Chinook

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LA REVUE CANADIENNE DE LA MÉTÉO ET DES OCÉANS

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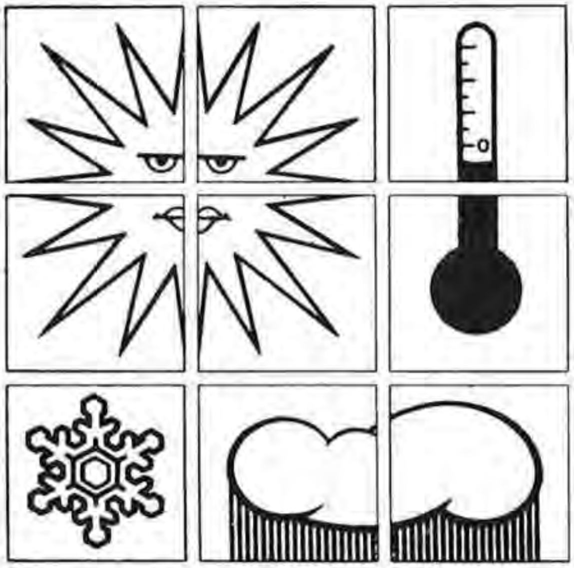

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FROM THE EDITOR'S DESK

This last issue of 1988's *Chinook* will arrive in your home well into 1989. We apologize for the delay, but sometimes, even with the best of intentions, other events will dominate and interfere with out "best made plans".

From the West Coast, Peter Jackson provides a surrealistic view of the sky. You will agree though, that his article is very down to earth and very real! Since the beginning of time humankind has looked up and wondered; this was before we had tephigrams and hodographs to decipher the mysteries of temperature, wind and moisture.

From the East Coast we feature David Wartman's report about an unpleasant experience on the Atlantic. This too is part of a weatherman's (person's?) fare. It is an important part of a modern Weather Service requiring a great deal of skill and knowledge.

Our Weather Map Series features the cold blast on the Prairies this past January and early February. As you read this, you should be about ready for the golf clubs ...

Last, but not least, it is awfully quiet at this desk; hardly a word is received from you, the reader! Is anybody reading this? We would like to hear from you! Good, bad or indifferent! We could also use some of your contributions.

Hans VanLeeuwen

COVER

Clouds observed on looking northwestward from Vancouver across Burrard Inlet on the afternoon of February 5, 1987. The undulating character of the clouds is thought to be due to atmospheric waves (photograph courtesy of Scott Robeson).

COUVERTURE

Nuages visibles de Vancouver, en regardant vers le nord-ouest au-dessus de l'inlet Burrard l'après-midi du 5 février 1987. La forme ondulée des nuages est possiblement due à des ondes atmosphériques (Photo : Scott Robeson).

Contributions, enquiries, comments and suggestions from readers are welcome. They should be addressed to:
Editor, *Chinook*, Suite 903, 151 Slater Street, Ottawa, Ont. K1P 5H3.

Chinook

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SURREALISTIC CLOUDS

by Peter L. Jackson

In Vancouver on the afternoon of February 5, 1987, there appeared a cloud cover that someone commented "...resembled some kind of surrealistic landscape..." (see Figure 1). What kind of clouds were they? How and why were they formed? Let us try and answer these questions.

If the answer to these questions is a puzzle, the first pieces can be fitted together by examining the clouds. The remaining pieces can be fitted by carefully analysing the meteorological conditions that led to the clouds' formation. One key to the analysis will be to look at the atmosphere's vertical structure of temperature and wind at the time of the clouds' appearance.

First let us look at the clouds themselves. They have two unusual features (see Figure 1): the undulating or wave-like form of the cloud bases, and the protuberances extending down from them. The cloud bases were estimated by trained observers to lie between 3000 and 3600 m above the ground. Precipitation was also reported in the mountains nearby along with an unsteady surface pressure. This evidence combined with the clouds' shape indicates that the proper cloud classification should be "altocumulus undulatus mamma". A definition of this latin name follows:

Altocumulus – a middle altitude cloud, based between 2000 and 4000 m. It has some structure or texture due to vertical (up and down) air motions. This is in contrast to altostratus, which is also based between 2000 and 4000 m, but is flat and sheet-like in appearance because the vertical air motions are small.

Undulatus – an implied undulating or wave-like appearance that is generally caused by gravity waves in the atmosphere. Atmospheric gravity waves are similar to water waves that are seen on the surface of any body of water – gravity is the restoring force causing the oscillating wave-form in both cases.

Mamma – the protuberances on the cloud base. Mamma can often be seen in and around summer thunderstorms and are created when moist unstable air (i.e., air that often has a lot of vertical motion) lies over drier stable air (i.e., air that often has very little vertical motion). In the moist unstable layer, there is cloud, as well as up and down vertical motions. When the vertical motions bring this air into contact with the dry stable air below, the cloud droplets evaporate forming the cloud base. At the same time the upward and downward motions are "damped" by the stable layer in the following way: While the downward vertical motion in the unstable air above the inversion impinges on the stable layer, it at some point becomes warmer (lighter or less dense) than the surrounding air and is forced to stop its downward motion and then begins to rise. This process can cause the convoluted protuberances (mamma) on the cloud base. You can think of the inversion as a sort of "flexible ceiling" which damps the upward and downward motions above it but still gets pushed and pulled into a convoluted shape by the vertical motions. The sharpness of the cloud base is due to the dryness of the air below, while the convoluted appearance is likely caused by the strong vertical motions in the unstable air, which are "damped" by the stable layer.

Figure 1 Clouds observed from the campus of The University of British Columbia in Vancouver on February 5, 1987.

By examining the cloud, we have classified it, but the next question is: How was it formed? In order to find out, let's look at a satellite picture for the same time (Figure 2). Superimposed on this picture is a jet-stream analysis made with aircraft and weather balloon observations of wind speed and direction. The picture is infrared, the lighter shades indicating clouds with colder temperatures, and hence higher tops. The jet-stream paths are indicated by the thick lines in Figure 2, with the arrow on the end of each line indicating the wind direction. The aircraft and weather balloon observations of wind are taken at about 10,000-m altitude, and are indicated by the thin barbed lines in Figure 2. The line points in the direction the wind is blowing, with each barb on the line equalling 10 knots (18.5 km/h) and each solid (triangular) barb equalling 50 knots (92.6 km/h).

A jet stream is a narrow "river" of rapidly moving air about 10,000 m up in the atmosphere. The positions, strengths and curvatures of jet streams, as well as the minor ripples or kinks in their paths, govern the day-to-day weather patterns around the globe. As you can see, there are two jet streams passing over British Columbia. The northern one, crossing the Queen Charlotte Islands, is the stronger with winds at 10,000 m in excess of 120 knots (222 km/h). The southern jet stream, cross-

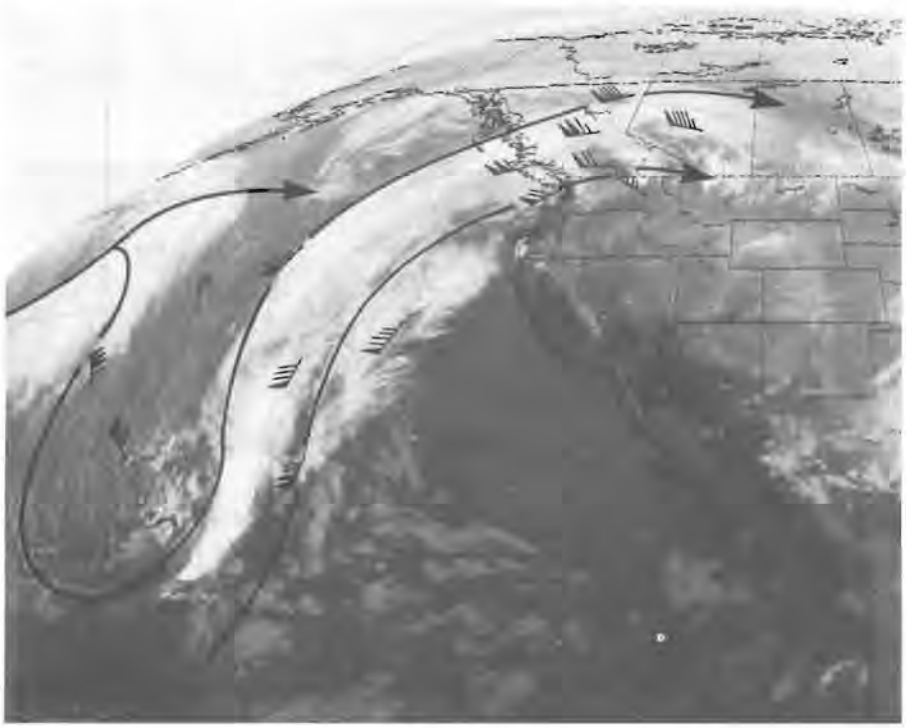
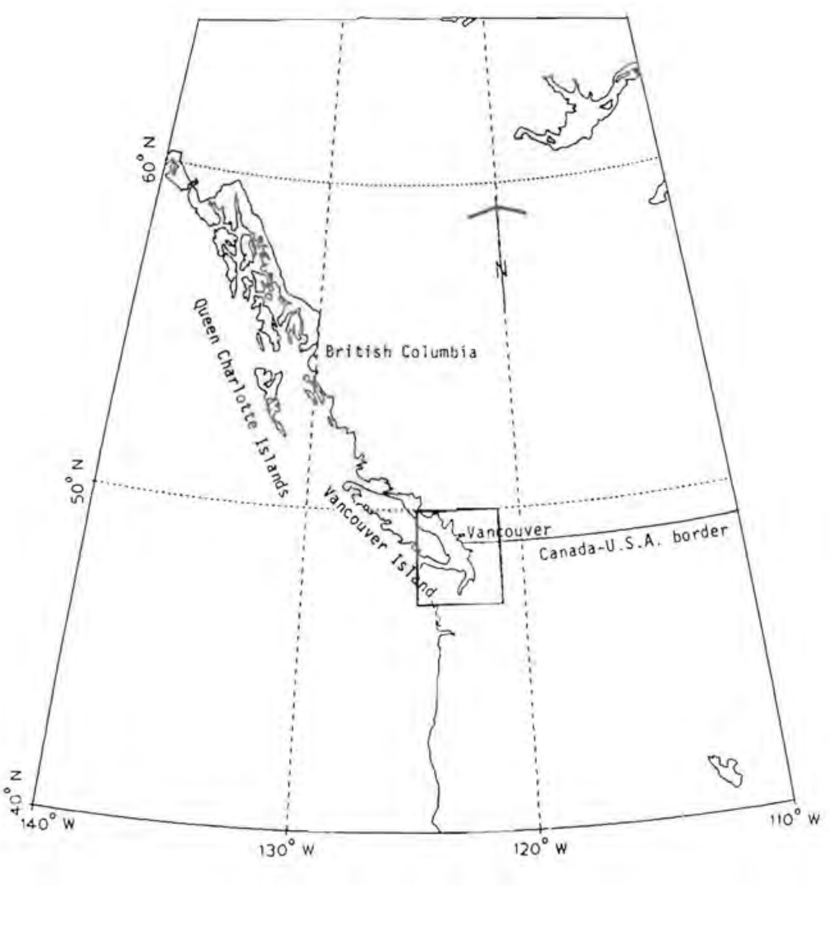


Figure 2 Infrared geostationary satellite picture taken at 4:00 p.m. PST on February 5, 1987. Superimposed on the picture are winds reported at 10,000-m altitude by aircraft and radiosonde, as well as the position of the jet stream.

ing near Vancouver, is weaker, with winds at 10,000 m near 90 knots (167 km/h). The southern jet stream has subtropical origins, originating near 20°N latitude. Subtropical streams often carry warm, moist, unstable air at middle levels to the region.

The presence of a jet stream over the Vancouver area indicates strong winds at higher levels. Notice the orientation of the jet stream – it traces a line from the high terrain of the Olympic Peninsula (see Figures 2 and 3) to Vancouver. Further information about the wind can be gained by referring to the hodograph (Figure 4) for Quillayute (see Figure 3) on February 6 at 0000 UTC (4:00 p.m. PST on February 5, 1987).

A hodograph is a plot of wind speed and direction values for various levels in the atmosphere and is obtained by tracking the position of a meteorological balloon (referred to as a radiosonde). The triangles on the dashed line are labelled according to altitude and are the heads of imaginary arrows or vectors extending from the "bull's-eye" in the centre of the plot. These vectors or arrows represent the wind speed and direction at each given altitude. The length of the vector corresponds to the wind speed, measured by the scale formed by the concentric rings. The vector's direction points in the direction



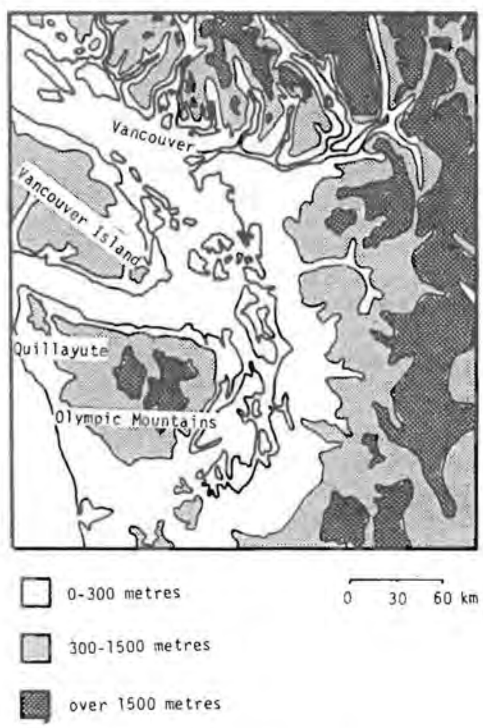


Figure 3 Location map with an expanded view of southwestern British Columbia showing elevation contours at 500-m intervals.

the wind is blowing. For example, point A on the hodograph (Figure 4) would correspond to a wind of 150 km/h from the south or 180° (i.e., blowing to the north).

The interpretation of the hodograph yields the following conclusions:

- The winds are strong, especially at lower levels. Winds are in excess of 65 km/h above 600-m altitude and increase to over 100 km/h above 3000 m.
- The clockwise turning of the wind with increasing height from 600 to 4200 m indicates warm air advection. In other words the wind is blowing warmer air from the south to southwest into these levels. The change in the temperature of this layer due to warming advection is about 1.3°C/h.
- The slight counter-clockwise turning of the wind with increasing height above 4200 m indicates some cool air advection. Therefore, the warm advection at low levels is capped by the slight cool advection above 4200 m, so that the atmosphere is tending towards a decrease in stability. In other words, the air mass will become less stable (i.e., potentially increasing the vertical motion) with time. The reason is that the warm air at low levels is lighter than the cooler air aloft, resulting in buoyant upward and downward air motions as the cold heavy air sinks and the warm air rises.
- The rapid change in wind direction between 1200 and 2700 m indicates the presence of an elevated front near these altitudes. The front would be oriented east to west since this is the direction of the wind velocity change with altitude (also called the wind shear).
- The wind above the frontal zone increases in speed and turns counterclockwise indicating an active warm front – one that has convergence and uplift above the front.

In short, the hodograph interpretation leads to the analysis of an active warm front situated somewhere between 1800 and 2700 m with decreasing stability and increasing wind speed above the front.

As well as providing data for a hodograph, a radiosonde ascent also produces measurements for a tephigram (Figure 5). A tephigram, known as a temperature-entropy chart, is a plot of temperature versus pressure and is useful for assessing the stability of the air. When this is combined with moisture data it can also be used to show the types and extent of clouds. In Figure 5, the lines of equal pressure (isopycnals) are horizontal, whereas the lines of equal temperature (isotherms) slope to the right with decreasing pressure. The lines that are at right angles to the isotherms are called the dry adiabats. A dry parcel of air that is lifted upwards will cool while it rises such that its temperature profile runs parallel to the dry adiabats. Notice how the pressure decreases along the vertical axis, just as it does in the atmosphere as altitude increases. The vertical axis then corresponds to height above sea-level. The exact relationship between height above sea-level and pressure depends on temperature, but an approximate height scale is given to the right of the figure. As you can see from the profile, temperature generally decreases with height. An exception to this is a small layer around 770 millibars (2300 m) where the temperature is constant or even increases slightly with height. This is called an inversion, and it can indicate that a front lies at this level. Consideration of atmospheric moisture (not shown) as well as the temperature structure of the atmosphere leads to the analysis of latent instability in a layer above the inversion to about 4000 m. Latent instability implies that if air is forced to rise above a certain altitude, it will become warmer (and hence lighter) than the air around it and then continue to rise on its own accord, generating turbulent and convective clouds (cumulus or perhaps thunderhead types). The moisture profile indicates a broken cloud layer from 1800 to 2500 m and a broken to overcast cloud layer above 4000 m.

Now that the wind, stability and moisture of the Quillayute sounding have been analysed, let us try and interpret these results in terms of the clouds observed. The clouds are unusual for two reasons: first, the mamma protruding from below the cloud base, and second, the wave-like appearance of the cloud base. A likely scenario for mamma cloud, as mentioned in Richard Scorer's book *Clouds of the World*, is a moist unstable layer overlying a dry stable one. As the analysis has shown, the atmosphere had this structure. There was a stable (frontal inversion) layer topped at 2400 m. The tephigram

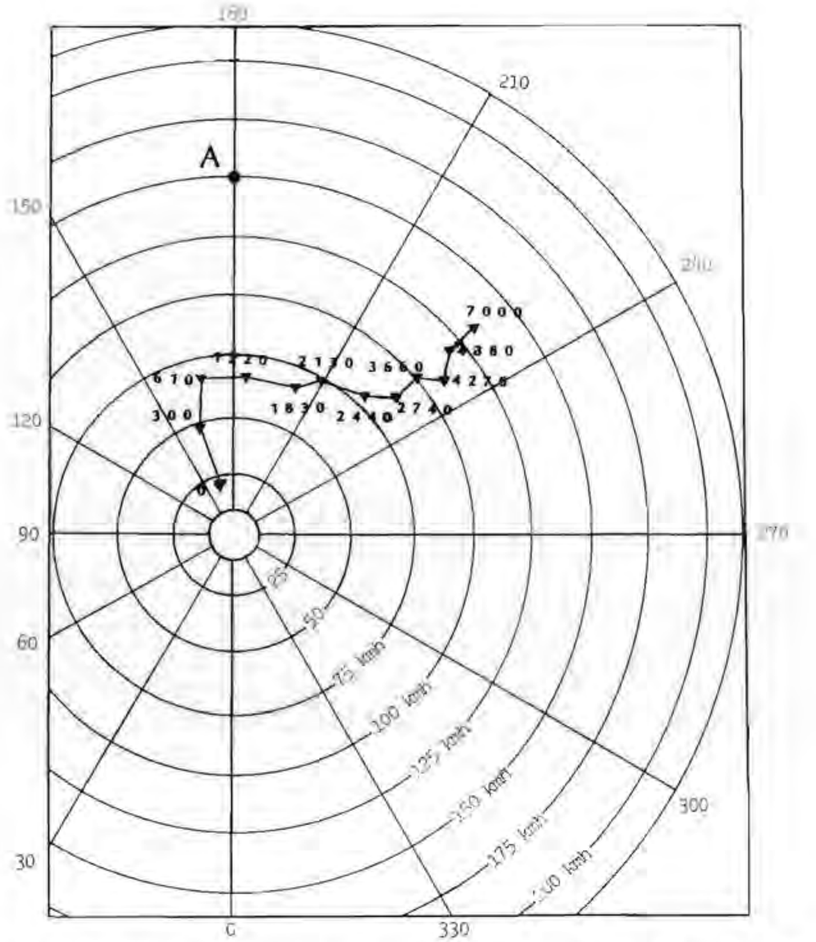


Figure 4 Hodograph from a radiosonde ascent at Quillayute made at 4:00 p.m. PST on February 5, 1987. The number beside each triangle indicates the altitude in metres.

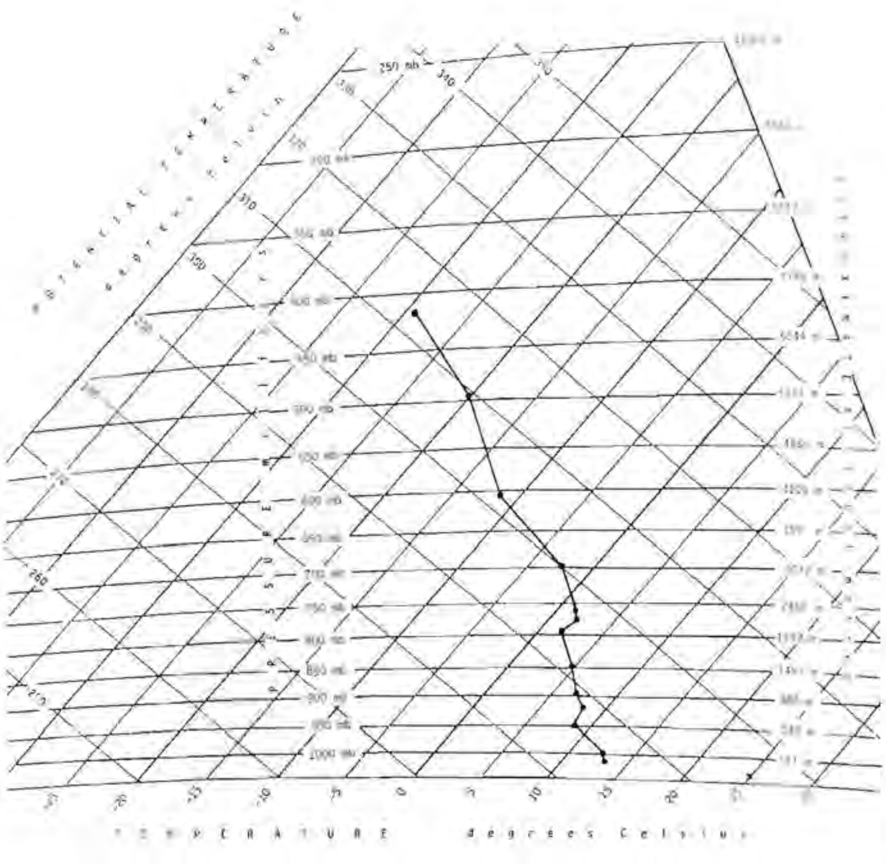


Figure 5 Tephigram from a radiosonde ascent at Quillayute made at 4:00 p.m. PST on February 5, 1987.

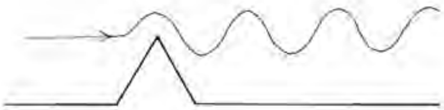


Figure 6 Diagram showing the formation of trapped lee waves by the flow of air over a mountain barrier, which can occur under certain meteorological conditions.

indicated unstable air above this inversion to 4300 m. The hodograph indicated a destabilizing trend, with warm advection underlying slight cold advection. The hodograph also indicated an active warm front, with dynamically induced uplift above the front. The presence of the mamma can therefore be easily accounted for.

Waves in the atmosphere are ubiquitous, occurring at nearly all scales from tens of metres to thousands of kilometres. Gravity waves in particular are very common. Atmospheric gravity waves, like water waves, consist of up and down oscillating motions propagating in a specific direction, with gravity causing the oscillations. The type of gravity waves that are evident here are trapped lee waves. These are gravity waves that are generated by strong winds blowing over an obstacle, such as a mountain – in this case the Olympic Mountains. After the air is forced up over a mountain, it repeats its up and down motion downstream, (see Figure 6). Ronald Smith in his book, *The Influence of Mountains on the Atmosphere*, mentions that the conditions favourable for the formation of trapped lee waves are a strongly stable layer in the lower atmosphere near mountain-top level and strongly increasing wind speeds with height at right angles to the barrier. Both of these conditions exist in this case: a stable layer exists near 2400 m, which is the height of the highest peaks in the Olympic Mountains, and the wind does increase quite strongly with height in a direction at right angles to the mountains above this level.

Thus, by carefully examining the clouds and by analysing the meteorological situation, it is possible to confirm their classification as Altocumulus undulatus mamma, and to identify the processes that acted to create their unusual appearance.

FURTHER READING

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Peter Jackson is a meteorologist from the Pacific Weather Centre in Vancouver, currently on educational leave at The University of British Columbia. He is working towards a Ph.D. in the Geography Department studying mesoscale meteorology. His particular interest is in "Squamish" winds – very strong winds that can blow out of the inlets and fiords of the B.C. coast during the winter months.

RÉSUMÉ *Souvent, en regardant les nuages, on essaie de les identifier et de savoir le comment et le pourquoi de leur formation.*

Prenons par exemple les nuages de la figure 1 : des Altocumulus que l'on trouve habituellement entre 2 000 et 4 000 m d'altitude. Leur forme ondulatoire indique la présence d'ondes de gravités dans l'atmosphère et, donc, des mouvements verticaux ascendants et descendants. Dans ce cas on a pu analyser un fort courant-jet avec des vents de plus de 200 km/h, à 10 km d'altitude. L'hodographe nous permet de localiser d'importants cisaillements verticaux du vent; le changement de direction du vent peut indiquer le genre d'advection, chaude ou froide, présente à différents niveaux. Le téphigramme permet d'établir la position et d'un front.

Ces analyses détaillées de données métérologiques ainsi que les effets associées à la topographie locale nous donnent assez de renseignements sur l'origine et la présence de ces nuages. Les nuages nous indiquent aussi quels sont les processus qui ont contribué à leur formation.

SPRING AND SUMMER OF 1988 IN REVIEW

SPRING: by Alain Caillet

Following a winter that was mild and drier than normal in most of Canada, there was no relief for dehydrated farmland on the southern Prairies or in Ontario. Spring 1988 added to the evidence that was being advanced by those who hold that climatic change is under way: temperatures were above normal from sea to sea, and the spectre of Depression-like drought conditions became more of a reality while a critical precipitation deficit made itself felt on the southern Prairies and in Ontario.

TEMPERATURE

Beginning in early March, western Canada enjoyed very mild temperatures, especially in Alberta and the Yukon. A temperature of almost 20°C was reached at Medicine Hat in Alberta, which was in its seventh consecutive month of above-normal temperatures. In April, the northwest experienced an early spring; Dawson (Yukon) reached 29°C, and summer seemed to have arrived in the B.C. interior and in Alberta, where temperatures rose to 30 and 27°C, respectively. By mid-May, the temperature had already reached 34°C at Medicine Hat. In central and eastern Canada, temperatures were much more variable. Despite mean temperatures that were above normal, repeated influxes of cold air resulted in spring weather that was mild but capricious.

PRECIPITATION

The hydrological situation in western Canada started to become critical in early March. For over seven months in the southern B.C. interior and the southern Prairies, precipitation had been below normal. The probability of the situation being redressed before summer was small, though there was some respite in central Alberta and Saskatchewan, which received appreciable amounts of rain. In April, there was no improvement for the Prairies or northwestern Ontario, where monthly accumulations were 25% below normal. Only southeastern Saskatchewan and the valleys of the southern B.C. interior received generous precipitation. In late May, under the influence of a strong and almost stationary ridge in the west, dryness indices were still rising in the Prairies and southern Ontario, while British Columbia, Yukon and the Mackenzie District received three to five times their normal precipitation for the month. Farther east, few spectacular storms occurred, and precipitation was variable, but most stations in Quebec and the Atlantic provinces recorded more or less normal amounts.

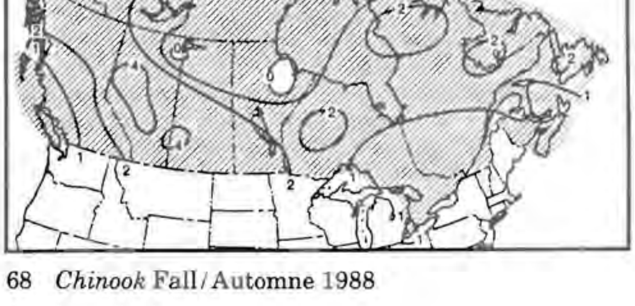
IMPACTS

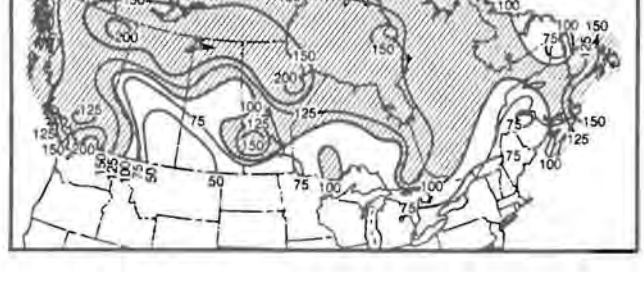
The remarkable spring weather had both direct and indirect effects on the economy and other aspects of Canadian life. The mild temperatures were perceived very differently from region to region and province to province. In the north and northwest, the early arrival of spring was a cause for celebration. On the Prairies, despite low, soil-water reserves, people were grateful because winter-kill losses to winter wheat and last fall's rye crops were low, and because the spring seeding was progressing rapidly. In Ontario and Quebec, however, the mild weather brought an early end to maple syrup production, and ski resorts had to close early.

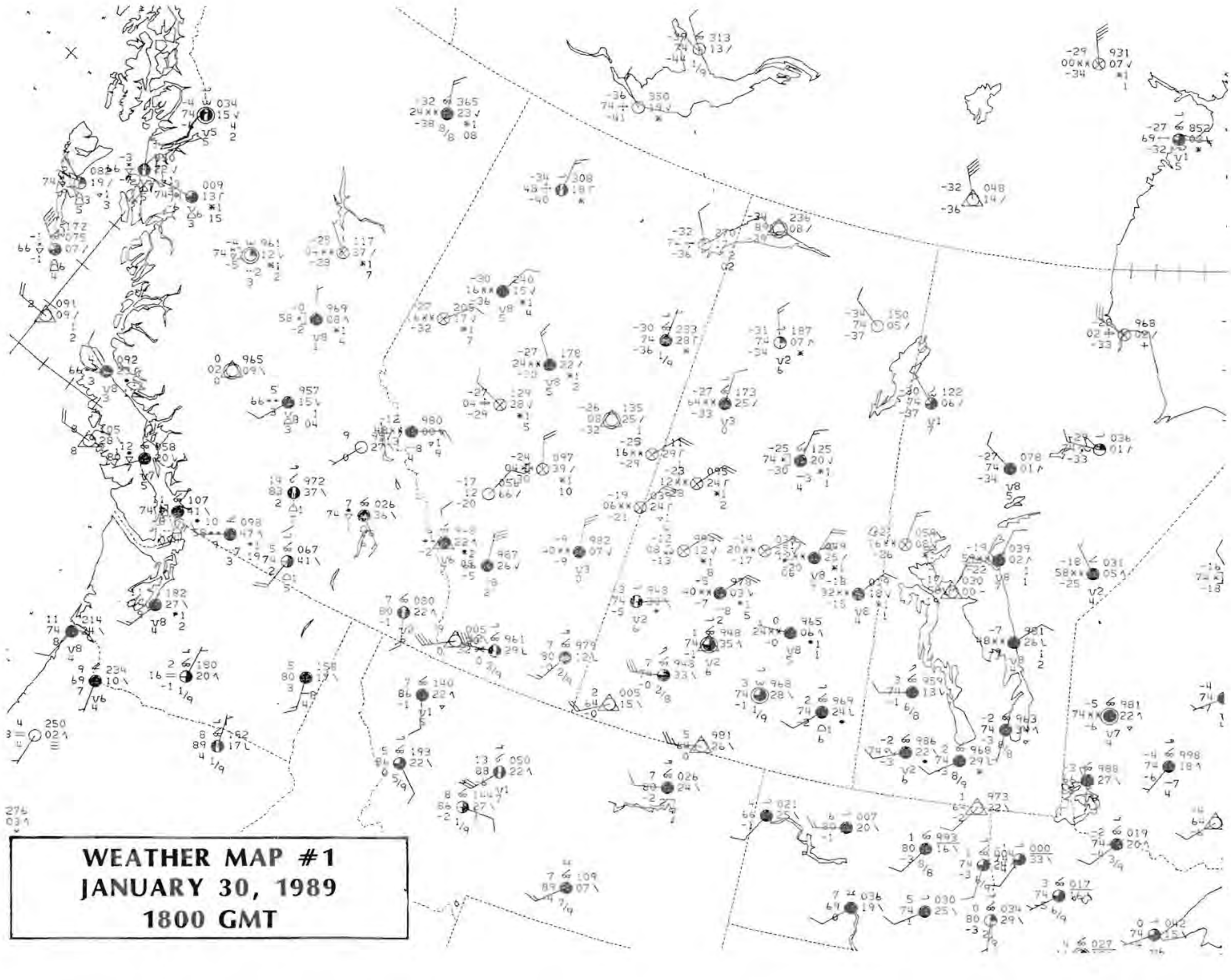
Soon, a large number of small rural communities and farms in western Canada were forced to arrange for the transport of the water they needed. Wind erosion was ravaging many farms, and forest fires were breaking out everywhere. By late May, the only hope for the crop on the Prairies was normal rainfall during the remainder of the growing season.

Meanwhile, variable skies in Nova Scotia, often bringing ample precipitation, gave the province its best maple syrup harvest in many years and, in general, fewer brush fires were reported in the Maritimes.

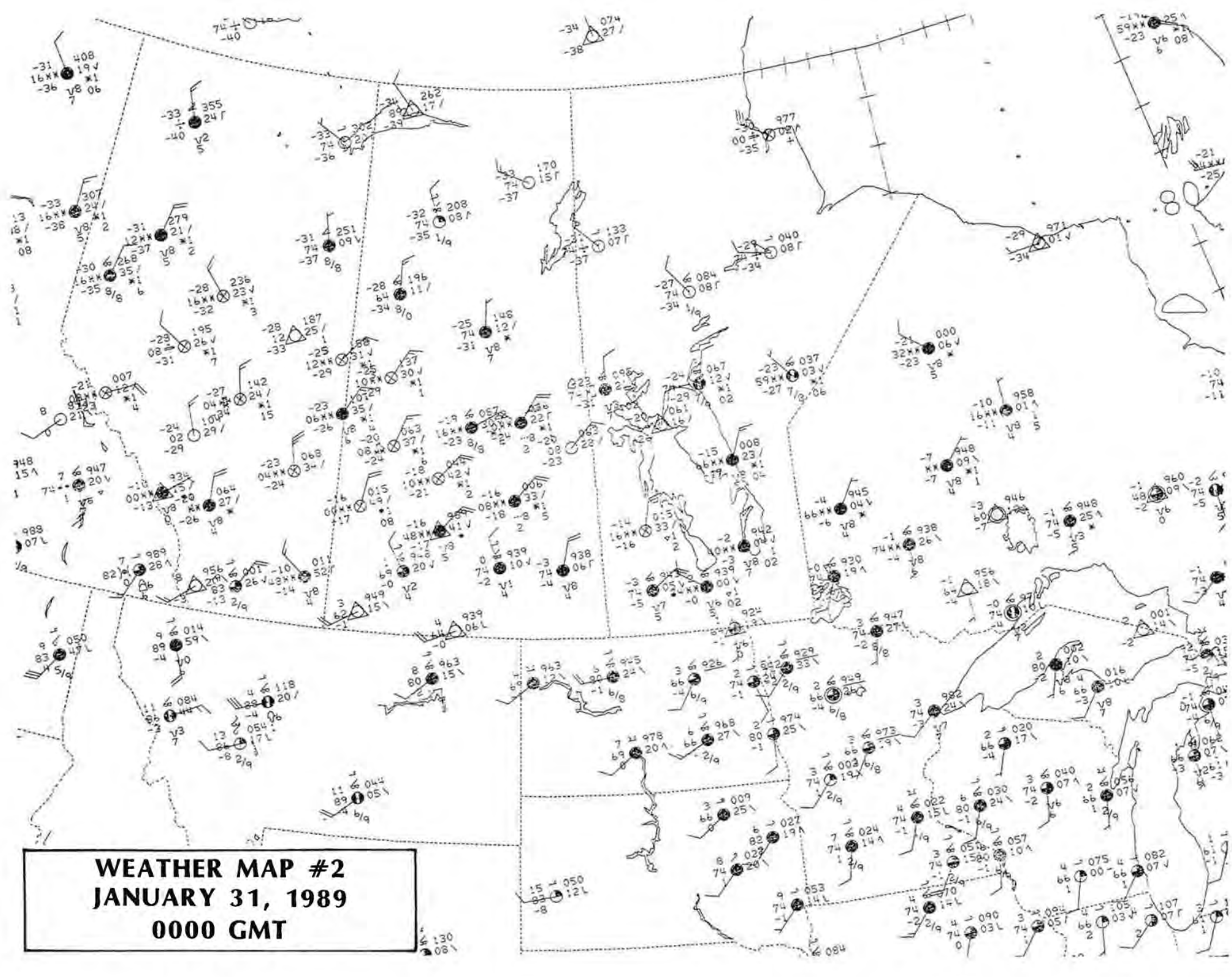
Two big storms occurred, one affecting the Maritimes, the other, Quebec. On April 18 and 19, while 40 cm of snow fell along the North Shore at Sept-Îles, Quebec, freezing rain accumulated on the high-voltage power lines that supply almost the entire province, as well as some parts of the Maritimes and the United States. A spectacular, generalized power failure resulted, causing losses of several million dollars to industry and trade. On May 2–4, Nova Scotia and Prince Edward Island were hit by a storm bringing high winds, up to 148 km/h on Cape Breton Island. Lobster fishermen on Pictou Island, Nova Scotia, lost 70% of their traps. Damage to buildings, uprooted trees and traffic accidents were reported, though fortunately no lives were lost.







WEATHER MAP #1
JANUARY 30, 1989
1800 GMT



WEATHER MAP #2
JANUARY 31, 1989
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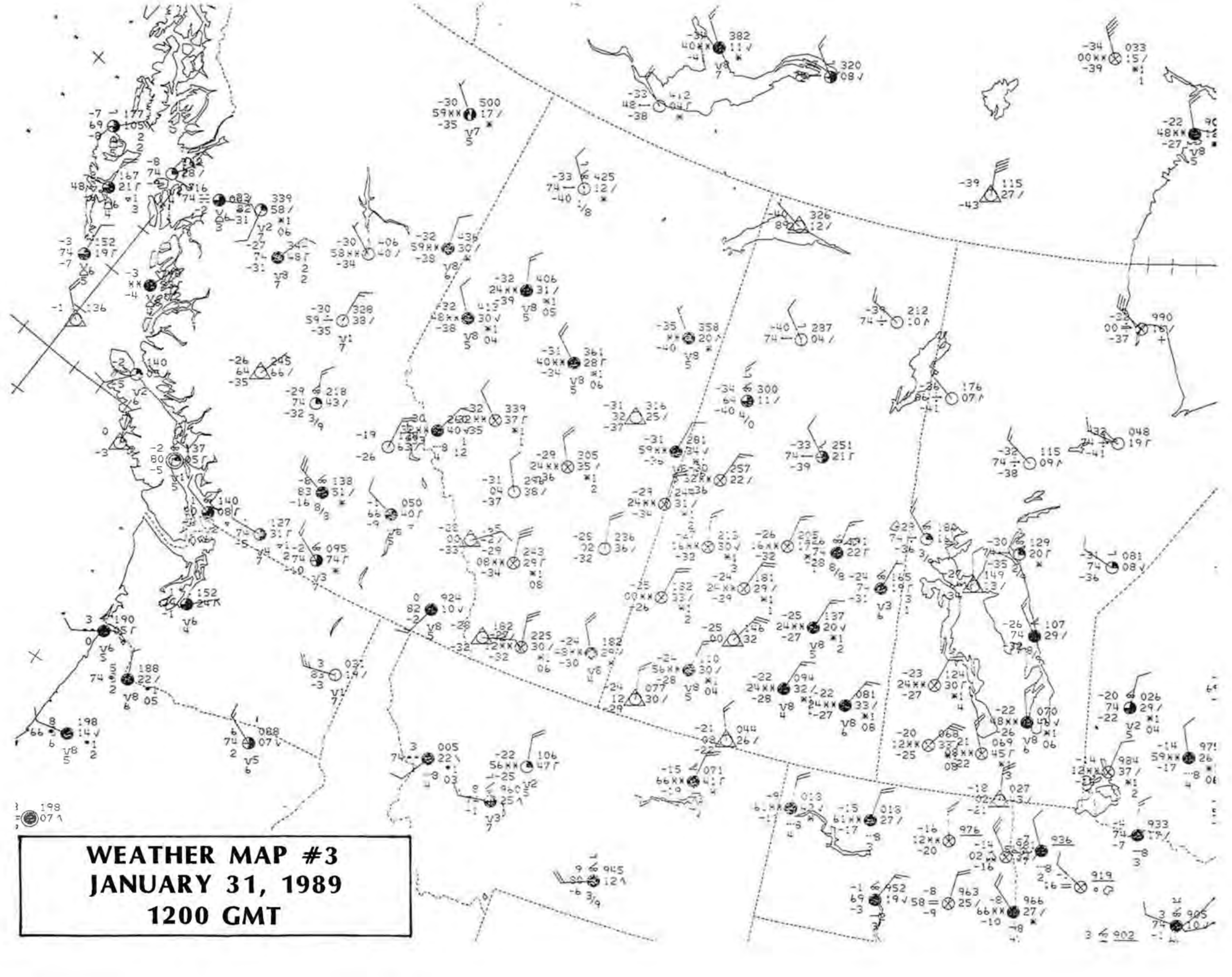
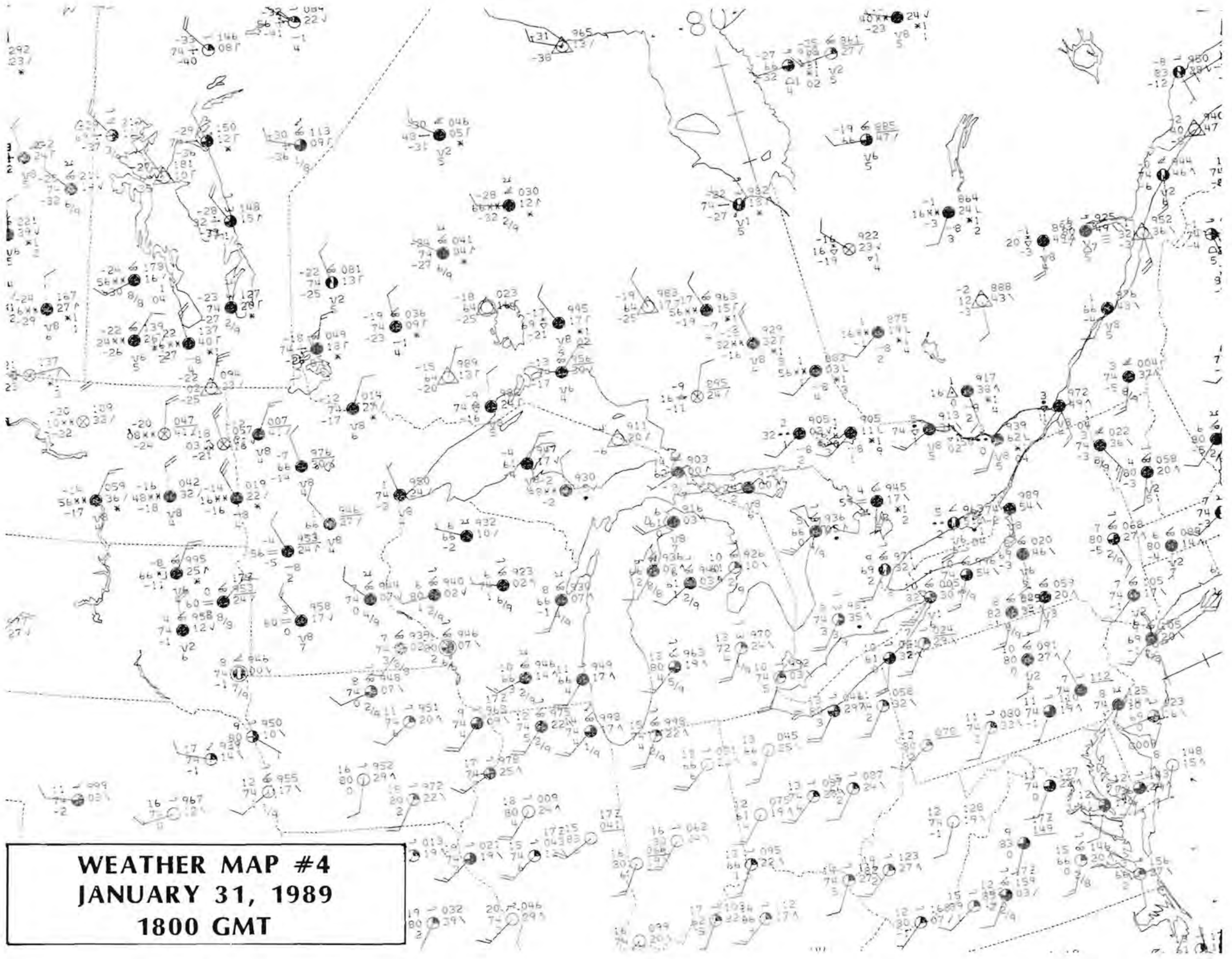


WEATHER MAP #3
JANUARY 31, 1989
1200 GMT



WEATHER MAP #4
JANUARY 31, 1989
1800 GMT

SPRING AND SUMMER OF 1988 IN REVIEW

SUMMER: by Aaron Gergye

North America's upper atmospheric circulation was dominated by an amplified mid-continental ridge with a large positive height anomaly over the Dakotas. The result was an extended drought over the Canadian Prairies as well as southern Ontario while the anomaly oscillated during the summer period. An amplified trough and a slack 500-mb height gradient in the Gulf of Alaska led to numerous slow-moving lows passing through the Yukon and Northwest Territories accompanied by copious amounts of rainfall.

TEMPERATURE

June was a warm month in the Yukon and the Territories but the Prairies and southern Ontario were focal points. The Prairies were 4 to 7°C above normal with some climate stations soaring to 44°C while the drought persisted. Drought continued into July over the Prairies and southern Ontario. Six record-smashing afternoon highs above 35°C in Toronto made it the hottest July there since 1955. Southwestern Quebec also experienced the warmest July in recent years.

During August, temperatures were once again above normal over the Yukon and the Territories, though not as much as in previous months. The Prairies were generally cool but Manitoba was the most pleasant of the three provinces with temperatures reaching 40°C by mid-month. The first two weeks in Ontario were hot and humid; however, the passage of a sharp cold front dramatically ended the heat wave. Warm, humid conditions prevailed in the Maritimes. Twenty-nine days of persistent fog ended at Yarmouth, N.S., on August 14.

PRECIPITATION

Most of the heavy rain in the Northwest Territories fell during June and July with some stations recording 200 to 400% of their July normals. British Columbia experienced wet weather during June and coastal areas recorded over 200% above August normals. The drought continued over the Prairies and southern Ontario during June and July. By mid-July, enough precipitation had fallen over most parts of Ontario to effectively end the drought. The Prairies were generally wet and dreary for most of August. The Maritimes experienced cloudy and humid conditions in July with thunderstorms being the highlight of that month.

IMPACTS

Yukon and Northwest Territories

- Heavy rains during June and July caused numerous wash-outs and road closures.

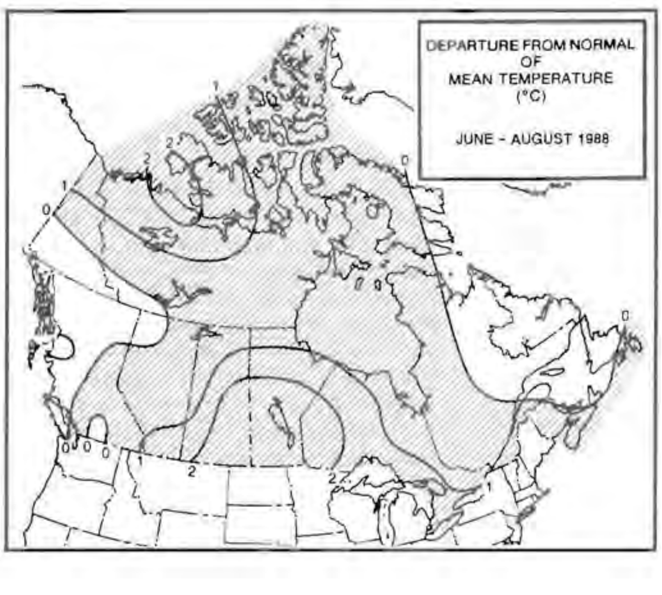
British Columbia

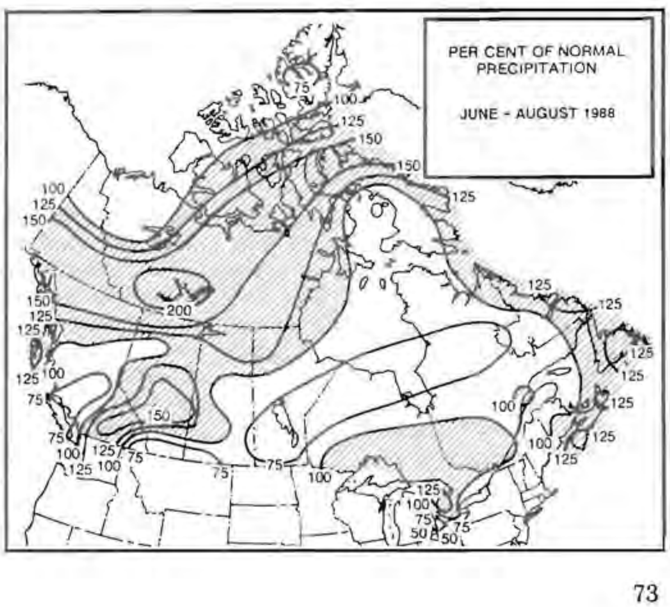
- Hay harvesting and cherry splitting problems resulted from wet June weather.
- Thunderstorm gusts capsized boats in Lake Okanagan.

Prairies

- A Camrose, Alberta, tornado on June 5 caused $5 million damage.
- Edmonton's worst rainstorm in 35 years dumped 96 mm of rain in 30 hours causing flooding.
- Thunderstorms caused flooding in Calgary on August 16.
- Drought reduced Prairie crops to two thirds their normal size. Only half the usual amount of grains will be available for export (Canada Grains Council; *Toronto Star*, Sept. 12, 1988).
- Canada Grains Council predicts Canada's grain handling and transportation sectors could see an average loss of 47% in revenue this year: up to 55% of grain revenue for railways and a 45% drop for primary grain elevators (*Toronto Star*, Sept. 12, 1988).
- The duck population is expected to be at its lowest level ever because of the drought (*Ducks Unlimited of Canada; Winnipeg Sun*, June 20, 1988).
- The U.N. organization warns that grain reserves may sink to the lowest levels of the decade if drought in Canada and the U.S. continues for two more weeks (June 28, 1988).
- An estimated 24,000 farmers and farm workers have abandoned agriculture in the last 12 months owing to drought (Employment and Immigration Canada, June 1988).
- Avian cholera has devastated the goose population in Saskatchewan because of drought conditions (*Saskatoon Star Phoenix*, May 11, 1988).

Continued on page 77





WEATHERMAN'S STORMY SEAS

by David Wartman

In early March 1988, as part of an effort to develop an ongoing liaison program with the Canadian Coast Guard (CCG), I was afforded the opportunity of embarking on a familiarization trip on board the CCGS *William*. Although the trip was scheduled as a short supply run (36 hours) from Halifax to Sable Island and back, an emergency search and rescue mission resulted in my trip being much longer than anticipated. The prolonged excursion, although not totally enjoyable at all times, proved to be a rewarding experience and provided me with a valuable insight into the work performed by the CCG and the effects a powerful and threatening sea can have on that work. This article describes some specific information about the ship itself and a chronological sequence of events.

CCGS *William*.

THE CCGS *WILLIAM*

The CCGS *William* (formerly called the *Sir William Alexander*) is a 272-ft vessel that carries a crew of 40. Most of the ship's time is spent near the coast, devoted to such tasks as laying cable and deploying buoys. In addition, the CCGS *William* is charged with making a supply trip to Sable Island every three months and with responding to search and rescue calls. Although it has an ice-breaker hull, the *William* is no longer officially certified as an icebreaker. Because of such a hull, however, the vessel has no stabilizing fins and therefore is susceptible to both pitching and rolling motions in rough seas. The CCGS *William* is one of the older Coast Guard ships and is expected to be taken out of service in 1989.

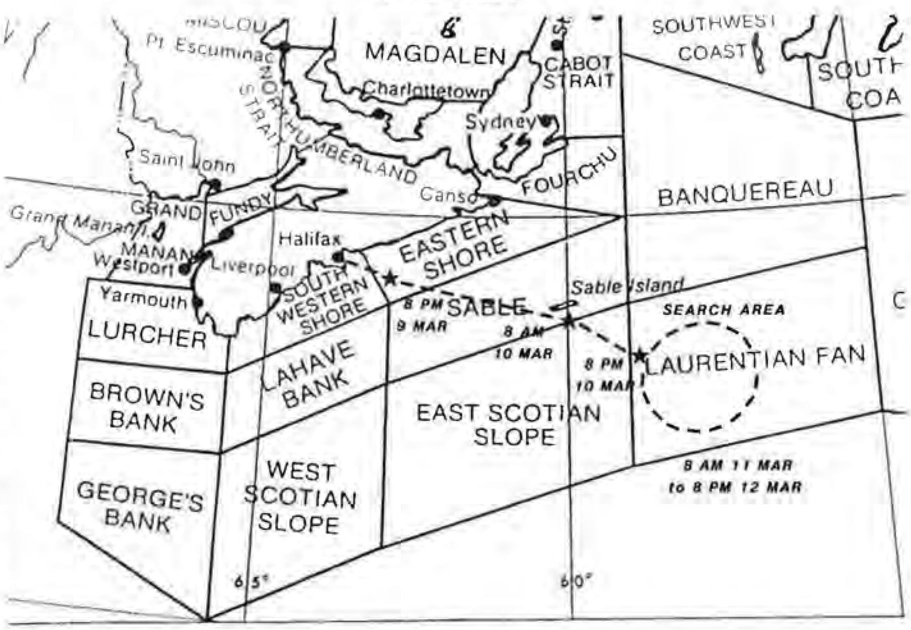


Figure 1 Route of the CCGS *William* on its journey to the *Bonnie Lou II* search area, March 9–12, 1988, plotted on a map of the Atmospheric Environment Service marine forecast areas.

OUTWARD BOUND

I arrived at the ship, which was docked at the Coast Guard base in Dartmouth, at 1415 AST on Wednesday, March 9, 1988; then I was met by the Captain, Amos Morash, and shown to my cabin, which was on the lower deck next to the engine room. I was to room with two stewards and, as the "new kid on the block", was assigned the top bunk. After a delicious meal we steamed out of port at 1800 en route to Sable Island (Figure 1). Some northerly swell was encountered on the way out as a result of a recently departed storm, but the winds were light and no wind wave was present; consequently, I enjoyed a peaceful first night aboard. The lone excitement was a distress call from a fishing vessel that was taking on water 15 miles north of Sable Island. However, another Coast Guard vessel, the *Sir William Alexander*, was in the vicinity and picked the crew up safely, although they were unable to prevent the vessel from sinking.

I arose on Thursday to find the ship had anchored near Sable Island. A light rain was falling and the visibility was occasionally fair in mist. The winds were light southerly. Early breakfast was called at 0530 for 0600. Although meal times are set at 0730, 1130, and 1630, the Captain has the option of changing these, depending on operational requirements. This was the case that day. We were tasked with "slinging" the supplies onto Sable Island by helicopter. Because this operation is constrained by ceiling and visibility, the Captain chose to get an early start since the current marine forecast called for the visibility to drop to near zero in rain and fog that morning. If we were unable to sling all of the supplies in that

Figure 2 Light seas near Sable Island as seen from the bridge of the CCGS *William* on Thursday morning, March 10, 1988.

Figure 3 Rapidly building seas about 125 n. mi. southeast of Sable Island on Saturday morning, March 12, 1988.

day, we would have to remain anchored near Sable Island until the conditions improved enough for the operation to be carried out. The slinging of supplies is also governed by the sea state. If the sea is too rough, the helicopter cannot land and take off safely. However, the weather was cooperating (see Figure 2) and the chopper began its operations at 0700. At 0715, I was ferried aboard Sable Island by chopper and spent the morning on land.

By the time I was shuttled back to the ship about 1100, fog was starting to develop. Fortunately the supplies were all safely on the Island, and I thought for a brief moment that we would be heading back to Halifax. Suddenly, however, we received a message from the Rescue Coordination Centre in Halifax regarding a missing 65-ft fishing boat, the *Bonnie Lou II*, which carried a crew of 5. We immediately began steaming eastward with an expected destination near the last estimated position of the fishing boat. Two other Coast Guard vessels, the *Sir William Alexander* and *The Narwhal*, were deployed as part of the search effort. In addition, three Canadian Forces aircraft (two Buffalos from Summerside and an Aurora based at Greenwood) were dispatched to work in conjunction with the surface vessels and aid in the search. At about 1500, we received a call from one of the aircraft that had spotted a line of debris south of Sable Island. We started to steam towards this location; however, the winds had picked up to south 20 to 25 knots and the visibility had dropped to zero in fog. These factors, coupled with our ETA for the location (near 43°20′N, 58°30′W) being 2100 (darkness), eliminated any possibility of a visual sighting that day and we continued southward overnight.

STORMY SEAS

Friday, March 11, saw a marked change in the weather. The winds had shifted to westerly gales overnight and the visibility was unlimited. The waves were beginning to build dramatically as cold westerly squalls registered up to 45 knots on the ship's anemometer and the bite of the wind increased (see Figure 3). A further aircraft sighting of debris resulted in our steaming southeastward to near 43°N, 58°W. A possible sighting of a cabin door was reported by one of the crew in the afternoon, but it was questionable given the roughness of the sea. By evening we were forced to "hove to" and move slowly with the waves and swell to the southeast in order to avoid being hit broadside by the increasingly powerful sea. However, Friday night a rogue wave hit us fully broadside and one of the engines was knocked out of service with the impact. The realization of the power of the sea hit me at that moment. The force of the rogue wave sent everything into disarray. Pop machines crashed down, chairs were toppled over, and everyone aboard was shaken awake. At that point, the trip had ceased to be an enjoyable experience and had become a bit frightening. The Captain maintained an almost constant presence on the bridge for the next day of rough weather.

By Saturday morning, the winds had increased to westerly 45 with squalls to 60 knots and the Captain was estimating the significant wave height at 10 m with some waves breaking over the bridge at 20 m (see Figures 4 and 5). We managed to turn around and head back into the wave and swell toward the west. However, we could only manage a sustained speed of 3 knots. The trip had certainly not become any less real or less frightening overnight. The effect of the rough seas on the crew and on their ability to perform their duties cannot be overestimated. Although I was not seasick, I battled nausea for several days. Much of the crew was in the same state or worse, but they still had to go about their assigned jobs, whether cooking food, maintaining a watch, or cleaning the washrooms. The effect of the heavy sea on me was draining. It took great effort to perform the simplest of everyday tasks, such as taking a shower or eating. The sea tends to steadily erode one's energy. My respect for the crew grew, on seeing their resolve to stick with it.

Another implication of these rough seas was the almost absolute impossibility of any kind of surface visual sighting of debris. Also, we were covering precious little area at a forward speed of only 3 knots. That afternoon, an aircraft sighting of a life raft was reported and one of the other Coast Guard ships, the *Sir William Alexander*, endeavoured to retrieve it. Although the *Sir William Alexander* reportedly had considerable difficulty in manoeuvring to do this, she eventually picked it up and confirmed that the battered and punctured debris was from the missing *Bonnie Lou II*. Saturday evening, given the amount of time the

Figure 4 Heavy seas on Saturday afternoon, March 12, 1988. The significant wave height was estimated at 10 m.

Figure 5 Waves breaking over the ship on Saturday afternoon, March 12, 1988.

Bonnie Lou II had been missing, the water temperature (less than 5°C) and the recovery of the life raft, the search was downgraded and we were released from duty. It was still slow forward progress in the rough seas Saturday night as we started our return to Halifax (Figure 6).

RETURN TO PORT

Sunday began with the seas continuing to diminish and our forward speed increasing. By Sunday morning the winds had diminished to marginal westerly gales 25 to 35 knots, and by afternoon they dropped off to light. It proved to be quite an uneventful day for me after the previous two days. I spent my time conversing with the crew and enjoying the trip once again. However, Sunday brought to light another of the problems that faces a Coast Guard crew at sea – boredom. There is precious little one can do to pass the time when not on duty. There is no TV or radio, and reading is impossible in rough seas. This boredom adds to the feeling of being kept in confined quarters for a lengthy period of time. Late Sunday evening we re-entered Halifax Harbour. Despite having the ship run aground in the harbour, I was on land again and back home by early Monday morning.

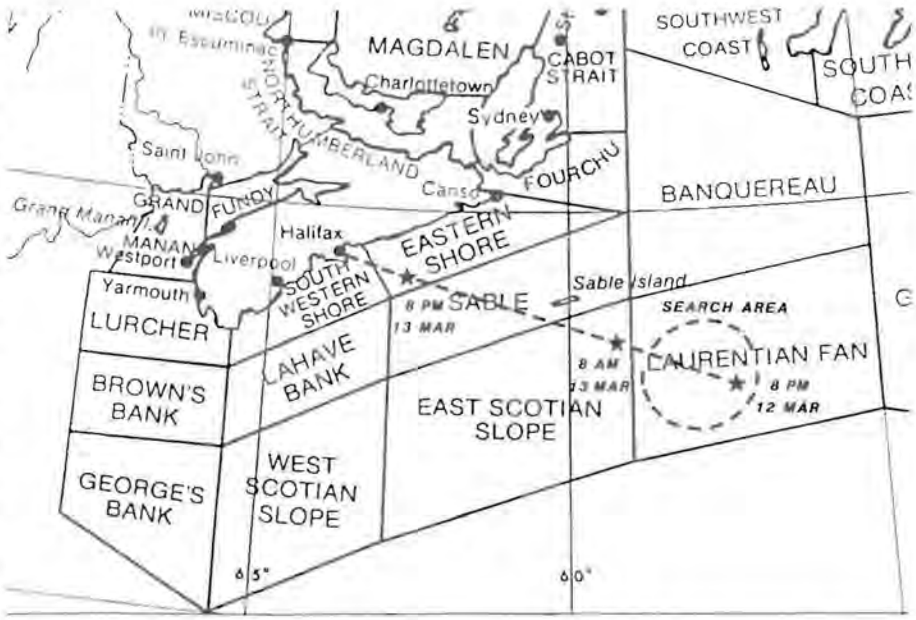


Figure 6 As Figure 1, except for the return trip to Halifax, March 12–13, 1988.

David Wartman is a senior operational meteorologist with the Maritimes Weather Centre in Bedford, Nova Scotia. A graduate of Mount Allison University, he previously served at the Pacific Weather Centre in Vancouver.

This article is based on David Wartman's report, Familiarization Trip on the CCGS *William*, 09–14 March 1988, published in Atlantic Region Forecast Operations Notes MWC 88-001, 31 May 1988.

RÉSUMÉ *Le voyage de familiarisation d'un météorologiste du Centre météorologique des Maritimes à bord du* William, *navire de la Guarde côtière canadienne, s'est avéré plus qu'intéressant. De Dartmouth, Nouvelle-Écosse, le navire s'est dirigé vers l'île de Sable. Le deuxième jour devait être consacré au ravitaillement de l'île mais le Centre de coordination de la Recherche, à Halifax, a demandé au* William *de participer aux recherches pour retrouver un navire de pêche de 65 pieds.*

Le jour suivant, les conditions météo ont changé considérablement. Pendant la nuit de forts vents froids de l'ouest ont commencé à souffler. Poussées par des rafales de 45 noeuds, les vagues sont devenus plus fortes. Le soir, une énorme vague frappa le navire de travers, envoyant tout promener. Le samedi, les vents ont augmenté à 60 noeuds et les vagues atteignaient près de 10 m. La hauteur des vagues rendait très difficile l'observation des débris flottant sur l'océan.

PRAIRIE STORM – ARCTIC BLAST!

Weather Map Series, January 30 and 31, 1989

by Hans VanLeeuwen

The last week of January was one of the coldest on record in the northwest part of North America. Temperatures in Alaska had dropped down to uncivilized and unbearable levels between -50 and -60°C. Minimum temperatures over the Yukon and the Territories were not any different. Most of the southern Canadian Prairies, however, were not subjected to the usual weather patterns, the kind of conditions that we used to hear so much about: "forty below" weather that one had to walk to school in!

January 1989, particularly the latter part, was on average well above normal for temperatures. In the week of January 16 to 22, some stations in Alberta and Saskatchewan reported temperatures 8 to 10°C above normal, whereas in the following week these departures increased to as much as 14 to 16° across the central portions of the Prairie Provinces. However, things were about to change.

By the latter part of the month the colder air slowly began to move southward behind a series of eastward moving storms. On January 29 all the fun started, when a storm over central Alberta moved east-southeastward, dragging frigid air behind it. Temperatures dropped in spectacular fashion, following the passage of the cold front, and combined with the snow and strong winds we had the makings of an old-fashioned Prairie blizzard.

The weather map series we have selected for this issue of *Chinook*, is to remind you that cold and bone-chilling weather is still very much a part of the Canadian scene, the Greenhouse Effect notwithstanding. Also, while you are reading this – and hopefully trying your hand at analysing the maps – it will likely be all but forgotten; robins will have invaded the garden and you may even have put in your first game of golf.

The first map indicates the conditions on Monday morning, January 30 at 1800 UTC (1100 MST). Notice how folks in Edmonton and Calgary are experiencing very different conditions from those at Lethbridge and Medicine Hat in southern Alberta. The cold front is just past Calgary. Farther east, a good isobaric analysis will locate the centre of the storm slightly north of Moose Jaw, Saskatchewan. Of particular interest is the well defined windshift line between the very cold air and the much less cooler air mass to the south of this line. Therefore, it should not be too difficult to draw in a good position for the cold front west of the low-pressure centre, and a warm front east of the centre.

Six hours later, at 0000 UTC, late Monday afternoon (1700 MST or 1800 CST), the rush-hour period across the Prairies shows an even more interesting picture; the centre of the storm is now well into southern Manitoba with pressures having dropped to 992.4 mb (99.24 kPa). Early Tuesday morning shows a grim picture: the January 31, 1200 UTC (0500 MST) map shows not only deep-freeze and blizzard conditions, but also a brief interruption in the golfing season on the West Coast! The final map of the series takes us to heartland, the Great Lakes region. This is midday on Tuesday, January 31, at 1800 UTC (1300 EST), with the storm centre in Northern Ontario.

May I suggest you try and hone your analysis skills on the charts and map out some of the other more interesting parameters, such as pressure, temperature, pressure fall (pressure tendency as plotted to the right of each station plot), visibility, and precipitation type. Sometimes it is interesting to just look at one particular station and describe the weather occurring there over the period covered by the maps, in plain language; in other words, how you would write about it to a friend in New Zealand or Florida. Have fun and please let us know about your efforts.

Summer

Continued from page 73

Ontario

- Soaring temperatures during the week of July 4 caused 6 deaths. Great Lakes–St. Lawrence Seaway grain workers were laid off on July 22 in anticipation of a drop in grain handling requirements as a result of drought-reduced yields.
- Great Lakes water levels were the lowest in more than a decade. A further drop of 5 inches in expected this year (Environment Canada, Canada Centre for Inland Waters).
- A five-year-old boy was killed in Luther Village by a tree uprooted during thunderstorms on July 29.
- Property and livestock losses on July 30 were caused by a tornado southeast of Woodstock.

Quebec

- A tornado caused $3 million damage on June 21 in St. Bernard.
- Thunderstorms caused a landslide and a train derailment at Couteau Station on June 22.
- Basements were flooded in Quebec City on July 8.
- Automobiles were damaged by hail in the Capital Region during the first week of July.

Maritimes

- Heavy rain on June 30 caused flooding and power outages in the Halifax-Dartmouth area.
- Thunderstorms knocked out 20 transformers in Yarmouth, N.S., on July 12.

Allain Caillet and Aaron Gergye are climate meteorologists with the Canadian Climate Centre where they are members of the editorial staff of *Climatic Perspectives* and work on the development and production of long-range weather forecasts.

Canadian Meteorological and Oceanographic Society

La Société Canadienne de Météorologie et d'Océanographie

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EDITORIAL / NOTES DU RÉDACTEUR

LETTERS / LETTRES

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GUIDELINES FOR CONTRIBUTORS OF ARTICLES TO *CHINOOK*

1. Content, Language and Readership
Articles on topics of general interest in meteorology and oceanography, written in either English or French and suitable for a high school readership, are invited.

2. Length and Format
The suggested article length is in the range of 1500 to 3000 words with two to four figures (and captions). Clear illustrations and photographs are particularly encouraged. Contributors are also asked to provide a 100-200 word summary, preferably but not necessarily in the other language. Summaries will be translated (if necessary) and published in the other language only.

3. References
Literature citations within the text are discouraged. Instead, it is suggested that credit for results and ideas be given by naming the authors or their institutions in the text, and including references at the end of the text in the form of a short "Suggested Reading" list. A reference to a journal article should include the authors' names and initials, year of publication, full title of article, and journal name, volume number and page numbers. A reference to a book should include the authors' names and initials, year of publication, title of book, and the publisher's name and address. All references should be listed in the alphabetical order of the first authors' surnames.

4. Procedure for Submission
Two double-spaced typewritten copies of the manuscript should be sent to: *Chinook* Editor, c/o Canadian Meteorological and Oceanographic Society, 151 Slater Street, Suite 903, Ottawa, Ontario, Canada K1P 5H3. Finished line drawings and good quality black-and-white photographs (one original and two photocopies of each) should be included. Colour illustrations or photographs are welcome as candidates for the front cover of each issue. Contributors are also asked to provide a short description (about 50 words) of their professional affiliation (if any) and their meteorological and oceanographic interests, and to indicate whether their contribution has been or will be published elsewhere.

5. Editorial Policy
The suitability of articles for publication will be decided by the Editor upon consultation with at least one other member of the Editorial Board. Particular attention will be given to the readability of articles by a lay readership.

6. Reprints
Reprints of articles will not be made available. Four copies of the issue in which an article appears will be provided to the principal author. Additional copies will be supplied at the author's cost, provided the request is received before printing.

PRÉSENTATION D'ARTICLES POUR LE *CHINOOK* À L'INTENTION DES AUTEURS

1. Contenu de l'article, langue et lecteurs

On vous invite à présenter des articles d'ordre général, rédigés soit en anglais, soit en français, dans le domaine de la météorologie et de l'océanographie, et qui conviennent à des lecteurs du niveau scolaire secondaire. Les opinions exprimées dans le texte reflètent celles de l'auteur.

2. Longueur et format

La longueur suggérée d'un article est de 1500 à 3000 mots, avec deux à quatre figures (et légendes). La présentation de photographies et d'illustrations nettes est particulièrement encouragée. Les auteurs sont priés de fournir un résumé de 100 à 200 mots, de préférence dans l'autre langue officielle. Au besoin, les résumés seront traduits et publiés dans l'autre langue.

3. Références

Les citations littéraires dans le texte même sont à éviter. On suggère plutôt d'y indiquer le nom des auteurs ou de l'organisme à qui le mérite est attribué et d'ajouter, à la fin de l'article, les références sous forme d'une liste brève de « lectures recommandées ». Toute référence à un article de revue doit comporter le nom et les initiales du ou des auteurs, l'année de publication, le titre de l'article en entier, le nom de la revue, le numéro du volume et le numéro des pages concernées. La mention d'un livre doit arborer le nom et les initiales du ou des auteurs, l'année de publication, le titre du livre, et le nom et l'adresse de la maison d'édition. Toutes les références doivent être présentées dans l'ordre alphabétique selon le nom de famille de l'auteur principal.

4. Mode de présentation des articles

Le manuscrit doit être dactylographié à double interligne et soumis en deux exemplaires au Rédacteur du *Chinook*, a/s de la Société canadienne de météorologie et d'océanographie, 151, rue Slater, suite 903, Ottawa (Ontario), Canada, K1P 5H3. Les épreuves finales des figures tracées et les photographies en noir et blanc de bonne qualité (l'original et deux photocopies de chacune) doivent accompagner le manuscrit. Nous faisons bon accueil aux illustrations ou photographies en couleurs qui pourraient paraitre en page couverture du numéro. Les auteurs sont priés de fournir une brève description (50 mots environ) de leur affiliation professionnelle (le cas échéant) et de leur intérêt en météorologie et en océanographie; ils devraient de plus indiquer si leur article a déjà été publié ailleurs ou le sera plus tard.

5. Politique de la rédaction

Le rédacteur en chef décidera de la pertinence des articles à publier en consultation avec au moins un autre membre du conseil de rédaction. On prêtera une attention toute particulière à la lisibilité des articles par des profanes.

6. Tirés à part

On ne pourra pas faire réimprimer les articles. L'auteur principal recevra quatre tirés à part du numéro de parution de l'article. Des exemplaires additionnels seront fournis au frais de l'auteur pourvu que la demande soit faite avant l'impression.

Chinook

THE CANADIAN MAGAZINE OF WEATHER AND OCEANS

WHAT? *Chinook* is a popular magazine concerned with two major components of the Canadian environment – the atmosphere and the oceans. It is published quarterly by the Canadian Meteorological and Oceanographic Society (CMOS).

Features in *Chinook* include articles, weather summaries, interpretations of satellite and other photographs, and news and notes. These appear in the language submitted (English or French). In addition, summaries of all articles appear in the other language.

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- to inform Canadians about the education, information and interpretative services available to them on climate, weather and oceans

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On retrouve dans *Chinook* des articles, des sommaires du temps, des interprétations de photos satellitaires et autres, des articles d'actualité et des notes. Ces articles paraissent dans la langue originale, le francais ou l'anglais; tous les résumés sont rédigés dans l'autre langue.

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- éveiller la curiosité du public en ce qui a trait aux aspects de la météorologie et de l'océanographie au Canada et à l'informer des réalisations scientifiques et technologiques d'aujourd'hui;
- stimuler l'intérêt du public et l'aider à mieux comprendre les effets du climat, du temps et des océans sur la société et sur l'économie du Canada;
- renseigner les canadiens sur les services d'éducation, d'information et d'interprétation qui leurs sont disponibles et qui traitent du climat, du temps et des océans.

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- les exploitants d'établissements de nautisme, de sports et de tourisme, et les amateurs des ces activités
- les aviateurs
- les observateurs amateurs de phénomènes naturels
- les spécialistes d'autres sciences
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COMMENT? On peut s'abonner à *Chinook* en envoyant le formulaire ci-contre.

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