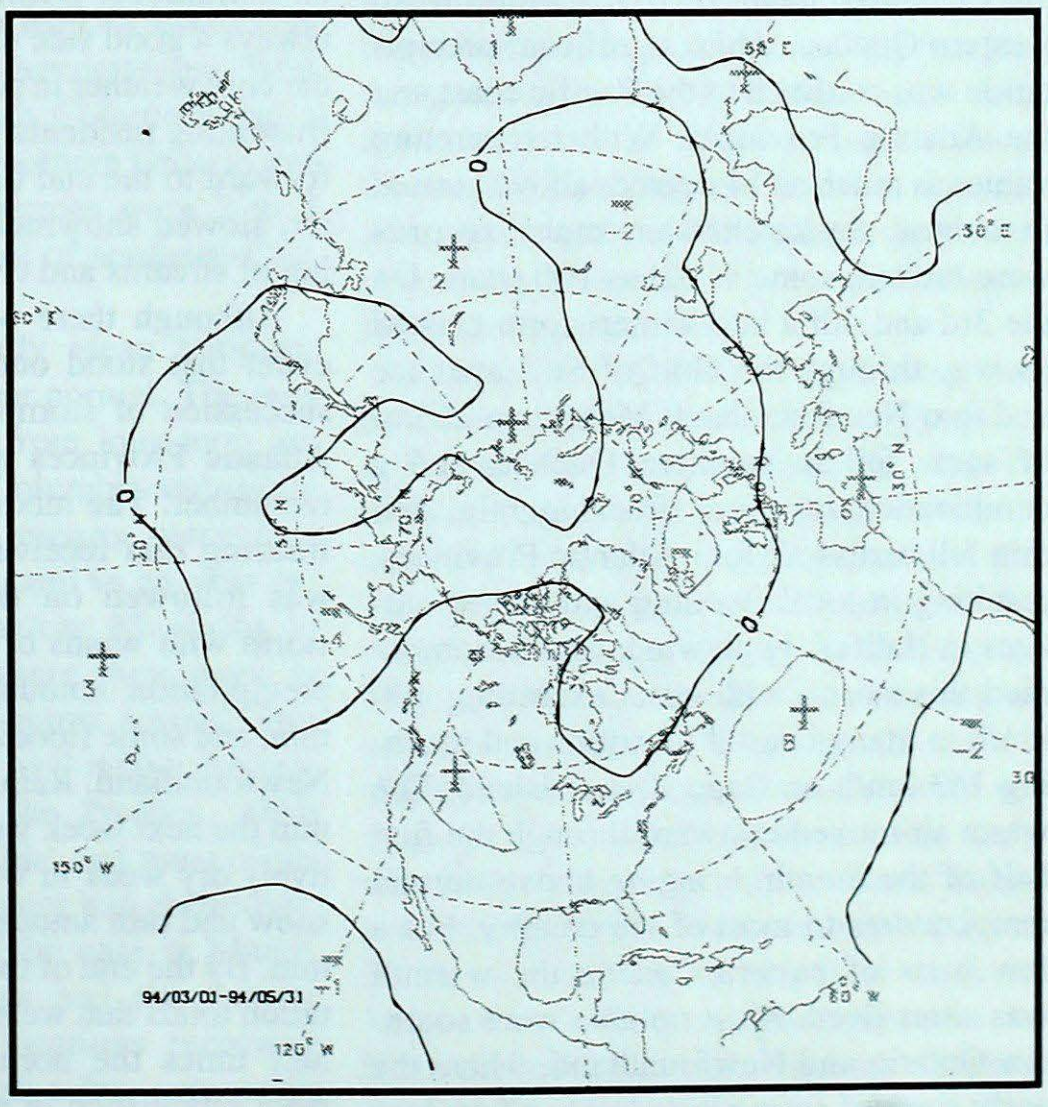
Aaron Gerge

50-kPa ATMOSPHERIC CIRCULATION

Spring 1994



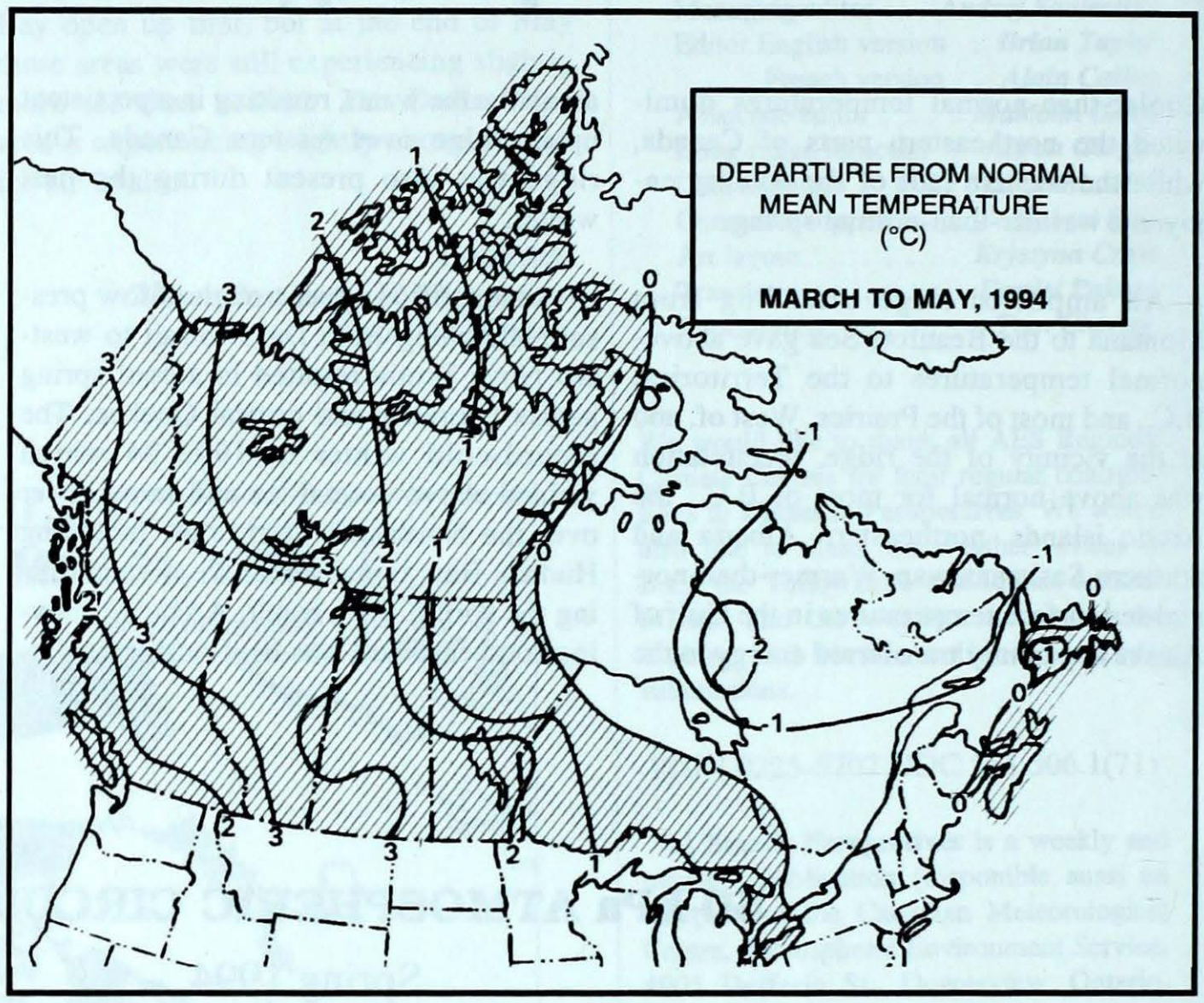
Mean geopotential heights
- 5 decametre interval -



Mean geopotential height anomaly
- 5 decametre interval -

Spring 1994

March



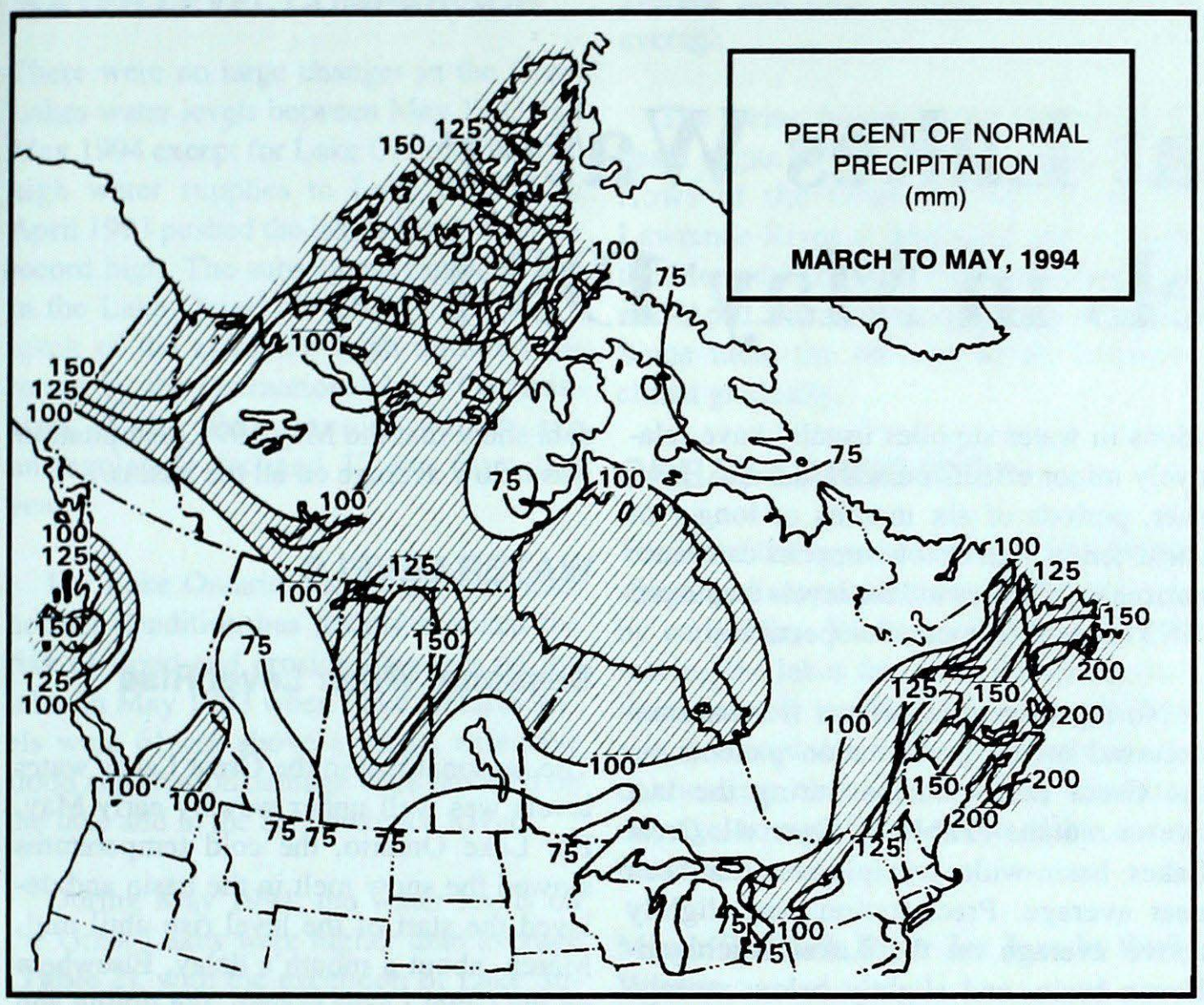
March was, for the most part, a warm and dry month for much of Canada. With the exceptions of southern Ontario, Newfoundland, and the eastern half of the far north, monthly mean temperatures were above normal. Only the Atlantic Provinces, the northeastern Prairies, and portions of northern Quebec received significantly more than their usual share of moisture, as precipitation values were well below average over most of the southern half of the country. Of particular interest were the southern Prairies, where mean temperatures were 6 to 8 Celsius degrees above the thirty-year average, precipitation values were generally only 20 to 40% of normal, and a few locations received less than a millimetre of water. For much of the area this was the driest March in over 25 years. In contrast, just a short distance away, northern Manitoba was experiencing its second wettest March on record, with precipitation amounts that were as much as 300% of normal.

During the first week of the month mild air extended from British Columbia to western Quebec, while significant precipitation was confined to the Pacific coast and the Atlantic Provinces. With temperature values as much as 14 degrees above normal in central Saskatchewan, many records were broken, some as old as 100 years. On the 3rd and 4th a late-winter storm blasted its way through the Gulf of St. Lawrence and into Newfoundland. More than 25 cm of snow fell in southern Quebec, and a combination of snow, freezing rain, and rain fell across all four Atlantic Provinces, resulting in local flooding and power outages in Halifax. High winds also accompanied this storm, with gusts exceeding 100 km/h in many coastal locations and reaching 163 km/h on Cape Breton Island. The warm air moved eastward through the first half of the month, bringing above-normal temperatures to most of the country. For a few parts of eastern Canada the warmth was short-lived. Most notable were southern Ontario and Newfoundland, where the early signs of spring lasted only a few days before there was a return to cool late-winter conditions. Demonstrating that there's always a good side to every weather event, the cool weather in southern Ontario, while frustrating residents who had been looking forward to the end of a long and cold winter, slowed snowmelt and kept any flooding of streams and rivers to a minimum.

Although there was no single weather event that stood out during the month, a succession of storms moving through the Atlantic Provinces made this a March to remember. The mixture of rain, snow, and freezing rain received on the 3rd and 4th was followed on the 10th by a similar storm with winds of more than 100 km/h, precipitation amounts of more than 100 mm, and some flooding in Nova Scotia and Newfoundland. Rainfall totals of 50 to 100 mm the next week were followed by a relatively dry week in which a combination of snow and rain amounted to "only" 30 to 40 mm. By the end of the month, with precipitation totals that were generally two-and-a-half times the normal, new records had been established in all four Atlantic Provinces.

April

After a March in which warm and dry conditions dominated across much of the country, the first ten days of April saw a turnaround to cooler, and in many cases, wetter weather. A cold front advancing across the Prairies brought 10 cm of wind-driven snow and temperatures that were a couple of degrees below normal. The same cold front moved through southern Ontario on the 3rd, pushing out warm air that had made a brief incursion into the lower Great Lakes. After reaching a high of 21°C at Windsor on the 2nd, 2 cm of snow fell the next day. During the week that followed, several storm systems brought snow to many areas of the country. On the 6th and 7th, parts of southern British Columbia and Alberta received 5-10 cm of snow. At the same time, a general snowfall of 10 to 20 cm occurred from southern Ontario through southern Quebec and New Brunswick to Labrador. In northern New Brunswick more than 30 cm was recorded. The same storm brought 70 mm of rain to



Prince Edward Island, Nova Scotia, and Newfoundland.

As milder conditions returned to all of southern Canada by mid-month, daytime highs reached 20°C in all provinces except Newfoundland. Flooding occurred in New Brunswick when accelerated melting of snow and ice combined with 50 mm rainfalls. A few communities along the Saint John River were briefly evacuated, the Trans-Canada Highway was closed, and two people drowned in their car as the result of rapidly-rising flood waters.

At the same time that warmth had spread across the southern portions of the country, cold air had moved into the remainder of the north. As April passed the halfway mark temperatures were 4 to 8 degrees below normal across the Territories and most locations were still recording overnight lows below -30°. This cold air mass slid southward through the latter half of April, allowing milder conditions to move into the north, but also bringing an end to the mid-month warmth that much of the south had been enjoying. Along with the cooler conditions came winter's last gasps as 10 cm of snow fell in southwestern Alberta on the 25th, 23 cm fell north of Lake Superior, and snow streamers occurred along the west coast of Newfoundland. As well, the season's first sign of summer severe weather was found as heavy thunderstorms moved through the Ottawa Valley on the 27th, bringing damaging winds and a tornado. As April drew to a close, all the Arctic regions were experiencing above-normal temperatures. With the exception of British Columbia and a few small portions of southern Ontario and the Maritimes, temperatures were 2 to 5 below normal across all of southern Canada.

Overall, the monthly mean temperatures for April were near normal. The only significant departures from long-term average came in British Columbia and southern Alberta, where means were two degrees above normal, and in an area extending from northeastern Manitoba to northern Labrador, where they were as much as four degrees below normal. Precipitation values were well below the seasonal average across the Prairies, while parts of British Columbia, and most of the eastern third of the country had above-normal amounts. As was the case in March, the Atlantic Provinces had the wettest weather, with most locations receiving more than 100 mm and a few surpassing the 200 mm mark.

May

The dry conditions that dominated the weather across Canada's Prairies in April took a sharp turn in May. A series of storms moving across the area resulted in precipitation totals that exceeded 50 mm in most areas, as much as twice the normal. In British Columbia, northern Ontario, and northern Quebec, where copious precipitation had fallen in the previous month, below-normal amounts were received in May. Damp conditions that had dominated the weather from the Great Lakes to the Atlantic in April continued this month. Totals ranged from 100 mm in southern Ontario and southern Quebec to more than 200 mm in parts of Nova Scotia and Newfoundland. For many parts of the Atlantic Provinces this was the third wet month in a row, resulting in spring totals that were as much as 200% of normal.

Mean temperatures this month were generally near normal across the country. Only in the northwestern Arctic, where means were generally 2 to 4 degrees above normal, was there any significant departure from the long-term average. May began with temperatures near normal over the east and slightly above normal in the west, and with only a few brief exceptions, continued that way through most of the rest of the month. As a result, there were few occurrences of unusually warm or cold conditions in May. With no significant turnaround from the cool weather that had dominated much of the spring, crop development in southern Ontario was delayed by about two weeks.

During the first week of the month, winter-like conditions were still in evidence as snow and frost were reported in parts of southern Ontario on the 6th, and 18 cm of snow fell in central Newfoundland on the 7th. Several storms moved through the Atlantic Provinces during the first half of May, producing frequent occurrences of one-day rainfalls that exceeded 25 mm. A slight diminishment in east coast storm activity at the month's midpoint was only temporary, and many parts of Nova Scotia and Newfoundland received another 25 to 50 mm of rain during the final week of May. Above-normal precipitation in Southern Ontario and southern Quebec

...continued on Page 10

Great Lakes Water Levels in May 1994

Water levels on Lake Superior and Lakes Michigan-Huron were similar to those one year ago. Lake Erie and particularly Lake Ontario levels have declined considerably from the very high levels of May 1993. Although ice on the Great Lakes remained longer than usual, the absence of major storms and an improved water level condition on the lower lakes have prevented serious flood and erosion damage.

PRECIPITATION FOR THE PAST 12 MONTHS

Because of their large size and storage capacities, the lakes respond slowly to changes in water supply. Short-term variations in water supplies usually have relatively minor effects on water levels. However, periods of six months or longer of consistently high or low supplies can cause noticeable changes in lake levels (see April 1993 issue of Climatic Perspectives).

No significant departures from normal occurred in the precipitation patterns on the Great Lakes basins during the last twelve months (**Table 1**). Over all, Great Lakes basin-wide precipitation has been near average. Precipitation was slightly above average on the Lakes Michigan-Huron basin, and slightly below average on the Lake Superior basin. Preliminary data show that the May 1994 precipitation was below average on all the basins.

WATER LEVELS

Seasonal Water Level Rise

The seasonal rise in the Great Lakes water levels was well under way by early May. For Lake Ontario, the cold temperatures slowed the snow melt in the basin and delayed the start of the level rise until mid-March, about a month's delay. Elsewhere on the Great Lakes system, the timing and magnitudes of the seasonal rise so far this year have been close to normal.

Table 1. Great Lakes Basin Precipitation as Percentage of Average During the Past 12 Months

Month/Yr	Superior Basin	Mich-Huron Basin	Erie Basin	Ontario Basin	All Basins
June 93	107	147	131	132	132
July	143	122	93	81	112
Aug	97	125	58	82	103
Sept	92	113	160	113	113
Oct	85	110	101	107	101
Nov	83	92	109	116	96
Dec	74	61	68	77	68
Jan 94	93	108	119	103	105
Feb	49	87	63	66	71
Mar	76	63	77	10	174
Apr	152	110	137	134	127
May[(1)]	65	68	58	85	68
Jun 93 -May 94[(1)]	96	103	99	100	99

Source: U.S. National Oceanic and Atmospheric Administration (NOAA)
[(1)] Preliminary Data

WATER LEVEL COMPARISON

There were no large changes in the Great Lakes water levels between May 1993 and May 1994 except for Lake Ontario. Record high water supplies to Lake Ontario in April 1993 pushed the lake's levels to near-record high. The subsequent rapid decline in the Lake Ontario levels in 1993 was a result of the extremely high outflows directed by the International Joint Commission. Lake Erie levels, which are un-regulated, declined 12 cm from last year.

For Lake Ontario, the return to a more normal condition has greatly reduced the risk of flood and erosion damages on the lake. In May 1993 when Lake Ontario levels were 61 cm above average, extensive flood and erosion damage were reported on the lake and in the St. Lawrence River.

During May 1994, the water levels on the Great Lakes were higher than average (**Table 2**), with the exception of Lake Superior which was near average. Lakes Erie and St. Clair have the largest departures from average, by about 27 cm. Lakes Michigan-Huron level was 17 cm above average and Lake Ontario 10 cm above average.

The spring freshet on the Ottawa River basin began in early April, increasing the flows of the Ottawa River to the St. Lawrence River at Montréal. As a result, the Montréal Harbour level rose sharply in mid-April, but no flooding was reported. Since then, the harbour levels have declined gradually.

GREAT LAKES ICE

The ice of the severe winter of 1993-94 had virtually disappeared from the Great Lakes by early May. While the ice was slow in leaving the lakes this year, the spring melt was relatively trouble-free. Although there was potential for serious ice-jams in the connecting channels and for shoreline damage, no significant events of this nature occurred.

Minor St. Clair River Ice Jam In Early Winter

During January and again near the end of February, an ice jam occurred in the St. Clair River thereby reducing temporarily the outflows of Lakes Michigan-Huron. No noticeable impacts occurred on Lakes Michigan-Huron, owing to their large size. However, temporary lowering of the Lake St. Clair level of about 50 cm occurred in mid-January.

Ice in St. Lawrence River posed No Serious Problems

While ice in the St. Lawrence River was exceptionally thick this past winter, it did not pose any serious difficulties for Lake Ontario regulation throughout the winter of 1993-94.

The ice roughness coefficient on January 8, for the reach of the river between Morrisburg and Iroquois, was found to be the highest since regulation began in 1960. Ice roughness coefficients are used to measure the flow resistance due to ice. As expected, the ice roughness coefficients were high at the beginning of the ice season, and then gradually decreased as the winter progressed. This was due to wearing off of the ice roughness caused by the water flow underneath.

Commercial navigation in the St. Lawrence Seaway, which includes the Welland Canal connecting Lake Erie and

Table 2. Great Lakes Water Level Comparison for the Month of May

Lake	Average[1]	Maximum[1]	Minimum[1]	1993	1994[2]
Superior[3]	183.39	183.74	182.76	183.37	183.40
Mich-Huron	176.53	177.28	175.74	176.70	176.70
St. Clair	175.12	175.83	174.42	175.43	175.38
Erie1	174.28	174.97	173.44	174.67	174.55
Ontario[3]	75.00	75.73	74.11	75.61	75.10
Montreal Harbour	7.43	8.93	6.42	7.32	7.02

Water Level Elevations in Metres, IGLD (1985)

Source: Environment Canada, Ontario Region

[1] Monthly values for May based on the period 1918-1992 for the Great Lakes, and 1967-92 for Montreal Harbour.
[2] Preliminary Data
[3] Lake Superior and Lake Ontario outflows are regulated.

Lake Ontario, re-opened on April 5. The flow restriction due to ice in the Beauharnois Canal near Montréal caused some hydraulic headlosses in the canal affecting shipping (ships and hydro-power operations use the same canal). The flows at the Beauharnois Power Plant had to be reduced for several days to ensure adequate depths for navigation. Except for these minor problems, navigation in the system so far this year has been trouble-free.

REGULATING LAKE ONTARIO AND LAKE SUPERIOR OUTFLOWS

The regulation of the outflows of Lake Superior and Lake Ontario this past winter and early spring has encountered only minor problems in the St. Lawrence River due to ice. The water levels on these lakes are currently well within the historical range of fluctuation. No large changes in the outflows are expected for the next several months.

FORECASTS AND ACCESS TO INFORMATION

Great Lakes water levels are influenced by the weather, with precipitation being the dominant factor. Environment Canada, Ontario Region, issues monthly a six-month forecast of the water levels of the Great Lakes and Montréal Harbour. The forecasts are issued based on exceedance probability.

Great Lakes water levels are expected to continue with their seasonal rise over the next several weeks. Seasonal peaks are expected to occur in June or July on the lower lakes including Lake St. Clair. Lakes Michigan-Huron and Superior are expected to peak some time in August or September.

If you wish to receive the monthly Great Lakes water level bulletins, please contact: Great Lakes Water Level Communications Centre, Environment Canada, Ontario Region, P.O. Box 5050, Burlington, Ontario L7R 4A6, or telephone, 905-3364581.

Peter Yee
Great Lakes - St. Lawrence Regulation Office
Environment Canada, Ontario Region
June 1, 1994

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was capped off on the 31st by severe thunderstorm activity that generated three small tornadoes, one near Toronto, and two more southeast of Québec City.

The wet weather was not confined to eastern portions of the country as a series of disturbances brought unusually moist conditions to the Prairies. After experiencing only scattered shower activity during the first half of the month, all three Prairie Provinces received more-than-adequate amounts of precipitation during the final two weeks of May. Most notable was a storm that moved through central Saskatchewan on the 17th and 18th, bringing 48 mm of rain to Saskatoon, only 2 mm short of the May record. As the cold front associated with this storm moved through southern Manitoba, heavy thunderstorms developed, producing in just a few hours, rainfalls of 50 to 100 mm in and around Winnipeg. Along with some flooding, property damage occurred as winds exceeded 150 km/h. More severe weather occurred on the 26th in west central Alberta as thunderstorms associated with another cold front spawned funnel clouds southeast of Edmonton and produced damaging winds and baseball-sized hail.

Malcolm Geast