Environment Canada Environnement Canada

Climatic Perspectives

Monthly Review **April 1992** *Vol. 14*

CLIMATIC HIGHLIGHTS

Warm, dry weather continued across the southern Prairies, while the rest of the country was on the cool side. Profuse amounts of precipitation that fell over Ontario, Quebec, and the Mackenzie District of the Northwest Territories, combined with rising spring temperatures, and in some cases, ice breakup on major rivers, resulted in flooding. However, a dearth of precipitation in some parts of British Columbia and Alberta, resulted in an early start to the forest fire season.

Flood threats

This month, heavy rains across Ontario resulted in flooded basements, property damage and submerged roads. Toronto's Pearson International Airport set a new April precipitation record, dousing the old record set in 1991. There were some concerns over flooding of the Moose River watershed and the Ottawa River. However, these areas did not experience any major over flow.

In the Gatineau Park area of Quebec, the bursting of some beaver dams resulted in damage to homes and hydro poles. On the La Pêche River several near bursting dams, threatened to inundate the village of Ste Cécile de Masham. Fortunately, on the St François River, the water rose only slightly above the banks in a few flood-prone areas, such as downtown Sherbrooke. An ice jam on the Matapédia, near the village of Matapédia in the Gaspé resulted in authorities evacuating a few residents, as a precautionary measure only.

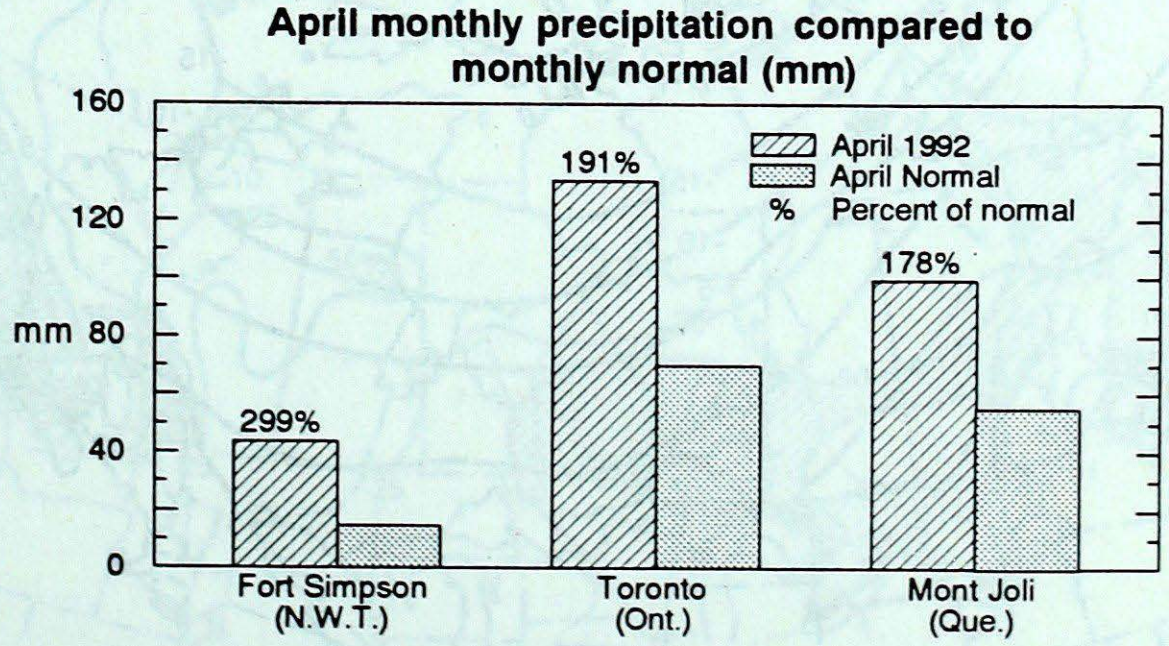
Also, the villages of Hay River and Fort Simpson, in the Northwest Territories, were threatened by flooding from the Hay and Liard rivers. About 150 persons in Hay River were evacuated, beginning April 26. On the 29th, the residents of Fort Liard of the Liard River were also evacuated. Damage to property was minimal in both cases. Overall, thinner and softer than normal ice this year, due to the mild winter temperatures, produced less effective damming on the northern rivers, thus averting serious flooding.

Warm weather continues in the West

Warm weather, due to the El-Niño phenomenon, continued across Saskatchewan, Alberta and British Columbia, although the temperature departures from normal were not as pronounced over these areas as they had been in March. Temperatures were, at the most, 3.5°C above normal across the Prairies, while March temperatures over these areas were at least 8°C above normal. This tendency toward normal temperatures during April was due to a southeastward shift and weakening of the upper atmospheric ridge over the Prairies, a feature which has dominated the winter.

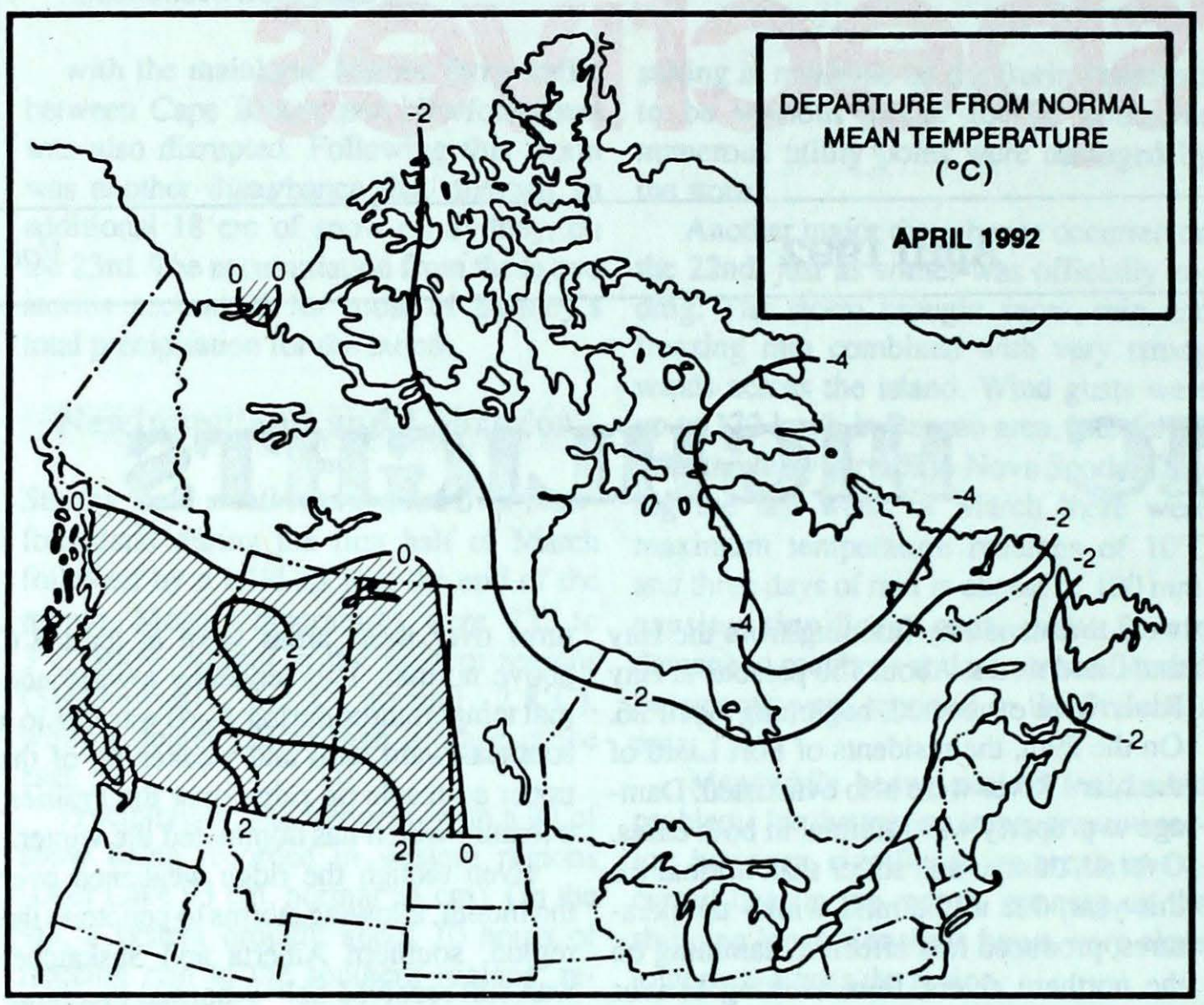
Even though the ridge weakened over the month, allowing storms to penetrate the region, southern Alberta and Saskatchewan still received below-normal precipitation amounts. This, along with low snowfall amounts during the past winter may cause a delay in plant germination and growth. However, it should be kept in mind that studies done by the Canadian Wheat Board indicate that major droughts across the Prairies tend to occur during La-Niña years (when tropical Pacific sea surface temperatures are below normal), and not during El-Niño years. This is encouraging news for the agricultural community for the upcoming growing season.

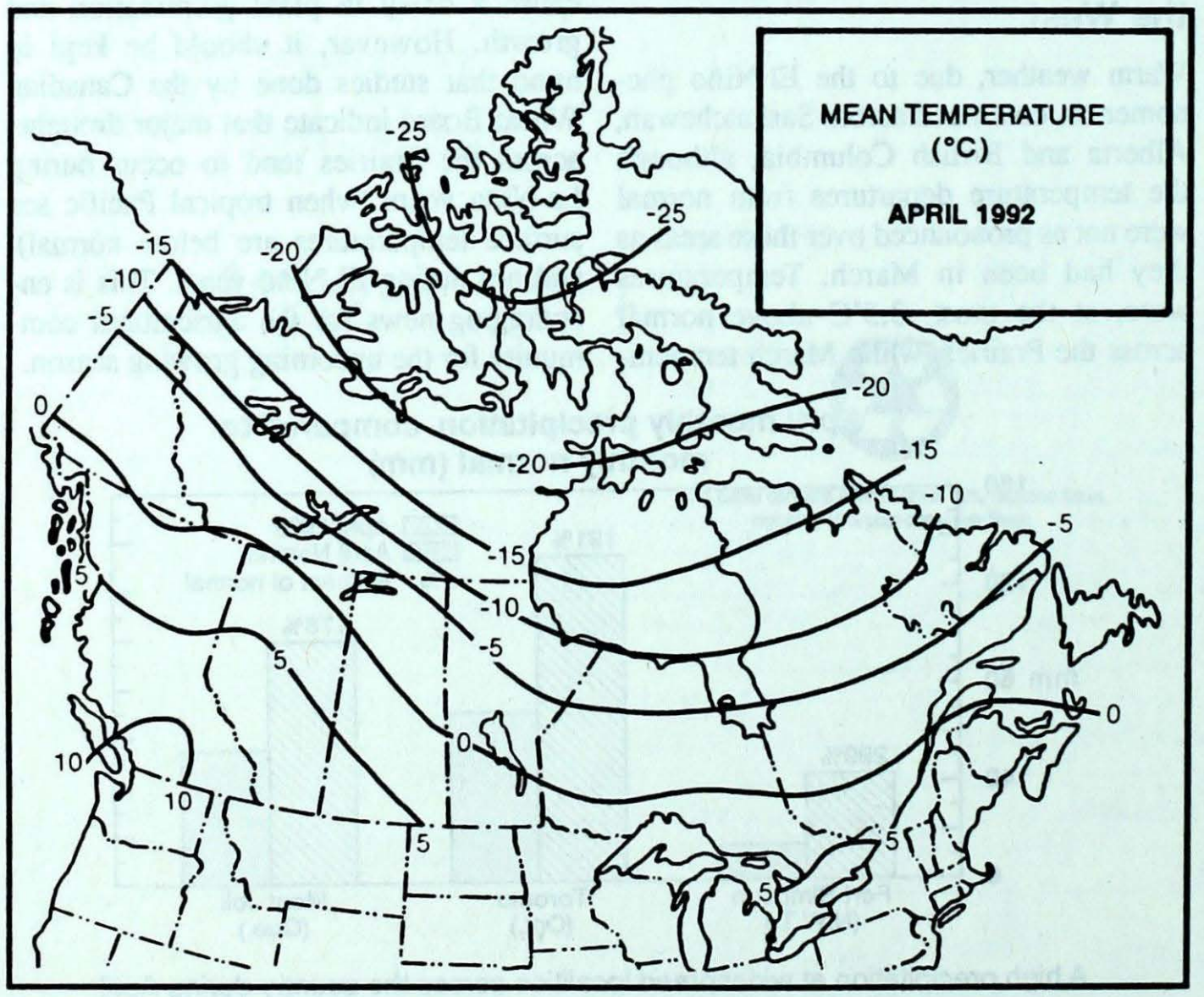
April monthly precipitation compared to monthly normal (mm)



A high precipitation at widespread localities across the country during April contributed to the risk of flooding

Canada





Across the country

Yukon and Northwest Territories

Yukon's April temperatures ranged from near normal in the south to slightly below normal in the Ogilvie Mountains on the Dempster Highway.

The coldest temperature for the territory was a very chilly -42.0°C on the 13th. Arctic Slopes, at Komakuk Beach was exactly 1°C above normal and the far south with the Ross River was 0.5°C warmer than usual. The warmest temperature for April was spread between seven stations from Mayo to Watson Lake, all recording a high of 14.0°C on the 15th or 16th.

Precipitation in Yukon varied. In Haines Junction and Fraser there were isolated dry sections where less than half of the monthly average amounts were measured at 26 and 21 percent respectiveley. The Arctic Slopes varied from slightly above normal in Old Crow to 208 percent of normal in Shingle Point on the shores of the Arctic Ocean. Swift River received the most precipitation with a total of 35.3 mm.

April turned out to be a cold and dry month for most of the Northwest Territories. Mean temperatures were below normal by 3°C, in all but the western part of the territory. Mould Bay's monthly mean temperature was only 0.6°C below normal. Eureka was the coldest spot with a mean temperature of -30.9°C (3.3°C below normal). This was also the only site where the temperature dropped to -43.7°C, although all areas reported that the mercury did fall to -30°C or colder during the month. Although Baker Lake came close, none of the reporting stations rose above the freezing mark. The mildest temperature at Baker Lake was -0.3°C. Eureka could do no better than -20.1°C.

Precipitation was also below normal. In fact Eureka, Resolute Bay and Mould Bay tallied no more than a trace amount of precipitation for the entire month. Normal precipitation amounts for these site are 3 mm to 6 mm. Amounts increased towards the south and were close to normal at

Baker Lake with 13.2 mm and Rankin Inlet with 9.8 mm.

Total sunshine hours varied from above normal by 99 hours at Resolute Bay to below normal by 56 hours at Mould Bay. Eureka was the sunniest spot with a total of 379.4 hours of sunshine - an average of over 12 hours per day.

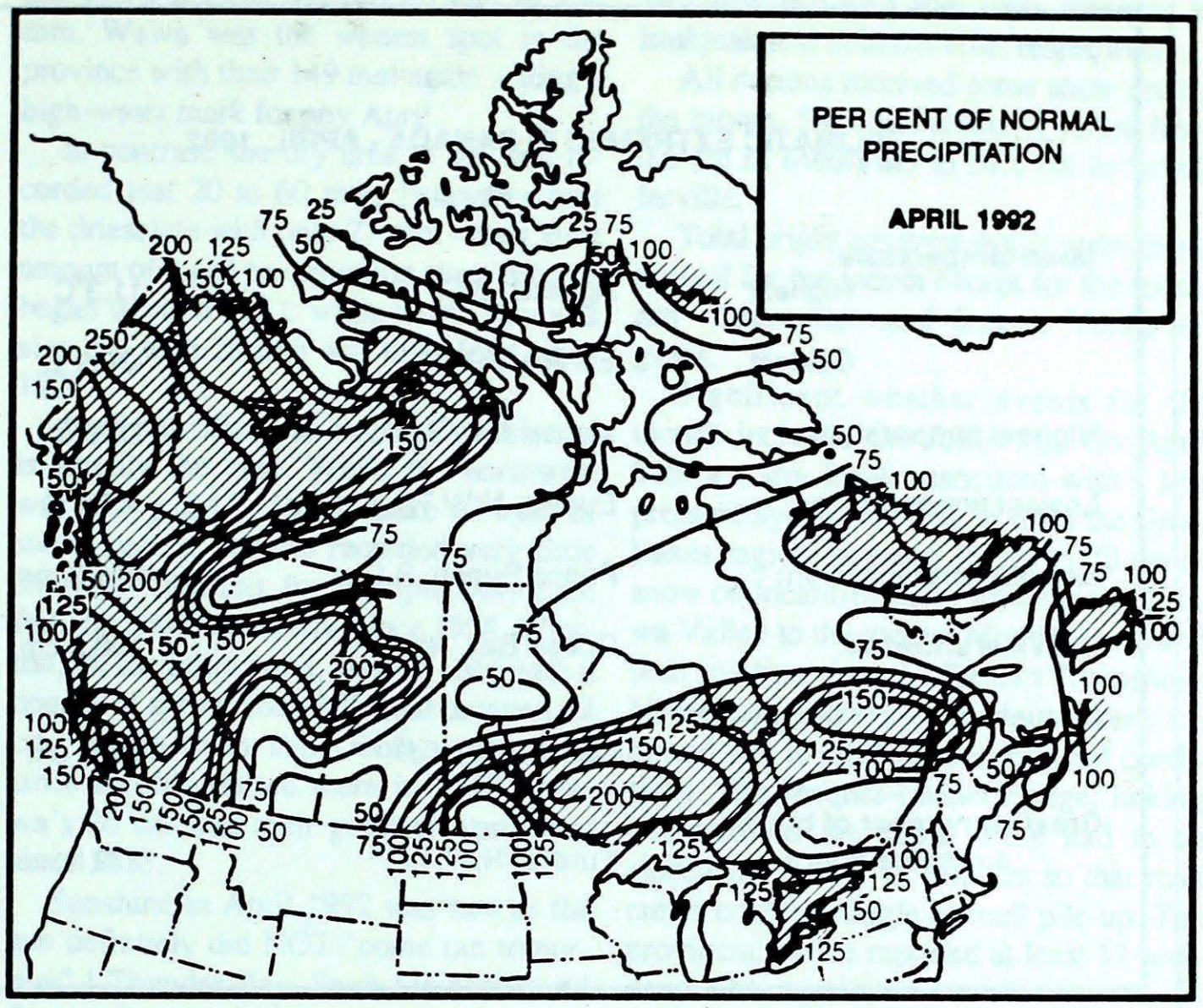
British Columbia

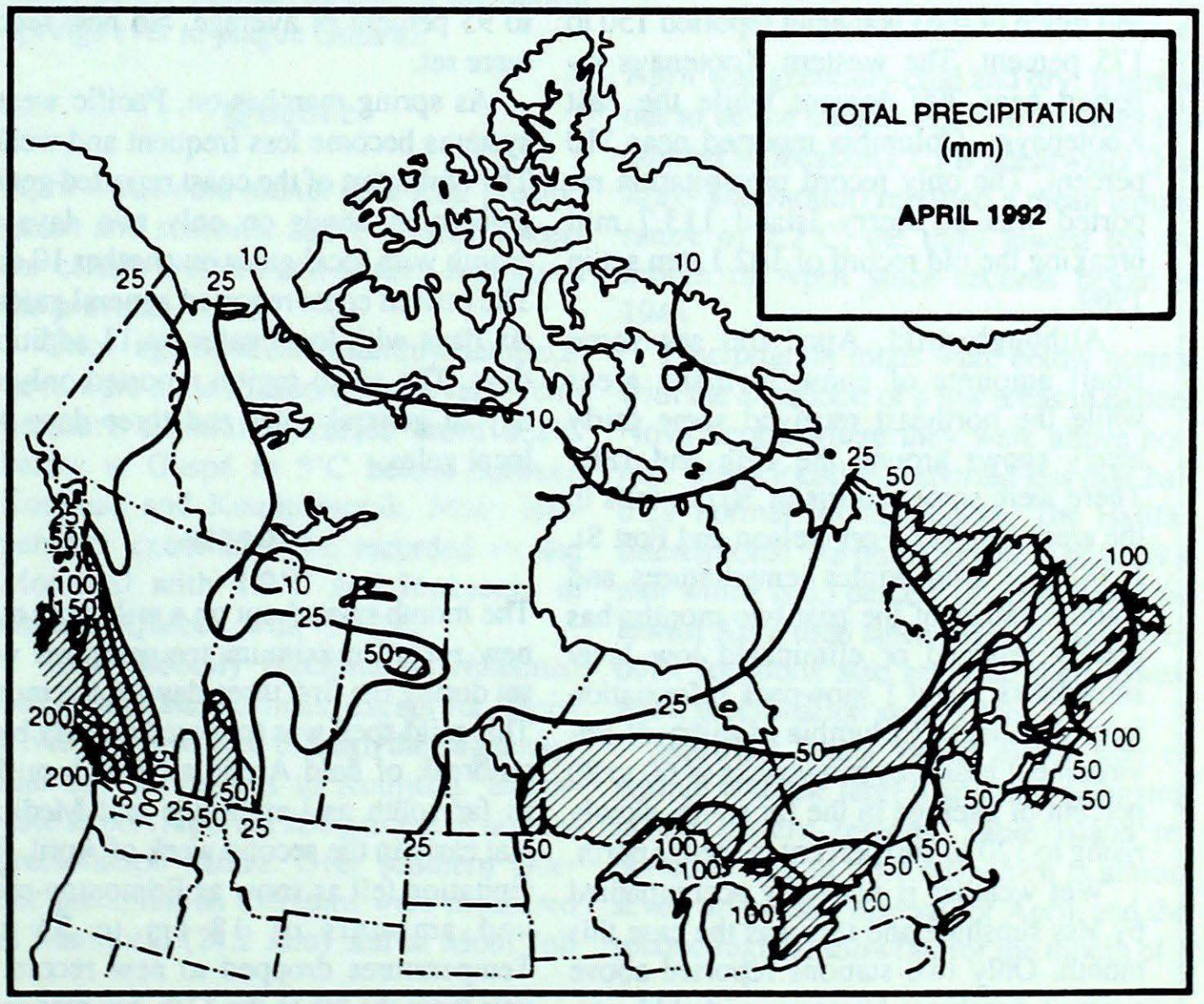
The pattern of mild weather set last fall and carried through most of the winter prevailed again in April. However, after a dry and sunny March, April turned out to be much wetter and a little less sunny than average.

The extreme northeast corner of the province was the only area to report below average temperature. Fort Nelson reported a mean temperature 0.3°C below average. Most of British Columbia, north of 55 degrees latitude and the Queen Charlotte Islands reported 0.5°C to 1°C above average except for the Mackenzie - Peace River area, with 1.5°C to 2°C above average. Much of the rest of the province reported 1.5°C to 2.0°C above average. Three stations reported record high mean temperatures for the month: Cape Scott 8.5°C (was 7.6 in 1986), Merry Island with 10.8°C (was 10.6 in 1990), and Port Hardy with 8.2°C (was 7.9 in 1948).

Although overall monthly temperatures were above average, some cold air around the 5th to the 10th did result in frost in the southern interior areas. There is some concern that fruit trees in blossom may have suffered some damage. The extent of the damage will not be known until the fruit appears on the trees.

Precipitation was well above average in much of the province. Relatively few areas reported below average precipitation including 58 percent of average at Princeton, 88 percent at Fort St. John. Much of the Chilcotins and the southern Queen Charlotte Islands reported 70 to 90 percent of average. In the far north, Dease Lake reported 307 percent with departures falling to near 150 percent along 55 degrees latitude. The lower mainland - south coast mountains reported near 225 percent of average falling to near 150 percent on most of east Vancouver Island and to just above





CLIMATIC EXTREMES IN CANADA - APRIL, 1992

Mean temperature:		
Highest	Agassiz, B.C.	11.3°C
Coldest	Eureka, N.W.T.	-30.9°C
Highest temperature:	Moose Jaw, Sask.	29.2°C
Lowest temperature:	Eureka, N.W.T.	-43.7°C
Heaviest precipitation:	Prince Rupert, B.C.	221.6 mm
Heaviest snowfall:	Goose Bay, Nfld.	108.3 cm
Deepest snow on the ground on April 30, 1992	Cartwright, Nfld.	268 cm
Greatest number of bright sunshine hours:	Eureka, N.W.T.	379 hours

average on the west coast of Vancouver Island. The Prince-George Cariboo areas and much of the Okanagan reported 150 to 175 percent. The western Kootenays reported near 200 percent while the east Kootenays - Columbia reported near 110 percent. The only record precipitation reported was at Merry Island 113.7 mm breaking the old record of 102.1 mm set in 1969.

Although mild, April did see some small amounts of snow in many areas while the northeast received some fairly heavy snows around the 17th and 18th. There were some reports of 30 cm falls in the areas between Fort Nelson and Fort St. John. The mild winter temperatures and warm weather of the past two months has greatly reduced or eliminated low level snowpacks. April 1 snowpack information from the British Columbia Ministry of Environment indicates snowpacks of 60 to 80 percent of average in the far south, slowly rising to 120 to 140 percent in the far north.

Wet weather is normally accompanied by less sunshine and this was the case this month. Only two stations reported above average sunshine: Victoria, with 111 percent, and Prince Rupert with 105 percent. The remainder of the province reported 80 to 95 percent of average. No new records were set.

As spring marches on, Pacific weather systems become less frequent and weaker. The north part of the coast reported general gale force winds on only two days this month with local gales on another 10 days. The central coast reported general gales on six days with local gales on 11 additional days. The south region reported only one day of general gales and three days with local gales.

Alberta

The month started out on a mild note as 30 new record maximum temperatures were set during the first three days of the month. This mild spell was followed quickly by an outbreak of cold Arctic air which pushed as far south as Lethbridge and Medicine Hat early in the second week of April. Precipitation fell as snow as Edmonton received amounts of 18 cm to 21 cm. Temperatures dropped to new record levels from the 8th to the 11th, but recovered by mid-month with new record highs at seven locations. The last two weeks of April saw temperatures remain on the mild side with some instability occurring as an upper disturbances crossed Alberta. One such disturbance on the 17th and 18th gave precipitation amounts up to 17 mm in the Peace Country. As this system moved across east central districts, it dropped 29.6 mm on Cold Lake. Two more systems crossed the regions before the end of the month with lesser precipitation amounts.

Hours of sunshine for April were above normal in extreme southern Alberta by 15 to 20 hours. The rest of the province was below normal by 20 to 30 hours.

Saskatchewan and Manitoba

Monthly mean temperatures were a degree above or below normal. Manitoba's temperatures were below normal while Saskatchewan's were above. Anomalies were greater in the northeast and southwest corners of the region, where temperatures were below normal by 3°C and above normal by 2°C, respectively. Mean temperatures ranged from 5.8°C at Kindersley to -13.4°C at Churchill, and temperature extremes ranged from a maximum of 29.2°C at Moose Jaw to a minimum of -30.6°C at Churchill. The minimum temperature of 8.8°C on the 27th is the highest minimum temperature ever recorded at La Ronge. The old record was 7.8°C set on April 28, 1980.

Precipitation totals were quite variable. Small areas that tallied more than twice the normal were surrounded by stations with less than normal precipitation. Parts of the region with less than 50 percent of normal precipitation were adjacent to areas with above normal precipitation. Areas the received less than half their normal precipitation were the Hudson Bay coast, parts of central Manitoba and southwestern Saskatchewan. More than double the normal precipitation fell in southwestern Manitoba and central Saskatchewan. Lesser amounts were 10.6 mm, 11.4 mm and 11.8 mm at Kindersley, Swift Current and Churchill, respectively. Some of the higher totals were 61.1 mm, 55.5 mm, 46.2 mm and 44.2 mm at Dauphin, La Ronge, Estevan and Broadview, respectively. A rain and snow storm on the Easter weekend was

responsible for more than half of the monthly totals in southeastern Saskatchewan and southern Manitoba. Up to 45 cm of snow fell in the some of southwestern Manitoba that weekend. Snow, rain and icy roads in southern Manitoba forced hundreds of Easter travellers to spend the night in motels or community centres.

Sunshine was below normal everywhere with the exception of Swift Current. Sunshine deficits of 40 to 60 hours were common in several areas.

Ontario

Ontario's wait for pleasant spring weather continued unrequited as April 1992 , like March before it, proved to be a wet, stormy, cold and sunless month. Indeed, as the poet T.S. Elliot once wrote if "April was the cruellest month" then April 1992 was "cruëller" than normal.

Examining the soggy details reveals that April's monthly mean temperatures were from 1°C to 2°C colder than normal province wide, resulting in the coldest April since 1989 at most locations. At Sault Ste Marie, however, April 1992 was the coldest since 1978, while both Thunder Bay and Hamilton recorded the coldest April since 1982. Interestingly, while April daytime temperatures fared cold under cloudy skies, the nights were often relatively mild again as a result of the blanket of cloud. Overall then, the final temperature statistics for April 1992 were not as cold as expected.

Precipitation was heavy in Ontario with the exception of a region east of Georgian Bay north to Timiskaming including the Ottawa Valley. In a wet southern Ontario, total April precipitation ranged from 90 mm to 135 mm as records for wettest April ever were set at St Catharines with 121 mm and Toronto's Pearson Airport with 134 mm. Other southern sites to top 100 mm included: Kitchener 117 mm, Sarnia 111 mm, Windsor 108 mm and Hamilton 104 mm. Given normal April precipitation in the 70 mm to 80 mm range, April 1992 looked very bleak; however, at several locations April 1991 was wetter.

Northern and northwestern Ontario also measured an over-abundance of moisture. Whereas normally only 40 to 60 mm falls, this April records reached 65 mm to 150 mm. Wawa was the wettest spot in the province with their 149 mm again setting a high-water mark for any April.

In contrast, the dry area in the east recorded just 20 to 60 mm. Petawawa was the driest site with only 21 mm - their least amount of April precipitation since records began there in 1971; while North Bay was also dry with 28 mm was their least since 1976.

April snowfall was extremely varied as is usually the case. While the northwest was snowy led by Pickle Lake's 74 cm of snow, central Ontario recorded very little snow. At Timmins, for example, only 2 cm fell, the least April snow since 1958. Wiarton, on the other hand, was hit hard with a couple of spring snowfalls that dumped 42 cm, giving them their most April snow since records started there in 1947. Ottawa's 26 cm was their greatest April total since 1975.

Sunshine in April 1992 was rare as the sun definitely did NOT "come out tomorrow" ! Thunder Bay, Sault Ste Marie and Sarnia all set records for the cloudiest April ever as total hours lagged from 40 to 90 hours below normal, as one of the dullest springs ever to plague Ontario.

Quebec

April was a cold month with total precipitation and sunshine above normal, except for certain western and eastern regions of the province.

Once again, mean monthly temperatures were close to record low levels. Temperature anomalies varied from 0.2°C below at Gaspé to 5°C below between Kuujjuaq and Kuujjuarappik. Mean temperature extremes were recorded in and Montreal with 4.9°C and Inukjuak, in northern Quebec, with -14.7°C.

Total monthly precipitation remained below seasonal normals, except for Trois-Rivières, northward through the Saguenay-Lac St-Jean regions to Kuujjuaq. Bagotville airport reported 206 percent of normal precipitation values. Over southern Quebec precipitation extremes were measured at Maniwaki (24.2 mm) and at Mont Joli (99.4 mm). In northern Quebec totals of 14.2 mm and 46.8 mm were recorded in Inukjuak and Schefferville, respectively.

All regions received some snow during the month. Snowfall amounts varied from 0.6 cm in Maniwaki to 54.8 cm in Schefferville.

Total bright sunshine hours were above normal for the month except for the southern Laurentian and Ottawa Valley regions.

Significant weather events for the month included the following. On April 11th a warm front, associated with a low pressure system moving in from the Great Lakes region, dumped 15 cm to 20 cm of snow on localities eastward from the Ottawa Valley to the greater Montréal area and then southwards to the Eastern Townships. Numerous highway accidents were reported due to slippery and icy road conditions. The Jacques-Cartier bridge, linking Montreal to the south shore had to be closed for almost 45 minutes so that road crews could untangle a small pile-up. The provincial police reported at least 12 accidents with injuries.

Maritimes

April was generally cold and dry. It turned out to be the coldest April in 20 years at a number of locations. CFB Shearwater (Halifax- Dartmouth) reported a mean temperature of 2.2°C, the third lowest for the month of April since records began in 1944.

Precipitation totals were below normal with the exception of a few areas in eastern Nova Scotia where they were above normal. Many locations reported less than half their normal for the month. The Halifax International Airport, reported only 39.4 mm which is 35 percent of normal and the lowest April total since 1966. A number of other locations also reported their lowest April precipitation since 1966.

Snowfall totals varied either side of normal with the largest amounts occurring in the eastern regions. Sable Island reported a total of 40.1 cm which is almost seven times their normal for April, and the second highest snowfall for the month of

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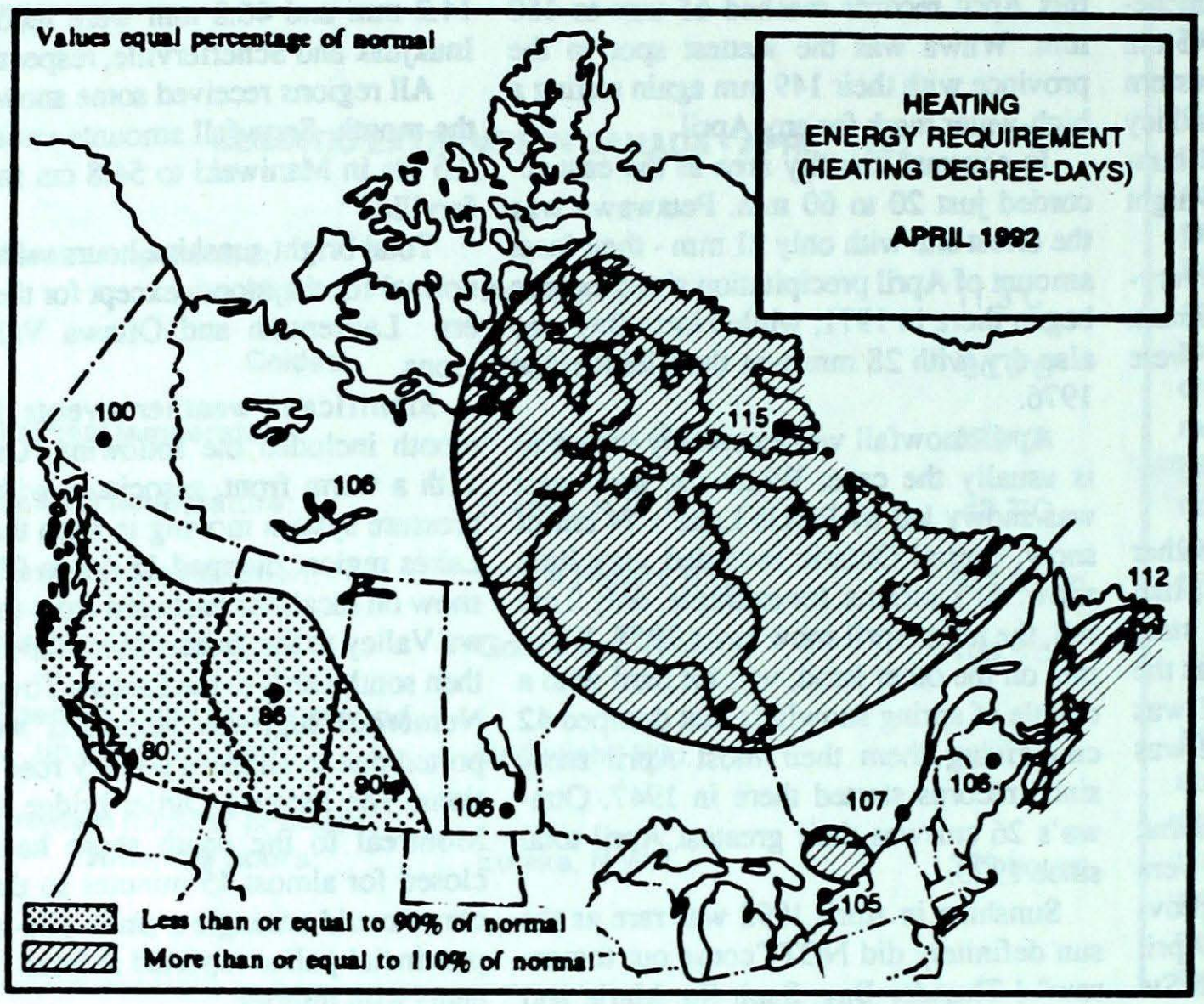
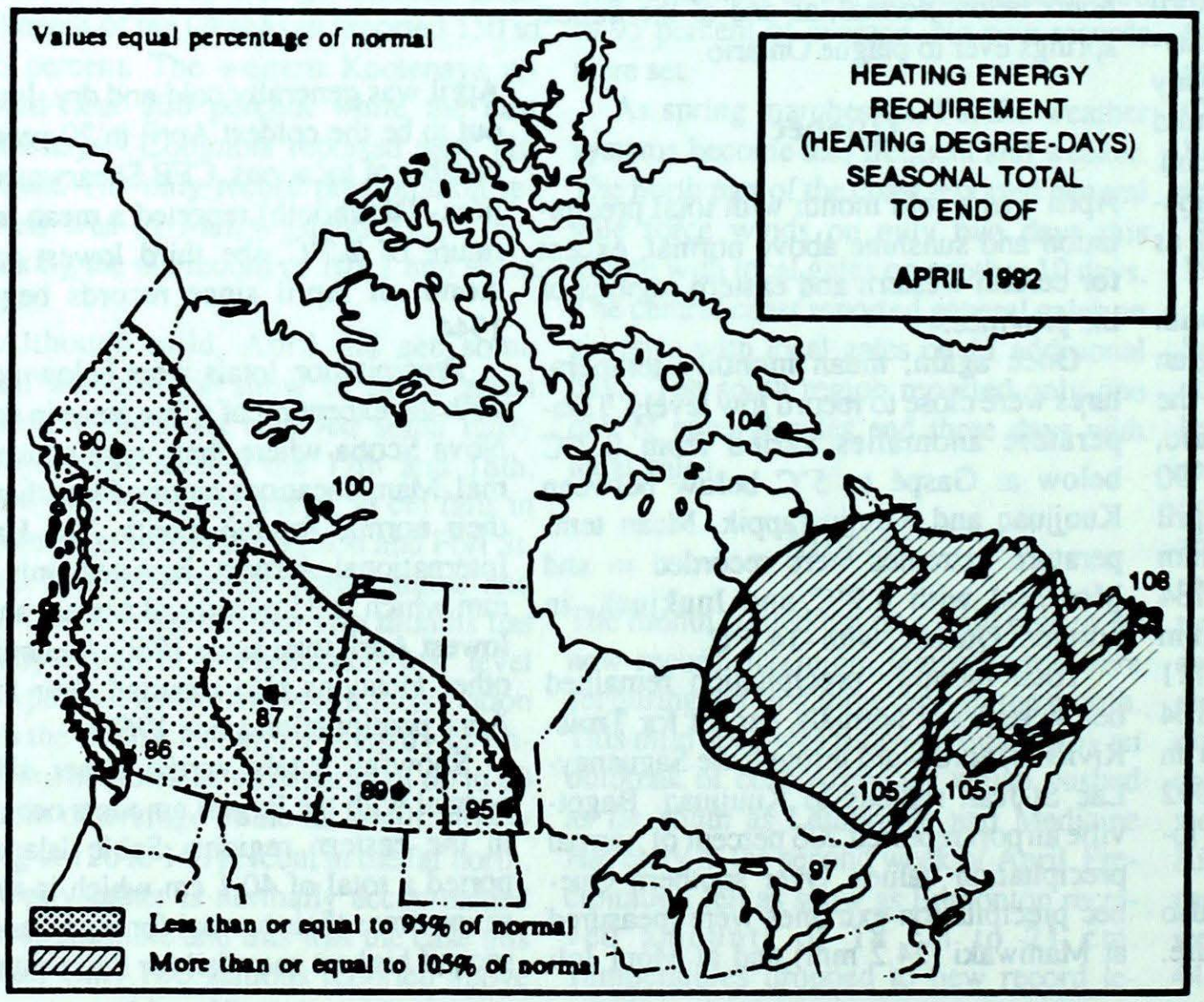


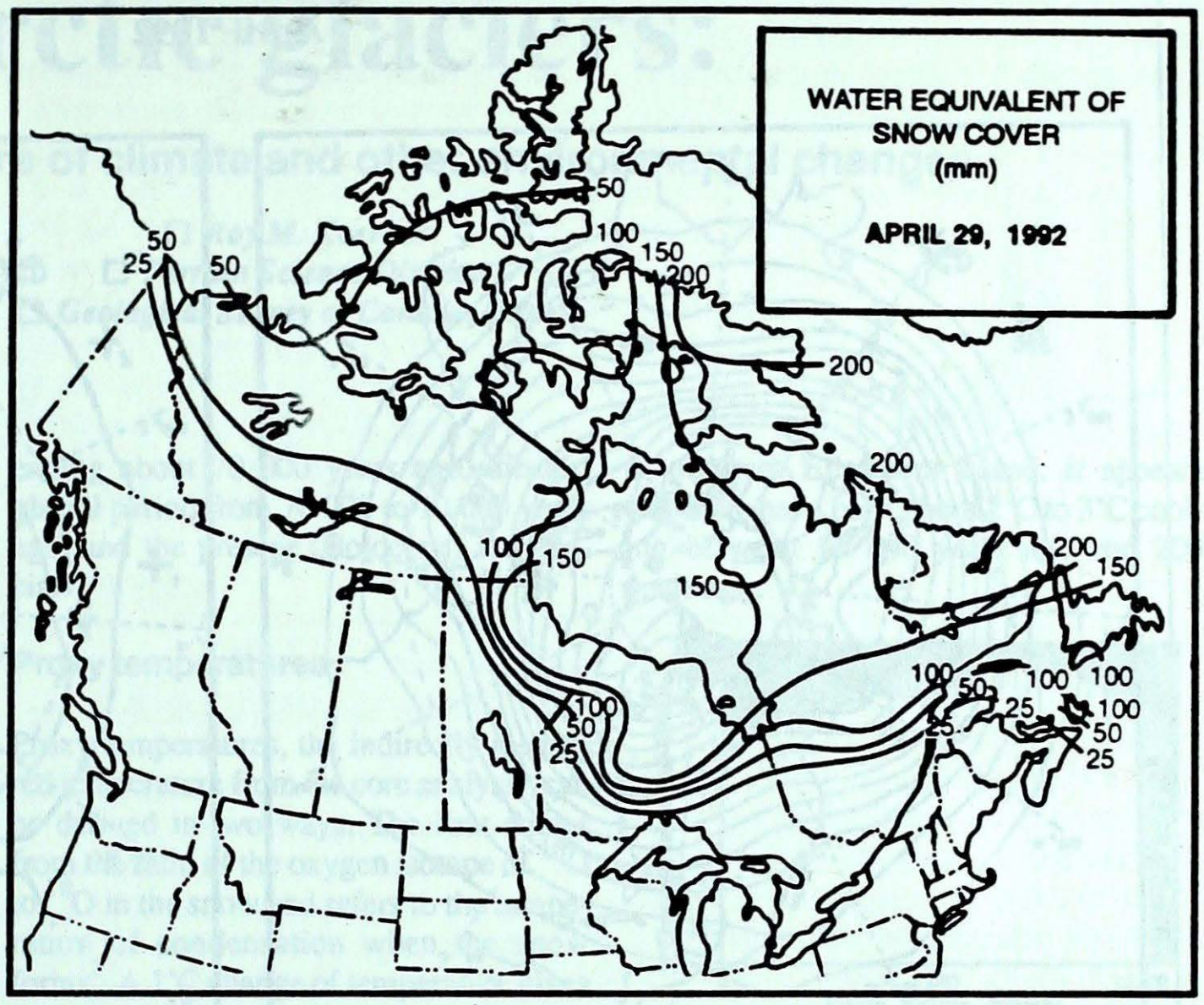


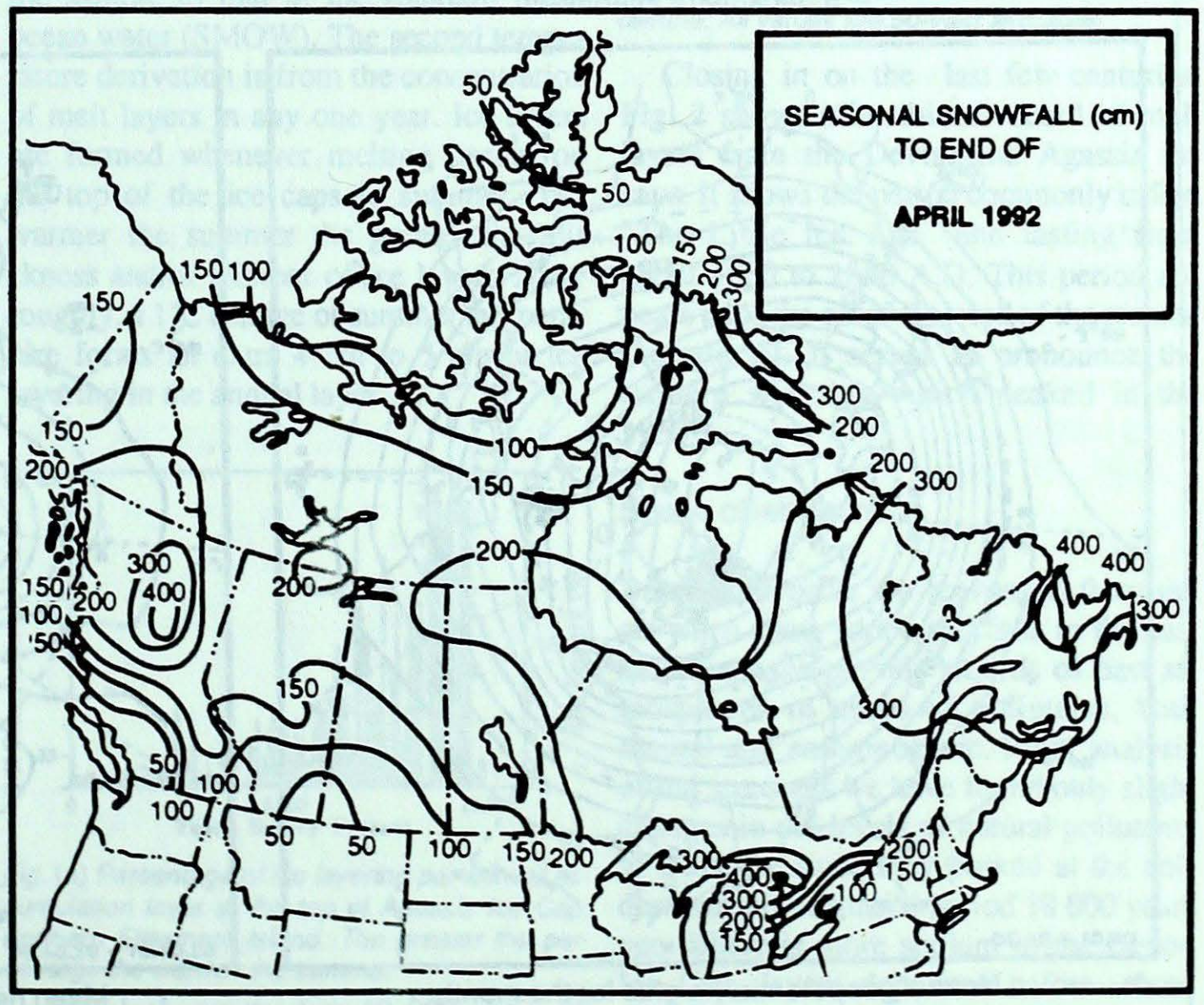
SEASONAL TOTAL OF HEATING DEGREE-DAYS TO END OF APRIL

	1992	1991	NORMAL
BRITISH COLUMBIA			
Kamloops	2908	3398	3562
Penticton	2840	3295	3285
Port Hardy	2812	3130	3238
Vancouver	2366	2694	2745
Victoria	2446	2768	2805
YUKON TERRITORY			
Whitehorse	5848	6419	6471
NORTHWEST TERRITORIES			
Iqaluit	9184	9382	8860
Inuvik	9222	9112	9313
Yellowknife	8001	8216	7972
ALBERTA			
Calgary	4062	4573	4979
Edmonton Mun.	4468	4796	5146
Grande Prairie	5037	5516	5759
SASKATCHEWAN			
Estevan	4695	5033	5178
Regina	4913	5200	5529
Saskatoon	5149	5506	5718
MANITOBA			
Brandon	5635	5643	5767
Churchill	8450	8361	8248
Dauphin	5483	6189	5775
Winnipeg	5506	5276	5591
ONTARIO			
Kapuskasing	6129	5938	5965
London	3802	3500	3856
Ottawa	4595	4128	4437
Sudbury	5185	4808	5079
Thunder Bay	5362	5249	5327
Toronto	3767	3482	3868
Windsor	3337	3075	3435
QUEBEC			
Baie Comeau	5722	5573	5504
Montréal	4502	4006	4300
Québec	5095	4688	4849
Sept-Îles	5940	5835	5600
Sherbrooke	4938	4397	4880
Val d'Or	5993	5570	5643
NEW BRUNSWICK			
Fredericton	4593	4225	4394
Moncton	4629	4326	4360
NOVA SCOTIA			
Sydney	4304	4008	4020
Yarmouth	3790	3380	3658
PRINCE EDWARD ISLAND			
Charlottetown	4448	4196	4244
NEWFOUNDLAND			
Gander	4924	4701	4501
St. John's	4554	4277	4209

SEASONAL SNOWFALL TOTALS (cm) TO END OF APRIL

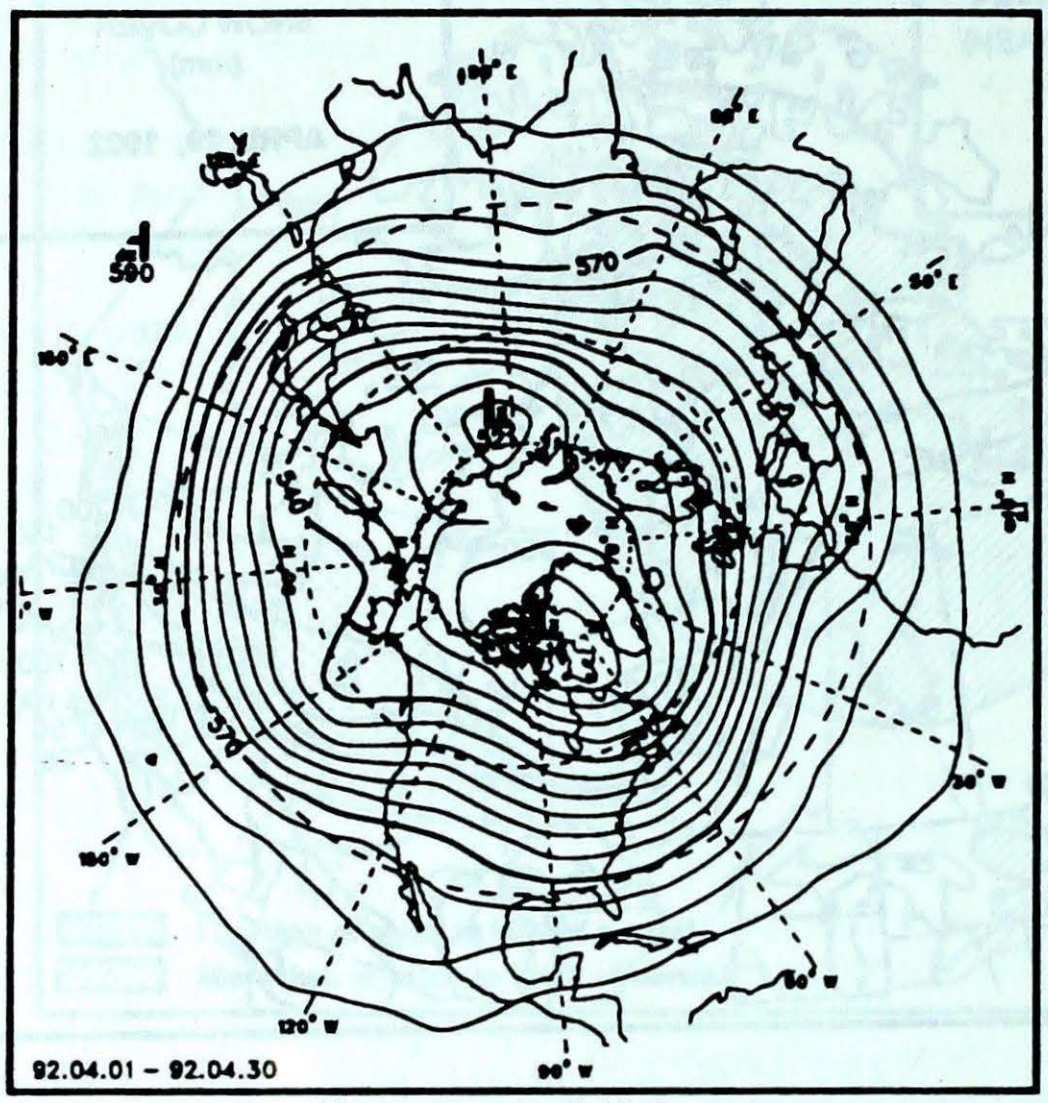
	1992	1991	NORMAL
BRITISH COLUMBIA			
Kamloops	32	96	91
Port Hardy	1	72	72
Prince George	208	309	236
Vancouver	2	118	60
Victoria	5	73	50
YUKON TERRITORY			
Whitehorse	218	184	133
NORTHWEST TERRITORIES			
Iqaluit	155	*	222
Inuvik	170	157	162
Yellowknife	191	183	132
ALBERTA			
Calgary	80	114	142
Edmonton Namao	146	110	129
Grande Prairie	170	190	176
SASKATCHEWAN			
Estevan	83	114	114
Regina	88	85	119
Saskatoon	109	119	111
MANITOBA			
Brandon	155	116	115
Churchill	228	218	173
The Pas	188	134	164
Winnipeg	109	121	123
ONTARIO			
Kapuskasing	258	269	310
London	218	184	209
Ottawa	268	185	226
Sudbury	265	263	245
Thunder Bay	206	181	209
Toronto	96	88	131
Windsor	32	83	117
QUEBEC			
Baie Comeau	310	464	368
Montréal	225	197	223
Québec	238	316	343
Sept-Îles	311	452	421
Sherbrooke	295	212	291
Val d'Or	288	291	307
NEW BRUNSWICK			
Charlo	340	396	411
Fredericton	198	273	289
Moncton	455	321	339
NOVA SCOTIA			
Sydney	409	184	313
Yarmouth	252	122	207
PRINCE EDWARD ISLAND			
Charlottetown	348	209	329
NEWFOUNDLAND			
Gander	437	431	389
St. John's	360	251	347



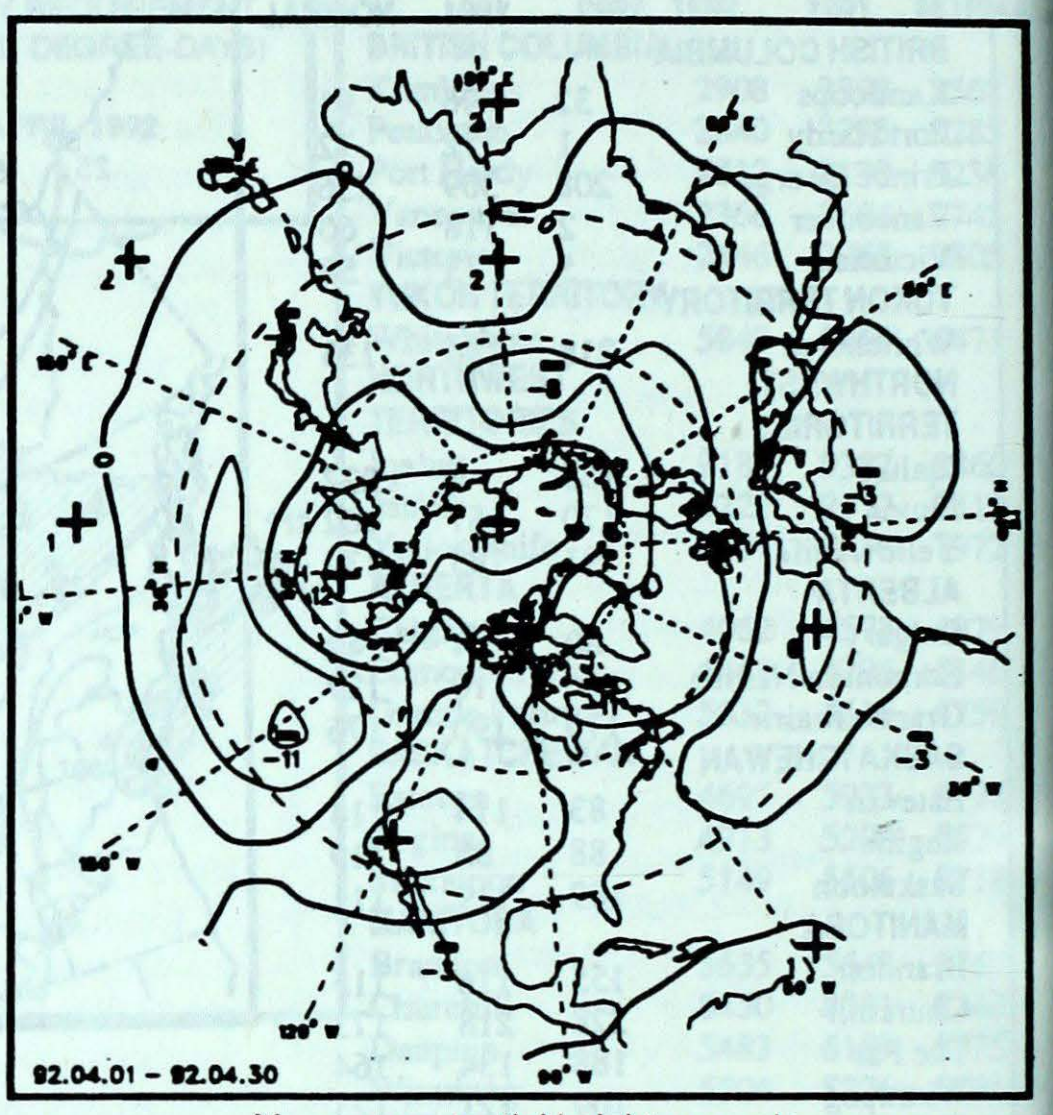


50-kPa ATMOSPHERIC CIRCULATION

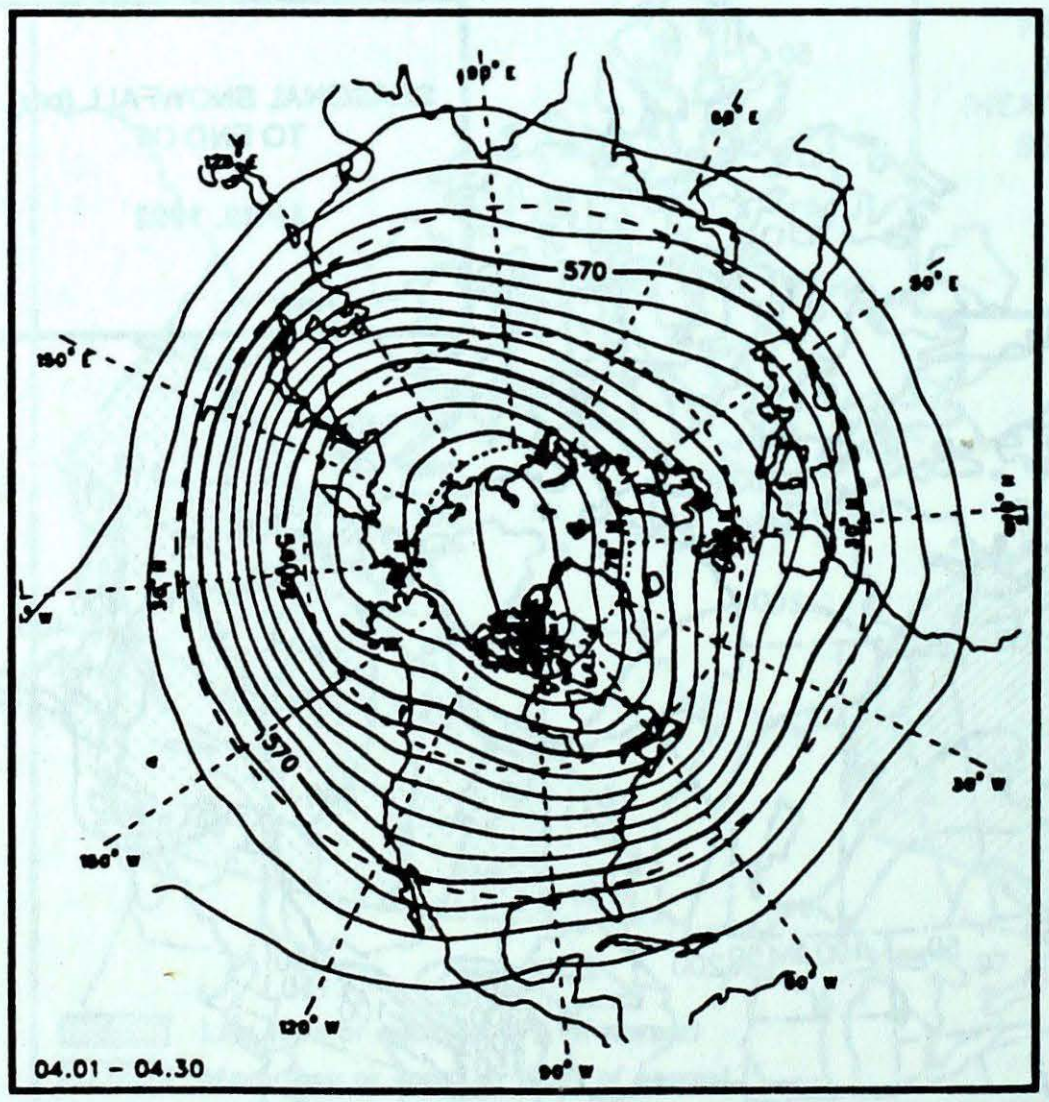
April 1992



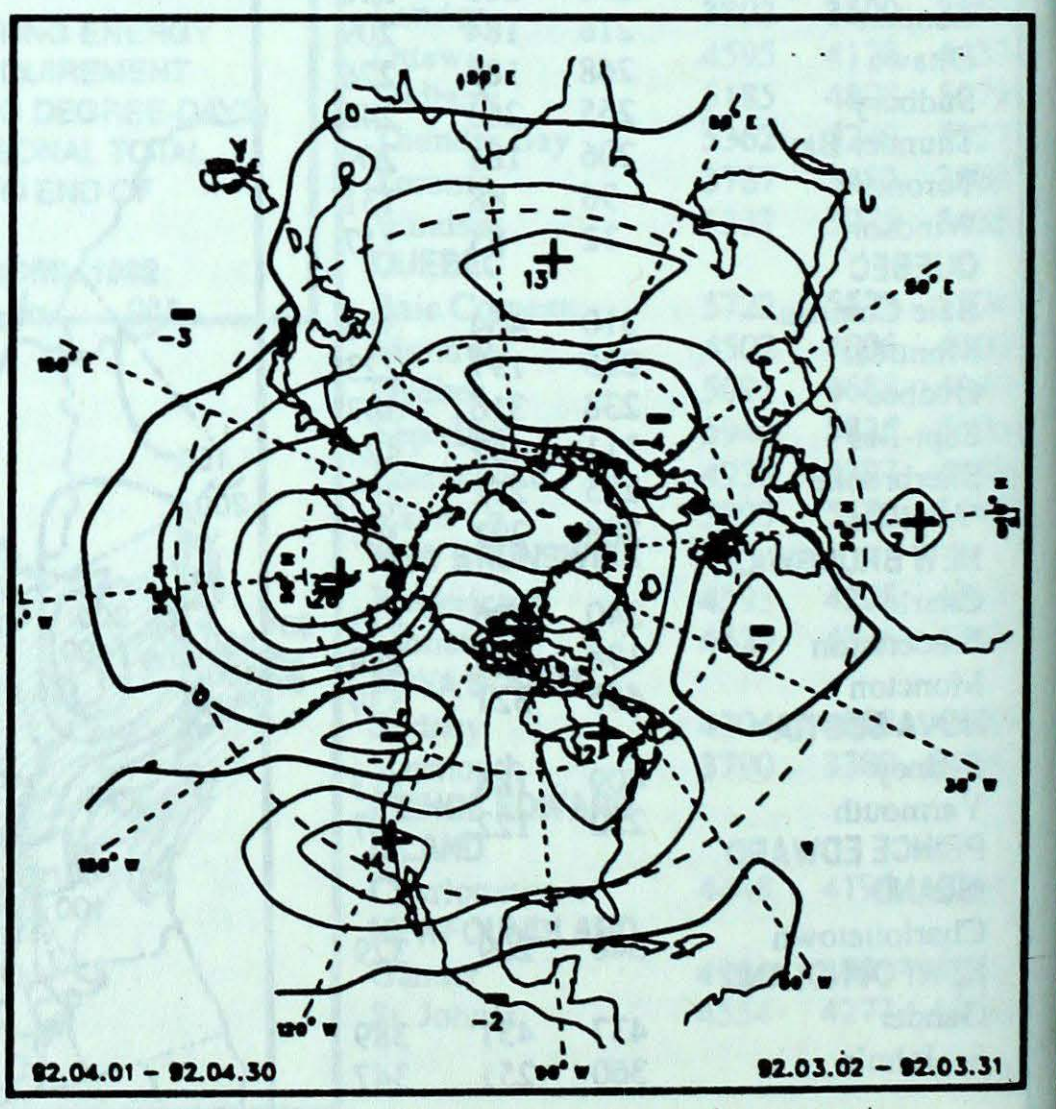
Mean geopotential heights
- 5 decametre interval -



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 -

Arctic glaciers:

valued chroniclers of climate and other environmental changes

□ *Roy M. Koerner*
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Introduction

In the light of the modern climate debate, research is urgently required to determine how climate has changed in the past; how, and where it is changing now; and what are the causes of the changes. The general consensus is that the major swings from the ice age to the interglacial are due to changing orbital parameters of the planet. These changes are, however, in terms of several thousands of years. Today, the concern is with the way the climate may change in a 100 years.

Lovelock[1], in his elegant theory of Gaia, illustrated the interplay between life, the land, oceans and atmosphere. He conceives the planet as a living organism. In his concept, micro-organisms play the dominant part in climate control. Now, climate modellers are showing that the human life-form is having a profound effect on climate by extensively changing the ecology of the oceans and the land masses, and by injecting gases and aerosols into the atmosphere that affect the radiation balance of the Earth.

One of the many global change studies that the Terrain Sciences Division of the Geological Survey of Canada has undertaken involves the use of glaciers and ice caps in the study of climate change and pollution of the Arctic. The work involves drilling surface-to-bedrock ice cores and measuring the annual mass balance of three ice caps. The mass balance is computed by subtracting the annual melt runoff from the snow accumulation.

At the top of ice caps in the high Arctic very little snow melts each year, and there is a net accumulation. Aerosols and atmospheric gases trapped with the snow are buried thereby preserving a record that, in the case of the Queen Elizabeth Island ice caps, is about 100 000 years long. This interval covers the last interglacial period, ending about 70 000 years ago, the last glacial period from 70 000 to 10 000 years ago, and the present (Holocene) interglacial.

Proxy temperatures

Proxy temperatures, the indirectly measured temperature from ice core analysis, can be derived in two ways. The first comes from the ratio of the oxygen isotope of ^{16}O to ^{18}O in the snow and refers to the temperature of condensation when the snow forms[2]. A 1°C change of temperature gives 0.62‰ (δ-^{18}O) difference where δ is the fractional difference between the ratio in the sample to that in the standard mean ocean water (SMOW). The second temperature derivation is from the concentration of melt layers in any one year. Ice layers are formed whenever melting occurs on the top of the ice caps in summer. The warmer the summer the greater the thickness and/or number of ice layers. Very roughly, a 1°C change of summer temperature forms an extra 4 cm to 5 cm of ice layering in the annual layer.

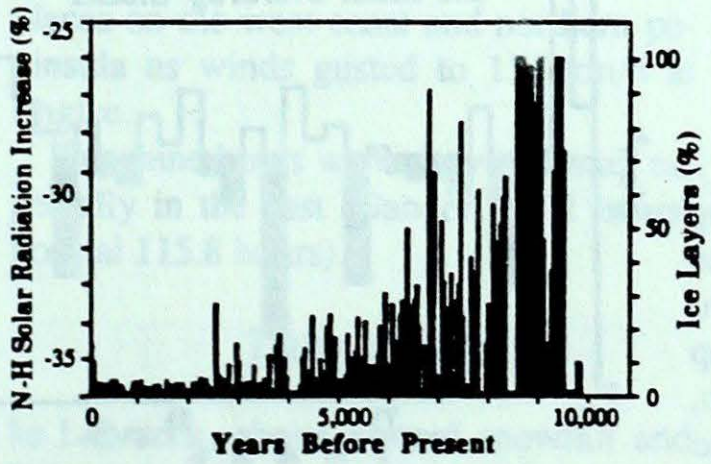

Fig. 1a) Percentage of ice layering per annual accumulation layer at the top of Agassiz Ice Cap, northern Ellesmere Island. The greater the percentage the warmer the summer.

Fig. 1 shows the last 10 000 years of record for stable isotopes and melt layering in northern Ellesmere Island. It appears that there have been about 2°C to 3°C cooling between 10 000 years ago and 200 years ago.

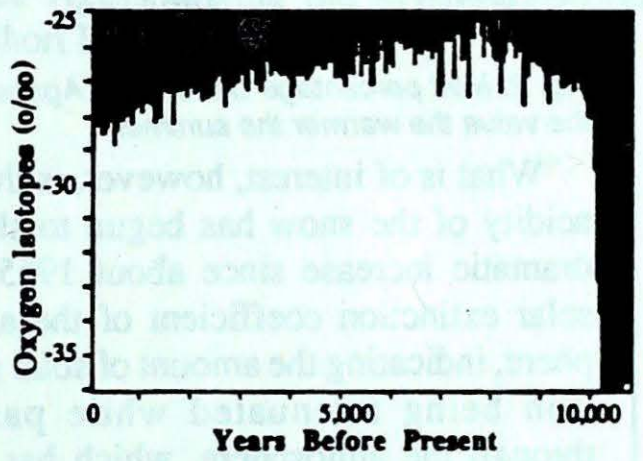

Fig. 1 b) Stable isotope (per mil), Agassiz Ice Cap. The more negative the δ the colder the climate. All values are 50-year averages.

Closing in on the last few centuries, Fig. 2 shows a combined record of melt layers from the Devon and Agassiz ice caps. It shows the period commonly called "The Little Ice Age" and lasting from about 1600 to 1850 A.D. This period appears to be the coldest period of the present Interglacial. It serves to pronounce the modern warming which peaked in the 1950's.

Snow chemistry

Because aerosols are scavenged from the air when snow forms and falls to the surface, ice caps provide records of past atmospheres in terms of pollutants, both natural and anthropogenic. From analysis of our ice cores we have found only slight changes in the levels of natural pollutants in the snow since they peaked at the coldest part of the glacial period 18 000 years ago. There is more sodium in the Devon Ice Cap layers deposited before about 5 000 years ago. This may be due to more open water in Baffin Bay at that time.

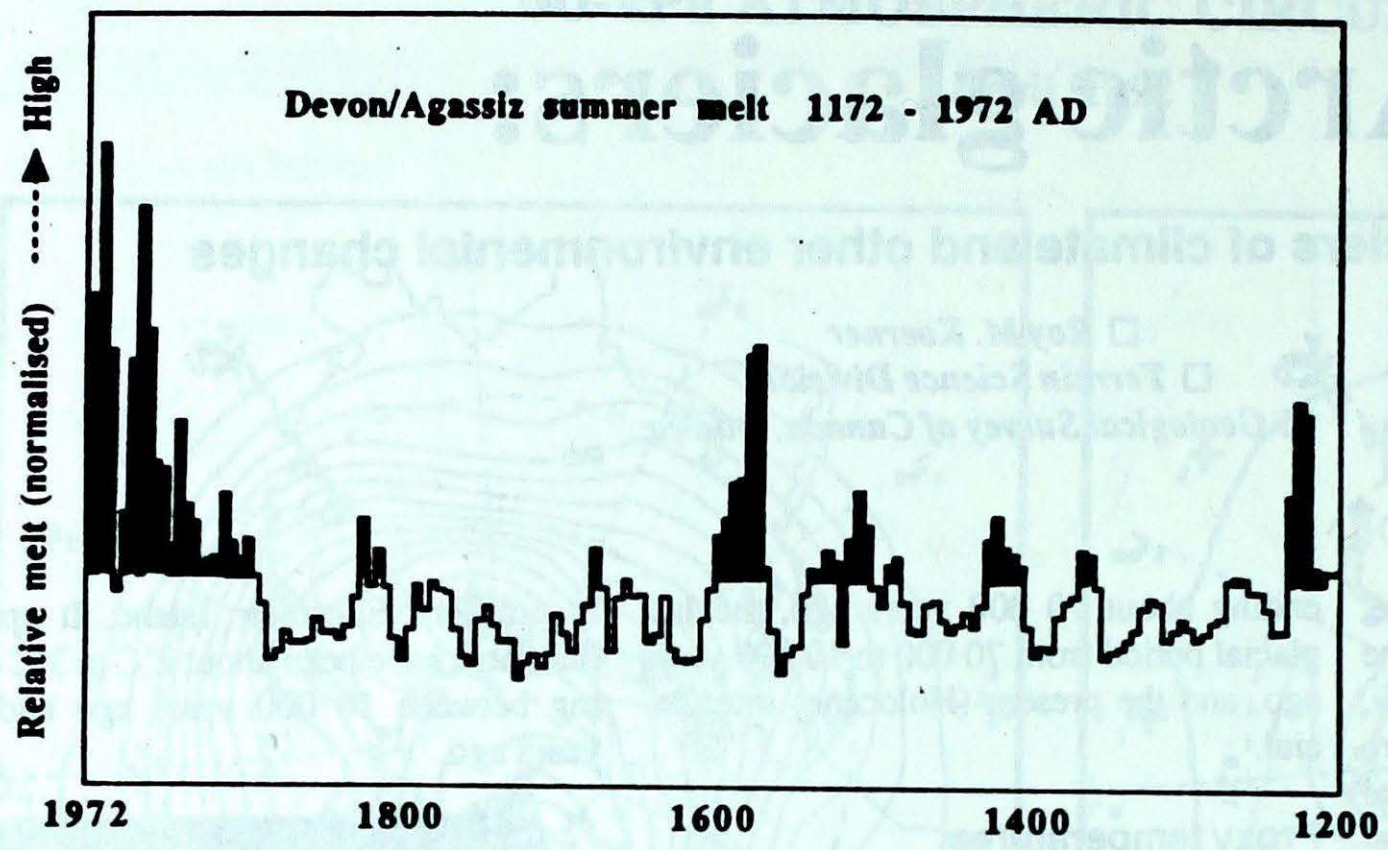

Fig. 2. Melt percentage Devon and Agassiz ice caps. Blended normalized values. Again, the higher the value the warmer the summer.

What is of interest, however, is that the acidity of the snow has begun to show a dramatic increase since about 1955. The solar extinction coefficient of the atmosphere, indicating the amount of solar radiation being attenuated while passing through the atmosphere, which has been measured by the U.S.S.R. (since the 1940's) on Franz Josef Island (on the Russian side of the Arctic Ocean), also began to increase about the same time. Both the acid concentrations in the snow and the solar extinction coefficient are partly dependent on aerosols in the atmosphere. We have now found that the increased acidity in our snow is due to sulphates and nitrates. The agreement between the two sets of measurements indicates the importance of acid aerosols as well as "greenhouse gases" in terms of climate change. This climatic effect will be referred to later.

Glacier mass balance

In addition to ice coring, we are continuing to measure the mass balance of four ice caps in the Queen Elizabeth Islands. Two of these records, one on Meighen Ice Cap and the other on Devon Island Ice Cap, began over 30 years ago. As mass balance consists of the balance between accumulation by snow and ablation (loss) by melting ice it is better to express the measurements separately if we are to relate any trends to climatic change.

Ablation is measured each spring by simply measuring the height of arrays of aluminum poles drilled into the ice at several locations on the glaciers and ice caps. At each location the pole height increases each summer according to how much ice melts. Usually, after three to four years, the poles have to be replaced as about a metre of ice melts each year. Melting decreases with increasing elevation until the *equilibrium line* is reached. At this elevation the only melting is of the previous year of snow. The 30-year record of melting for Sverdrup Glacier on Devon Island is shown in Fig. 3a. No significant trend to more, or less, melt each year is seen.

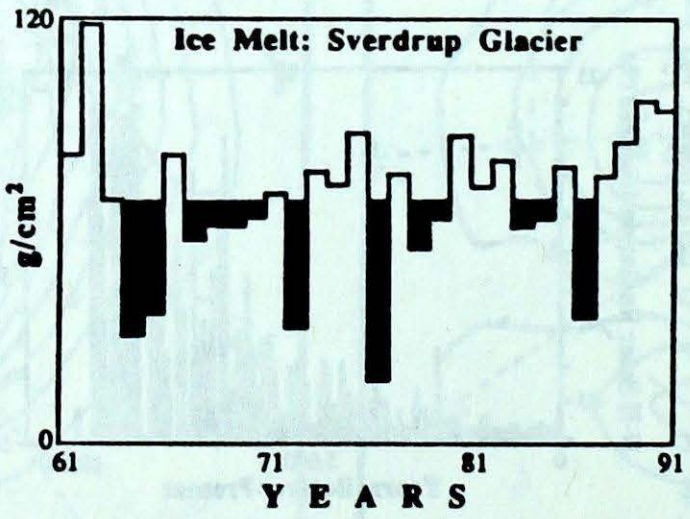

Fig. 3. a) Amount of ice melting each year, Sverdrup Glacier, Devon Ice Cap. The greater the melt, the warmer the summer.

Accumulation is in the form of snow, or refrozen snow-melt (superimposed ice). Winter and spring are seasons of accumulation but summer melting restricts *annual* accumulations to the regions about the *equilibrium line*. Winter snow accumulation is simple to measure each spring by probing to the hard, underlying surface of the previous summer's refrozen snow, or to the glacier ice surface. Density measurements give the snow mass. The annual accumulation is difficult to assess as melting above the *equilibrium line* percolates down and refreezes in the snow below. Small trays are buried to catch this water which then refreezes and can be measured the following spring. Fig. 3b shows the record of winter snow for the northwest side of Devon Ice Cap. There is again no significant overall trend in the data although the 1980's show higher snowfall. The records for Meighen Ice Cap do not show this feature and, again, no trends are seen.

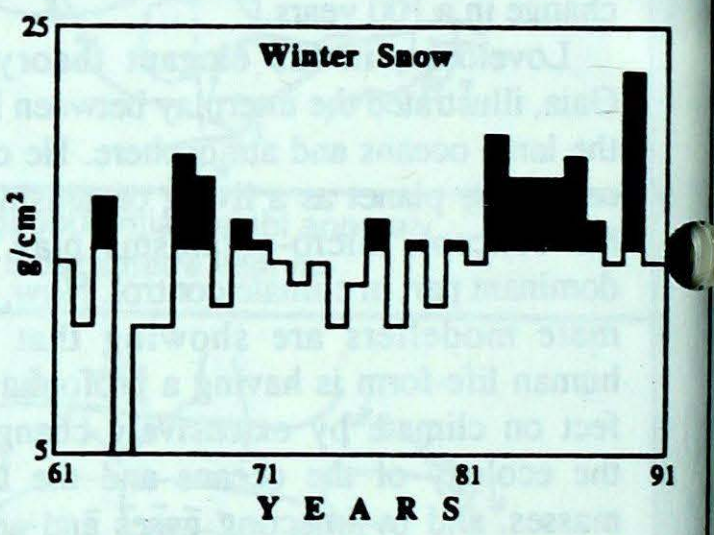

Fig. 3 b) Amount of winter snow (August to June), Devon Ice Cap, in the area where some snow remains each year.

The conclusion from this work is that we do not yet see any of the climate change predicted by models for the high Arctic. These models predict increased winter precipitation, much higher winter temperatures and modestly higher summer temperatures. Our records say nothing about winter temperatures but the melt record shows no change in the summer energy fluxes. Some modellers indicate that the reduced summer warming is partly due to the energy absorbed by increased melting of ice in the Arctic. If this is the case, (although they may be referring to sea ice), it must also affect glacier ice; we do not see this effect in our records.

A look at other glaciers in the north show a similar story; although here we are referring to mass balance and not the separate accumulation and ablation components. No trends are evident in the Svalbard records. Iceland and northern Sweden even show a turn to slightly healthier glacier conditions with less terminal recession and more positive balances in the 1980's. In this context, however, we should realize that the "Little Ice Age" saw glaciers at their maximum extent for 10 000 years. Even with no climatic change over the last 30 years, glaciers would be expected to be adjusting to the "new", warmer climate by showing less negative balances as they approach a new equilibrium. To see a clearer climatic link we need to look at the separate components of these records; this is planned for the future.

Pollution cooling

An intriguing possibility is that the Arctic haze may be counteracting the warming expected from anthropogenically produced "greenhouse gases". Our own proxy temperature (stable isotope) and ice layer records reached maximums in the 1950's (see for example Fig. 2). This is precisely when the pollution records show rapid increases in acidity. A global effect of this nature has been suggested by the recent update to the Intergovernmental Panel on Climate Change report on global climate; it bears further research by both modellers and field workers.

Summary

Thus, ice caps, through ice cores and mass balance measurements form a very valuable way of monitoring present climatic change and placing it into perspective by comparing any changes with those that have occurred in the past. They also allow us to monitor the levels of pollutants in the snow from year to year and, hopefully in the future, see how effective new policies are in reducing the levels of pollutants entering the high Arctic.

References

1. J.E. Lovelock, 1988. The ages of Gaia, Norton, New York. Penguin, Toronto. 252p.

2. For a popular summary of these procedures, see J. Imbrie, K.P. Imbrie, 1979. Ice Ages: Solving the Mystery. Enslow, Short Hills, New York, 224p.

...continued from page 5

April since records began in 1891; the highest record for April is 47.2 cm set in 1911.

Sunshine totals were generally above normal in New Brunswick and Prince Edward Island, and below normal in Nova Scotia.

Newfoundland

Cold and snowy conditions highlighted the weather pattern for much of Newfoundland. Mean monthly temperatures were up to 2°C below normal for the month except at Port-aux-Basques where a mean temperature of 0.6°C was near normal. Snowfall amounts were well above normal over all but southern regions (Gander 84.2 cm; normal 47.1 cm). On April 6 and 7 a system brought 30 cm to 50 cm of snow to eastern areas while on the Avalon Peninsula about eight hours of freezing rain preceded by heavy rain left 70 000 households without power. Another storm on April 14 caused blizzard-like conditions to many places on the west coast and northern peninsula as winds gusted to 154 km/h at Englee.

Sunshine hours were above normal, especially in the east (Gander 177.2 hours; normal 115.8 hours).

Labrador

In Labrador, above normal snowfall and below normal temperatures prevailed across much of the region. Mean temperatures ranged from 3°C to 4°C below normal in central and northern areas (Nain -8.9°C; normal -4.9°C) and up to 2°C below normal over the remainder of Labrador. Snowfall was abundant during the month in all areas but the west. Goose Bay recorded 108.3 cm, more than double the normal amount. Western locations recorded 45 cm, close to normal. At the end of April some eastern locations had over 250 cm of snow on the ground, while western areas had 30 cm.

Sunshine hours were near 180 hours in the west, 30 hours above normal, while eastern locations received near 120 hours, a little below normal.

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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									
BRITISH COLUMBIA													
ABBOTSFORD A	11.1	2.4	24.2	-0.6	0.0	0	174.4	170	0	17	159	97	212.1
ALERT BAY	8.8	1.4	17.2	0.2	0.0	0	127.8	153	0	19	*	*	277.4
AMPHITRITE POINT	9.5	1.5	17.0	2.2	2.2	275	271.5	133	0	21	*	*	258.4
BLUE RIVER A	6.1	1.8	21.0	-10.1	8.2	91	76.4	199	0	13	137	82	*.*
CAPE ST JAMES	7.7	1.2	12.8	2.8	0.0	0	104.8	98	0	15	168	*	309.9
CAPE SCOTT	8.5	1.6	14.8	2.2	5.0	143	187.0	91	0	20	*	*	286.0
CASTLEGAR A	9.3	1.2	25.1	-4.7	2.6	31	89.4	190	0	11	155	90	261.6
COMOX A	9.3	1.3	13.1	5.4	0.0	0	116.7	204	0	15	159	*	261.5
CRANBROOK A	7.7	1.9	25.7	-6.5	0.0	0	28.4	100	0	4	207	95	307.9
DEASE LAKE	0.9	0.6	13.7	-19.2	20.8	173	37.8	307	17	9	156	82	513.9
FORT NELSON A	1.3	-0.3	17.9	-23.1	24.5	152	40.5	243	0	10	212	*	500.0
FORT ST JOHN A	4.6	1.7	19.5	-17.4	9.6	59	19.0	88	0	3	182	*	401.3
HOPE A	11.2	1.9	26.0	0.3	0.0	0	157.8	151	0	15	137	85	203.9
KAMLOOPS A	11.0	1.9	27.5	-3.1	0.0	0	12.1	116	0	3	192	97	211.3
KELOWNA A	9.4	1.9	23.9	-5.8	0.0	0	24.8	122	0	7	182	90	257.0
MACKENZIE A	4.2	1.2	18.9	-15.6	6.8	64	37.5	229	0	10	183	89	415.5
PENTICTON A	9.8	1.2	23.2	-5.0	0.0	0	32.0	150	0	8	167	79	245.7
PORT ALBERNI A	9.4	1.5	24.3	-3.7	0.0	0	155.0	163	0	19	136	*	258.4
PORT HARDY A	8.2	1.6	17.0	-1.6	0.2	15	97.7	91	0	17	122	85	295.2
PRINCE GEORGE A	6.1	1.8	21.5	-11.5	4.0	40	48.4	177	0	9	178	88	357.7
PRINCE RUPERT A	6.8	1.5	17.7	-4.8	0.0	0	221.6	122	0	19	142	105	334.8
PRINCETON A	8.2	2.0	26.4	-7.0	1.4	40	8.6	58	0	4	209	*	*.*
REVELSTOKE A	8.7	2.2	20.7	-4.7	1.0	6	67.6	167	0	10	143	80	279.5
SANDSPIT A	6.6	0.6	12.9	0.6	0.0	0	99.7	118	0	15	145	94	340.5
SMITHERS A	5.0	0.8	18.5	-9.2	8.5	121	22.6	128	0	6	168	95	390.9
TERRACE A	7.1	1.4	15.2	-2.7	1.4	12	74.9	122	0	16	142	96	327.8
VANCOUVER INT'L A	10.6	1.8	22.1	1.8	0.0	0	126.2	212	0	15	169	93	222.9
VICTORIA INT'L A	10.1	1.7	21.5	-1.1	0.0	0	59.8	152	0	12	199	111	237.5
WILLIAMS LAKE A	5.9	1.5	21.4	-9.0	3.0	31	30.4	141	0	8	177	85	363.5

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	-2.0	*	13.4	-30.1	*	*	11.9	*	*	*	*	*	*
MAYO A	-0.6	-0.2	13.6	-20.8	8.0	107	23.1	269	*	*	*	*	*
WATSON LAKE A	-1.7	-1.1	13.5	-26.1	26.8	194	30.3	201	12	6	185	85	588.4
WHITEHORSE A	0.2	-0.1	11.9	-19.6	18.0	171	16.6	175	0	6	164	71	536.3
NORTHWEST TERRITORIES													
BAKER LAKE A	-19.4	-2.1	-0.3	-31.7	13.2	97	13.2	96	44	3	213	91	1123.1
CAMBRIDGE BAY A	-24.3	-2.4	-11.6	-36.0	10.0	123	9.4	131	39	3	286	113	1269.2
CAPE PARRY A	-17.4	1.3	-6.4	-31.4	12.4	95	8.9	93	26	2	*	*	1060.6
CLYDE A	-20.4	-2.0	-10.2	-33.1	16.2	118	14.6	107	48	7	213	86	1152.6
COPPERMINE A	-19.4	-1.9	-1.8	-31.4	10.4	102	9.8	89	95	3	203	94	1122.2
CORAL HARBOUR A	-19.8	-3.5	-3.5	-35.8	6.8	47	6.8	50	36	4	234	84	1135.0
EUREKA	-30.9	-3.3	-20.1	-43.7	0.0	0	0.0	0	18	0	379	107	1468.3
FORT SIMPSON A	-3.9	-2.3	13.5	-29.5	36.2	309	43.6	289	25	3	193	87	658.3
FORT SMITH A	-2.0	0.2	18.7	-26.6	8.1	60	10.8	67	4	4	257	106	598.9
IQALUIT	-19.2	-4.9	-8.4	-31.7	20.8	72	10.0	38	10	5	262	112	1115.0
HALL BEACH A	-22.6	-1.7	-11.1	-36.6	6.0	52	5.8	53	37	2	*	*	1219.1
HAY RIVER A	-5.2	-1.0	13.5	-29.2	13.0	99	14.0	89	13	3	*	*	697.1
INUVIK A	-15.3	-1.0	3.0	-31.5	34.6	204	28.1	190	54	8	176	71	998.4
MOULD BAY A	-24.7	-0.6	-14.8	-34.1	0.4	7	0.0	0	13	0	230	81	1282.9
NORMAN WELLS A	-8.6	-1.4	5.8	-25.8	39.6	259	24.6	160	4	8	179	76	806.1
POND INLET A	-24.1	*	-12.3	-35.7	1.4	*	1.2	*	18	0	305	*	1261.4
RESOLUTE A	-25.6	-2.5	-12.8	-36.3	0.0	0	0.0	0	12	0	375	136	1309.3
YELLOWKNIFE A	-8.3	-1.4	7.9	-31.8	16.0	163	16.0	155	15	2	246	93	788.3
ALBERTA													
BANFF	4.6	2.2	21.8	-17.1	14.4	46	36.0	96	0	6	*	*	401.5
CALGARY INT'L A	6.4	3.1	24.4	-13.4	17.0	66	24.6	75	0	6	194	95	348.5
COLD LAKE A	4.6	1.7	24.6	-20.6	4.4	35	39.8	184	0	6	195	85	401.5
CORONATION A	5.7	2.7	24.8	-14.2	14.4	93	45.4	191	0	10	189	82	368.5

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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
EDMONTON INT'L A	5.4	2.2	24.6	-14.7	24.8	192	37.0	183	0	6	204	88	380.0
EDMONTON MUNICIPAL	6.0	1.8	25.0	-15.3	26.1	*	34.5	159	0	6	198	87	355.3
EDMONTON NAMAO A	5.7	1.8	24.3	-16.3	17.4	149	30.4	169	0	7	*	*	372.6
EDSON A	4.2	1.0	22.8	-14.5	25.1	170	26.1	110	0	10	167	82	402.0
FORT CHIPEWYAN A	-0.2	11.1	18.0	-27.0	2.8	11	9.6	49	*	*	*	*	*
FORT MCMURRAY A	3.4	1.3	25.3	-24.6	17.6	130	33.1	161	0	5	186	80	439.6
GRANDE PRAIRIE A	5.2	2.5	21.3	-13.8	4.4	37	19.9	102	0	6	200	*	383.9
HIGH LEVEL A	1.8	-0.4	20.1	-21.4	0.6	4	7.2	44	0	1	220	89	487.4
JASPER	5.0	1.7	20.9	-14.5	16.6	152	37.2	165	0	8	179	*	389.8
LETHBRIDGE A	8.3	3.4	27.4	-12.7	2.0	7	12.6	30	0	5	213	108	292.2
MEDICINE HAT A	8.2	2.6	28.1	-12.2	3.3	18	19.1	63	0	7	221	110	289.7
PEACE RIVER A	5.0	2.9	21.4	-17.1	1.0	11	46.4	324	0	5	*	*	390.8
RED DEER A	5.8	2.7	23.5	-12.6	8.7	51	16.1	61	0	5	*	*	364.8
ROCKY MTN HOUSE A	4.5	1.5	22.9	-15.6	16.4	57	20.0	58	0	7	*	*	393.7
SLAVE LAKE A	4.6	1.5	22.6	-19.1	1.2	13	31.2	177	0	6	213	91	402.7
SUFFIELD A	7.8	*	26.2	-11.5	2.6	*	9.5	*	0	4	214	*	307.7
WHITECOURT A	5.4	2.7	23.8	-15.6	11.8	67	27.8	103	0	8	*	*	378.8
SASKATCHEWAN													
BROADVIEW	2.9	0.3	26.6	-13.0	19.4	137	44.2	142	0	4	182	87	453.3
CREE LAKE	-1.3	0.5	19.7	-26.0	15.4	82	15.1	78	0	2	200	83	579.1
ESTEVAN A	4.6	0.5	28.3	-12.8	14.8	91	46.2	124	0	6	180	86	403.7
HUDSON BAY A	1.9	*	24.1	-17.4	7.0	*	29.2	*	0	6	186	*	485.1
KINDERSLEY	5.8	2.0	25.6	-16.4	4.4	40	10.6	50	0	4	221	*	366.6
LA RONGE A	1.7	0.7	21.1	-20.4	16.5	120	55.5	282	0	5	*	*	490.3
MEADOW LAKE A	4.0	*	25.8	-18.4	6.8	*	20.8	*	0	3	193	*	418.7
MOOSE JAW A	5.4	1.2	29.2	-14.4	2.8	21	12.3	41	0	4	206	94	378.2
NIPAWIN A	2.4	*	23.6	-14.9	6.7	*	15.0	*	0	5	205	*	467.3
NORTH BATTLEFORD A	4.8	1.8	25.3	-16.5	10.4	96	23.0	109	0	3	*	*	397.9
PRINCE ALBERT A	3.4	1.5	24.1	-15.8	6.4	57	18.8	85	0	5	218	97	438.4
REGINA A	4.8	1.5	28.7	-13.1	9.4	86	19.9	84	0	4	182	87	395.8
SASKATOON A	4.6	1.3	26.2	-18.0	10.4	109	12.1	57	0	5	*	*	403.3
SWIFT CURRENT A	5.6	2.1	25.7	-14.1	5.2	34	11.4	40	0	4	213	102	373.7
YORKTON A	2.2	0.0	27.5	-14.7	11.2	85	21.0	95	0	4	160	71	473.5
MANITOBA													
BRANDON A	2.5	-0.3	25.5	-13.7	18.2	161	33.4	99	0	5	174	*	477.0
CHURCHILL A	-13.4	-3.3	5.9	-30.6	16.8	75	11.8	52	17	6	191	93	943.5
DAUPHIN A	1.9	-0.4	22.8	-14.7	23.7	145	61.1	192	0	7	166	75	482.9
GILLAM A	-7.8	-3.7	10.1	-23.5	33.4	87	20.6	84	16	7	*	*	773.0

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
ISLAND LAKE	-2.5	0.7	14.2	-22.7	13.1	47	12.7	47	2	2	*	*	612.4
LYNN LAKE A	-3.6	-0.1	18.2	-24.7	24.8	105	17.0	100	0	5	229	99	646.5
NORWAY HOUSE A	-2.2	*	12.4	-27.0	29.4	*	31.4	*	0	5	*	*	604.2
PORTAGE LA PRAIRIE	2.5	-0.7	23.9	-12.3	13.8	83	34.6	81	0	8	*	*	465.9
THE PAS A	-0.2	-0.2	21.0	-21.0	16.0	82	10.9	40	0	7	185	82	544.2
THOMPSON A	-3.8	-1.5	14.8	-27.8	13.2	44	13.8	62	0	5	221	96	654.5
WINNIPEG INT'L A	2.5	-0.9	20.3	-12.0	11.8	104	35.8	93	0	7	143	65	464.8
ONTARIO													
BIG TROUT LAKE	-5.3	-1.5	13.9	-25.0	25.0	105	22.8	81	3	4	168	*	700.1
EARLTON A	1.2	-0.7	16.6	-13.2	2.2	11	49.6	99	*	6	*	*	503.2
GERALDTON A	-1.9	*	12.4	-20.5	30.8	*	66.6	*	4	7	*	*	598.3
GORE BAY A	2.1	-1.6	14.6	-12.8	17.2	161	76.0	116	0	10	*	*	477.2
HAMILTON A	4.8	-1.3	22.6	-7.2	10.8	169	103.4	132	0	12	*	*	394.6
KAPUSKASING A	-0.7	-1.2	14.4	-15.5	9.0	36	79.0	148	2	10	*	*	562.4
KENORA A	0.6	-2.1	12.8	-14.6	31.6	156	64.7	154	0	8	*	*	521.6
KINGSTON A	4.7	-0.6	17.1	-5.2	10.8	142	92.0	120	0	10	161	80	400.7
LONDON A	5.3	-1.1	22.1	-5.7	1.8	20	86.8	107	0	9	96	57	381.1
MOOSONEE	-4.3	-2.0	15.8	-21.0	9.6	45	51.2	121	10	7	171	99	668.3
MUSKOKA A	5.1	0.6	17.9	-14.9	25.8	215	64.0	87	0	10	*	*	444.7
NORTH BAY A	1.4	-1.8	14.8	-13.6	3.2	19	27.6	44	0	7	182	93	499.4
OTTAWA INT'L A	4.9	-0.7	22.5	-8.3	25.6	312	51.4	74	0	7	176	99	392.8
PETAWAWA A	2.9	-0.8	21.7	-12.5	3.6	60	21.2	33	0	5	*	*	451.7
PETERBOROUGH A	4.7	-0.9	19.4	-7.8	12.8	197	95.8	138	0	10	*	*	399.5
PICKLE LAKE	-2.6	-2.1	12.6	-20.4	73.6	249	105.6	242	20	11	*	*	618.1
RED LAKE A	-0.8	-2.3	14.6	-17.9	48.2	258	77.4	205	*	10	133	*	564.3
ST CATHARINES A	6.1	-0.6	25.2	-4.9	9.4	285	120.8	152	0	13	150	*	357.5
SARNIA A	5.3	-1.0	22.7	-5.1	16.0	262	110.5	144	0	12	128	67	380.7
SAULT STE MARIE A	1.7	-1.2	12.7	-16.9	16.3	163	70.4	108	0	16	116	59	489.9
SIOUX LOOKOUT A	-0.6	-2.0	14.1	-16.3	32.3	127	63.5	140	2	10	*	*	557.1
SUDBURY A	1.8	-0.9	14.5	-12.1	4.0	25	45.7	75	0	8	169	82	485.3
THUNDER BAY A	1.2	-1.3	14.8	-12.9	21.0	130	72.2	142	0	8	124	58	505.5
TIMMINS A	0.2	-0.8	15.4	-16.5	1.8	8	69.1	142	0	7	*	*	533.1
TORONTO	6.6	*	17.3	-4.0	1.0	*	110.4	*	0	9	*	*	342.6
TORONTO INT'L A	5.6	-0.6	18.9	-6.1	0.6	8	133.8	191	0	9	*	*	372.8
TORONTO ISLAND A	5.6	*	15.5	1.4	0.6	9	92.4	*	0	8	*	*	373.5
TRENTON A	5.2	-1.2	19.3	-6.2	5.2	84	86.2	113	0	8	*	*	384.1
WATERLOO WELLINGTON	4.9	-0.4	21.7	-6.9	1.0	14	117.2	142	0	9	*	*	393.8
WAWA A	0.1	*	13.4	-17.3	8.4	*	148.6	*	0	8	*	*	536.1
WIARTON A	3.5	-1.2	19.7	-9.7	41.6	385	92.7	135	0	7	155	80	435.5
WINDSOR A	7.0	-1.1	24.2	-5.3	0.8	19	107.7	130	0	14	*	*	328.9

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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	0.7	-1.5	16.8	-14.7	30.3	153	98.4	206	0	12	*	*	518.2
BAIE COMEAU A	-0.9	-1.1	10.5	-14.0	32.4	111	78.0	110	0	13	185	107	566.4
BLANC SABLON A	*	*	6.4	*	45.0	113	*	*	0	12	155	*	634.6
GASPE A	0.6	*	5.9	-4.7	27.8	*	26.6	*	0	6	189	*	521.1
INUKJUAK A	-14.7	-3.8	-2.1	-25.8	15.8	119	14.2	97	23	5	*	*	980.8
KUUJJUAQ A	-14.3	-5.1	0.4	-27.9	25.8	119	25.8	111	23	8	200	101	968.4
KUUJJUARAPIK A	-12.1	-5.3	5.9	-30.8	19.4	88	23.4	87	12	8	186	100	901.9
LA GRANDE IV A	-7.4	*	*	*	27.6	*	26.4	*	6	9	183	*	*
LA GRANDE RIVIERE A	-6.7	*	10.9	-24.2	27.6	*	32.4	*	18	9	7	*	740.5
MANIWAKI	2.2	-1.4	20.7	-13.3	0.6	5	25.2	42	0	4	169	88	474.3
MONT JOLI A	0.9	-0.7	16.3	-12.0	34.8	124	99.4	177	0	10	173	113	516.4
MONTREAL INT'L A	4.9	-0.8	24.3	-8.3	23.8	245	41.2	56	0	4	193	102	392.4
MONTREAL MIRABEL I/	4.1	*	23.8	-9.7	18.1	*	36.6	*	0	7	215	*	416.9
NATASHQUAN A	-1.3	-0.8	9.5	-13.3	28.4	95	32.4	43	0	7	207	127	588.9
QUEBEC A	3.0	-0.3	19.3	-11.0	9.8	60	49.2	68	0	9	180	105	449.6
ROBERVAL A	0.9	-0.8	5.3	-3.5	12.8	58	77.9	165	0	10	179	*	513.3
SCHEFFERVILLE A	-11.5	-4.3	6.2	-31.6	54.8	134	46.8	103	51	14	*	*	884.8
SEPT-ILES A	-1.3	-1.3	10.9	-14.9	39.8	121	62.0	79	1	9	188	101	596.8
SHERBROOKE A	3.0	-0.3	24.0	-13.6	24.4	104	56.2	78	0	10	172	*	451.4
STE AGATHE DES MONT	1.2	-1.0	18.5	-13.1	20.8	103	42.6	53	0	7	180	93	505.5
ST HUBERT A	4.8	-0.9	24.8	-7.7	23.0	*	55.4	74	0	7	190	*	395.0
VAL D'OR A	-0.6	-1.5	15.9	-17.8	5.0	23	44.0	86	1	7	197	107	556.6
NEW BRUNSWICK													
CHARLO A	0.8	-0.1	17.5	-12.7	33.9	99	50.2	60	1	8	201	124	201.0
FREDERICTON A	3.3	-0.8	23.7	-9.0	10.8	50	25.8	32	0	6	178	*	441.4
MONCTON A	1.1	-1.9	15.7	-9.8	34.8	123	49.9	56	0	8	176	110	497.1
SAINT JOHN A	2.0	-1.2	13.0	-8.7	31.0	150	43.0	40	0.	7	165	104	481.0

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	3.3	-1.3	18.9	-6.2	18.1	104	36.0	48	0	11	*	*	438.6
HALIFAX INT'L A	2.1	-1.2	20.1	-7.7	11.3	47	39.9	35	0	10	*	*	476.1
SABLE ISLAND	2.1	-1.2	9.2	-3.6	40.1	657	124.3	127	0	14	117	86	476.8
SHEARWATER A	3.8	-0.2	17.8	-5.8	15.8	122	45.4	45	0	9	139	84	477.1
SYDNEY A	-0.2	-2.2	15.8	-8.7	46.0	181	107.2	105	0	10	153	98	545.5
YARMOUTH A	2.8	-1.9	16.0	-6.4	35.2	542	81.6	85	0	11	161	91	455.5
PRINCE EDWARD ISLAND													
CHARLOTTETOWN A	1.2	-1.1	17.0	-10.0	21.0	77	50.6	62	0	9	*	*	503.9
NEWFOUNDLAND													
BONAVISTA	-0.6	-1.2	10.3	-7.0	42.6	190	114.4	177	0	12	*	*	556.4
BURGEO	-0.8	-2.1	9.0	-8.8	26.8	113	79.7	67	5	12	*	*	562.6
CARTWRIGHT	-5.0	-2.4	10.4	-18.4	82.9	144	89.9	112	268	13	118	92	691.2
CHURCHILL FALLS A	-7.7	-1.7	10.0	-25.7	70.8	136	66.3	103	68	13	180	116	771.9
COMFORT COVE	-0.7	-1.3	14.5	-10.0	58.2	126	78.7	91	5	10	*	*	559.7
DANIELS HARBOUR	-1.8	-2.1	9.7	-13.4	62.8	220	69.6	133	2	13	136	101	588.6
DEER LAKE A	-0.7	-1.5	14.5	-14.3	54.1	182	48.5	90	2	11	*	*	560.8
GANDER INT'L A	-0.6	-1.5	13.2	-86.9	84.2	179	105.2	113	3	12	177	153	557.4
GOOSE A	-4.4	-2.7	1.4	-10.2	108.3	223	76.4	125	9	12	168	120	672.4
MARY'S HARBOUR	-3.2	-1.2	9.2	-15.3	37.8	74	48.0	63	78	8	*	*	633.9
PORT AUX BASQUES	-0.6	-1.4	6.8	-7.2	31.1	130	80.0	86	0	17	159	*	548.7
ST ANTHONY	-3.2	-1.3	8.5	-13.5	81.8	189	86.2	91	30	13	*	*	641.0
ST JOHN'S A	-0.9	-2.1	11.6	-8.4	35.3	102	126.1	109	0	14	132	114	566.3
ST LAWRENCE	-0.5	-1.6	12.5	-7.5	13.7	74	85.5	82	0	13	*	*	553.6
STEPHENVILLE A	-0.4	-2.2	13.6	-10.1	44.3	201	79.0	133	0	13	*	*	551.7
WABUSH LAKE A	-6.7	-1.1	9.3	-21.9	46.0	93	31.3	60	31	8	184	129	741.7

AGROCLIMATOLOGICAL STATIONS

APRIL

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	11.3	1.8	24.5	-2.5	0.0	154.8	140	0	19	157	190.3	490.7
SUMMERLAND	10.1	1.4	24.5	-3.0	0.0	25.4	130	0	10	182	155.5	237.4
ALBERTA												
BEAVERLODGE	5.1	2.5	20.5	-16.0	5.2	22.1	115	0	9	196	73.8	103.3
LACOMBE	6.0	2.9	23.5	-13.0	3.0	27.2	115	0	5	173	90.5	98.2
SASKATCHWAN												
INDIAN HEAD	4.3	1.2	27.0	-11.0	0.0	24.0	85	0	3	69	*.*	*.*
MELFORT	2.8	1.5	24.5	-13.0	2.5	8.6	46	0	3	168	37.0	37.0
REGINA	4.3	1.3	28.5	-18.0	10.0	16.4	69	0	5	**	71.5	71.5
SCOTT	4.4	1.7	24.5	-17.0	9.5	17.0	71	0	6	206	70.0	71.3
SWIFT CURRENT	5.9	1.9	27.0	-15.5	1.4	11.2	44	0	4	183	97.7	125.0
MANITOBA												
BRANDON	3.1	-0.2	26.6	-14.5	17.0	30.2	82	0	5	**	46.2	46.2
MORDEN	3.1	-0.3	29.0	-13.0	16.6	34.0	91	0	6	162	*.*	49.0
GLENLEA	2.5	-1.5	20.5	-14.0	9.7	39.7	96	0	5	135	11.0	11.0
ONTARIO												
DELHI	5.6	-1.1	24.0	-9.0	0.6	102.9	110	0	13	**	66.4	74.1
ELORA	4.6	-0.5	20.3	-7.6	0.0	120.9	172	0	11	**	53.5	54.9
GUELPH	4.8	-1.0	21.8	-8.1	0.3	136.2	184	0	11	133	54.6	58.5
HARROW	7.1	-0.8	23.0	-5.5	0.0	106.0	131	0	15	103	92.7	106.6
KAPUSKASING	-1.1	-1.6	13.5	-17.0	13.0	85.0	175	0	8	157	5.3	5.3
OTTAWA	5.2	-0.5	22.2	-8.0	15.4	42.6	66	0	8	176	66.5	66.5
SMITHFIELD	5.7	-0.4	20.4	-6.5	2.4	101.5	125	0	8	**	61.0	65.0

Courtesy of Agriculture Canada

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	Mean	Difference from Normal	Maximum	Minimum							This month	Since jan. 1st
QUEBEC												
LA POCATIERE	2.3	-0.5	17.5	-10.0	7.9	66.4	105	0	10	182	15.3	16.1
L'ASSOMPTION	4.8	-0.2	24.0	-8.0	9.9	35.4	49	0	8	181	48.3	48.3
NORMANDIN	-1.1	-1.6	12.5	-17.0	4.6	43.6	90	0	9	184	0.0	0.0
NEW BRUNSWICK												
FREDERICTON	3.7	-0.3	23.0	-8.0	11.8	20.8	25	0	5	178	22.0	25.0
NOVA SCOTIA												
KENTVILLE	3.3	-1.1	19.5	-6.0	12.7	34.5	42	0	7	150	21.0	26.6
NAPPAN	2.1	-1.2	17.0	-8.0	28.3	46.1	61	0	8	152	8.7	12.0
PRINCE EDWARD ISLAND												
CHARLOTTETWN	*.*	*.*	*.*	*.*	*.*	*.*	**	***	***	**	*.*	*.*
NEWFOUNDLAND												
ST.JOHN'S WEST	0.2	-1.4	13.0	-9.0	42.0	124.8	99	0	13	109	2.3	2.3

Courtesy of Agriculture Canada