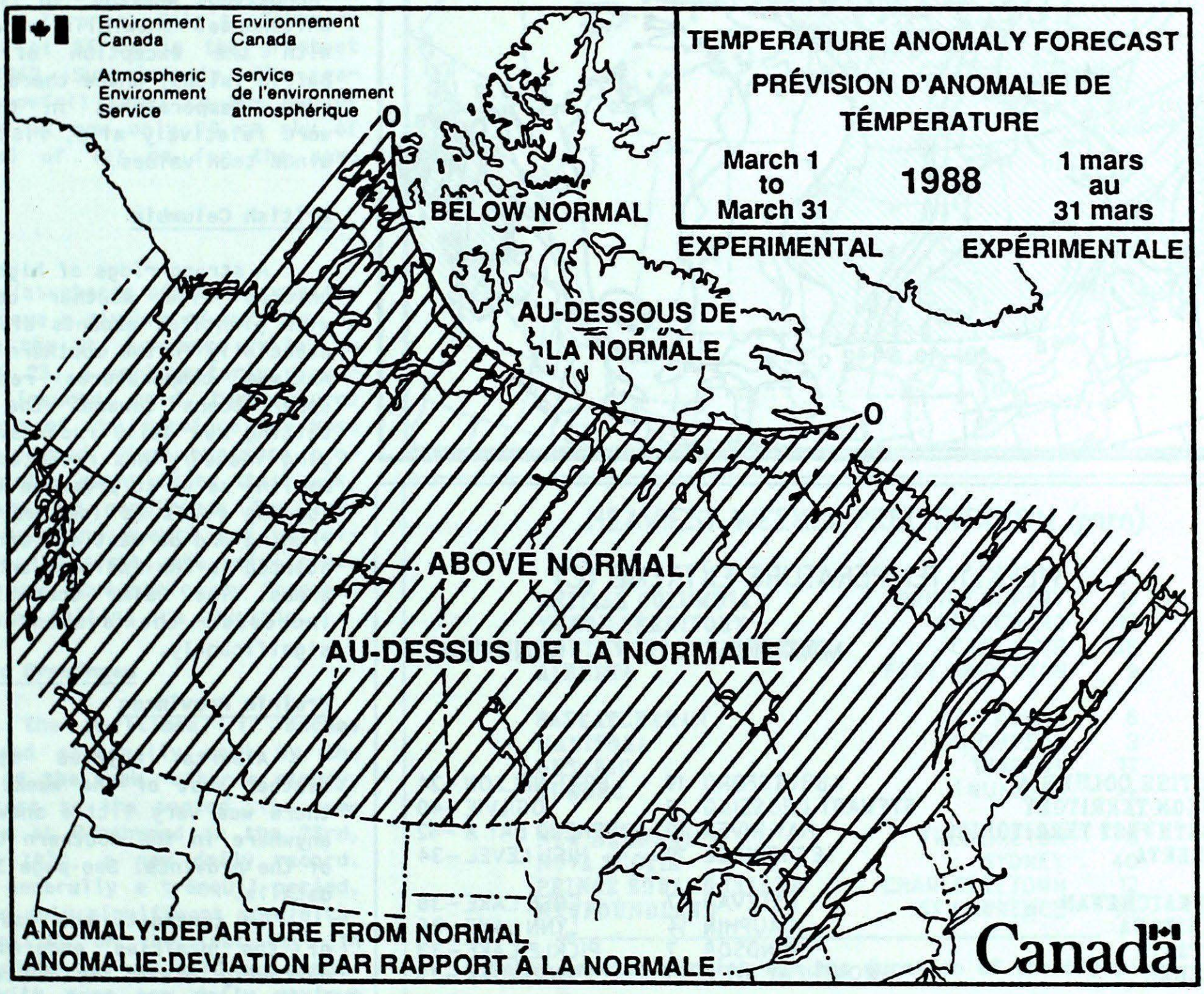
Environment Canada Environnement Canada

Climatic Perspectives

February 23 to 29, 1988 *A weekly review of Canadian climate* *Vol. 10 N°9*



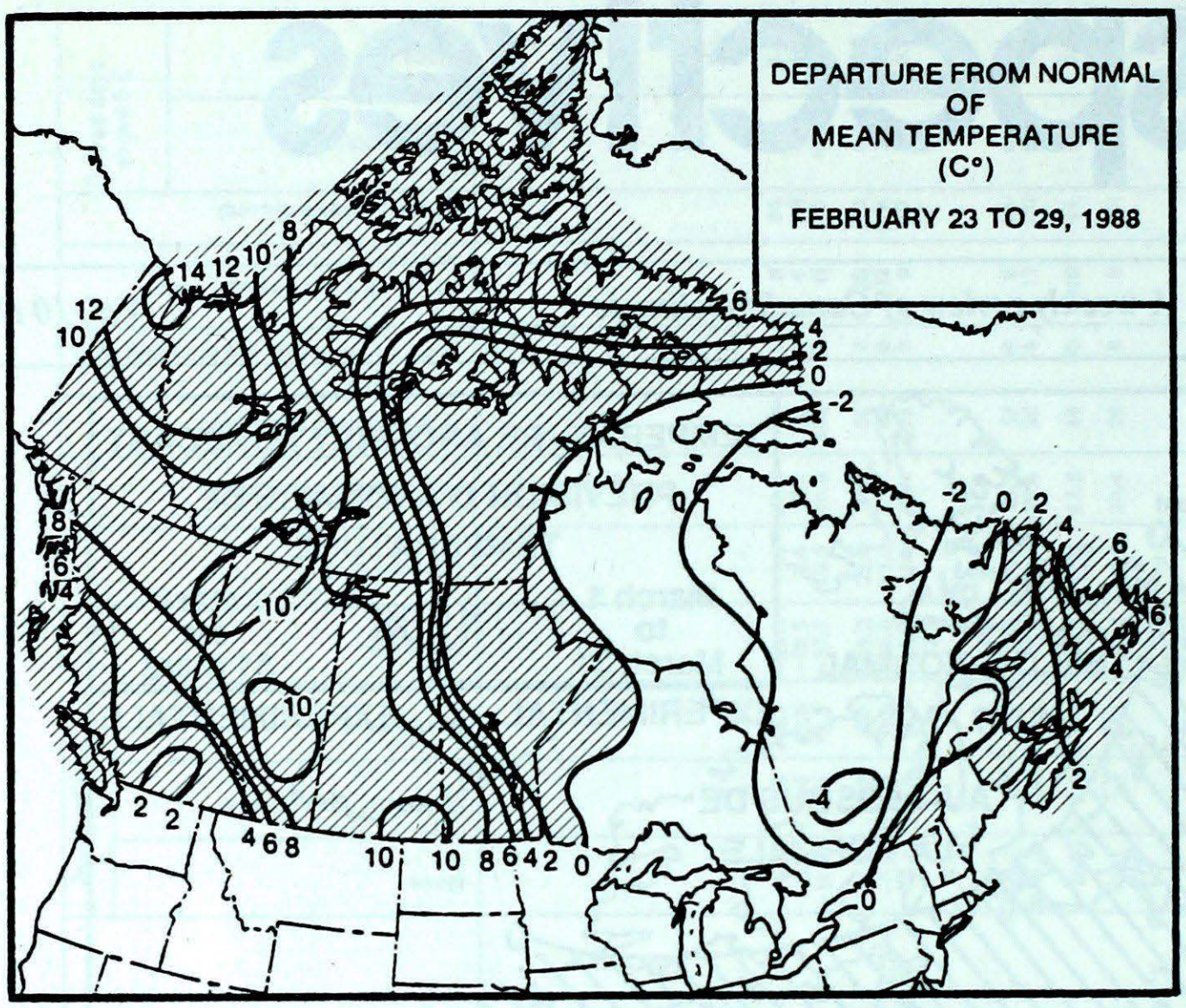
The above map is the latest in the evolution towards devoping an acceptable format to be used in the official public product which will be formally introduced May 16,1988. Stations near the line separating the two categories are expected to be in the transition zone between above and below normal averaged temperatures. Please forward any comments to the Canadian Climate Centre at the address or phone number listed on page 4.

• Signs of spring in the air

– Record warmth during the last week of the Olympics

– Ample sunshine in many areas

TEMPERATURE



WEEKLY TEMPERATURE EXTREME (C)

	MAXIMUM		MINIMUM	
BRITISH COLUMBIA	ABBOTSFORD	19	FORT NELSON	-24
YUKON TERRITORY	STEWART CROSSING	8	OGILVIE	-40
NORTHWEST TERRITORIES	HAY RIVER	10	SHEPHERD BAY A	-42
ALBERTA	LETHBRIDGE	19	HIGH LEVEL	-34
SASKATCHEWAN	ESTEVAN	17	CREE LAKE	-36
MANITOBA	DAUPHIN	14	LYNN LAKE	-36
ONTARIO	WINDSOR	7	PICKLE LAKE	-33
QUEBEC	MONTREAL INT'L	5	INUKJUAK	-39
NEW BRUNSWICK	MONCTON	8	CHARLO	-23
NOVA SCOTIA	GREENWOOD	14	GREENWOOD	-12
PRINCE EDWARD ISLAND	CHARLOTTETOWN	9	CHARLOTTETOWN	-17
NEWFOUNDLAND	ST JOHN'S	10	WABUSH LAKE	-34

ACROSS THE NATION

WARMEST MEAN TEMPERATURE	9	HOPE	BC
COOLEST MEAN TEMPERATURE	-34	GLADMAN POINT A	NWT

ACROSS THE COUNTRY

Yukon and Northwest Territories

A southwesterly flow brought mild temperatures to the Yukon and Mackenzie District. In the south, maximum readings climbed well above freezing, setting new daily records, and resulting in the third warmest "Rendezvous Weekend" in 13 years at Whitehorse. Snowfalls were spotty. With the exception of southern Baffin Island, where there was heavy snow. Temperatures in the Arctic were relatively mild, rising to the minus teen values.

British Columbia

A strong ridge of high pressure ensured fine weather conditions, with plentiful amounts of sunshine, especially in the southern interior. Maximum temperatures reached the upper teens towards the weekend, setting new daily records. The logging industry has reverted to night hauling so as to preserve the frozen logging roads as long as possible. Pruning and dormant oil spraying has started in the Kamloops and Okanagan areas. The balmy conditions have increased the avalanche hazard significantly.

Prairie Provinces

Alberta enjoyed spring-like weather most of the week. In fact, there was very little snow reported anywhere in the southern two thirds of the province. See page 3 for more details.

In contrast, the eastern half of the prairies endured another northerly blast, as bitterly cold Arctic air covered the region. Strong winds produced dangerous wind chills, especially in northern Manitoba, where the visibility was reduced by blowing snow. By the middle of the week, under sunny skies, temperatures moderated sharply. Over the weekend readings in Saskatchewan reached the double digits, breaking many daily temperature records.

Ontario

A northwesterly flow kept temperatures on the cool side. Snow

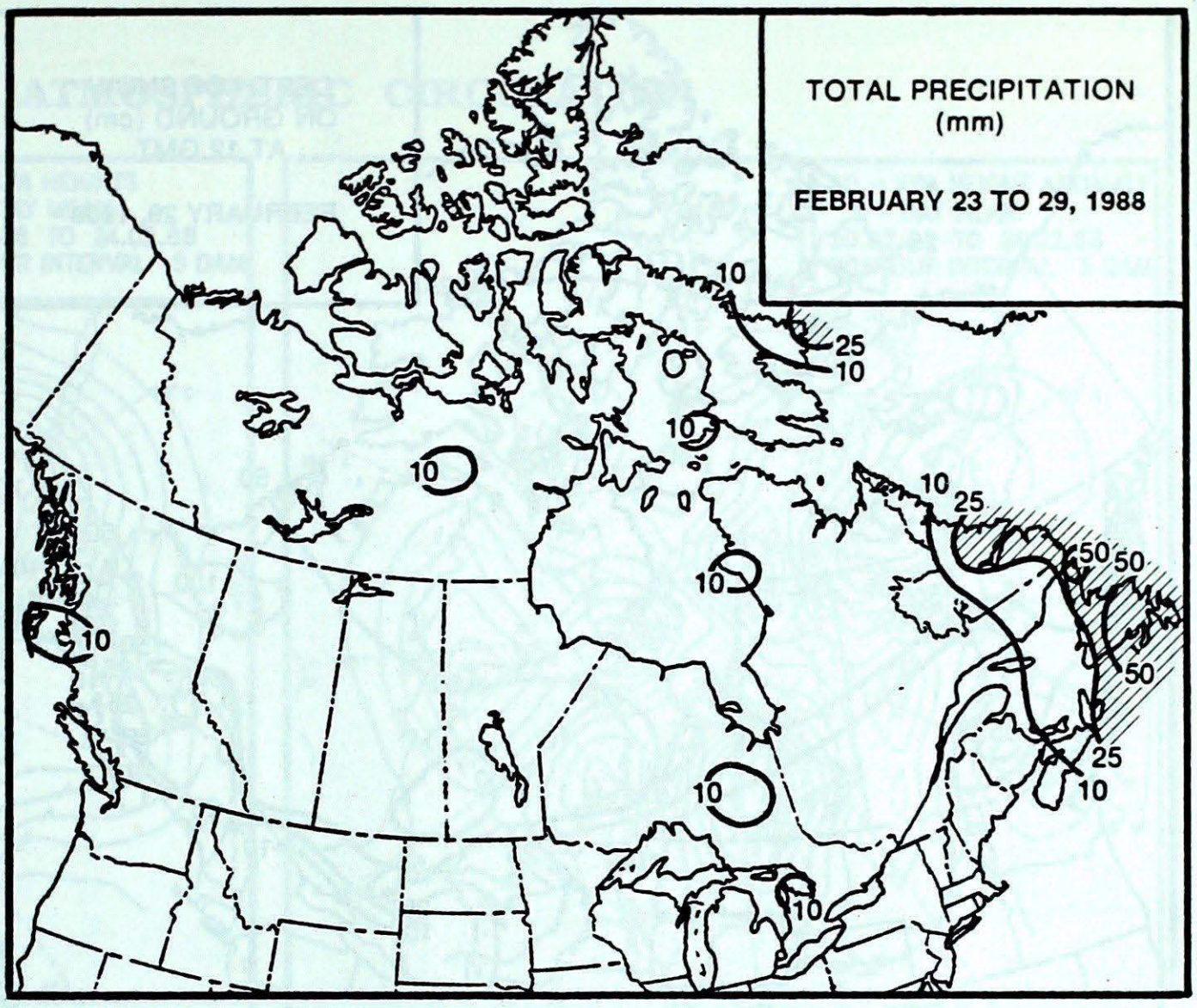
squalls dumped as much as 20 cm of snow to the lee of Lake Huron and Georgian Bay on February 24 and 25. Passing disturbances gave northern Ontario a fresh 10 to 20 cm covering of snow. In southern Ontario, the frozen ground is covered by only a shallow snow pack. As a result, a heavy March rainfall could lead to spring flooding. After a snow free start to the winter in southern Ontario, Toronto City's February snowfall of 56 cm is the greatest since 1962. Surprisingly, the seasonal snowfall total to the end of February is now only 20 cm shy of a normal of 107 cm for the same period.

Quebec

A disturbance affecting western Quebec gave a mixture of wet snow or rain to the St. Lawrence Valley on February 23. A northwesterly circulation insured cold temperatures over much of the province for most of the period. High pressure produced mostly sunny skies this week, ideal weather conditions for late winter sporting events and activities. In the north, the cold, clear weather was accompanied by frequent reports of falling ice crystals.

Atlantic Provinces

In the Maritimes, it became sunny and seasonally cool by the middle of the week, after a cloudy, mild start to the period. The temperature at Greenwood on the 23rd, reached 14°C, a new daily record. It was generally a tranquil period, with the only significant precipitation falling on the last day. In Newfoundland, it was mild and unsettled, with some new daily maximum temperature records broken. A number of disturbances affected the Island, bringing a mixture of snow, freezing rain and rain. Rain and temperatures as high as 10°C at St. John's on Wednesday caused some flooding of streets and basements. In Labrador, cloudy conditions and light snow started off the week. Fair weather prevailed until the weekend, when another weather system produced a mixture of rain and snow, depositing as much as 40 cm of snow on the ground.



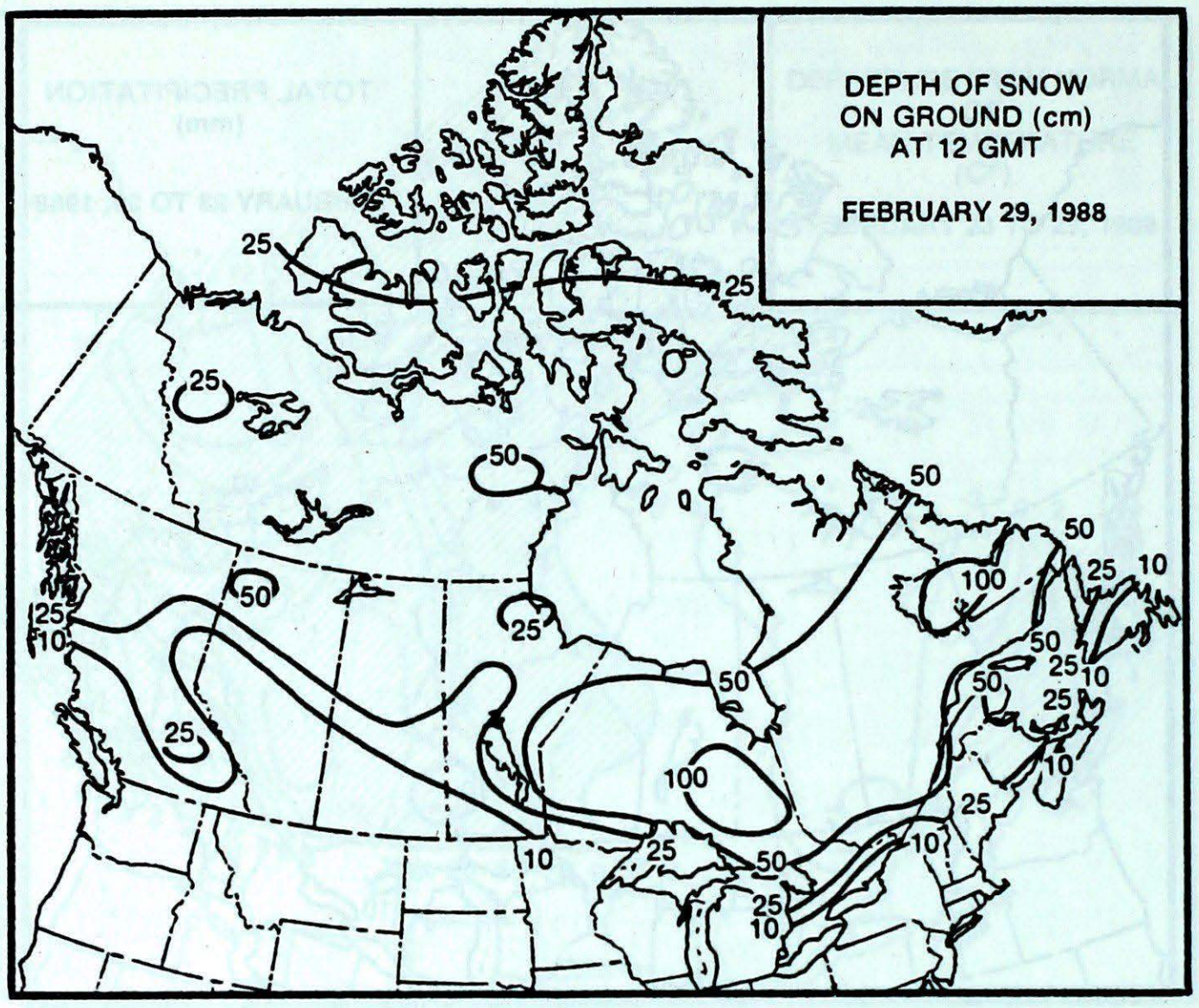
HEAVIEST WEEKLY PRECIPITATION (mm)

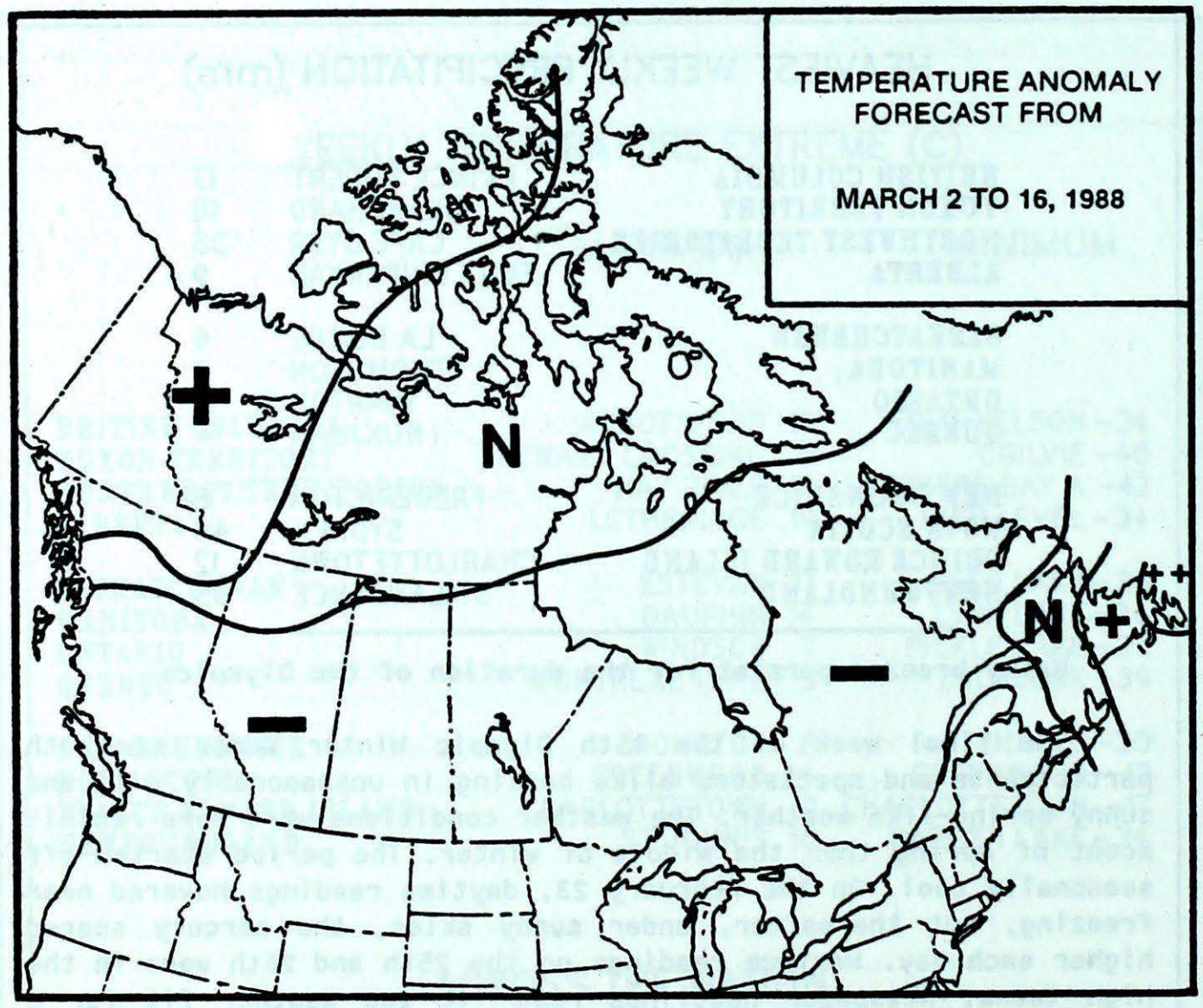
BRITISH COLUMBIA	PRINCE RUPERT	17
YUKON TERRITORY	BLANCHARD	18
NORTHWEST TERRITORIES	CAPE DYER	38
ALBERTA	FORT CHIPEWYAN	9
SASKATCHEWAN	LA RONGE	6
MANITOBA	THOMPSON	3
ONTARIO	WIARTON	17
QUEBEC	INUKJUAK	14
NEW BRUNSWICK	FREDERICTON	8
NOVA SCOTIA	SYDNEY	40
PRINCE EDWARD ISLAND	CHARLOTTETOWN	12
NEWFOUNDLAND	ST LAWRENCE	95

Balmy breezes persist for the duration of the Olympics

The final week of the 15th Olympic Winter Games saw both participants and spectators alike basking in unseasonably mild and sunny spring-like weather. The weather conditions were more reminiscent of spring than the middle of winter. The period started off seasonally cool. On the February 23, daytime readings hovered near freezing, but thereafter, under sunny skies, the mercury soared higher each day. Maximum readings on the 25th and 26th were in the high teens. Newspaper headlines read "it was weather fit for a camel". Although winds were not as strong as last week, the bob sled and ski jumping events had to be postponed on the 25th and 27th, respectively. Sustained winds were clocked as high as 37 km/h, with gusts to 57 km/h. A cold frontal passage on the morning of 27th, gave a brief dusting of snow, but pleasant weather returned in time for the closing ceremonies on the 28th.

FORECAST





Temperature Anomaly Forecast

This forecast is prepared by searching historical weather maps to find cases similar to the present. The historical outcome during the 15 days subsequent to the chosen analogues is assumed to be a forecast for the next 15 days from now.

++	much above normal
+	above normal
N	normal
−	below normal
−−	much below normal

CLIMATIC PERSPECTIVES VOLUME 10

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Unsolicited articles are welcome but should be at maximum about 1500 words in length. They will be subject to editorial change without notice due to publishing time constraints. The contents may be reprinted freely with proper credit.

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

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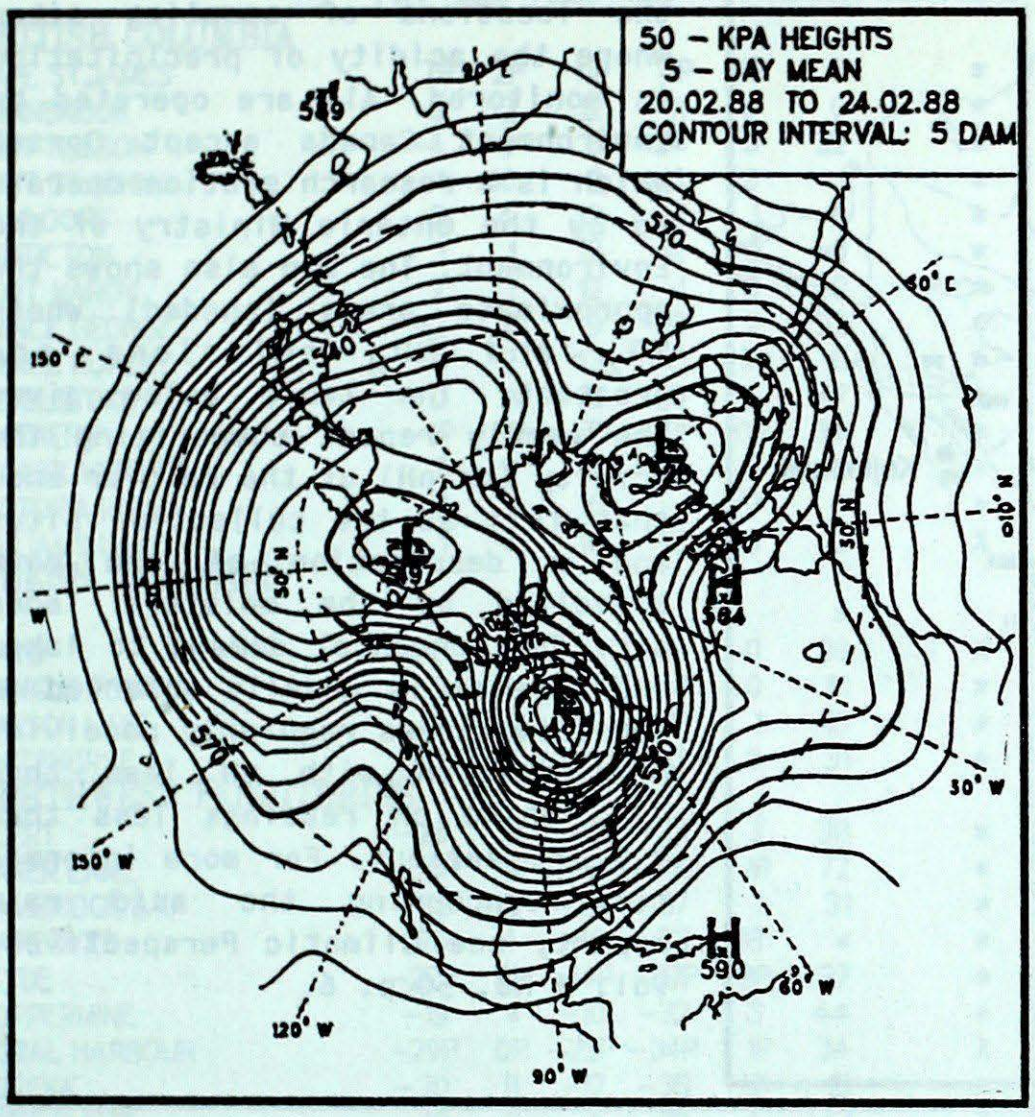
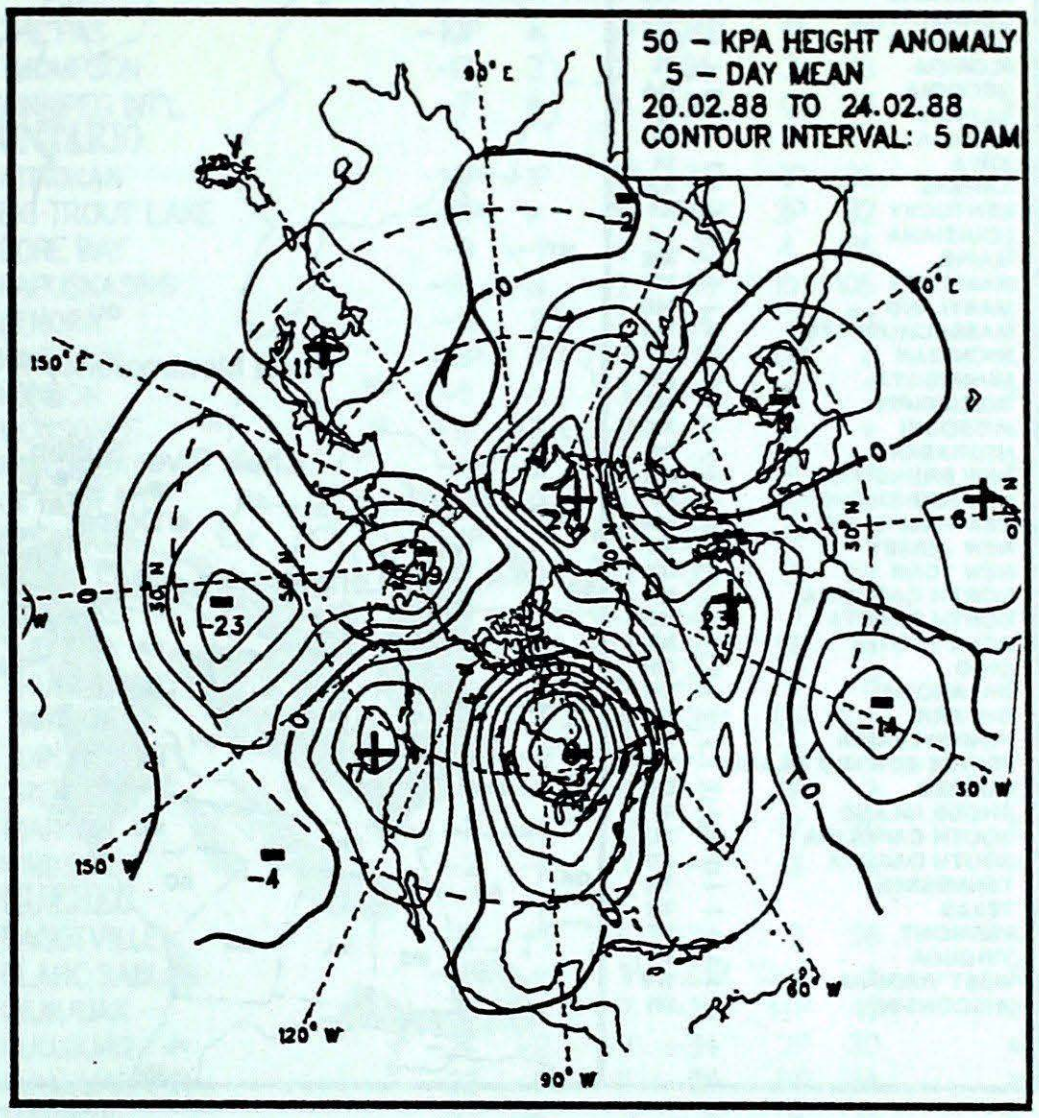
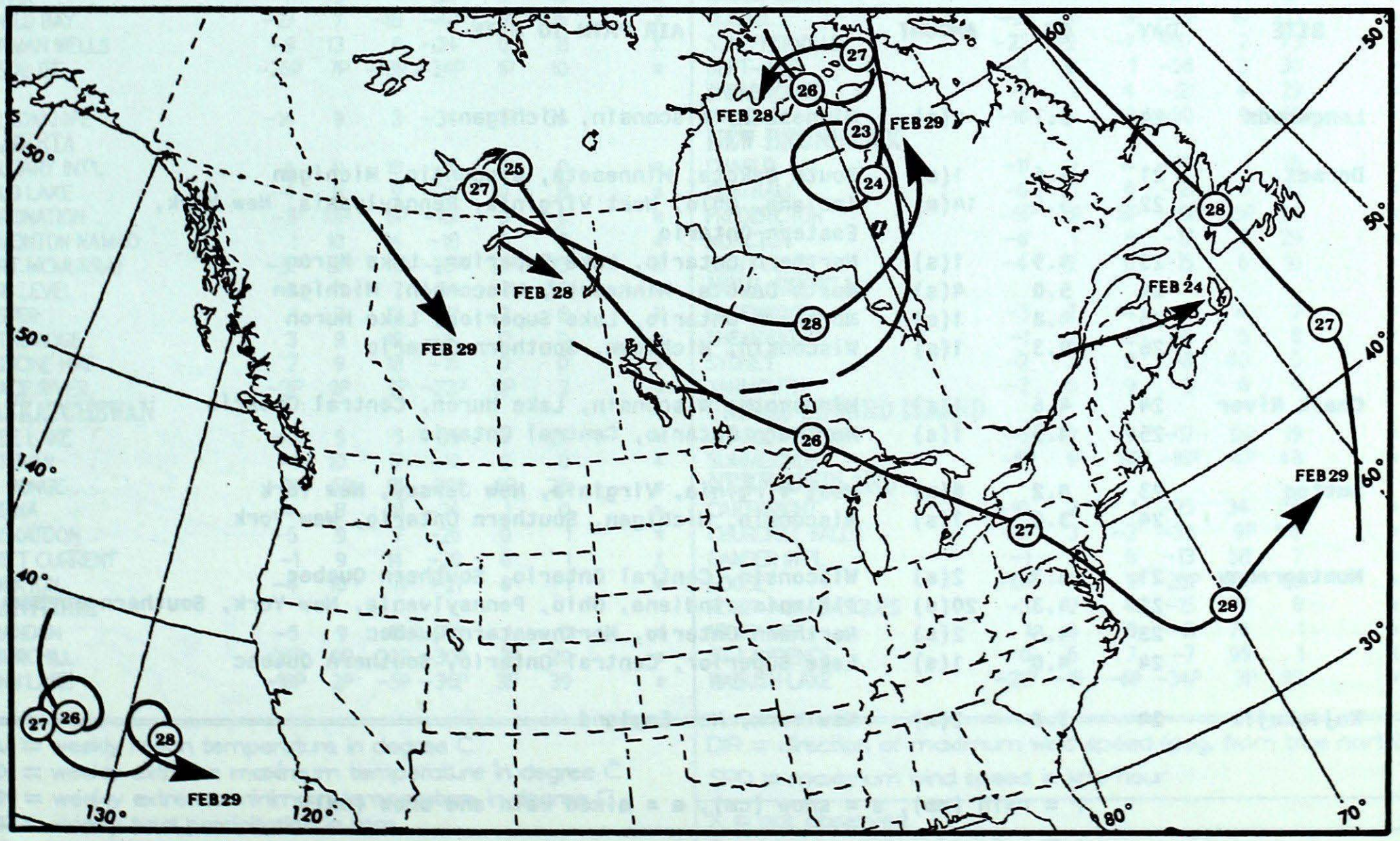
50 kPa ATMOSPHERIC CIRCULATION



Mean geopotential heights
50 kPa level (in decameter)



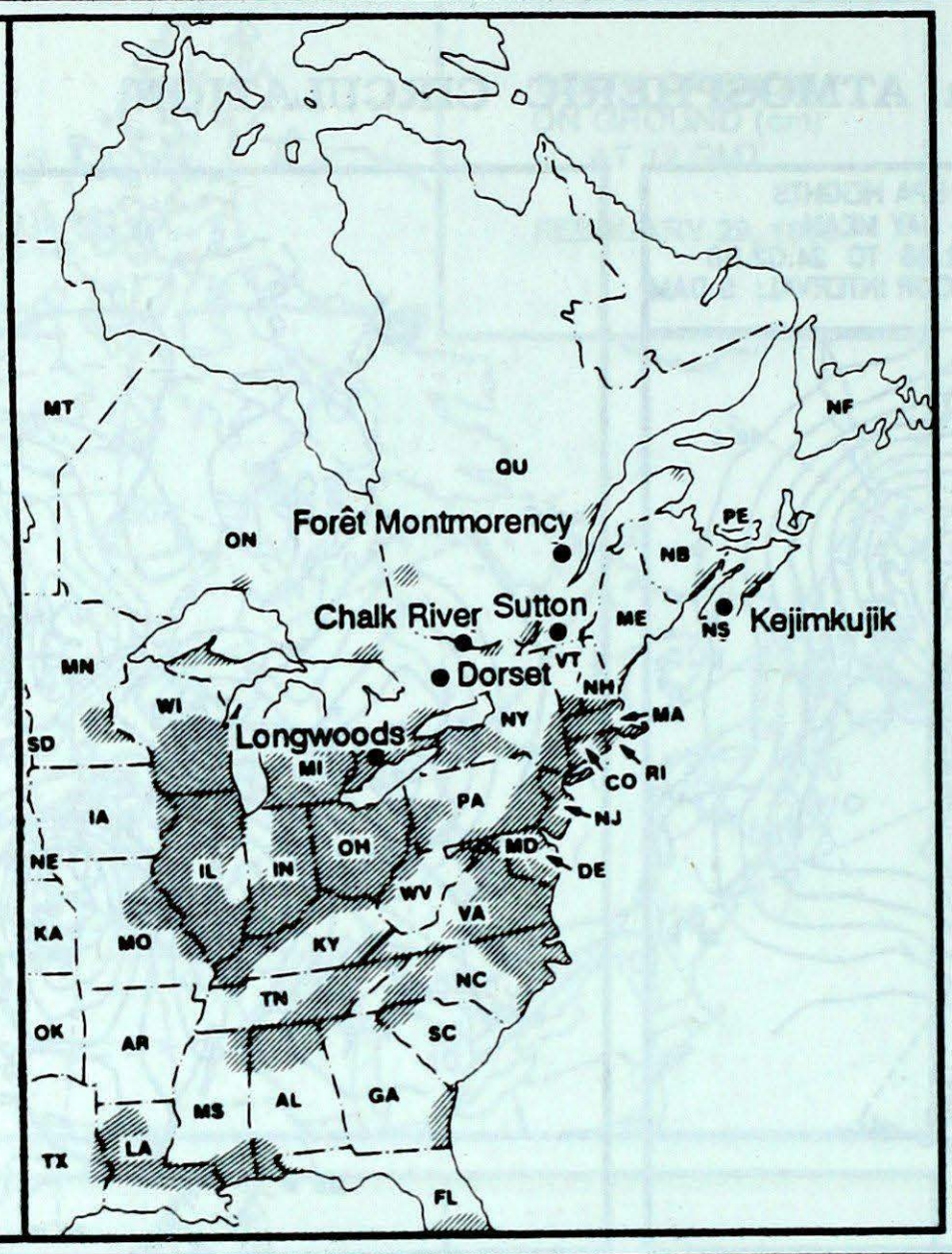
Mean geopotential height anomaly
50 kPa level (in decameter)



Storm track - Position of storm at 12 GMT during the period: February 23 to 29, 1988

ACID RAIN

ALABAMA	—	AL
ARKANSAS	—	AR
CONNECTICUT	—	CO
DELAWARE	—	DE
FLORIDA	—	FL
GEORGIA	—	GA
ILLINOIS	—	IL
INDIANA	—	IN
IOWA	—	IA
KANSAS	—	KA
KENTUCKY	—	KY
LOUISIANA	—	LA
MAINE	—	ME
MANITOBA	—	MT
MARYLAND	—	MD
MASSACHUSETTS	—	MA
MICHIGAN	—	MI
MINNESOTA	—	MN
MISSISSIPPI	—	MS
MISSOURI	—	MO
NEBRASKA	—	NE
NEW BRUNSWICK	—	NB
NEWFOUNDLAND	—	NF
NEW HAMPSHIRE	—	NH
NEW JERSEY	—	NJ
NEW YORK	—	NY
NORTH CAROLINA	—	NC
NORTH DAKOTA	—	ND
NOVA SCOTIA	—	NS
OHIO	—	OH
OKLAHOMA	—	OK
ONTARIO	—	ON
PENNSYLVANIA	—	PA
PRINCE EDWARD ISLAND	—	PE
QUÉBEC	—	QU
RHODE ISLAND	—	RI
SOUTH CAROLINA	—	SC
SOUTH DAKOTA	—	SD
TENNESSEE	—	TN
TEXAS	—	TX
VERMONT	—	VT
VIRGINIA	—	VA
WEST VIRGINIA	—	WV
WISCONSIN	—	WI



ACID RAIN REPORT

The reference map (left) shows the locations of sampling sites where the acidity of precipitation is monitored. All are operated by Environment Canada except Dorset which is a research station operated by the Ontario Ministry of the Environment. The map also shows the approximate areas (shaded) where SO_2 and NO_x emissions are greatest. The table below gives the weekly report summarizing the acidity (or pH) of the rain or snow that fell at the collection sites and a description of the path travelled by the moisture laden air. Environmental damage to lakes and streams is usually observed in sensitive areas regularly receiving precipitation with pH less than 4.7, while pH readings less than 4.0 are serious. For more information concerning the acid rain report, see Climatic Perspectives, Vol. 5 No. 50 p. 6.

FEBRUARY 21 TO FEBRUARY 27, 1988

SITE	DAY	pH	AMOUNT	AIR PATH TO SITE
Longwoods	24	5.7	2(s)	Minnesota, Wisconsin, Michigan
Dorset	21	4.6	1(s)	South Dakota, Minnesota, Wisconsin, Michigan
	22	5.6	14(m)	Indiana, Ohio, West Virginia, Pennsylvania, New York, Eastern Ontario
	23	4.9	1(s)	Northern Ontario, Lake Superior, Lake Huron
	24	5.0	4(s)	North Dakota, Minnesota, Wisconsin, Michigan
	25	4.8	1(s)	Northern Ontario, Lake Superior, Lake Huron
	26	4.3	1(s)	Wisconsin, Michigan, Southern Ontario
Chalk River	24	4.6	1(s)	Minnesota, Wisconsin, Lake Huron, Central Ontario
	25	4.5	1(s)	Northern Ontario, Central Ontario
Sutton	23	4.2	8(m)	West Virginia, Virginia, New Jersey, New York
	24	3.9	1(s)	Wisconsin, Michigan, Southern Ontario, New York
Montmorency	21	4.3	2(s)	Wisconsin, Central Ontario, Southern Quebec
	22	4.3	20(s)	Illinois, Indiana, Ohio, Pennsylvania, New York, Southern Quebec
	23	4.5	2(s)	Northern Ontario, Northwestern Quebec
	24	4.0	1(s)	Lake Superior, Central Ontario, Southern Quebec
Kejimkujik	24	3.8	2(m)	New York, New England

r = rain (mm), s = snow (cm), m = mixed rain and snow (mm)

STATISTICS

TEMPERATURE, PRECIPITATION AND MAXIMUM WIND DATA FOR THE WEEK ENDING 0600 GMT MARCH 1,1988

STATION	TEMPERATURE				PRECIP.		WIND MX	
	AV	DP	MX	MN	TP	SOG	DIR	SPD
BRITISH COLUMBIA								
CAPE ST.JAMES	7P	2P	11P	4P	14P	0		*
CRANBROOK	0	2	12	-11	0	0		*
FORT NELSON	-4	9	8	-24	0	32		*
FORT ST.JOHN	1	10	9	-16	0	1		*
KAMLOOPS	3	4	13	-7	1	0		*
PENTICTON	3	1	12	-8	0	0		*
PORT HARDY	7	3	12	-1	8	0		*
PRINCE GEORGE	-2	*	9	-17	2	22		*
PRINCE RUPERT	4	2	13	-3	17	0		*
REVELSTOKE	0	1	8	-10	4	47		*
SMITHERS	-1P	3P	7P	-12P	0P	34		*
VANCOUVER INT'L	7	3	14	-2	4	0		*
VICTORIA INT'L	7	2	15	-1	3	0		*
WILLIAMS LAKE	1	*	10	-13	3	3		X
YUKON TERRITORY						*		
MAYO	-5	11	7	-19	0	28		X
SHINGLE POINT A	-9	14	-1	-30	0	41		*
WATSON LAKE	-9	6	4	-23	1	45		*
WHITEHORSE	-2	9	5	-13	0	31		*
NORTHWEST TERRITORIES								
ALERT	-26	8	-19	-35	3	38		*
BAKER LAKE	-31P	1P	-28P	-33P	1P	72		*
CAMBRIDGE BAY	-32	2	-25	-37	1	31		*
CAPE DYER	-20	4	-10	-33	38	*		*
CLYDE	-22P	6P	-14P	-37P	3P	27		*
COPPERMINE	-19	*	-10	-32	3	44		*
CORAL HARBOUR	-29P	0P	-25P	-34P	1P	34		X
EUREKA	-30	8	-17	-38	2	15		*
FORT SMITH	-10	9	6	-29	4	42		X
IQALUIT	-28P	-3P	-14P	-40P	1P	42		*
HALL BEACH	-24P	7P	-17P	-33P	2P	33		*
INUVIK	-11	13	1	-27	3	45		X
MOULD BAY	-27	7	-18	-40	3	16		X
NORMAN WELLS	-9	13	6	-24	0	8		X
RESOLUTE	-26P	7P	-18P	-34P	1P	10		*
YELLOWKNIFE	-14	9	3	-34	1P	35		*
ALBERTA								
CALGARY INT'L	4	11	18	-15	0	0		*
COLD LAKE	-4	8	9	-24	0	8		*
CORONATION	-1P	10P	8P	-18P	0	0		*
EDMONTON NAMAO	1	10	14	-18	0	0		*
FORT MCMURRAY	-5P	8P	11P	-26P	2P	33		X
HIGH LEVEL	-7	11	7	-34	1	50		*
JASPER	1	7	13	-17	2	8		X
LETHBRIDGE	3	9	19	-14	0	0		*
MEDICINE HAT	2	9	18	-16	0	0		*
PEACE RIVER	-3P	9P	9P	-22P	0P	2		*
SASKATCHEWAN								
CREE LAKE	-11	9	5	-36	6	27		*
ESTEVAN	-1	10	17	-19	0	0		*
LA RONGE	-8P	6P	8P	-29P	6P	26		*
REGINA	-4	8	11	-24	1	0		*
SASKATOON	-5	9	7	-26	0	1		*
SWIFT CURRENT	-1	9	14	-20	0	1		X
YORKTON	-4	10	11	-21	0	1		*
MANITOBA								
BRANDON	-5	9	13	-21	1	0		*
CHURCHILL	-25P	0P	-20P	-30P	1P	20		*
LYNN LAKE	-18P	2P	-5P	-36P	3P	39		*
THE PAS	-10P	*	5P	-24P	1P	15		*
THOMPSON	-17	3	2	-36	3	18		*
WINNIPEG INT'L	-7	6	6	-20	0	2		*
ONTARIO								
ATIKOKAN	-14P	-1P	2P	-31P	1P	26		*
BIG TROUT LAKE	-18P	*	-1P	-28P	3P	82		*
GORE BAY	-9	-1	0	-21	4	26		*
KAPUSKASING	-16	-2	-2	-30	10	105		*
KENORA	-11	2	4	-24	2	37		*
KINGSTON	-5P	1P	4P	-11P	0P	0		X
LONDON	-5	-1	3	-12	5	3		*
MOOSONEE	-19	-2	-2	-31	8	*		*
NORTH BAY	-11	-2	-2	-22	8	59		*
OTTAWA INT'L	-7	0	4	-16	4P	19		X
PETAWAWA	-11P	-2P	3P	-27P	4P	*		X
PICKLE LAKE	-17	0	0	-33	3	58		*
RED LAKE	-14	-1	3	-28	1	58		*
SUDBURY	-12	-2	-2	-23	11P	75		X
THUNDER BAY	-10	1	4	-22	0	8		*
TIMMINS	-15P	-2P	-1P	-31P	12P	106		*
TORONTO INT'L	-5	-1	3	-12	6	4		*
TRENTON	-5	-1	6	-13	3P	3		X
WIARTON	-7	-1	2	-16	17	45		X
WINDSOR	-2	-1	7	-8	3	0		*
QUEBEC								
BAGOTVILLE	-12	-1	4	-24	7	56		*
BLANC SABLON	-11P	*	1P	-23P	34P	*		X
INUKJUAK	-28	-4	-17	-39	14P	49		*
KUUJJUAQ	-24	-2	-7	-34	2P	30		*
KUUJJUARAPIK	-22	0	-5	-35	8P	34		*
MANIWAKI	-13	-4	3	-26	9	38		*
MONT JOLI	-9	0	4	-20	3	39		*
MONTREAL INT'L	-6	1	5	-15	3	3		*
NATASHQUAN	-10	1	1	-24	11	52		*
QUEBEC	-9P	0P	3P	-18P	6P	103		*
SCHEFFERVILLE	-22	-2	-7	-37	2	73		*
SEPT-ILES	-11	0	1	-26	8	30		*
SHERBROOKE	-9	1	4	-21	4	29		*
VAL D'OR	-16	-4	-2	-30	9	62		*
NEW BRUNSWICK								
CHARLO	-11	0	4	-23	1	75		*
CHATHAM	-6	1	6	-21	4	42		*
FREDERICTON	-5P	2P	8P	-16P	8P	24		*
MONCTON	-6	1	8	-17	6	29		*
SAINT JOHN	-4	2	6	-15	6	10		*
NOVA SCOTIA								
GREENWOOD	-3	2	14	-12	4	2		*
SHEARWATER	-1	2	8	-8	5	8		*
SYDNEY	-2	3	8	-8	40	5		*
YARMOUTH	-2	0	9	-9	6	0		*
PRINCE EDWARD ISLAND								
CHARLOTTETOWN	-5	2	9	-17	12P	19		*
SUMMERSIDE	-5P	1P	8P	-16P	4P	48		*
NEWFOUNDLAND								
CARTWRIGHT	-10	2	1	-25	34	155		*
CHURCHILL FALLS	-17	3	-2	-33	9P	105		*
GANDER INT'L	-1	5	8	-13	58	7		*
GOOSE	-15P	-1P	1P	-28P	41P	85		*
PORT-AUX-BASQUES	-3	2	4	-15	17	8		*
ST JOHN'S	1	5	10	-8	76	1		*
ST LAWRENCE	0	5	7	-7	95	1		X
WABUSH LAKE	-21P	-1P	-6P	-34P	3P	80		*

AV = weekly mean temperature in degree C
MX = weekly extreme maximum temperature in degree C
MN = weekly extreme minimum temperature in degree C
TP = weekly total precipitation in mm
DP = departure of mean temperature from normal in degree C
SOG = snow depth on ground in cm, last day of the period

DIR = direction of maximum wind speed (deg. from true north)
SPD = maximum wind speed in km/hour

X = not observed
P = value based on less than 7 days
* = missing

FEATURE

MOUNTAIN WAVES

by
Andy Radomski

As with a stream of water, ripples or waves develop in the atmosphere, when the air flow is obstructed by a barrier. The air waves, which result, are called standing waves. When the obstruction is a mountain or a range of mountains, the waves are referred to as mountain waves.

In order for mountain waves to form, the wind has to be blowing across the barrier at a sufficiently strong enough velocity. The wind speed and direction are important, especially the angle of the trajectory in relation to the barrier. A strong vertical wind shear should be present above the barrier, such as from a fast moving jet stream. The minimum wind speed at which a mountain wave will develop is 25 kts measured at the elevation of the peak. If the atmospheric conditions are just right, standing waves can even be observed to the lee of low rolling hills and escarpments.

The effects of a mountain wave can often be felt throughout the troposphere, and sometimes in the stratosphere. The usual extent of mountain waves varies from 50 to 250 km or more downwind, to the lee the barrier.

The force of the wind has a direct bearing on the length of the individual waves. The stronger the wind the longer the wave length, and the more pronounced the waves.

Clouds

Only when sufficient moisture is present, characteristic cloud formations and patterns develop, making it possible to visually identify the presence of mountain waves. Three types of clouds are associated with mountain waves.

Cap Clouds will be found on the tops of the mountain range, and frequently extend down the leeward slope. They are caused by orographic lift.

Rotor Clouds are found in the lower levels of the moutain wave immediately below the crest of the individual waves. They frequently resemble fair weather cumulus clouds. Rotor cloud marks the presence of turbulence, in the form of powerful circular eddies.

Lenticular Clouds form on the wave crests, and may extend vertically in layers to well above 12,000 metres. They resemble patchy dome-like layer clouds, and usually remain nearly stationary, forming where the crest of each individual wave is located. Horizontally, they may extend in rows several hundred kilometers downstream, parallel to the mountain range, as seen in last week's satellite photo (Vol. 10 No. 8).

Hazards

Standing waves are extremely hazardous to aviation. The turbulence can become quite severe, especially if near a jet stream. Another aviation hazard is due the to strong downdrafts, which these waves can produce, decreasing the altitude of a plane dramatically. Some downdrafts might be so smooth that a pilot might have little indication of their presence.

Chinooks

Chinooks, such as those experienced during the Winter Olympics in Alberta, can also be present at the same time, causing the temperature at the surface to rise 10°C to 25°C in a few of hours. There will be more information on chinook winds in a upcoming issue.