Environment Canada
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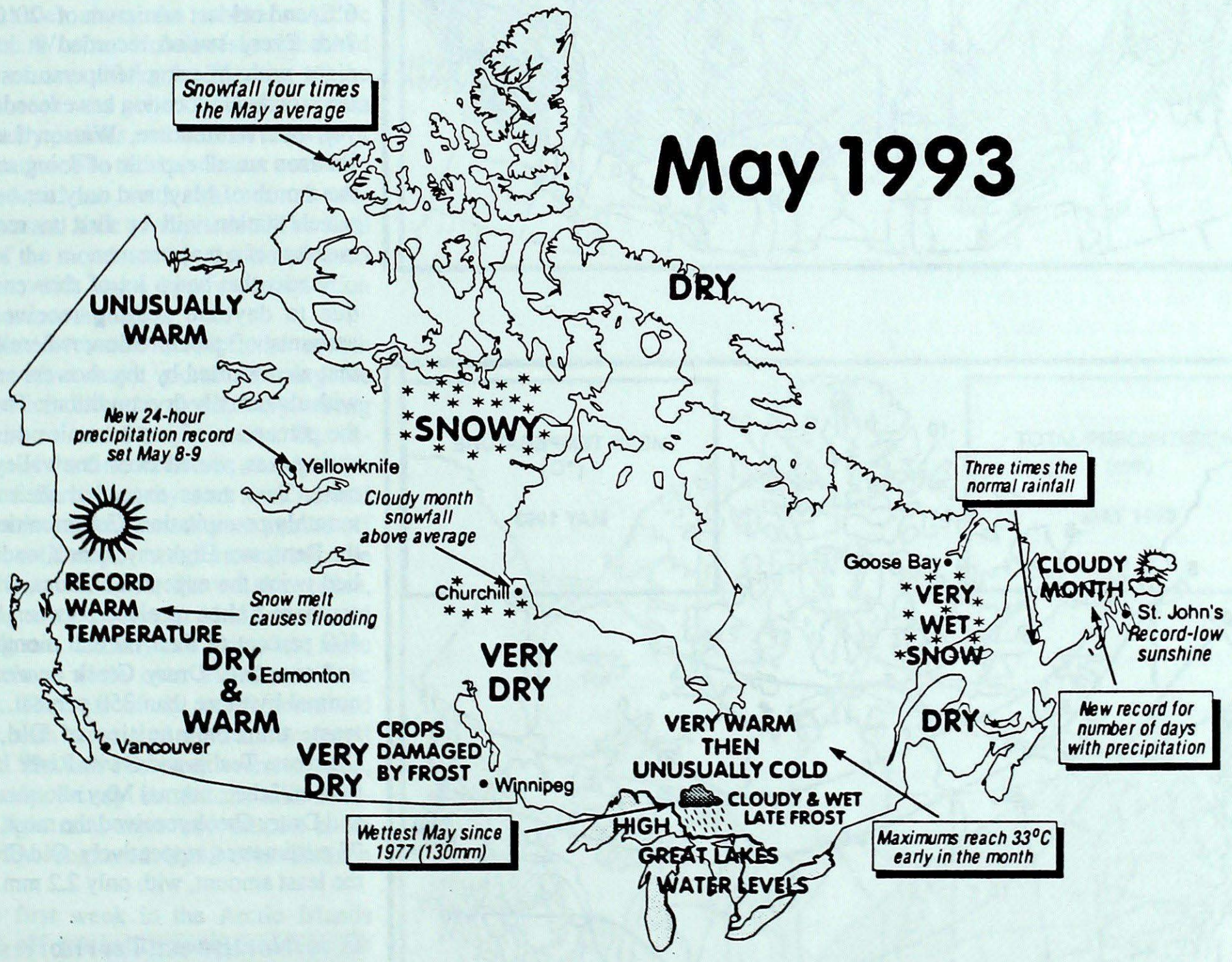
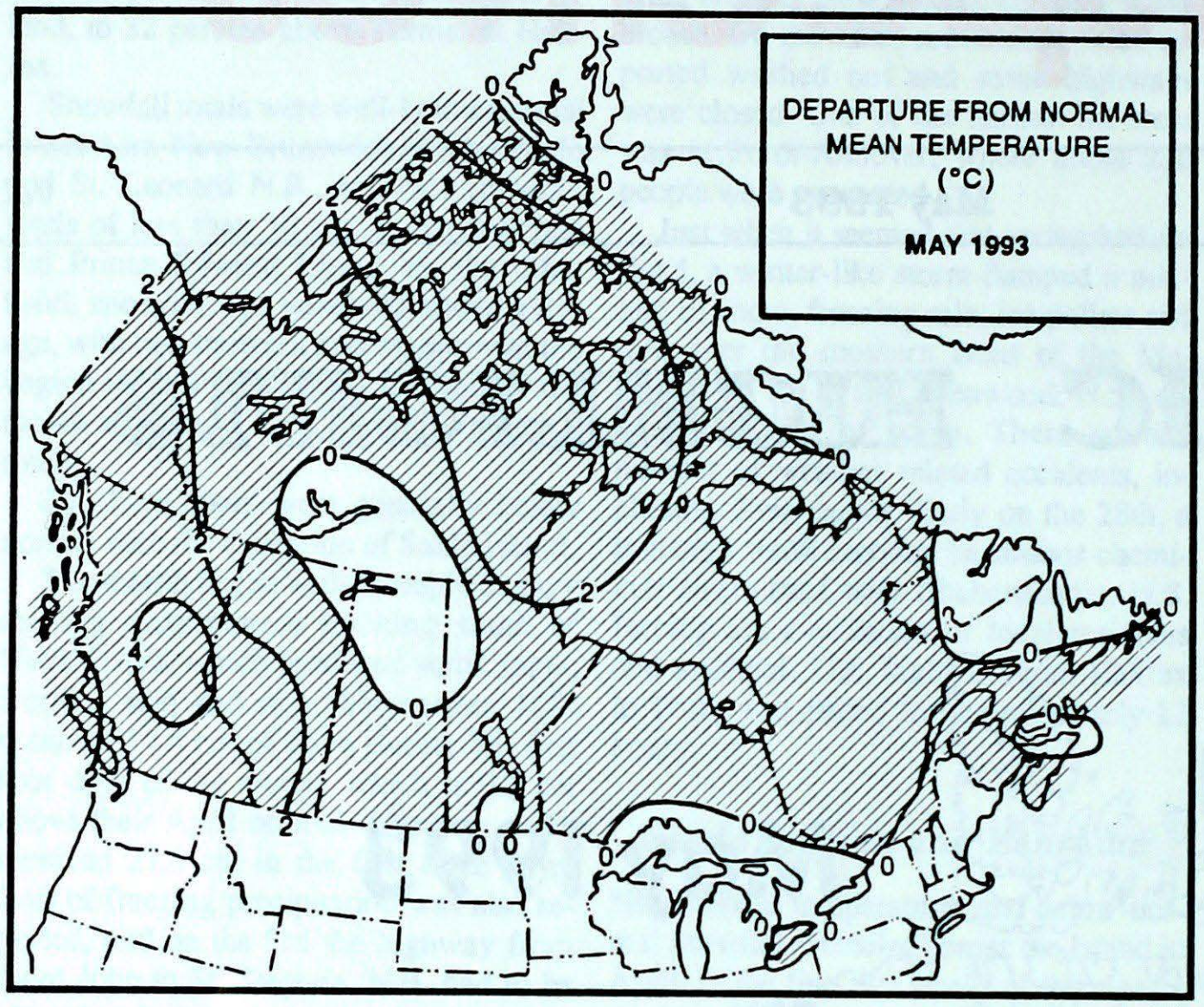
Climatic Perspectives

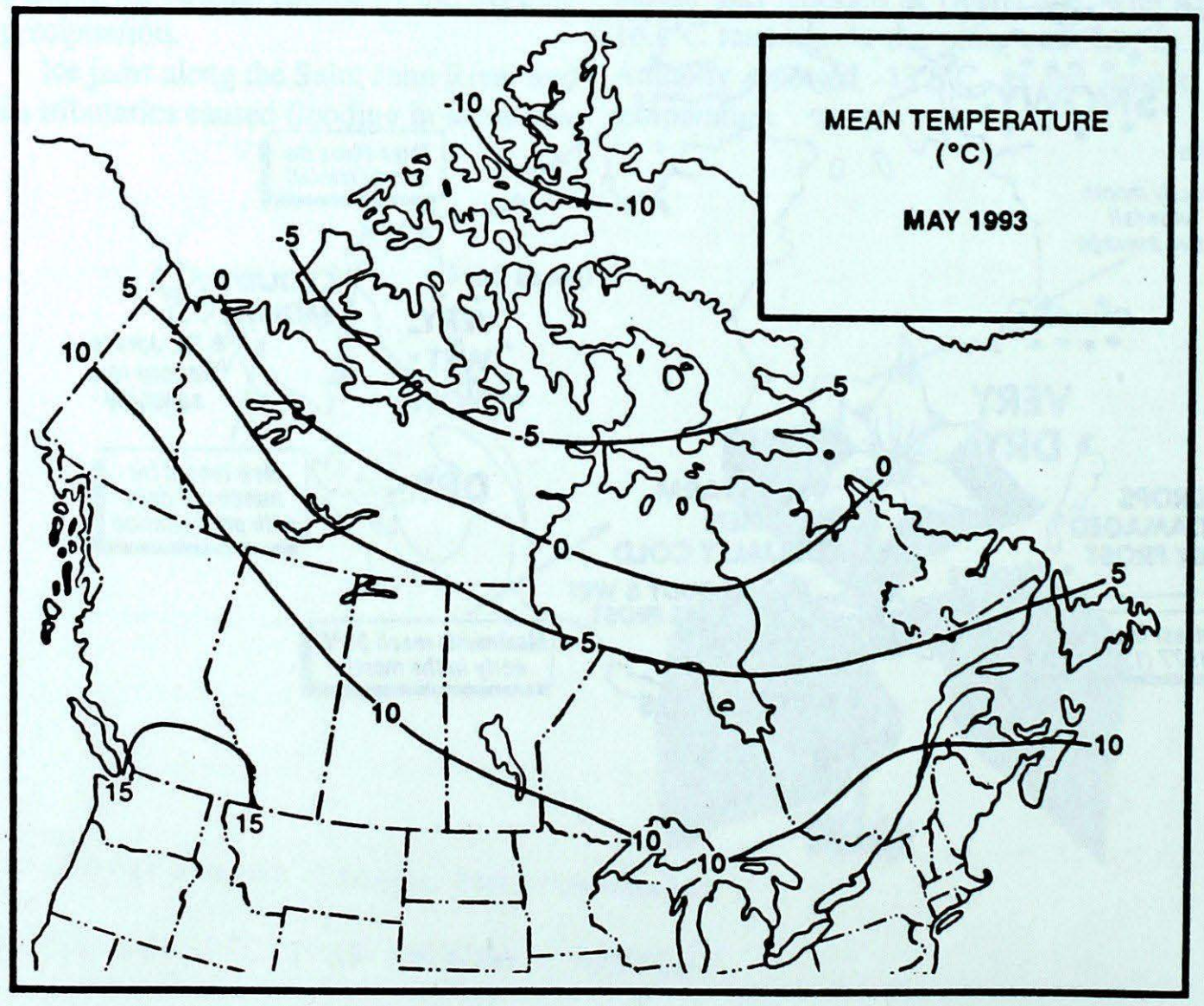
Monthly Review + Spring 1993 Review **May 1993** *Vol. 15*

CLIMATIC HIGHLIGHTS



Canada





Across the country

Yukon

May was the second consecutive month to have all locations exceed their normal monthly mean temperature. Last month, Whitehorse broke a high mean temperature record, and this month Whitehorse managed to tie the May record set back in 1942.

The Territory hot spot goes to Carmacks, with 28°C on the 16th. Several other stations managed to reach 27°C. Komakuk Beach held cold spot honours for recording the coldest maximum of only 6°C, and coldest minimum of -20°C on the 2nd. Every station recorded at least one night with freezing temperatures during the month. No location has exceeded 30°C yet, but Whitehorse, Watson Lake and Dawson are all capable of doing so during the month of May, and only time will tell which station will be first to reach this measure of a real summer.

Areas that had a lot of shower activity due to daytime heating received large amounts of precipitation, whereas areas that were skirted by the showers ended up with abnormally dry conditions. Therefore, the perception of just how nice this year's spring was, varied from one valley to the next. Two areas exceeded their normal monthly precipitation. Communities along the Dempster Highway, near Klondike, tallied twice the expected amount, while the southern Yukon received between 150 and 400 percent of their normal monthly rain and snowfall. Drury Creek exceeded the normal by more than 350 percent. In contrast, the communities of Old Crow, Carcross, Teslin and Swift River had less than half their normal May allotment. Faro and Drury Creek received the most, 77 and 73 millimetres, respectively. Old Crow had the least amount, with only 2.2 mm.

Northwest Territories

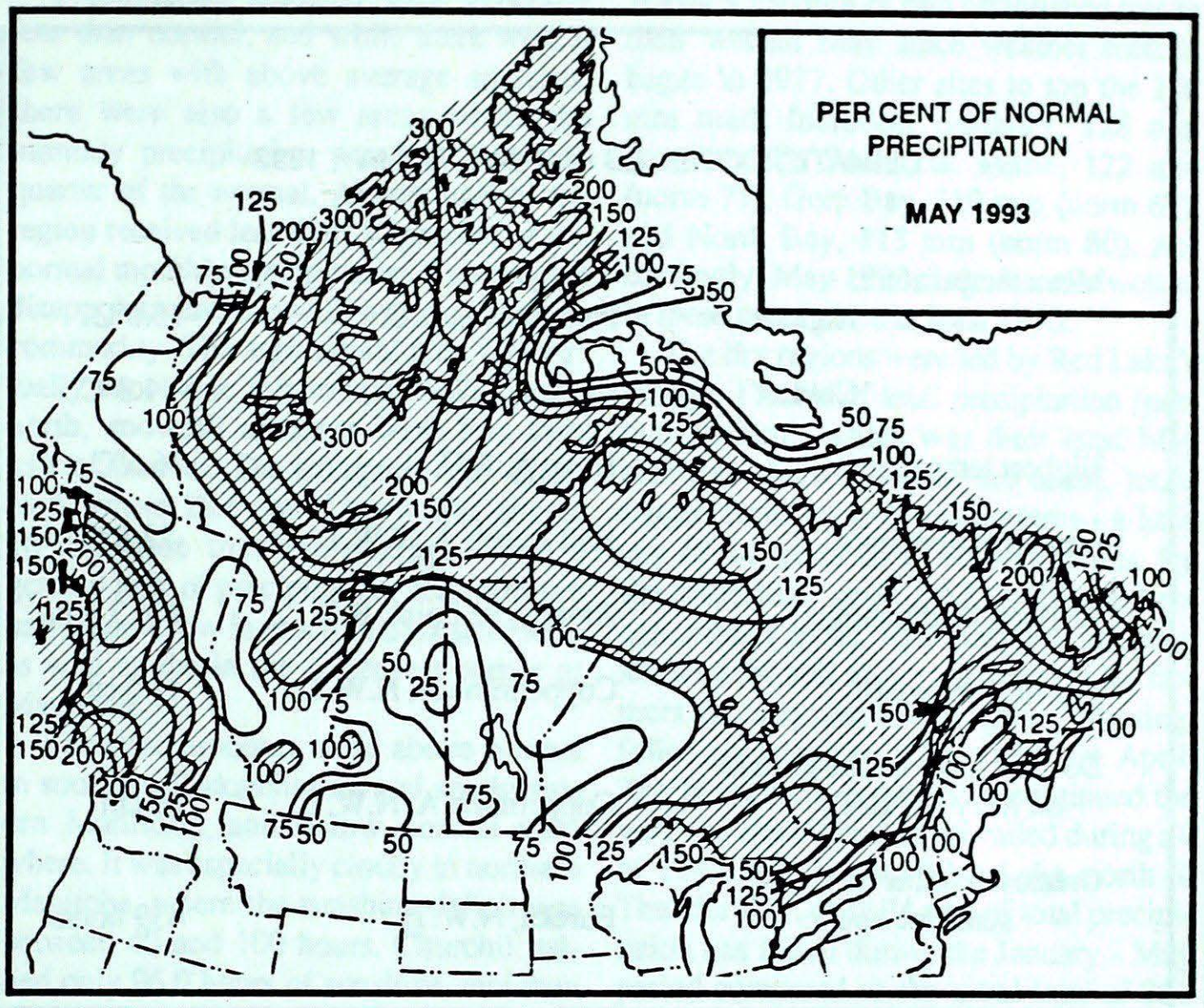
May continued where April left off, maintaining the cold temperatures in the eastern Arctic and the warm trend in the West. Temperatures during the first week alone,

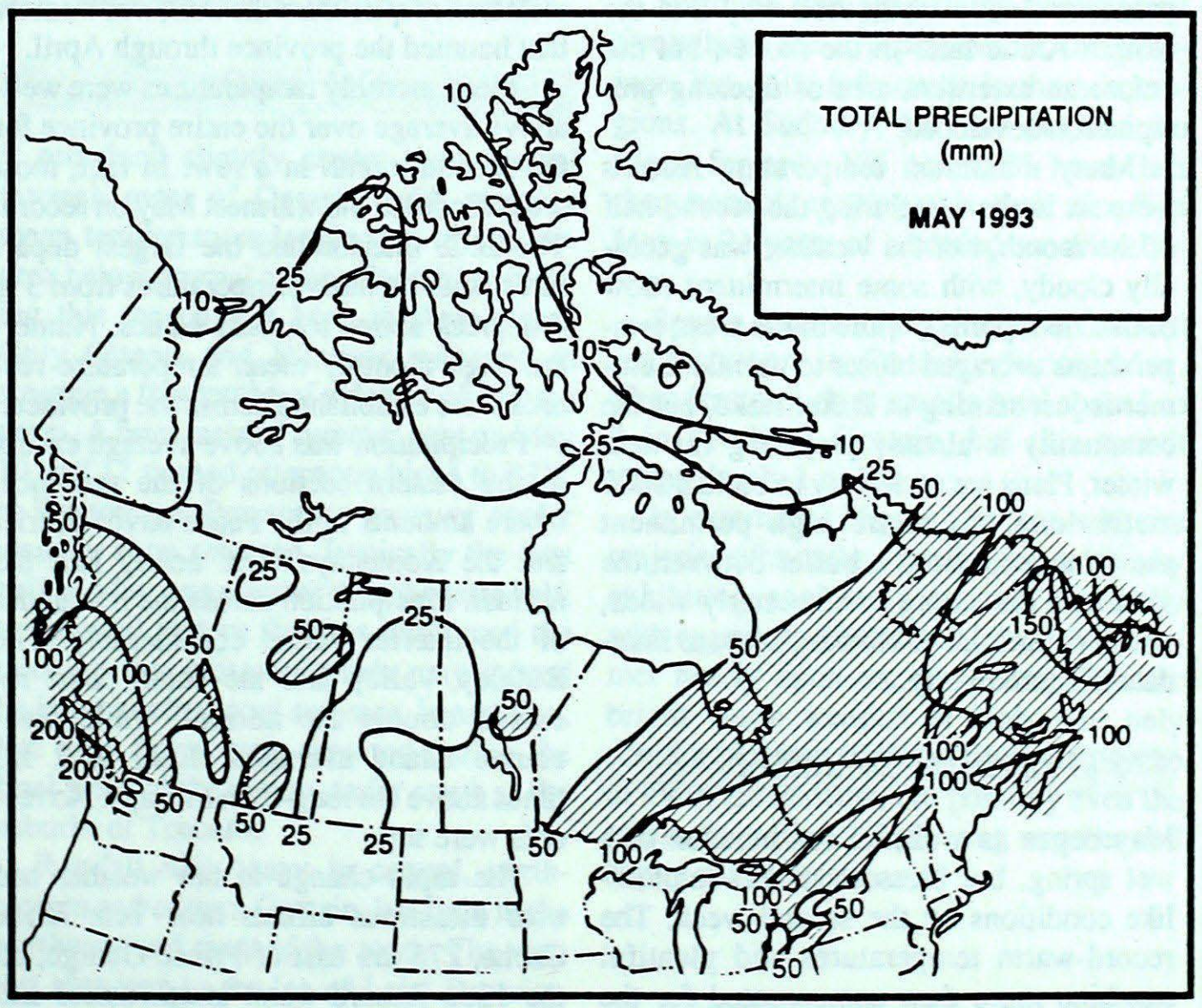
ranged from as low as -29°C at Hall Beach to as high as 28°C at Fort Smith.

In the Mackenzie Valley, the first week began dry, with a mixture of cloud and sun throughout the region. The mildest temperatures occurred in the southwest. The weekend of May 8 saw a major storm move northwards from Alberta to affect the Great Slave Lake region. Extensive precipitation was associated with this system in the form of rain and wet snow. Yellowknife received nearly 40 mm of precipitation during the weekend, setting new 24 hour precipitation records for May 8 and 9. Strong north winds accompanied this system. The storm gave blizzard conditions to communities along the southern Arctic coastline. Winds at Holman Island reached speeds of over 90 km/h. The rest of the second week was generally sunny, with a few cloudy periods and little in the way of precipitation. The third week saw a mixture of cloud and sun, with near-normal temperatures and little precipitation. The final week of the month saw a mixture of cloud and sun, with some spotty precipitation falling across the region.

In the Keewatin district, the month began with a major storm affecting the area, which brought cloud, very strong winds, snow and blowing snow. The remainder of the first week was cloudy, with scattered flurry activity and near normal temperatures. The second week started off stormy, as a major storm moved into the region from the Great Slave Lake region, bringing with it cloud, wind, snow and freezing rain. Luckily this storm lost some of its clout, while over the Great Slave region. The rest of the week remained cloudy, with occasional wind and scattered flurries. The last two weeks were marred, by cloudy, windy conditions and occasional light rain, snow and drizzle, as an upper low anchored itself over Hudson Bay.

The first week in the Arctic Islands started off generally sunny, except for some periods of cloud and wind along the Arctic Coast. By the second week, a storm moved into the western regions giving cloud, strong wind and snow. Mould Bay received over 30 cm of snow - almost four times the amount for May. Spring-like tem-





CLIMATIC EXTREMES IN CANADA - MAY, 1993

Mean temperature:		
Highest	Penticton A, B.C.	16.6°C
Coldest	Eureka, N.W.T.	-11.3°C
Highest temperature:	Hope A, B.C.	36.6°C
Lowest temperature:	Hall Beach A, N.W.T.	-28.8°C
Heaviest precipitation:	Amphitrite Point, B.C.	266.3 mm
Heaviest snowfall:	Coppermine A, N.W.T.	47.0 cm
Deepest snow on the ground on May 31, 1993	Coppermine A, N.W.T.	66 cm
Greatest number of bright sunshine hours:	Eureka, N.W.T.	439 hours

peratures finally made their way into the eastern Arctic later in the month, but not before an extensive area of freezing precipitation developed.

Many maximum temperature records were set in the east during the second half of the month, but the weather was generally cloudy, with some intermittent snow or drizzle reported, while in the west, temperatures averaged closer to normal. Summer is just starting in Baker Lake, but the community is already preparing for next winter. Plans are underway to build a 2000 metre long, six-metre high permanent snow fence to act as a buffer between the town and the strong northwesterly winds, which cause a lot of blowing snow to inundate the community.

British Columbia

May began as a dismal continuation of a wet spring, but blossomed into summer-like conditions by the second week. The record-warm temperatures and plentiful sunshine more than compensated for the above-average precipitation, which was a welcome respite from the dull, wet weather that haunted the province through April.

Mean monthly temperatures were well-above average over the entire province for the second month in a row. In fact, most areas recorded the warmest May on record. The B.C. interior had the largest departures, with monthly temperatures from 3 to 4 degrees above seasonal values. Numerous high monthly mean temperature records were established across the province.

Precipitation was above average except in the eastern sections of the province, where amounts in the Peace River district and the Kootenays were nearly half the normal. Precipitation across the remainder of the interior varied considerably. The Bulkley Valley and the south coast received double the normal, while Vancouver Island averaged closer to 2 1/2 times above the long-term average. No records were set.

The rapid change to hot weather had near disastrous effects near Tete Jaune Cache, 275 km east of Prince George, on the 13th. Record-warm temperatures and eight consecutive days of high freezing levels caused rapid snow melt in the mountains. Some mountain streams were plugged by snow avalanches. When these temporary dams burst, flash flooding and mud slides ensued.The warm weather also resulted in flooding in the historic Barkerville area, as snowmelt and precipitation from a thunderstorm caused a local stream to overflow its banks.

The dry trend, which began during the second week of May, allowed many springtime activities such as haying and planting to commence. Activities associated with summer recreation also got underway. In spite of the above-normal precipitation earlier in the month, the warm temperatures further depleted the already low mountain snowpacks, and water shortages are still possible later this summer.

Sunshine was near or above average over most of the province in spite of the heavy precipitation that had occurred earlier. The southeast was the sunniest, with amounts averaging from 120 to 125 percent of long-term values. The northeast and southwest were the exceptions, with sunshine hours averaging slightly below normal. No records were established.

Alberta

It was in general, a seasonally dry and warm month. Only small areas in the southern and the northeastern portions of the province were unusually wet, where precipitation exceeded 50 mm. The month started off sunny, with brisk southerly winds. Daytime maximums dropped on the 2nd, as strong northwesterly winds developed behind a southbound cold front. Showers, developing along the foothills, spread eastward late in the day. Fort McMurray saw a record high temperature of 26.1°C on the May 5. An area of precipitation lingered in the eastern regions, resulting in as much as 50 mm of rain.

A southerly flow of warm air resulted in dozens of record-high temperatures above the 30 degree mark across the province on the 11th and 12th. By the 14th a building ridge across northern and central regions produced mainly clear conditions, giving

sunny days and cool nights with frost reported from Edmonton northeastwards on the 16th. Southern regions saw unsettled conditions during this period with late day thundershowers producing small hail at some locales.

Only a few light showers were reported until May 21, when a system tracked across the province producing rain and wet snow in the north, and thundershowers in the central parts of the province. Edson received 21.6 mm of rain. The system produced cloud and showers over the entire province on the 22nd, with temperatures struggling into the double digits. There was a slow improvement in the southern regions on the 23rd and 24th, resulting in sunny skies and highs in the low twenties. Meanwhile, cold air plagued the north, with snow reported on May 24, and a record low of -5.0°C at Fort Chipewyan on the 25th. Frost was a problem for the next few days, while temperatures gradually recovered. A disturbance brought rain to south-central areas on the 29th (Calgary measured 18.6 mm), and kept temperatures around 10°C. A building upper ridge brought considerable improvement on May 30 and 31, with temperatures climbing to the mid-twenties under mainly sunny skies.

Manitoba and Saskatchewan

The month featured near-normal temperatures, and although there were a few pockets with above-normal precipitation, most areas were dry. Temperatures early in the month were warm, while the latter half was cool. The warm spell at the beginning of the month, when maximum readings approached or exceeded 30°C throughout much of the region, might have fooled some gardeners into thinking it was safe to plant their gardens early. Frequent frost later in the month forced backyard gardeners to cover their precious crops, while larger scale producers were forced to replant. In Manitoba, a killing frost on May 26, was responsible for significant damage to the canola crop. An estimated 25,000 acres of canola had to be reseeded because of the frost.

Precipitation amounts were generally less than normal, and while there were a few areas with above average amounts, there were also a few areas where the monthly precipitation was less than one quarter of the normal. Almost half of the region received less than 50 percent of the normal monthly precipitation. To no one's disappointment, snowfall was also a scarce commodity. The agricultural area was virtually snow free this month, while in the north, snowfall amounts were less than half of normal. The exception was Churchill, where 28.4 cm of snow was almost 10 cm more than the average. With a general lack of precipitation, soil moisture has become low in much of Saskatchewan, as well as the in the southwest corner of Manitoba.

Sunshine amounts were above normal in southern Saskatchewan and southwestern Manitoba, and below normal elsewhere. It was especially cloudy in northern Manitoba, where the sunshine deficit was between 40 and 100 hours. Churchill tallied only 96.0 hours of sunshine, less than half of the normal of 198.9 hours. In the area where sunshine hours were above normal, surpluses ranged from 3 to 30 hours.

Ontario

It remained slightly cooler than normal through most of Ontario, with monthly mean temperatures lagging up to one degree below normal at most localities, making this the coolest May in three years. Only Ottawa and Windsor managed to struggle a few tenths of a degree above the norm. A brief taste of summer heat on May 10 and 11 pushed afternoon highs to 33°C at Earlton and Petawawa, however cooler weather soon returned. Ironically the first half of May was warmer than the later half; an unusual pattern that has reinforced the thinking that eastern Canada may indeed be in for another cool summer. In addition, late May frosts were reported during the final week of the month, as far south as the suburbs of Toronto.

Rainfall was heavy in central, northeastern and eastern Ontario, but light in the northwest and most of the south. The wettest area was to the lee of Lake Superior. Wawa's 130 mm of rain established this as their wettest May since weather records began in 1977. Other sites to top the 100 mm mark included: Sudbury, 128 mm (normal 71); Sault Ste. Marie, 122 mm (norm 71); Gore Bay, 119 mm (norm 62); and North Bay, 113 mm (norm 80). Accordingly, May 1993 ranked as the wettest in these areas since at least 1990.

The dry regions were led by Red Lake's meagre 17 mm of total precipitation (normal 54 mm), which was their least May moisture since 1976. In the south, totals ranged from 40 to 60 millimetres - a little shy of the usual 60 to 80 millimetres, for the driest May since 1988. In the southern agricultural areas, light May precipitation allowed the soil to dry sufficiently for farmers to carry out timely spring planting, following a snowy winter and wet April. The Northwest, meanwhile, continued the very dry trend that has prevailed during all of 1993, to-date. At Pickle Lake, north of Thunder Bay, only 74 mm of total precipitation has fallen during the January - May period compared to the usual total of 201 mm. The forests, as a result, are entering the summer in very dry condition.

Sunshine was predictably near normal throughout the dry portions of the province, but quite infrequent in the rainy regions. At Sudbury, for example, the sun shone for only 176 hours, 75 hours less than normal, making this their cloudiest May in 21 years of recorded sunshine history.

Severe weather episodes were few and far between in Ontario during May. Thunderstorm-days usually total about 3 to 4 in southern Ontario, but this month counted only 1 or 2.

In summary, May fell in line with the majority of months over the past twelve by exhibiting cool temperatures, especially with regards to afternoon highs. With summer nearly upon us, the anticipation for bright warm weather is high. Not only could a pleasant summer buoy the psyche of Ontario residents, but possibly even the economy, with good growing weather and happy vacationers.

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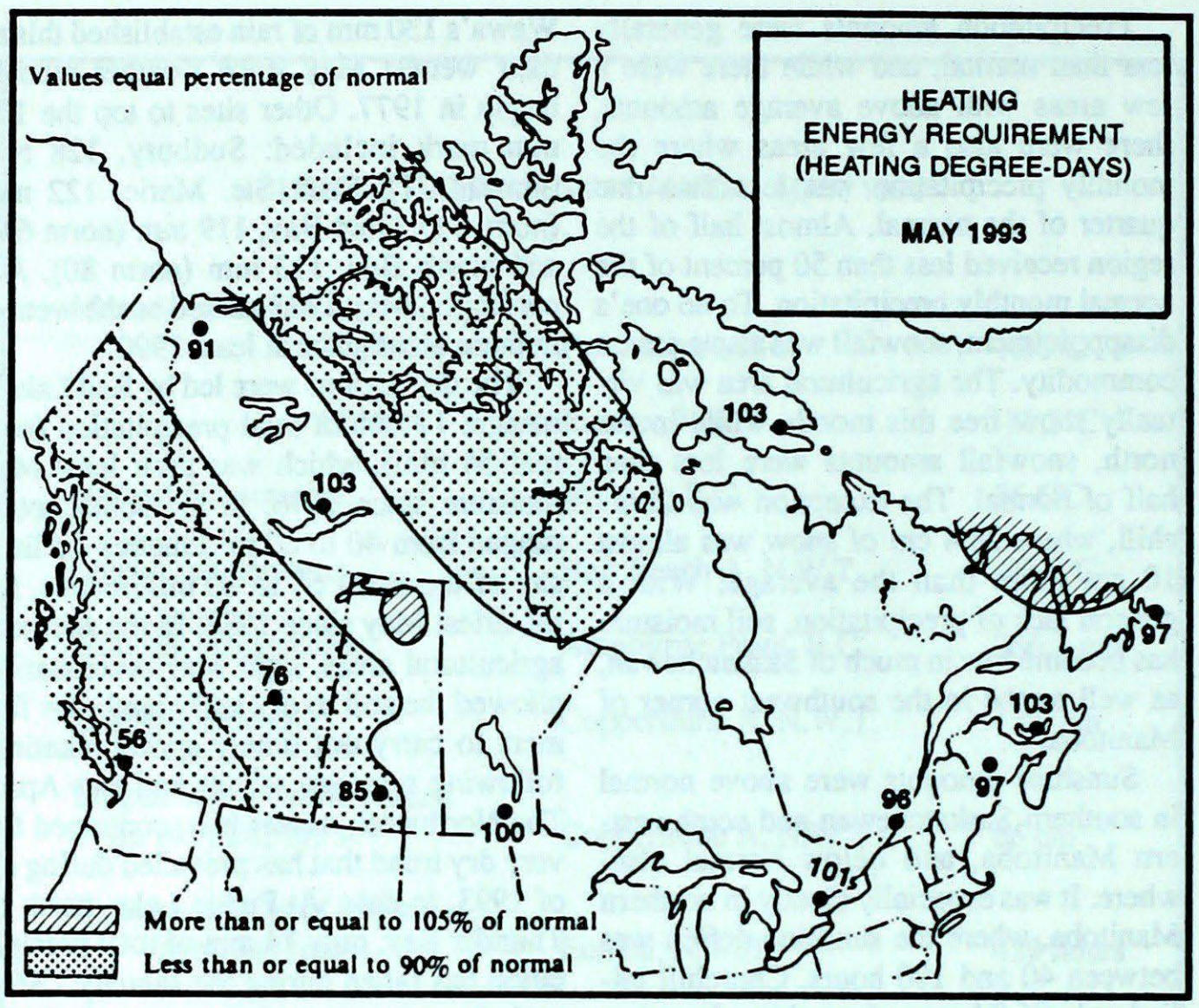
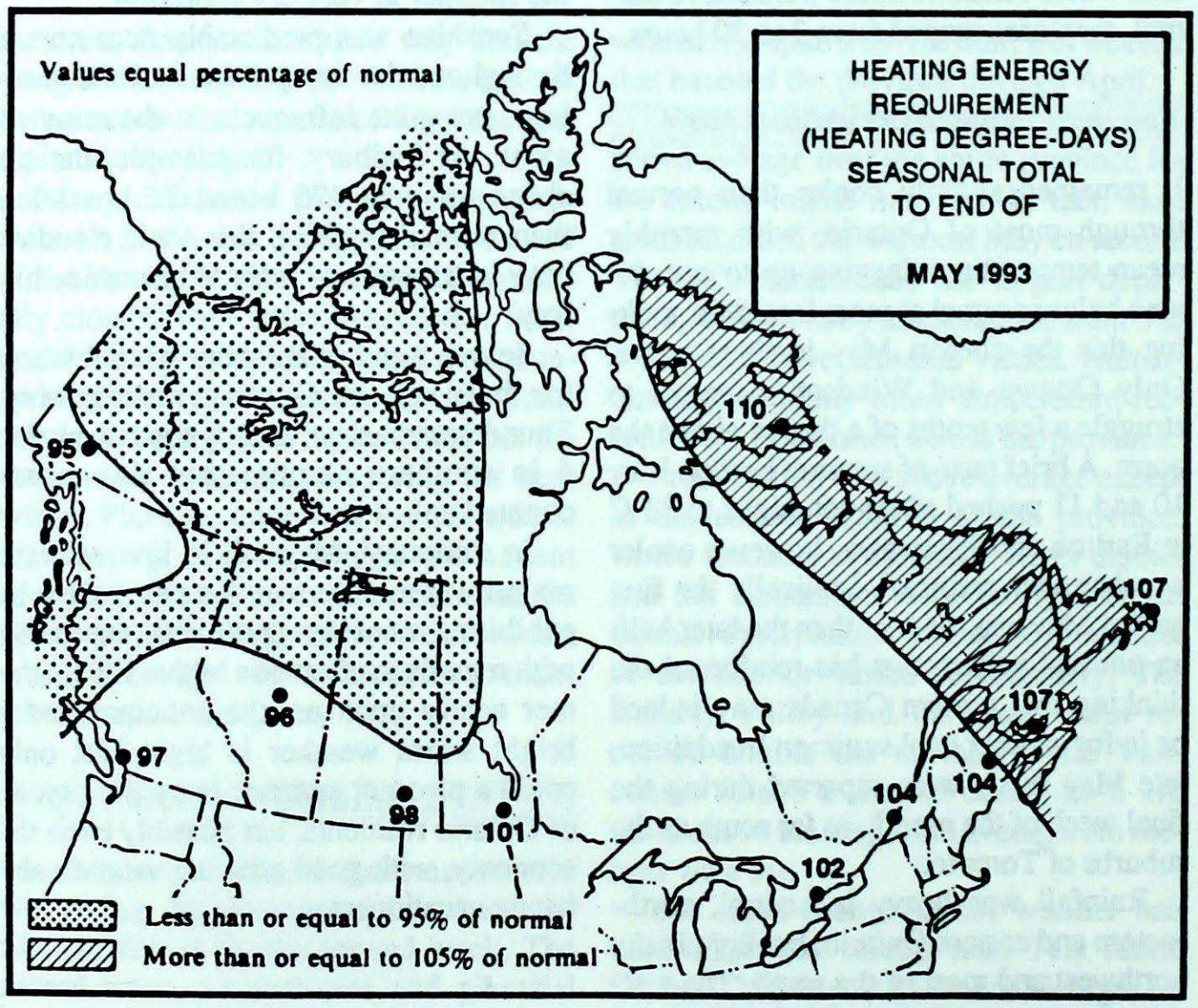


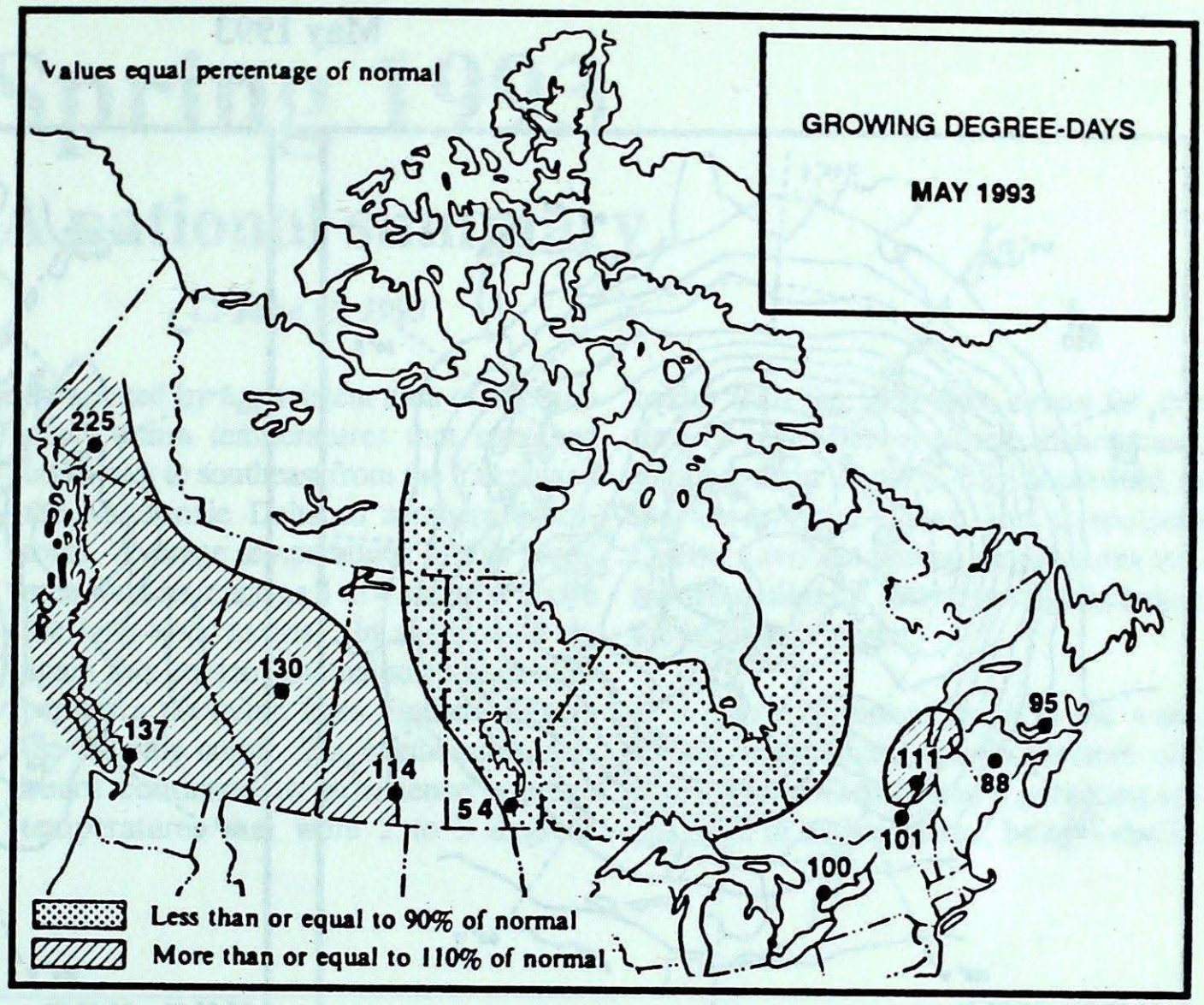


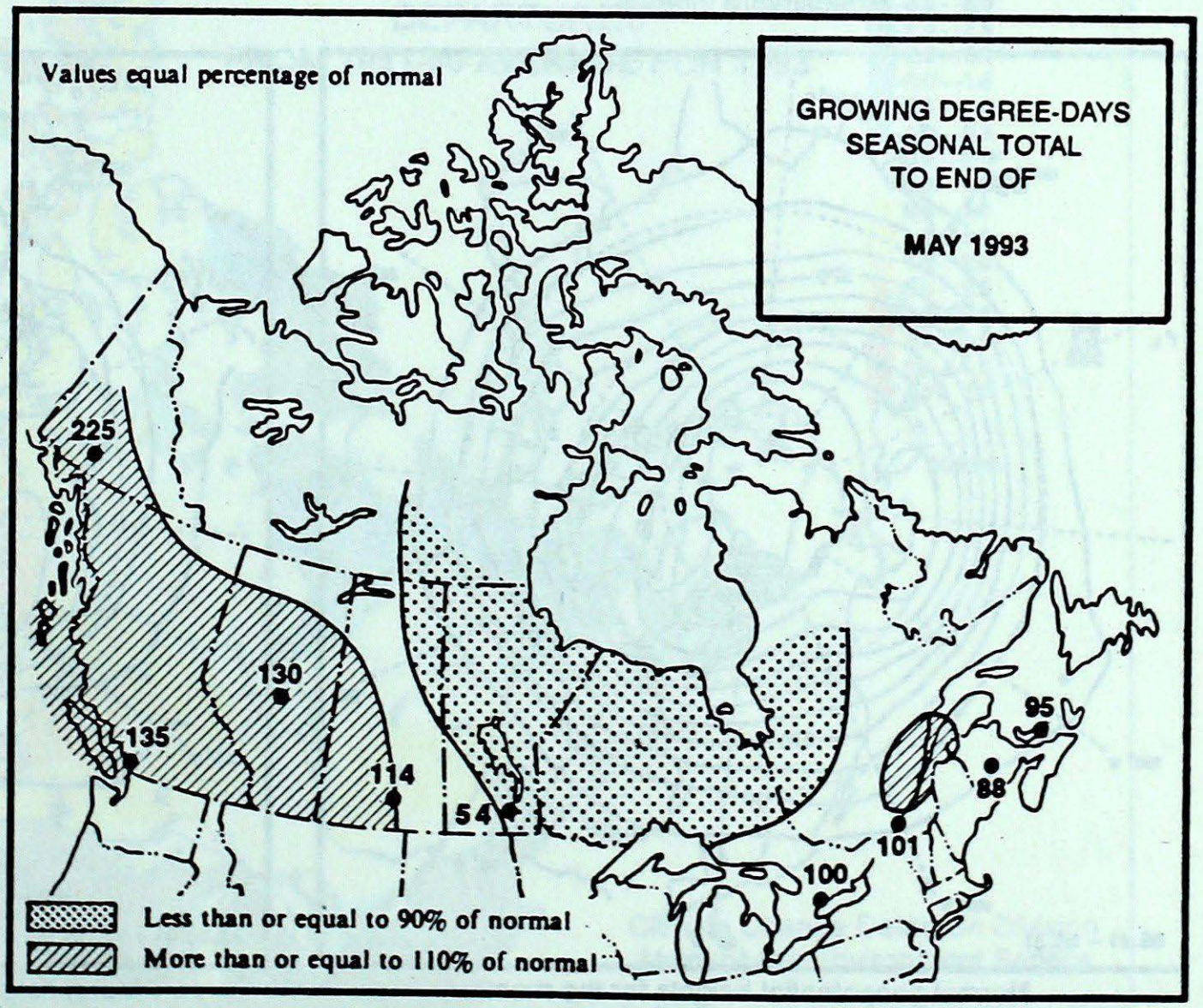
SEASONAL TOTAL OF HEATING DEGREE-DAYS TO END OF MAY

	1993	1992	NORMAL
BRITISH COLUMBIA			
Kamloops	3909	3012	3663
Penticton	3542	2937	3412
Port Hardy	3277	3043	3492
Vancouver	2813	2506	2912
Victoria	2883	2595	2987
YUKON TERRITORY			
Whitehorse	6468	6227	6793
NORTHWEST TERRITORIES			
Iqaluit	10392	9998	9478
Inuvik	9046	9829	9856
Yellowknife	7659	8427	8335
ALBERTA			
Calgary	5124	4327	5186
Edmonton Mun.	5128	4712	5324
Grande Prairie	5804	5318	5977
SASKATCHEWAN			
Estevan	5544	4898	5350
Regina	5613	5137	5710
Saskatoon	5849	5386	5895
MANITOBA			
Brandon	6040	5851	5959
Churchill	8697	9079	8805
Dauphin	5763	5725	5978
Winnipeg	5806	5501	5764
ONTARIO			
Kapuskasing	6283	6417	6232
London	4091	3964	4009
Ottawa	4672	4754	4574
Sudbury	5377	5420	5282
Thunder Bay	5658	5606	5580
Toronto	4095	3947	4022
Windsor	3517	3483	3530
QUEBEC			
Baie Comeau	6060	6061	5820
Montréal	4602	4660	4432
Québec	5153	5290	5028
Sept-Îles	6407	6326	5953
Sherbrooke	5096	5152	5082
Val d'Or	6192	5928	5975
NEW BRUNSWICK			
Fredericton	4802	4830	4595
Moncton	4913	4890	4601
NOVA SCOTIA			
Sydney	4648	4606	4325
Yarmouth	4157	4072	3910
PRINCE EDWARD ISLAND			
Charlottetown	4829	4732	4513
NEWFOUNDLAND			
Gander	5399	5281	4842
St. John's	4905	4912	4579

SEASONAL TOTALOF GROWING DEGREE-DAYS TO END OF MAY

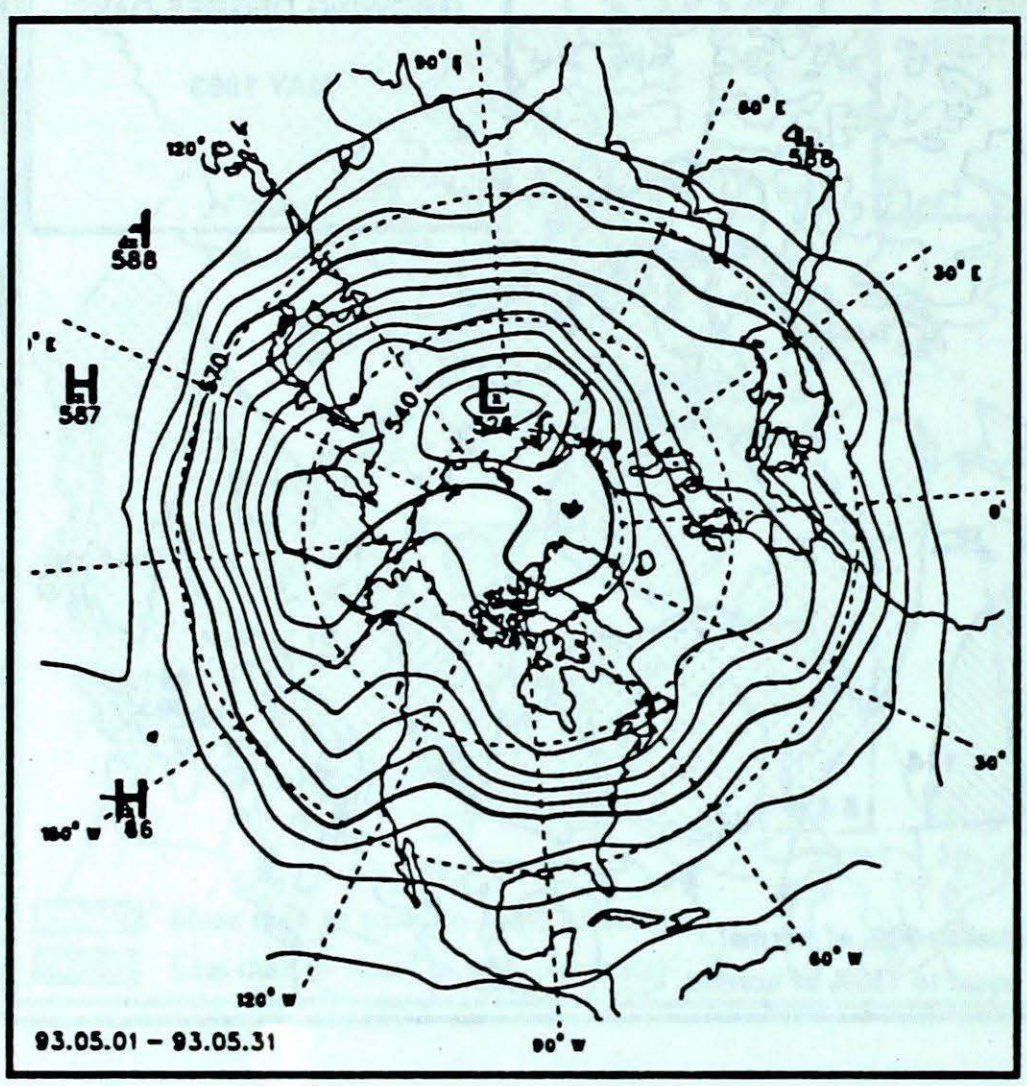
	1993	1992	NORMAL
BRITISH COLUMBIA			
Abbotsford	373	500	249
Kamloops	315	462	204
Penticton	401	429	294
Prince George	281	41	142
Vancouver	349	470	258
Victoria	330	374	237
ALBERTA			
Calgary	201	31	135
Edmonton Mun.	259	36	200
Grande Prairie	229	39	154
Lethbridge	279	46	196
Medicine Hat	281	*	229
Peace River	218	32	144
SASKATCHEWAN			
Estevan	180	16	182
Prince Albert	180	22	153
Regina	202	17	177
Saskatoon	184	40	183
MANITOBA			
Brandon	163	21	164
Churchill	*	*	*
Winnipeg	38	43	70
ONTARIO			
London	229	245	219
North Bay	166	7	167
Ottawa	248	279	230
Thunder Bay	32	18	59
Toronto	216	248	215
Trenton	214	243	221
Windsor	303	308	278
QUEBEC			
Baie Comeau	43	*	43
Maniwaki	189	156	189
Montréal	240	276	237
Québec	194	192	174
Sept-Îles	32	*	31
Sherbrooke	178	18	165
NEW BRUNSWICK			
Fredericton	100	102	114
Moncton	71	*	70
NOVA SCOTIA			
Sydney	70	55	70
Yarmouth	132	100	125
PRINCE EDWARD ISLAND			
Charlottetown	56	11	59
NEWFOUNDLAND			
Gander	*	*	*
St. John's	*	*	*
Stephenville	75	24	46



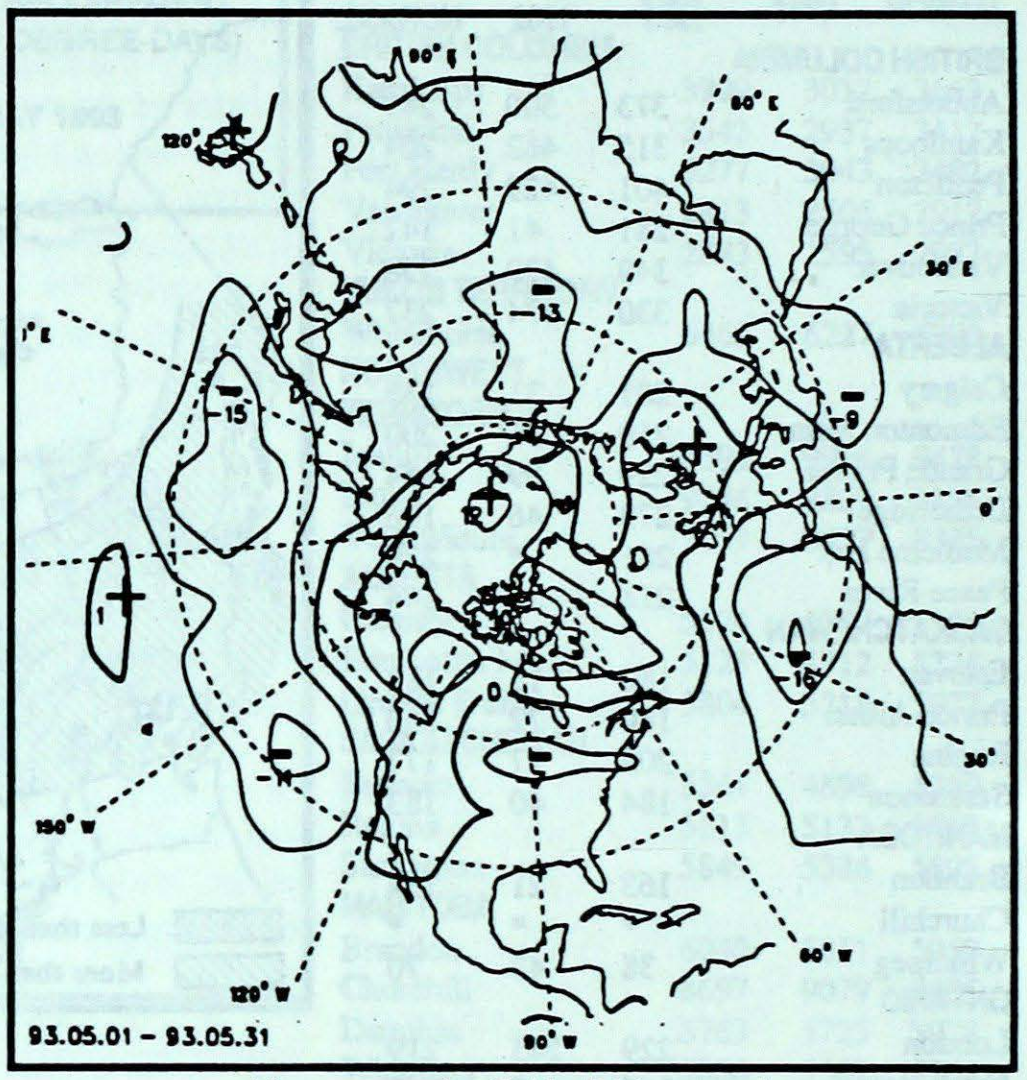


50-kPa ATMOSPHERIC CIRCULATION

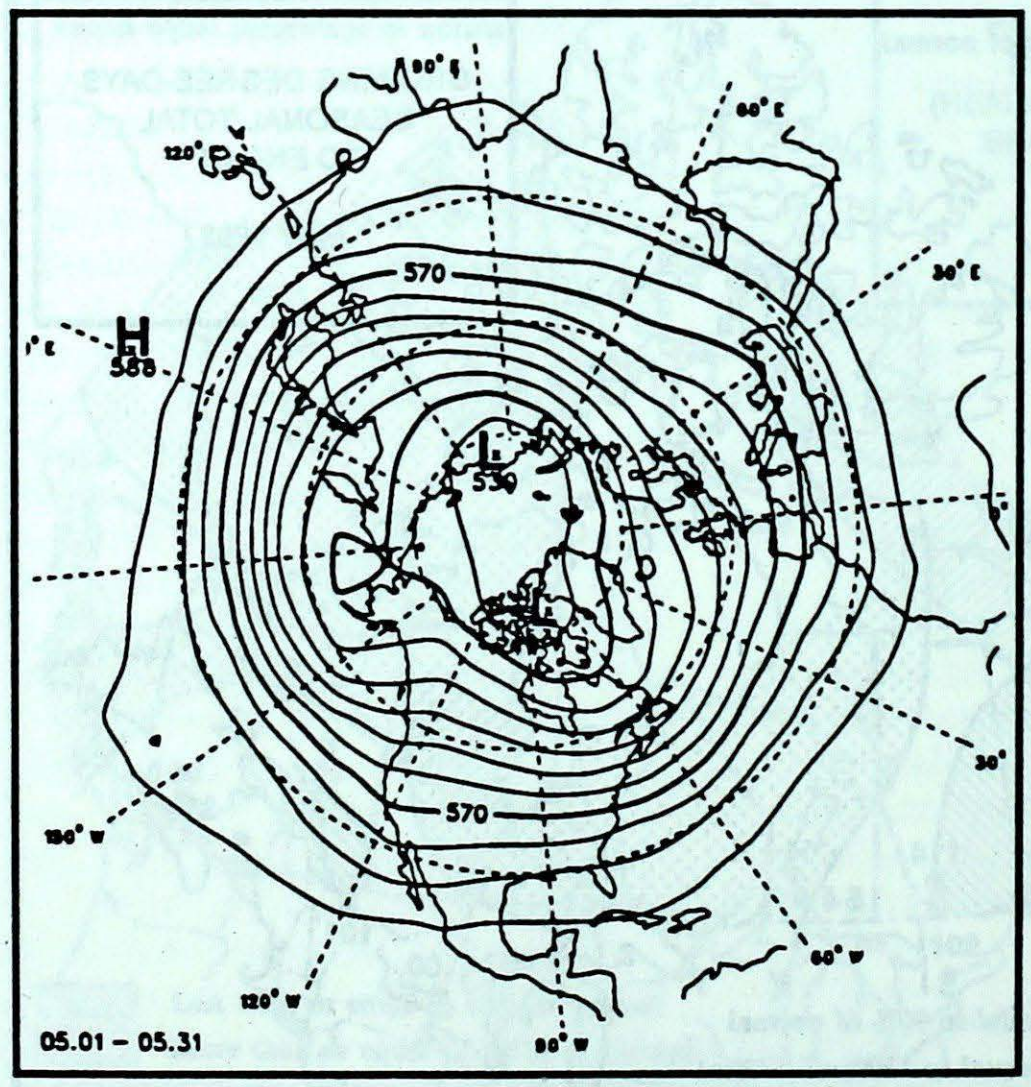
May 1993



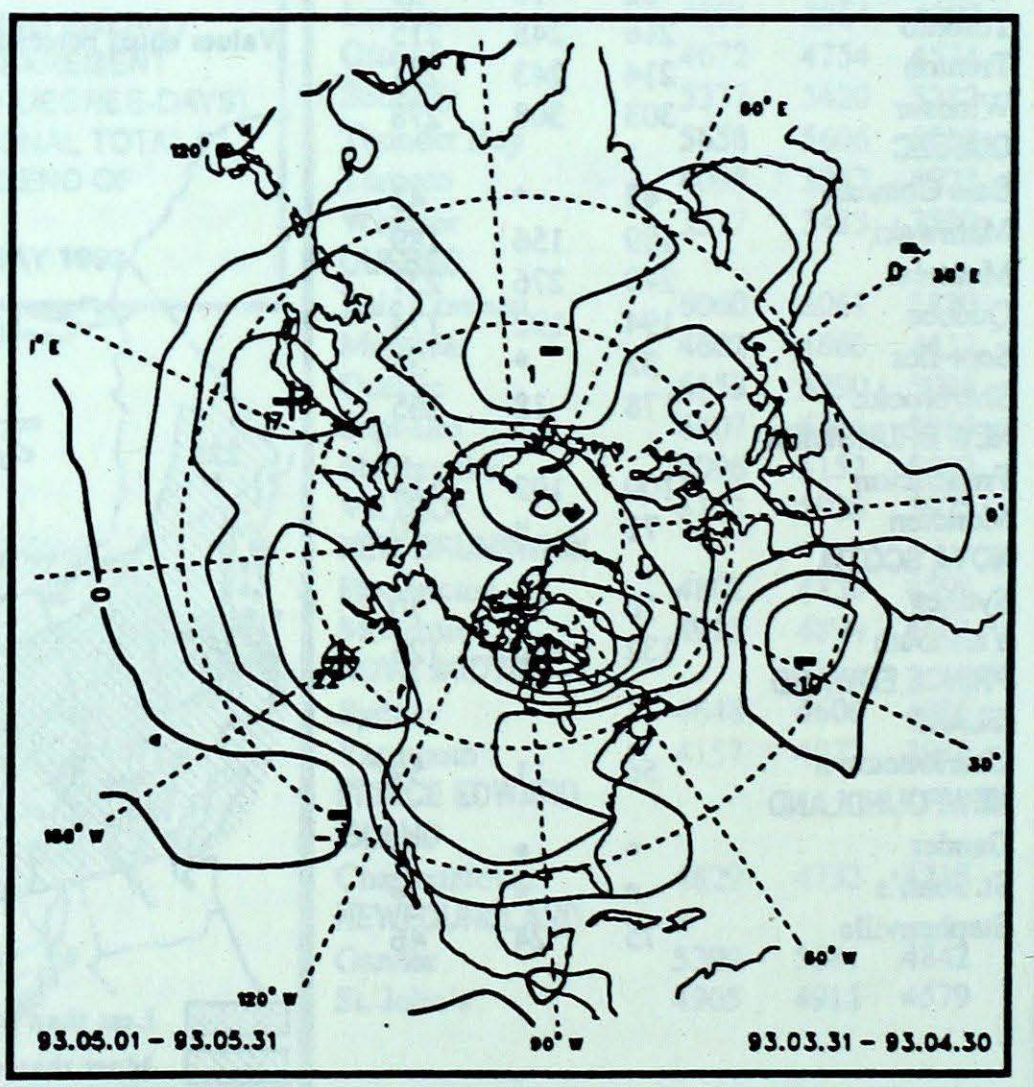
Mean geopotential heights
- 5 decametre interval -



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 -

Spring 1993

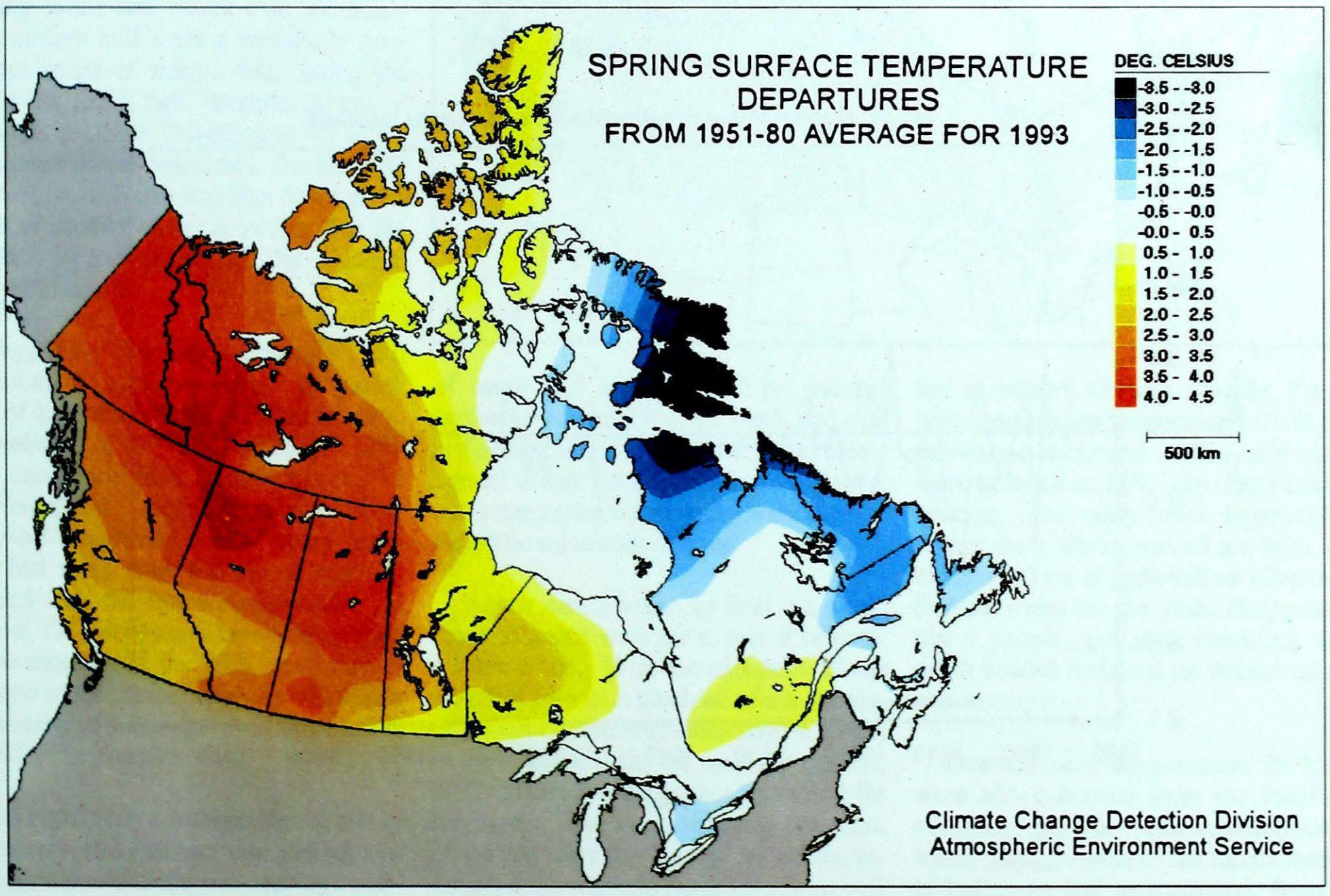
A national summary

□ *June 15, 1993*

The national average temperature for spring 1993 was 1.2°C above the long-term mean, making the March, April and May period this year the 14th warmest since 1895. Over this 99 year period, Canada has experienced a spring-time warming increase of 1.3°C. In fact, eight of the last ten springs have been warmer than the long-term mean.

The national average temperature departure map for the spring of this year was dominated by a persistent area of anomalously warm temperatures that stretched northwest to southeast from the Yukon and the Mackenzie Delta to southern Manitoba. Average temperatures in this broad area were as much as 3 to 4 degrees above the long-term means. In sharp contrast, again this season, anomalously cool temperatures prevailed from Hudson Bay to the Atlantic coast. The northeastern seaboard continued to experience average temperatures that were 2 to 3 degrees colder than the long-term means for this time of year. Between these dichotomous regions, from Hudson Bay southward to the lower Great Lakes, and to southern Québec, average spring temperatures varied from slightly above to slightly below the long-term means.

A likely causative factor in the warm spring experienced across western and northwestern Canada was a persisting upper ridge of high pressure, being a similar



feature in size and extent to that established last year during the El-Niño event. In May 1992 the effects in Canada of El-Niño seemed to end, but later some features resumed, and many characteristics of El-Niño still persist in the tropical Pacific, suggesting that this has been the longest episode since 1941. Experts expect it to end shortly. In northeastern Canada, on the other hand, the cooling that continued through spring 1993, has been attributed in part to the lingering volcanic aerosols from Mount Pinatubo across the Arctic, and in part to the greater snowfall and sea ice accumulations in this region during the past winter. These same volcanic aerosols, may have also suppressed to some extent, the warming experienced throughout northwestern Canada.

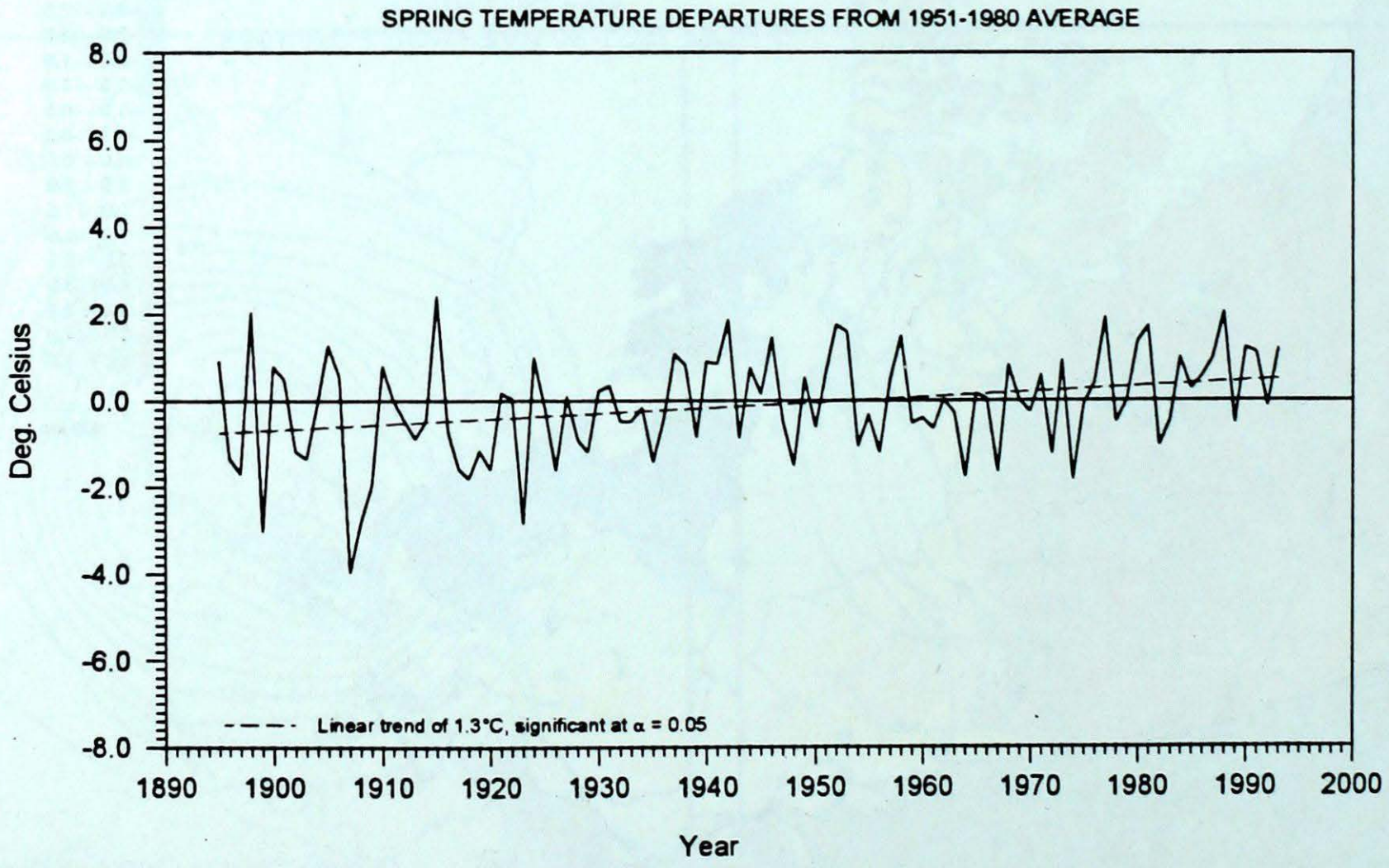
Precipitation amounts during spring 1993 were well above the long-term means along the Atlantic and Pacific coasts. Eastward-tracking disturbances off the Pacific Ocean, unable to penetrate the well-developed ridge, lost their moisture along the west-facing slopes of the coastal mountain ranges. On the other side of the continent, Atlantic Canada continued to be frequented by storms of tropical origin, again associated with El-Niño-related circulation patterns, tracking northeastward along the Atlantic seaboard and producing large amounts of precipitation.

Much of eastern Canada, including the Atlantic region, the Great Lakes Basin, and the northeastern seaboard region, comprising southern Baffin Island, northern Québec, and Labrador, experienced average spring temperatures that were reminiscent of those of a year ago, with values a few tenths of a degree below the long-term means.

West and northwest of a line from Hudson Bay to Lake Winnipeg average spring temperatures were considerably above the long-term means. From the southern Prairie provinces, northward through the boreal forests, to the Mackenzie River basin, spring 1993 was the 4th spring in a row with anomalously warm temperatures. Nine of the last ten springs in this region of the country have likewise been warmer than the long-term means. In the northern Prairie provinces and the Mackenzie Basin region, spring 1993 was in the warmest 3% and 2% respectively, of springs there since 1895. Further west, spring 1993 represents yet another in a long sequence of abnormally warm springs. It was the 11th consecutive warm spring in the interior British Columbia mountains, 8th along the Pacific coast and 7th in the Yukon Territory. In these regions, spring 1993 was among the warmest 8% of springs there since 1895, and in fact, in the Yukon Territory, it was among the warmest 4%.

Climate Change Detection Division

CANADA
1895-1993

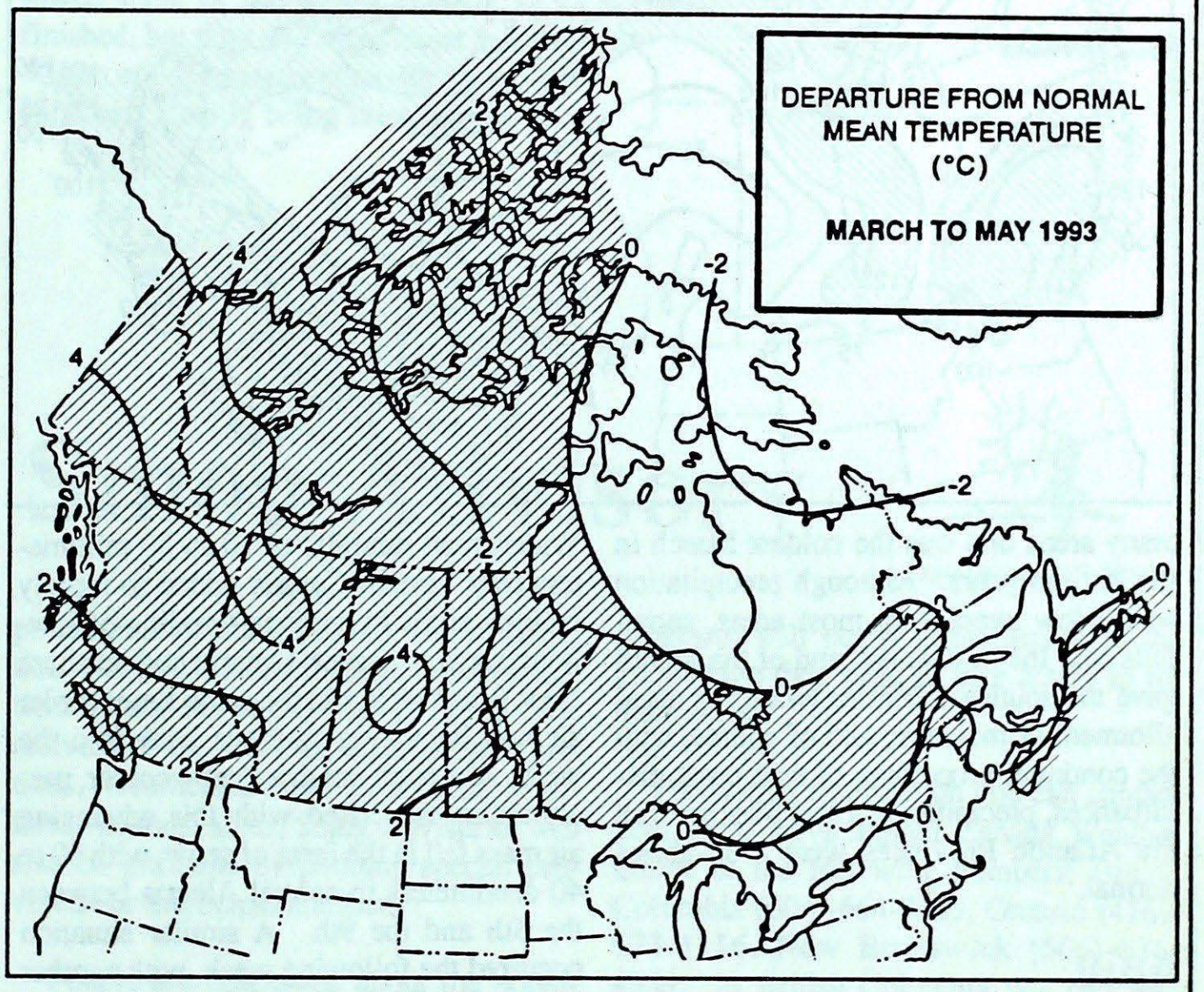


Spring 1993 - supplement

March

As March began, early spring conditions dominated western Canada. Daytime highs reached into the mid-teens for the first few days of the month and several new records were set. This was not to last however, as successively cooler air masses moved through the west, leaving most of the country several degrees below normal by the mid-month.

For the east, these cold temperatures were merely an extension of conditions that had dominated since the early winter. Adding to the late winter over the country's eastern half were a seemingly continuous series of storms that, during the first week and a half, dropped 20 cm of snow on southern Ontario and 40 to 60 centimeter on the Maritimes. On the 11th, much of Nova Scotia was shut down as the result of another 45 cm snowfall. But the month's biggest storm, and the winter's, was yet to come.

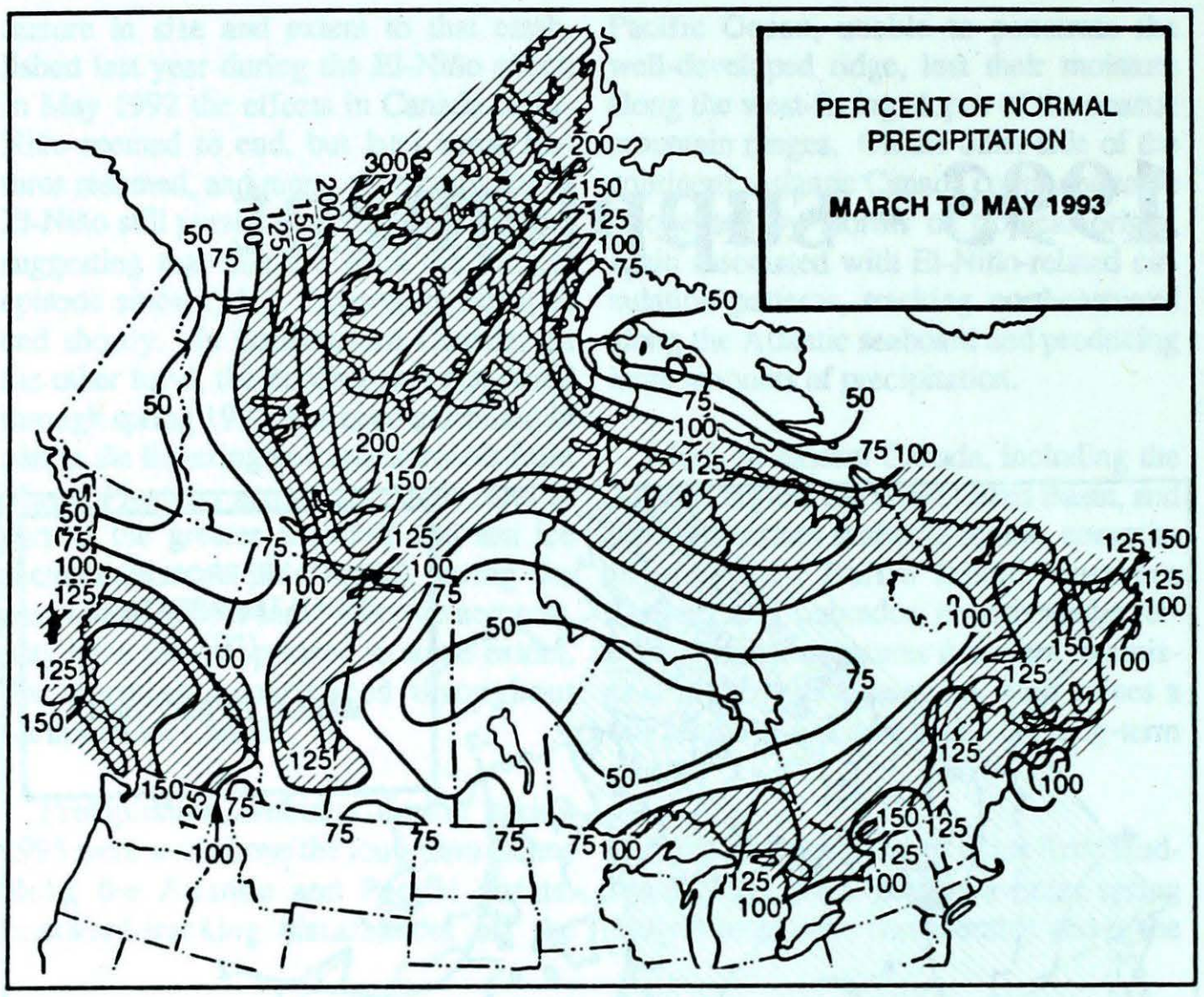


Tagged the "*storm of the century*", as it moved up the eastern seaboard, an intense area of low pressure hit the Maritimes on the weekend of the 13th, resulting in blizzard conditions from eastern Ontario to Newfoundland. Added to already hefty snow-on-the-ground totals, many areas now had more than 100 cm of snow to contend with the following Monday. At Ottawa, 135 cm of snow lay on the ground on the morning of the 15th, more than at any time in the station's history. Adding to the severity of the storm was a major influx of cold air in its wake.

Having already spread across the rest of the country, this air mass was also responsible for a break in the early spring conditions in western Canada. More than 20 cm of snow had accompanied its passage across Alberta earlier in the week, and with temperatures four to six degrees below normal across Canada, no doubt that there was some concern that spring's appearance would be somewhat delayed.

As the month began its final full week, those concerns were put to rest, if only for a short while. With the exception of the island of Newfoundland, all of the country experienced above-normal temperatures. In New Brunswick, the mercury reached 20°C, breaking records that had stood for fifty years. The warm air made fast work of the previous few weeks' snowfalls, reducing the amount on the ground from well over a hundred centimetres to only five to ten in eastern Ontario. In the Prairies, where maximum temperatures in all three provinces exceeded 20°C, daily means were as much as 14°C above the seasonal average. For many areas, however, this respite from winter was all too brief. As much as 40 cm of snow fell on Alberta and Saskatchewan on the 26th, disappointing many people, but also providing some much-needed moisture for the agricultural community.

Overall, mean temperatures for March were above normal from the Pacific to northern Ontario. The continuation of winter through most of the month resulted in below-normal temperatures from the Great Lakes eastward to the Atlantic. For



many areas this was the coldest March in the last ten years. Although precipitation was below average in most areas, snowfalls near the middle and end of the month gave the southern Prairies twice the usual allotment of moisture; and of course, with the continual procession of east coast disturbances, precipitation totals over most of the Atlantic Provinces were well-above normal.

April

In much the same way as March, the month of April began with above-normal temperatures, extending from the Pacific coast to Manitoba. Once again several new records were set as daytime highs reached 20°C in Saskatchewan and into the low teens as far north as the Yukon. These same conditions moved into eastern Canada shortly after the month began, but not before a late winter storm moved over the Great Lakes and then south of Nova Scotia, dropping 20 to 40 centimeters of snow and 10 to 20 millimeters of freezing rain from southern Ontario across southwestern Quebec and into the Maritimes. In the warm air that followed, there was little letup in the occurrence of precipitation. Widespread rainfalls of 10 to 30 millimeters over eastern Canada added to rapidly melting snow to produce flooding of low-lying areas in eastern Ontario and northern New Brunswick. At the same time, cooler air was beginning to move back into the west. Although not drastically colder, precipitation associated with this advancing air mass fell in the form of snow, with 30 to 40 centimeters in central Alberta between the 5th and the 9th. A similar situation occurred the following week, with another 25 cm of snow from Alberta to Manitoba and 30 mm of rain in the Ottawa Valley.

On the 20th, the year's first sign of spring severe weather occurred in southern Ontario. Thunderstorms developed on a cold front moving across Lake Huron, producing small hail, winds in excess of 100 km/h and a small tornado near the town of Bancroft. During the week that followed, several disturbances moved across the country, giving the month a wet ending for most of Canada. Persistent showers brought over 30 mm of rain to British Columbia, while a similar amount of moisture in the form of rain and snow fell over the Prairies. Ontario and Quebec received only a few showers during that week, but farther east a mixture of snow, ice pellets and freezing rain made the end of April more like the end January for the Atlantic Provinces.

In all, April precipitation was above normal across most of the southern half of the country, while average temperatures were within a degree or two of normal.

May

For the fourth month in a row, May began with an abnormally warm air mass covering the western part of the country. This time, however, the warm conditions extended farther east, and in British Columbia and the Yukon persisted throughout the month. By the second week of May daytime highs had reached 30°C in all provinces west of the Maritimes, breaking numerous records in the process. Only Newfoundland missed out on the early signs of summer-like warmth, where temperatures failed to break the 20°C mark until the month's midpoint.

In extreme western Canada there were no significant breaks in this early "heat wave", and as a result, mean temperatures for the month were as much as 4°C above normal in British Columbia and the Yukon, making this the warmest May on record at most locations. At one point the freezing level in the interior remained above the 3000 metre level for eight consecutive days and nights, melting much of the low-altitude snowpack, and creating numerous problems with flooding and mudslides.

From Saskatchewan to Quebec the warm weather came to a very noticeable end during the second week of the month. Shortly after one of the warmest Mother's Days on record, with daytime maximums surpassing 30°C in the eastern Prairies and northern Ontario, temperatures plunged across the central part of the country. At Petawawa a new record high of 33.2°C was set on the 10th, only to be followed by a record low of -2.7°C on the 14th. For the rest of May mean temperatures were as much as six degrees below normal, and as a result, the last half of the month was somewhat cooler than its beginning. Al-

though somewhat distressing for those people who had hoped to get a jump on summer, this wasn't entirely unwelcome as the early warmth had also meant an early start to the forest fire season.

In the Maritimes, temperature values were somewhat variable through the month, producing a near-normal monthly mean. In Newfoundland, despite a mild period late in May, the month's cold start was too much to overcome, and consequently monthly means were about one degree below normal. Fortuitously, the warmest conditions came on the Victoria Day weekend, when daytime highs, reaching into the mid-twenties, offered a welcome change from the cold May holiday weekends of the past couple of years.

Precipitation during May was lower than normal from Alberta to northern Ontario. Forty millimetres of rain that fell in northern Alberta, as a storm system moved northward through the province on the 9th, was the only significant precipitation to fall in any of the Prairie provinces during the month. The dry conditions have allowed most of the spring seeding to be finished, but with soil moisture at less than 40 percent of capacity at month's end, concerns are already being raised about poor growing conditions. Elsewhere across the country, a combination of moist unsettled air masses and a few coastal storm systems managed to raise precipitation totals to values somewhat above normal in British Columbia, central Ontario, and Newfoundland. Most significant of these events were the occurrence of 2 cm hail in western Quebec on the 6th, a 98 mm rainfall at Stephenville during the second week of the month, and 20 cm of snow in the Sept Îles and Gaspé areas between the 11th and the 13th.

Malcolm Geast

Green Plan Smog Advisory

CANADA'S GREEN PLAN

Individuals can play a valuable role in the fight to reduce smog. The Smog Advisory program is a Green Plan initiative to inform Canadians of local air quality so they can make responsible decisions to improve the environment.

Environment Canada, provincial and municipal governments are now working together to add Smog Advisories to existing air quality information programs. On days when smog levels are expected to be high, an advisory will inform people in the affected area. The message will encourage individuals to choose alternative actions, such as public transit or carpooling, that help reduce the smog problem. The program began this spring in the Lower Fraser Valley of British Columbia, southern Ontario, and southern New Brunswick. The program will be extended into Quebec shortly.

A Smog Advisory will highlight times when individual actions to help reduce air pollution are most required. The information will be provided through communication channels regularly used for the delivery of the weather, such as radio stations, Weatheradio and local weather offices. In some areas, Smog Advisories will also be available by phoning special provincial or municipal numbers.

People are concerned about the potential effect of reduced air quality on their health. Within a population, the sensitivity of individuals and their actual exposure to smog can vary extensively. Provincial health authorities, Health and Welfare Canada and other experts are working to provide the best available advice.

Although a Smog Advisory will provide specific information, increased public awareness of the smog issue is an important component of the program. Continued efforts by many groups and agencies to enhance public understanding of the smog issue, combined with the Smog Advisory program, will equip Canadians with the knowledge they need to take action to reduce smog.

For further information you can contact your local Environment Canada Weather Office at the following numbers; British Columbia (604)-664-9185, Ontario (416)-973-1116, New Brunswick (506)-636-4939. In British Columbia you can also contact the following: Lower Mainland Regional Headquarters of the Ministry of Environment, Lands and Parks 1-(800)-665-7027; Air Quality and Source Control Department of the Greater Vancouver Regional District (604)-436-6700. In Ontario you can also call the Ministry of the Environment and Energy office at (416)-323-4321 or 1-(800)-565-4923. In New Brunswick you can call the Provincial Air Quality Index to receive the latest report for the Saint John area (506)-658-2536.

Water surface temperature mapping using Satellite Data.

□ *by*
E. Milewska and H. Le
Data Integration Division, Atmospheric Environment Service

Every one hundred minutes, two environmental polar-orbiting satellites operated by the United States National Oceanic and Atmospheric Administration (NOAA) complete an orbit around the Earth.

During a twenty-four hour period they provide coverage four times over any given area on the globe, while the sensors of the Advanced Very High Resolution Radiometer (AVHRR) are continuously scanning the surface in visible and infrared wavelengths. Currently in Canada, signals from both satellites are read and stored in digital format on small high capacity tapes by two receiving stations located in Edmonton, Alta., and Toronto, Ont. An integrated semi-automatic system for fast and precise processing of these NOAA satellite images was developed by the Data Integration Division of Canadian Climate Centre in collaboration with B. W. Wannamaker from Sea Scan.

The image sent by satellites is geometrically distorted due to earth curvature and rotation, and small wobbles in spacecraft orbit and attitude (pitch, roll and yaw). For example, the resolution of the AVHRR scanner data element (pixel) directly under the satellite is about 1 km by 1 km, but becomes about 2 km by 6 km by the end of the scan to the right or left of the satellite path. Very complex models that account for the spheroidic shape of the earth and gravitational forces acting upon the satellite, are used to calculate the exact location of the satellite in space and then to find the precise latitude and longitude position of the pixel. This particular process, called the navigation of the data, leads to its final representation in the form of maps in some common geographical projections (e.g.: Lambert Conformal projection). At this stage, each pixel value is proportional to the energy measured by the satellite sensor.

The next step is to find the relationship between the infrared channel digital value, and temperature. This procedure, called calibration of the data, is based on Planck's Law, relating spectral radiant emittance to the temperature of the emitting body. Because of the electronic drift in the instruments, calibration has to be performed for every data set. It produces maps of apparent temperatures, as they are registered by the sensors in space above the atmosphere.

The atmosphere can significantly alter the signal coming from the earth surface or, in the presence of thicker clouds, even totally prevent it from reaching the satellite. Assuming cloud-free conditions, an upper air sounding is used to calculate atmospheric correction. These correction factors account for atmospheric attenuation due to water vapour content, thermal contrast between the atmosphere and the surface target, ozone profile and concentration of certain dust particles. They are used to adjust the calibrated temperatures and at this point final temperature maps are generated. They can be enhanced in a full range of color and then printed on paper or displayed on the computer screen from which the temperature can be accurately read just by "clicking the mouse" at the desired location.

In the past, because of its complexity, this kind of satellite data processing was very time and labour intensive, and navigation of the data was rather coarse. Recent advances in computer technology have allowed automation of most of the routines and significantly sped up the whole process. Currently, even though much more complicated and sophisticated navigation models are used, it takes only about one hour to process an image on a personal computer for any region in North America or the Arctic. Wherever possible, temperatures obtained from the satellites are being compared to the very scarce reports from buoys. For the Great Lakes the average difference between both types of readings appears to be about half a degree. One should bear in mind that satellites are measuring the "skin" of the water surface, while buoys are taking their measurements at a depth of about one metre.

These water surface temperature maps have been used as tools in weather forecasting (snow squalls, fog, lake breeze in the Great Lakes Basin) to predict the dates of freeze-up of the St. Lawrence Seaway. They are applied in climate impact and climate variability and change detection studies (dates of freeze-up and break-up of the lakes in the McKenzie Basin), in fisheries, to locate positions of polynyas in the Arctic and to follow water circulation patterns in James and Hudson Bays using an animated sequence of images, etc. For some of these applications, like water circulation or examining the exact extent and movement of ice, three AVHRR channels are assigned separate colours and then are combined together to create a so called "composite" picture that looks somewhat like a colour "snapshot" from an ordinary camera.

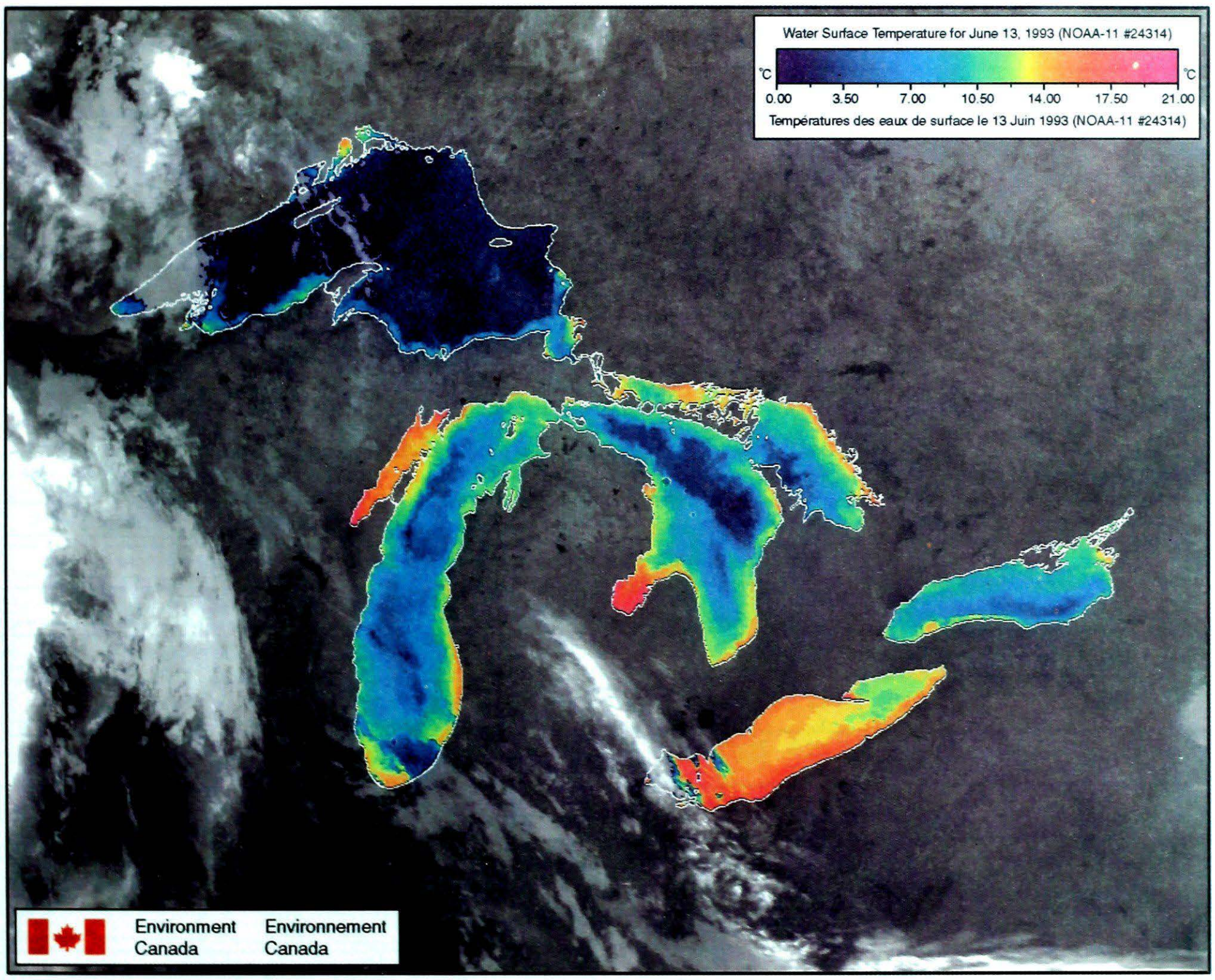
The sample of Great Lakes Water Surface Temperature Map shown here in colour version was produced from the NOAA 11 satellite data sent on the June 13, 1993.

A first glance at the picture brings out two main features: warm waters in Lake Erie (yellow to red) and, for the other lakes, narrow strips of warm water just along the shoreline. Lake Erie is the southernmost and shallowest of the Great Lakes and has the smallest volume of water. Therefore the Lake Erie water mass heats up faster, and the daily rate of surface water temperature increase during the spring months is double that of the other Great Lakes (Irbe G.J., 1992). The warming of the water mass begins in the shallow, nearshore zone. When the water on the surface warms up to four degrees, the temperature of maximum density, it becomes heavier than the water below and consequently sinks. This process called "the spring overturn" continues until the entire water column is heated to four degrees. After that, further water surface heating establishes a stable summer stratification with lighter warmer layers laying above the denser cooler ones. In deep lakes, the spring overturn proceeds at a slower rate from the near shore towards the deeper central portions of the lakes.

As we can see, satellite data contain enormous amounts of information, impossible to collect by other means. This information is invaluable in many applications from scientific research to fishing.

References

Irbe, G.J. (1992). Great Lakes Water Surface Temperature Climatology. Climatological Studies Number 43. Environment Canada. Atmospheric environment Service. Published by Minister of Supply and Services Canada.



Canadian Climate Centre, Climate Adaptation Branch, Data Integration Division
Water Surface Temperature combined with Infrared Image (AVHRR channel 4)
Lambert Conformal Projection (center: 45.0 N 84.0 W, coverage: 1500 km x 1200 km)

MAY 1993

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
BRITISH COLUMBIA													
ABBOTSFORD A	15.5	3.5	29.4	3.3	0.0	*	134.8	172	0	16	231	111	86.1
ALERT BAY	12.0	1.8	26.3	3.8	0.0	*	117.8	196	0	15	*	*	187.3
AMPHITRITE POINT	12.7	2.3	22.0	5.7	0.0	*	266.3	205	0	16	*	*	163.2
BLUE RIVER A	13.2	3.5	31.9	-4.5	0.0	0	64.6	103	0	12	247	125	*
CAPE SCOTT	10.9	1.8	19.7	5.3	0.0	*	186.6	114	0	18	*	*	219.0
CASTLEGAR A	16.1	3.1	32.6	2.3	0.0	*	54.2	99	0	11	285	123	177.7
COMOX A	13.7	1.9	27.0	3.7	0.0	*	105.8	283	0	16	217	*	133.2
CRANBROOK A	15.0	4.1	31.9	-2.1	0.0	0	36.3	86	0	7	307	120	107.2
DEASE LAKE	9.7	3.6	27.2	-4.1	10.0	217	50.2	217	0	7	248	118	257.5
FORT NELSON A	11.0	1.4	24.4	0.5	3.8	64	38.8	93	0	5	223	*	215.7
FORT ST JOHN A	11.5	1.8	23.6	2.1	0.0	0	23.2	60	0	8	255	*	201.7
HOPE A	16.4	3.4	36.6	6.3	0.0	*	93.8	131	0	13	226	124	76.4
KAMLOOPS A	17.7	3.6	35.5	3.6	0.0	*	22.0	122	0	5	305	121	58.9
KELOWNA A	15.9	3.8	33.2	-0.3	0.0	*	24.2	76	0	7	290	122	89.1
MACKENZIE A	12.7	4.6	27.9	-3.5	0.0	0	70.8	187	0	9	272	111	165.8
PENTICTON A	16.6	3.2	31.6	0.5	0.0	*	37.3	128	0	7	291	118	75.2
PORT ALBERNI A	13.4	2.2	30.3	2.6	0.0	*	124.2	188	0	18	172	*	143.2
PORT HARDY A	11.7	2.4	26.7	4.2	0.0	*	122.0	178	0	17	149	80	194.8
PRINCE GEORGE A	13.5	4.2	28.5	-1.1	0.8	36	56.4	119	0	9	259	103	144.4
PRINCE RUPERT A	11.2	3.1	27.9	1.8	0.0	0	109.2	75	0	14	210	111	212.5
PRINCETON A	14.9	4.1	35.5	-1.3	0.0	0	39.2	189	0	7	287	*	*
REVELSTOKE A	15.9	3.8	33.3	-0.3	0.0	*	61.6	111	0	11	255	120	83.4
SANDSPIT A	11.1	2.4	20.4	3.2	0.0	0	59.6	114	0	14	237	113	215.6
SMITHERS A	12.4	3.4	29.1	-2.0	0.0	0	74.1	247	0	10	225	100	171.6
TERRACE A	13.8	3.9	30.3	3.5	0.0	0	54.2	125	0	10	227	126	144.4
VANCOUVER INT'L A	14.7	2.5	26.2	7.3	0.0	*	100.8	195	0	16	218	89	105.4
VICTORIA INT'L A	14.2	2.6	27.6	5.6	0.0	*	76.2	267	0	14	243	95	118.7
WILLIAMS LAKE A	13.2	4.2	30.0	-1.1	0.8	27	49.8	158	0	7	281	110	159.2

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
YUKON TERRITORY													
DAWSON A	9.3	*	26.6	-2.7	0.0	*	26.4	*	0	*	*	*	*
MAYO A	10.2	2.7	26.5	-3.1	*	*	16.2	83	*	*	*	*	*
WATSON LAKE A	10.2	3.3	25.4	-4.2	0.4	7	19.6	67	0	4	224	88	240.9
WHITEHORSE A	9.5	2.8	26.6	-4.1	0.2	7	7.2	56	0	2	298	115	262.5
NORTHWEST TERRITORIES													
BAKER LAKE A	-3.4	3.0	6.4	-26.4	15.4	244	16.4	137	28	6	104	39	662.0
CAMBRIDGE BAY A	-7.4	2.0	1.8	-24.9	17.0	179	21.8	229	46	3	164	64	788.8
CLYDE A	-7.5	-0.2	5.6	-24.8	10.0	58	9.2	55	22	2	272	108	789.6
COPPERMINE A	-4.0	1.3	6.2	-14.9	47.0	580	41.4	345	66	8	201	89	683.1
CORAL HARBOUR A	-4.0	2.3	6.9	-27.1	18.6	127	31.8	188	10	11	144	51	680.7
EUREKA	-11.3	-0.6	0.8	-28.6	6.2	177	6.4	200	13	2	439	84	906.8
FORT SIMPSON A	8.9	0.4	22.3	-1.4	0.3	6	35.0	106	0	6	197	72	280.7
FORT SMITH A	7.3	-0.6	28.3	-4.2	2.4	50	45.9	165	0	6	29	10	33.1
IQALUIT	-4.1	-0.9	7.4	-22.2	8.2	35	7.8	31	0	2	188	94	684.7
HALL BEACH A	-5.9	3.2	4.3	-28.8	4.2	26	4.4	27	11	2	*	*	740.8
HAY RIVER A	4.2	-1.4	23.1	-5.5	0.2	5	30.8	153	0	5	*	*	426.4
INUVIK A	0.9	1.7	18.8	-17.2	7.6	58	8.6	49	0	3	245	83	529.4
MOULD BAY A	-9.0	2.2	1.3	-24.4	35.2	446	35.2	510	9	2	281	85	836.3
NORMAN WELLS A	6.8	1.4	21.4	-4.1	2.2	26	31.5	185	0	7	223	79	347.1
POND INLET A	-7.5	*	5.1	-25.6	9.6	*	9.0	*	11	2	359	*	790.6
RESOLUTE A	-8.6	2.3	2.5	-23.6	18.0	196	18.0	222	6	4	342	117	823.9
YELLOWKNIFE A	4.4	-0.6	17.9	-4.7	8.0	216	40.6	236	0	2	308	92	422.0
ALBERTA													
BANFF	10.0	2.3	29.0	-5.5	1.0	7	44.8	86	0	*	*	*	*
CALGARY INT'L A	11.5	2.1	29.3	-3.4	0.0	0	61.9	127	0	7	243	96	200.7
COLD LAKE A	11.4	1.0	32.1	-1.9	0.0	0	26.0	65	0	3	299	110	211.5
CORONATION A	11.0	0.7	30.1	-0.1	1.0	34	18.6	52	0	3	307	106	216.0

MAY 1993

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	12.2	2.1	32.6	-1.3	0.0	0	41.0	97	0	8	291	102	187.7
EDMONTON MUNICIPAL	13.0	1.7	31.5	1.9	0.0	*	36.8	87	0	5	289	104	162.9
EDMONTON NAMAO A	12.3	1.5	31.7	0.1	0.0	0	42.6	113	0	6	*	*	182.4
EDSON A	10.9	2.4	31.0	-2.0	0.0	0	44.7	74	0	5	240	98	218.4
FORT CHIPEWYAN A	7.3	-1.3	2.6	-6.0	0.2	3	31.4	103	*	*	*	*	*
FORT MCMURRAY A	10.6	0.9	32.6	-4.3	0.4	15	54.8	151	0	7	282	102	234.7
GRANDE PRAIRIE A	12.3	2.3	27.3	0.5	0.0	0	13.4	37	0	4	274	*	180.0
HIGH LEVEL A	10.1	0.8	26.5	-4.3	1.2	28	12.4	30	0	3	278	98	246.8
JASPER	12.0	3.3	30.4	-4.7	0.0	0	45.2	136	0	6	238	*	188.4
LETHBRIDGE A	13.0	2.0	30.3	-2.5	0.0	0	44.5	88	0	8	299	114	154.3
MEDICINE HAT A	13.7	1.4	32.1	-0.9	0.0	0	6.7	17	0	4	284	105	142.3
PEACE RIVER A	11.7	2.1	25.7	-0.2	0.0	0	25.6	85	0	4	*	*	196.1
RED DEER A	11.8	2.0	30.7	-3.7	0.0	0	45.2	93	0	7	*	*	200.6
ROCKY MTN HOUSE A	11.0	1.8	29.7	-4.6	0.0	0	43.6	72	0	9	*	*	217.8
SLAVE LAKE A	11.0	1.6	25.9	-1.8	0.0	0	58.2	133	0	6	268	96	221.7
SUFFIELD A	13.2	*	31.3	-2.2	0.0	*	15.9	*	0	2	281	*	158.4
WHITECOURT A	11.5	2.3	30.6	0.1	0.0	0	23.8	44	0	5	*	*	204.7
SASKATCHEWAN													
BROADVIEW	10.4	0.2	29.2	-4.7	2.0	31	27.8	65	0	6	257	92	237.6
CREE LAKE	6.5	-0.8	25.3	-5.8	0.2	1	16.6	62	0	3	275	95	358.0
ESTEVAN A	11.7	0.3	30.7	-3.5	0.0	0	30.4	55	0	5	276	96	199.5
KINDERSLEY	12.1	1.2	31.3	-1.8	0.0	0	17.0	50	0	4	322	*	191.4
LA RONGE A	8.8	0.3	27.8	-3.2	0.0	0	13.2	30	0	4	*	*	284.5
MEADOW LAKE A	10.6	*	34.0	-6.3	0.2	*	20.0	*	0	5	296	*	236.5
MOOSE JAW A	12.3	0.8	30.5	-1.8	0.0	0	20.7	47	0	6	284	102	183.8
NIPAWIN A	11.0	*	32.9	-3.5	0.0	*	10.8	*	0	3	277	*	218.9
NORTH BATTLEFORD A	11.8	0.6	31.4	-2.8	0.0	0	43.4	123	0	5	*	*	198.6
PRINCE ALBERT A	11.0	1.0	31.8	-2.0	0.0	0	23.5	60	0	8	300	111	218.5
REGINA A	12.1	1.0	30.1	-2.7	0.0	0	28.2	61	0	5	288	104	188.8
SASKATOON A	11.3	0.2	31.3	-3.3	0.0	0	36.8	92	0	7	124	*	212.0
SWIFT CURRENT A	11.6	1.1	30.5	-2.3	0.0	0	15.6	39	0	4	305	110	200.8
YORKTON A	10.4	0.0	30.2	-5.0	0.0	0	32.0	72	0	5	278	99	236.6
MANITOBA													
BRANDON A	10.7	0.0	29.2	-5.1	0.0	0	39.8	84	0	7	262	*	225.4
CHURCHILL A	1.0	2.5	18.9	-8.7	28.4	146	38.6	121	0	11	96	49	526.8
DAUPHIN A	10.1	-0.2	27.3	-6.1	0.0	0	24.8	52	0	7	278	104	244.7
GILLAM A	5.7	0.7	27.9	-5.6	7.6	43	26.0	68	0	5	*	*	381.1
ISLAND LAKE	8.3	0.3	28.5	-2.6	3.6	6	38.4	99	0	7	*	*	303.0
LYNN LAKE A	6.4	-0.2	28.4	-4.3	3.4	20	5.6	11	0	2	194	72	361.1
NORWAY HOUSE A	8.3	*	28.9	-2.6	0.2	*	59.4	*	0	10	*	*	303.1
THE PAS A	8.7	0.3	26.6	-2.2	0.0	0	10.4	28	0	1	275	99	291.2
THOMPSON A	7.0	0.7	29.6	-5.0	0.4	2	37.5	78	0	4	225	87	341.6
WINNIPEG INT'L A	11.2	-0.1	29.2	-3.3	0.0	0	34.8	53	0	3	251	95	217.6
ONTARIO													
EARLTON A	9.9	0.1	33.0	-1.6	0.4	12	112.8	184	0	15	*	*	261.2
GERALDTON A	7.4	*	27.7	-5.4	0.4	*	97.6	*	0	13	*	*	321.8
GORE BAY A	10.2	0.0	25.0	1.6	0.0	0	119.0	195	0	14	*	*	241.8
HAMILTON RBG	12.6	*	30.0	1.5	0.0	*	49.8	*	0	11	233	*	*
HAMILTON A	12.1	-0.5	28.6	0.4	0.0	*	50.2	76	0	10	*	*	186.0
KAPUSKASING A	8.7	0.4	30.8	-1.8	0.8	8	75.8	102	0	14	*	*	292.1
KENORA A	10.6	0.1	28.3	-1.8	0.6	13	48.9	85	0	7	*	*	230.7
KINGSTON A	11.2	-0.5	28.3	0.9	0.0	0	63.2	84	0	6	219	96	213.3
LONDON A	12.1	0.1	28.0	1.7	0.0	0	59.0	88	0	9	199	87	170.2
MUSKOKA A	10.9	0.0	28.0	-2.6	0.0	0	97.9	126	0	14	*	*	219.6
NORTH BAY A	10.5	-0.1	28.5	-0.5	0.0	0	113.4	164	0	16	205	84	235.4
OTTAWA INT'L A	13.3	0.5	30.7	*	0.0	0	80.2	118	0	10	253	106	153.0
PETAWAWA A	11.6	0.1	33.2	-3.0	0.0	0	77.8	130	0	8	*	*	202.3
PETERBOROUGH A	12.0	-0.6	29.2	-2.5	0.0	0	55.5	87	0	9	*	*	192.6
PICKLE LAKE	8.8	1.4	29.1	-4.1	1.0	10	30.0	41	0	8	*	*	289.4
RED LAKE A	9.2	0.0	26.0	-3.2	2.0	34	16.6	32	0	8	235	*	271.2
ST CATHARINES A	12.7	-0.8	28.6	1.7	0.0	*	42.4	60	0	10	244	*	166.7
SARNIA A	12.0	-0.6	25.5	1.9	0.0	0	54.6	82	0	9	250	100	186.6
SAULT STE MARIE A	8.7	-0.9	30.0	-2.7	0.0	0	121.8	163	0	12	208	81	288.8
SIOUX LOOKOUT A	9.8	0.6	26.5	-3.4	3.2	34	51.8	79	0	12	*	*	251.7
SUDBURY A	10.4	-0.1	30.2	-1.3	0.6	24	127.6	190	0	16	176	71	241.5
THUNDER BAY A	8.3	-0.5	29.0	-3.7	0.2	5	100.2	137	0	11	195	77	300.9
TIMMINS A	9.2	0.2	31.0	-2.1	0.5	8	119.5	170	0	14	*	*	278.9
TORONTO	13.7	*	28.3	4.5	0.0	*	57.8	*	0	10	*	*	142.3
TORONTO INT'L A	12.1	-0.2	28.6	0.0	0.0	0	51.6	78	0	10	*	*	185.7
TORONTO ISLAND A	11.7	*	27.7	4.3	0.0	*	50.2	*	0	10	*	*	197.4
TRENTON A	12.1	-0.4	27.4	0.7	0.0	0	51.0	70	0	7	*	*	184.2
WATERLOO WELLINGTON	11.6	-0.9	28.0	-0.6	0.0	*	42.4	59	0	9	*	*	199.5
WAWA A	7.0	*	24.7	-3.0	0.0	*	130.0	*	0	15	*	*	336.6
WIARTON A	10.1	-0.3	25.4	0.6	0.0	0	74.5	121	0	12	243	95	245.6
WINDSOR A	14.8	0.6	28.0	5.1	0.0	*	43.2	62	0	7	*	*	106.2

MAY 1993

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	10.2	0.9	23.9	1.9	0.4	9	83.5	121	0	18	*	*	240.0
BAIE COMEAU A	7.5	0.9	19.7	-0.9	5.4	338	100.2	140	0	15	168	77	327.1
BLANC SABLON A	2.6	-0.4	16.9	-11.1	6.4	44	95.4	150	0	14	83	*	47.8
CHIBOUGAMAU CHAPAIS	7.3	*	23.8	-2.0	*	*	97.1	*	0	14	*	*	330.0
GASPE A	6.9	*	25.8	-4.9	15.4	*	139.4	*	0	12	169	*	344.8
INUKJUAK A	-1.1	0.5	9.4	-15.2	12.8	115	41.8	179	0	8	138	96	591.4
KUUJJUAQ A	1.5	1.3	16.2	-16.3	13.2	86	38.0	120	0	10	200	145	512.4
KUUJJUARAPIK A	1.3	0.1	3.8	-10.2	31.0	161	50.0	118	0	11	138	76	519.6
LA GRANDE IV A	3.6	*	14.9	-9.1	12.8	*	81.8	*	0	17	121	*	445.1
LA GRANDE RIVIERE A	3.8	*	20.8	-5.0	11.0	*	41.0	*	0	10	158	*	439.7
MANIWAKI	11.3	0.5	32.7	-1.9	0.0	0	78.2	124	0	10	209	86	211.8
MONT JOLI A	9.1	1.0	23.5	-1.0	0.0	0	96.4	154	0	15	183	79	275.7
MONTREAL INT'L A	13.1	0.1	27.1	2.2	*	*	86.7	132	0	10	227	94	154.6
MONTREAL MIRABEL I/	12.1	*	26.5	-1.1	0.0	*	100.8	*	0	9	226	*	181.7
NATASHQUAN A	5.5	0.6	17.9	-7.7	0.2	3	101.6	111	0	13	176	81	388.8
QUEBEC A	11.5	0.7	23.0	-0.6	0.2	22	124.6	143	0	15	211	96	201.4
ROBERVAL A	9.9	0.4	25.2	0.6	0.0	0	72.0	104	0	14	163	*	25.1
SCHEFFERVILLE A	1.7	0.5	17.0	-15.1	19.0	76	63.2	128	0	13	148	89	505.4
SEPT-ILES A	5.6	-0.3	17.8	-5.6	21.8	363	105.8	126	0	14	163	70	382.7
SHERBROOKE A	11.0	0.4	24.2	-1.8	0.0	0	78.2	86	0	13	208	*	216.7
ST HUBERT A	13.0	0.2	27.0	0.9	0.0	*	85.8	118	0	10	229	*	156.7
VAL D'OR A	9.4	0.6	31.4	-2.0	0.4	11	108.4	170	0	14	149	63	274.8
NEW BRUNSWICK													
CHARLO A	8.7	0.9	24.2	-2.9	0.0	0	78.7	86	0	11	177	84	287.7
FREDERICTON A	10.8	0.0	24.0	0.2	0.0	0	103.2	124	0	10	*	*	222.5
MONCTON A	9.2	-0.2	22.8	-3.5	0.0	0	108.2	129	0	13	156	75	274.4
SAINT JOHN A	9.6	0.6	22.2	-0.8	0.0	0	78.8	73	0	9	168	83	261.3

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	11.0	0.5	23.4	-1.5	0.0	0	93.0	126	0	11	*	*	216.7
HALIFAX INT'L A	10.0	0.8	23.8	-3.2	0.6	18	73.1	69	0	11	*	*	248.9
SABLE ISLAND	7.8	1.1	13.7	-0.4	1.6	123	132.0	129	0	17	120	73	314.7
SHEARWATER A	9.7	0.8	20.9	-1.1	0.0	0	83.8	83	0	14	171	81	255.7
SYDNEY A	7.6	0.2	22.5	-6.9	0.0	0	99.8	105	0	13	162	82	322.3
YARMOUTH A	9.6	0.4	20.4	1.9	0.0	0	82.6	89	0	120	191	86	259.4
PRINCE EDWARD ISLAND													
CHARLOTTETOWN A	8.1	-0.4	21.8	-4.4	0.4	19	103.2	123	0	14	*	*	308.6
NEWFOUNDLAND													
BONAVISTA	4.7	0.2	20.3	-4.8	3.0	43	78.8	117	0	17	*	*	413.8
BURGEO	5.4	0.0	14.3	-6.2	0.0	0	197.4	154	0	15	*	*	403.1
CARTWRIGHT	2.3	-0.6	16.8	-10.0	6.8	39	105.4	168	0	17	79	58	485.5
COMFORT COVE	4.9	-0.9	23.2	-7.5	2.8	16	92.2	106	0	16	*	*	395.1
DANIELS HARBOUR	5.1	0.2	20.0	-9.0	1.6	22	158.6	231	0	16	111	60	400.9
DEER LAKE A	5.8	-0.6	23.5	-7.6	0.0	0	155.8	227	0	16	*	*	377.2
GANDER INT'L A	5.4	-0.8	21.3	-7.3	7.6	58	84.7	121	0	17	74	46	390.4
GOOSE A	4.2	-0.8	19.7	-11.7	13.6	74	101.0	158	0	16	150	85	428.1
MARY'S HARBOUR	1.4	-0.7	16.8	-10.0	5.8	38	140.4	244	0	16	*	*	516.1
PORT AUX BASQUES	5.5	0.8	14.5	-6.3	0.0	0	181.9	154	0	13	147	*	387.9
ST ANTHONY	3.2	0.6	13.8	-9.5	15.7	140	173.3	181	0	20	*	*	507.7
ST JOHN'S A	5.5	0.1	23.4	-6.7	2.9	26	66.5	65	0	15	85	*	385.8
ST LAWRENCE	5.6	1.1	16.4	-6.0	2.0	53	143.2	129	0	14	*	*	392.6
STEPHENVILLE A	7.1	0.2	20.1	-5.9	0.0	0	253.0	314	0	16	133	*	331.7
WABUSH LAKE A	3.6	0.9	18.2	-11.2	12.4	*	67.8	114	0	18	155	*	448.0

AGROCLIMATOLOGICAL STATIONS

MAY 1993

STATION	Temperature C				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	
	Mean	Difference from Normal	Maximum	Minimum							This month	Since jan. 1st
BRITISH COLUMBIA												
AGASSIZ	16.3	3.3	35.5	3.5	0.0	108.4	127	0	13	208	350.3	659.4
SUMMERLAND	16.5	3.0	31.5	1.5	0.0	38.6	140	0	8	284	353.0	473.3
ALBERTA												
BEAVERLODGE	12.2	2.8	27.5	-0.5	0.0	15.3	39	0	6	262	224.0	267.0
LACOMBE	11.6	1.7	36.0	-2.0	0.0	43.9	91	0	6	245	199.3	230.9
SASKATCHWAN												
INDIAN HEAD	11.4	0.8	29.5	-2.5	0.0	23.0	47	0	4	**	207.0	245.3
MELFORT	11.0	0.7	32.0	-1.0	0.0	13.0	34	0	4	260	365.0	400.5
REGINA	11.3	0.5	31.0	-6.5	0.0	25.2	58	0	4	**	203.2	229.0
SCOTT	11.2	0.9	31.0	-2.5	0.0	21.6	66	0	4	324	192.3	217.0
SWIFT CURRENT	12.2	1.6	31.0	-1.0	0.0	15.2	42	0	5	257	215.9	271.4
MANITOBA												
BRANDON	11.6	0.6	30.5	-3.9	0.0	40.0	80	0	9	**	204.4	232.9
MORDEN	12.1	0.7	30.0	-3.0	0.0	64.4	115	0	8	269	224.0	258.5
GLENLEA	12.5	0.6	29.5	-4.5	0.0	41.0	62	0	7	245	213.5	240.5
ONTARIO												
DELHI	12.9	0.1	30.0	0.0	0.0	57.5	78	0	10	**	245.1	353.7
ELORA	11.4	0.0	28.0	-1.6	0.0	67.4	87	0	***	270	*.*	*.*
GUELPH	11.4	-0.3	27.7	-2.3	0.0	51.2	70	0	11	180	198.7	270.3
HARROW	14.8	0.6	28.5	4.0	0.0	54.4	75	0	9	227	292.1	412.2
KAPUSKASING	8.7	0.4	30.0	-2.0	0.0	78.0	107	0	14	148	117.3	124.4
OTTAWA	13.6	0.8	30.2	1.0	0.0	88.0	130	0	12	253	265.1	328.7
SMITHFIELD	13.7	1.8	27.1	0.4	0.0	65.5	83	0	7	**	270.8	365.8

Courtesy of Agriculture Canada

STATION	Temperature C				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	
	Mean	Difference from Normal	Maximum	Minimum							This month	Since jan. 1st
QUEBEC												
LA POCATIERE	10.6	0.7	24.0	1.0	0.0	74.8	108	0	11	197	169.1	204.2
L'ASSOMPTION	12.7	0.4	26.5	-0.5	0.0	95.6	132	0	14	213	238.3	292.0
NORMANDIN	8.9	0.2	24.5	-1.7	0.0	71.4	101	0	20	176	123.4	133.3
NEW BRUNSWICK												
FREDERICTON	11.2	0.6	24.0	-0.5	0.0	106.7	121	0	10	188	194.0	256.3
NOVA SCOTIA												
KENTVILLE	10.9	0.5	25.0	-3.0	0.0	63.0	82	0	11	179	186.6	268.3
NAPPAN	10.0	0.8	21.0	-4.0	0.0	70.0	92	0	13	141	154.7	209.5
PRINCE EDWARD ISLAND												
CHARLOTTETWN	*.*	*.*	*.*	*.*	*.*	*.*	**	***	***	**	*.*	*.*
NEWFOUNDLAND												
ST.JOHN'S WEST	*.*	*.*	*.*	*.*	*.*	*.*	**	***	***	**	*.*	*.*

Courtesy of Agriculture Canada

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Quebec

For most of southwestern Quebec, the month started in fine fashion, but turned out to be a disappointment, when the warm weather of the first ten days turned colder. On May 10, the temperature reached 32.7°C at Maniwaki, less than a degree below the monthly record. However, temperatures during the last two weeks of the month averaged two degrees below the average of the first two weeks, bringing monthly mean temperatures down to within one degree of normal.

Except for sections of the Eastern Townships and the Lake St. John and Saguenay regions, precipitation was above normal. Amounts of more than 100 mm were reported from Abitibi to Quebec City, as well as along the North Shore and on the Gaspé Peninsula. The highest amount, 139.4 mm, was reported at Gaspé Airport. Between May 11 and 13, the Sept Iles and Gaspé areas also received from 15 to 22 centimetres of snow. Hail, due to thunderstorms, was reported in several areas of the province this month.

Hours of bright sunshine during May were above average over the National Capital Region and Ungava Bay, with values reaching 109 and 137 percent of normal, respectively. Elsewhere the weather was cloudier than normal.

As of May 31, the number of forest fires since the beginning of the season was 215 over an area of 248.2 hectares. The average for the last five years to-date, is 361 fires over an area of 4013.9 hectares.

Maritimes

May was cloudy and damp, with mean temperatures slightly above normal in Nova Scotia, and varying either side of normal in New Brunswick and Prince Edward Island.

Total hours of bright sunshine were well-below normal in all areas. Moncton, N.B. reported only 155.5 hours, which is 46.6 hours below normal, and the third lowest total for May since records began in 1961. Charlottetown, P.E.I. reported a total of 151.5 hours the lowest May sunshine total since 1979.

Precipitation varied either side of normal, ranging from 36 percent below normal at Saint John, N.B., to 33 percent above normal at Sable Island. A good portion of the precipitation fell during the last half of the month. Although the number of days with precipitation were above average, particularly in areas of Nova Scotia and Prince Edward Island, totals for the month were not excessive. Shearwater, N.S. reported 16 days with measurable precipitation, 4 days more than the normal for the month, but the total precipitation amount was 20 percent below normal.

Snowfall totals were below normal, with only a few locations reporting slight amounts of snow.

Newfoundland

Record-breaking low sunshine, frequent periods of rain, drizzle and fog, and below-normal temperatures prevailed across much of Newfoundland during May. Temperatures varied during the month, with maximum readings near 24°C over the Victoria Day weekend. However, minimum readings of -8°C were recorded early in the month.

Precipitation was common throughout the month, with heavy rain, at times, in western Newfoundland. Stephenville recorded 253 mm, well-above the normal of 84.7 mm. In the east, St. John's reported 66.5 mm, about 35 mm below normal. Measurable precipitation was recorded at Gander on 26 days, a new monthly record.

Sunshine was scarce, especially late in the month. St John's recorded 85.2 hours of bright sunshine, a new low monthly record, replacing the previous low of 96.3 hours set in 1955. Winds were variable during the month, with frequent episodes of northerly winds along the east coast.

In Labrador, below-normal temperatures and above-normal precipitation highlighted the month's weather. Early in the month, a series of disturbances brought strong winds and periods of snow to many locations. Milder temperatures were reported later in the period, however periods of rain or drizzle were common. Maximum readings near 20°C were reported on the 20th, with minimums near -12°C early in the month. Overall, mean temperatures were 1°C below normal except in the west.

Precipitation totals of 100 to 140 millimetres were reported from central and eastern locations, while western Labrador received approximately 70 mm, which is close to normal. Sunshine totals of approximately 150 hours were reported from inland locations. However, coastal stations reported about 80 hours, which is half of normal.