Learning Weather
A resource study kit, contains:

1. Mapping Weather
   A series of maps with exercises. Teaches how weather moves. Includes climatic data for 50 Canadian locations.

2. Knowing Weather
   Booklet discusses weather events, weather facts and folklore, measurement of weather and several student projects to study weather.

3. Knowing Clouds
   A cloud chart to help students identify various cloud formations.

Cat. No. EN56-53/1983-E Each kit $4.95

Order kits from:
CANADIAN GOVERNMENT PUBLISHING CENTRE
OTTAWA, CANADA, K1A 0S9

Découvrons la météo
Pochette documentaire comprenant:

1. Cartographie de la météorologie
   Série de cartes accompagnées d'exercices. Décrit les fluctuations du temps et fournit des données climatologiques pour 50 localités canadiennes.

2. Apprenons à connaître la météorologie
   Brochure traitant d'événements, de faits et de légendes météorologiques. Techniques de l'observation et de la prédiction de la météo. Projets scolaires sur la météorologie.

3. Apprenons à connaître les nuages
   Tableau descriptif des nuages aidant les élèves à identifier différentes formations.

Cat. N° EN56-53/1983F Chaque pochette: 4.95 $
A new year has started and with that a new volume of *Chinook*, which is also the tenth volume of our publication. Thanks to Mike Newark who had the foresight and energy to recognize the need in Canada for a popular magazine dealing with the weather and oceans.

Looking back over the first six years, we must note the tremendous amount of effort that Mike gave to his favourite project. We thank him for keeping the dream alive — thanks to Mike.

Winter / Hiver 1988 Vol. 10 No.1

Newark who had the foresight and energy to recognize the need in Canada for a popular magazine dealing with the weather and oceans.

A new year has started and with that a new volume of *Chinook*, which is also the tenth volume of our publication. Thanks to Mike Newark who had the foresight and energy to recognize the need in Canada for a popular magazine dealing with the weather and oceans.

Looking back over the first six years, we must note the tremendous amount of effort that Mike gave to his favourite project. We thank him for keeping the dream alive — thanks to Mike. We must note the tremendous amount of effort that Mike gave to his favourite project. We thank him for keeping the dream alive — thanks to Mike.

I know that I speak on behalf of the Society, the Board members, and more specifically on behalf of the editorial team, in expressing satisfaction with our progress to date. It has not been easy, but it has been most satisfying.

In this issue we are offering some insights into two of the most destructive forces in nature: forest fires and tornadoes. Forest fires consume millions of dollars of valuable timber in the vast forest regions extending from the Pacific to the Atlantic coast. Tornadoes often strike with little warning. We offer you a view from the forecaster’s desk of the horrible destruction that they bring.

The University of British Columbia

Vancouver, British Columbia

Richard Leduc

Ministère de l’environnement

Québec, Québec

Hans VanLeeuwen

Atmospheric Environment Service

Downsview, Ontario

Hans VanLeeuwen (Chairman)

Atmospheric Environment Service

Downsview, Ontario

The Dutch Armada of 1688

I have read with interest and pleasure the paper "Flavit et Dissipati Sunt..." by H.H. Lamb and C. Loader, published in the Spring 1987 issue of your journal.

In 1688 will be the 400th Anniversary of the attempted attack on England by the Spanish Armada. But there will be another important Anniversary in the same year: The 300th Anniversary of the "descent" on England by the Prince of Orange — the future William III.

I attach herewith a copy of a paper joint with S. Lindgren on the meteorological aspects of the "descent" and the historical situation in England that brought the Prince of Orange over to England.

J. Neumann

Department of Meteorology

Copenhagen University

October 1988

Hans VanLeeuwen

Atmospheric Environment Service

Downsview, Ontario

Hans VanLeeuwen (Chairman)

Atmospheric Environment Service

Downsview, Ontario

The Dutch Armada of 1688

I have read with interest and pleasure the paper "Flavit et Dissipati Sunt..." by H.H. Lamb and C. Loader, published in the Spring 1987 issue of your journal.

In 1688 will be the 400th Anniversary of the attempted attack on England by the Spanish Armada. But there will be another important Anniversary in the same year: The 300th Anniversary of the "descent" on England by the Prince of Orange — the future William III.

I attach herewith a copy of a paper joint with S. Lindgren on the meteorological aspects of the "descent" and the historical situation in England that brought the Prince of Orange over to England.

J. Neumann

Department of Meteorology

Copenhagen University


**From the Editor’s Desk**

**Letters**

Barry Grace

Agriculture Canada Research Branch

Lethbridge, Alberta

Yves Gratton

Université du Québec à Rimouski

Rimouski, Québec

Paul H. LeBlond

The University of British Columbia

Vancouver, British Columbia

Richard Leduc

Ministère de l’environnement

Québec, Québec

**Forest Fire Meteorology**

By Roger B. Street

**Forecaster Tells Edmonton Tornado Story**

By Garry Aitchison

**The Path of Destruction**

By Al Wallace

**TOM TAYLOR, TORNADO HERO**

**Understanding CO₂ and Climate**

**Summer of '87 in Review**

**By Amir Shabar**

**EDITORIAL BOARD / CONSEIL DE RÉDACTION**

Barry Grace

Agriculture Canada Research Branch

Lethbridge, Alberta

Yves Gratton

Université du Québec à Rimouski

Rimouski, Québec

Paul H. LeBlond

The University of British Columbia

Vancouver, British Columbia

Richard Leduc

Ministère de l’environnement

Québec, Québec

Hans VanLeeuwen

Atmospheric Environment Service

Downsview, Ontario

Hans VanLeeuwen (Chairman)

Atmospheric Environment Service

Downsview, Ontario

**EDITOR** Hans VanLeeuwen

**TECHNICAL EDITOR** Edward J. Timlin

**REDACTION TECHNIQUE**

**BUSINESS MANAGER** J. Carr-McNeil

**GÉRANT** Hans VanLeeuwen

**ILLUSTRATION** Bill Kelly / Joan Badger

**TRADUCTION** Joanne Gagnon / Paivi Taito

**FONDATEUR EDALEUR 1978-1984** Michael J. Newark

**ISSN 0705-4572**

**PUBLISHED BY:**

Canadian Meteorological and Oceanographic Society

Printed and produced in Canada and published quarterly by the Canadian Meteorological and Oceanographic Society, Suite 503, 151 Slater Street, Ottawa, Ont, K1P 5H3. Annual subscription rates are $10.00 for CMOS members, $12.00 for non-members and $15.00 for institutions. Contents copyright © by the authors 1988. Copying costs for other than personal or internal reference use without the expressed permission of the CMOS is prohibited. All correspondence including requests for special permission or bulk orders should be addressed to Chinook at the above address.

**SECOND CLASS MAIL REGISTRATION No. 4596**

Winter 1988 Date of Issue — March 1988

**COVERS**

Details about the front and back covers illustrating two of the atmosphere’s most devastating phenomena and their impacts are given in the articles on forest fire meteorology and the Edmonton tornado.

**COUVERTURES**

Les pages couvertures illustrent deux des phénomènes atmosphériques les plus dévastateurs; des détails sur ces phénomènes sont présentés dans l’article sur la météorologie et les incendies de forêt, et celui sur la tornade d’Edmonton.
FOREST FIRE METEOROLOGY

by Roger B. Street

Fire is a natural recurring phenomenon within Canada's forested areas. Our boreal forest regions in particular are dominated by tracts of even-age stands that attest to the relationships between our forests and fire. An analysis of the losses associated with forest fires during the period 1970–1985 (see Table 1) yields the relative frequencies of fires in Canada.

The inception, growth and behaviour of forest fires are closely linked to meteorological and climatic phenomena, forest fuels and topographic features. This complex has been labelled "the fire environment". A close relationship exists between the various factors of the fire environment, whose spatial and temporal variations occur in a dynamic and integrated fashion. However, the atmosphere plays the dominant role. This is reflected by its incorporation into all phases of forest fire management: suppression, prescribed burning, and natural fires. Information on the past, present and future states of the atmosphere is (or should be) an integral part of all fire management activities. This is due to the natural links that exist between weather and forest fires, including the exchange of water between the atmosphere and the forest fuels, ignition, and the combustion and the propagation processes.

In fire management there is a distinct advantage to be gained from being able to anticipate, well in advance, the forest fire hazard and the probable behaviour of burning fires. This capability is met, in part by meteorological information systems, by fire weather forecasts, and by the operation of the Canadian Forest Fire Danger Rating system (Charles Van Wagner, 1974). Recognition of the warning signs of a potentially dangerous situation, or of conditions that would not allow a particular fire management strategy to meet its objective, is necessary so that fire management plans can be successful.

The weather conditions that are conducive to rapid fire spread are strong winds, low relative humidities, high temperatures, and deficient rainfall. These critical fire weather conditions are normally associated with particular surface weather systems and upper-air patterns. If periods of critical fire weather can be recognized and monitored by means of their relationships with synoptic weather patterns, preparations can be made to counter a possible disaster and to reduce the amount of damage.

Certain characteristics of the upper-air flow are closely related to periods of critical fire weather. Those upper-air features that divert (or block) the flow of moisture or cooler air or both away from a particular area may pose a threat to that area's fire weather.

A comparison between monthly fire statistics for 1959–1980 as compiled by James Harrington in 1982 and corresponding weather features shows a relationship between the areas burned and specific weather patterns. This analysis revealed that during the months when the area burned in northwestern Ontario was significantly greater than the average a prominent weather feature was situated over the Prairie Provinces and/or over northwestern Ontario, which prevented the influx of atmospheric moisture into northwestern Ontario. In addition, this type of weather pattern sustained a flow of warm, dry air at the surface into northwestern Ontario from the south-central United States, which in turn heightened the probability of a severe forest fire.

Particular weather features are synonymous with severe fire weather. George Byram in a 1954 study of atmospheric conditions that accompanied a number of extreme fire events determined that fires seem most likely to blow up when the following conditions exist simultaneously:

- Fuels are dry and plentiful.
- The atmosphere either is unstable or was unstable for some hours and possibly days prior to the fire.
- The wind speed is 29 km/h or more at an elevation equal to or not much higher than the elevation of the fire.
- The wind speed decreases with height for several thousand metres above the fire with the possible exception of the first hundred metres.

Byram's analysis revealed numerous cases of explosive fire behaviour that were associated with wind speeds decreasing with height and on this basis he suggested a rather simple classification of wind profiles that were related to fire behaviour. The most dangerous types had winds in excess of 29 km/h at or just above the fire, and a marked decrease of wind with height above this layer. In a detailed analysis in 1964 of weather features associated with criti-

Table 1 Forest fire statistics for Canada (Gordon S. Ramsey and Douglas G. Higgins, 1986).

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Fires</th>
<th>Area Burned (hectares)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>9,357</td>
<td>757,260</td>
</tr>
<tr>
<td>1984</td>
<td>9,566</td>
<td>765,882</td>
</tr>
<tr>
<td>1983</td>
<td>8,930</td>
<td>1,194,175</td>
</tr>
<tr>
<td>1982</td>
<td>8,841</td>
<td>1,697,591</td>
</tr>
<tr>
<td>1981</td>
<td>10,145</td>
<td>5,413,365</td>
</tr>
<tr>
<td>1980</td>
<td>8,973</td>
<td>4,822,176</td>
</tr>
<tr>
<td>1979</td>
<td>9,793</td>
<td>2,700,785</td>
</tr>
<tr>
<td>1978</td>
<td>7,928</td>
<td>2,894,417</td>
</tr>
<tr>
<td>1977</td>
<td>8,888</td>
<td>1,483,194</td>
</tr>
<tr>
<td>1976</td>
<td>10,161</td>
<td>1,813,852</td>
</tr>
<tr>
<td>1975</td>
<td>10,995</td>
<td>1,628,034</td>
</tr>
<tr>
<td>1974</td>
<td>8,035</td>
<td>745,874</td>
</tr>
<tr>
<td>1973</td>
<td>7,503</td>
<td>1,184,283</td>
</tr>
<tr>
<td>1972</td>
<td>8,153</td>
<td>789,037</td>
</tr>
<tr>
<td>1971</td>
<td>9,125</td>
<td>1,695,013</td>
</tr>
<tr>
<td>1970</td>
<td>9,253</td>
<td>1,058,843</td>
</tr>
</tbody>
</table>
cal fire weather in the United States George Schroeder and others of the U.S. Forest Service found that the highest fire potential occurred in the peripheries of high-pressure areas in the vicinity of dry, cold fronts.

By examining a number of fire histories, Edward Brotak and William Reifsnyder in a 1976 study showed that the weather patterns associated with major fires were similar to those that usually produce precipitation and poor fire conditions. The reason for the lack of precipitation just before and during an extreme fire weather situation appeared to be a deficiency of moisture in the air over the affected area. They examined moisture advection (i.e., the horizontal moisture transport into an area) at low levels of the atmosphere (85 kPa) and found that in the vast majority (93%) of the fires, lack of low-level moisture advection was the major factor contributing to the development of large fires.

Moisture advection depends primarily on wind flow patterns and moisture sources. For areas in eastern and central North America the major sources of moisture are the Gulf of Mexico and the Atlantic Ocean. The lack of moisture advection at low levels for most of the fire runs studied by Brotak and Reifsnyder was due to a zonal flow pattern over the area of the fire. Flows with a more southerly or easterly trajectory (i.e., from the moisture sources) were found to be unfavourable for fire runs. In the western part of the continent, a zonal flow would be unfavourable for fire runs since the air would flow from a moisture source (Pacific Ocean and/or Gulf of Alaska). However, a flow pattern that was strongly meridional would normally result in poor moisture advection, i.e., favourable for fire runs, over western Canada.

The surface weather features normally associated with a critical fire weather situation are the dry, cold front and the high-pressure area, in particular its peripheries. These features are favourable for major fire runs (rapidly spreading fires) because they are the areas where high wind speed and turbulence, low relative humidities and lack of rainfall can be found. Edward Brotak and William Reifsnyder in their 1976 survey of 52 major wildland fires found that "...more than half of all fire runs occurred following the passage of a dry, cold front... with most runs occurring in the southeastern section of the frontal region" (Figure 1). They concluded that this is the primary area in which the proper combination of wind speed, moisture, temperature and fuel conditions are found. According to these investigators, "One quarter of the runs occurred prior to the passage of a cold front. Often, fires would make a run both ahead of and behind the front. Thus, three quarters of the fire runs were frontal situations". About 12% of the fire runs examined by Brotak and Reifsnyder occurred in the warm sectors of low-pressure areas, while 5% were associated with high-pressure areas situated far from any fronts or low-pressure areas. Usually, these high-pressure areas originated in low latitudes and had very high temperatures and extremely low relative humidities. Four fire runs (5%) occurred...
with other than a dry, cold front or high-pressure area as their dominant surface weather feature.

As outlined by George Byram, an unstable or recently unstable atmosphere is one of the conditions normally associated with severe fire weather. This relationship is mainly due to the turbulent winds usually associated with atmospheric instability, which can cause fires to build up very rapidly and to behave erratically. However, the existence of a stable layer near the ground can also produce hazardous fire weather. Two phenomena that can result in some of the most dramatic effects of stability on fire behaviour are the nocturnal and subsidence inversions. Fires burning within stable air are usually slow moving and easily controlled, however, they are potentially dangerous. When the inversion (stable layer) is shallow, it may dissipate quickly by convection from below induced by the sun’s radiation or the fire itself. Once the inversion is broken down, the turbulent energy that was isolated above the inversion is released and is suddenly made available to the fire. Explosive increases in the aggressiveness and rate of spread of fires are at times ascribed to this mechanism.

Associated with surface high-pressure systems and their divergent flow is a sinking of the overlying atmosphere. This sinking from aloft is the common form of subsidence. Because of its origin, subsiding air in the upper troposphere is usually very dry (relative humidities typically 2–5%) and warm. If this air reaches the surface the effect on fuel moisture and fire behaviour is dramatic, resulting in a potentially critical fire weather situation.

Subsiding air seldom reaches the surface as a broad layer, but more often sinks to the lower troposphere and stops. Some transport mechanism is then required to bring this dry, subsiding air down to the surface. One effective means is the convection current associated with daytime heating. The upward moving air and the compensating downward currents transport the dry air downward, causing it to mix with the air in the layer below the subsidence inversion. Although the resulting air is not as dry as the pure subsiding air, it still has a very low relative humidity and remains quite warm.

The relation between fire behaviour and the weather that precedes and occurs during a fire can be illustrated by examining in detail a fire that occurred in the Fort Francis, Ontario, area during 1981. A major weather system situated over the Prairie Provinces dominated the northwestern Ontario weather in the weeks preceding the ignition date. This system directed warm, dry air into the area and was instrumental in the earlier than normal spring snowmelt throughout northwestern Ontario. Both Kenora and Fort Frances reported no snow on the ground at the end of March. Precipitation was well below normal at Kenora during the months of April and May (32% and 13% of normal, respectively), while mean daily temperatures and hours of bright sunshine were well above their seasonal normals. This combination of meteorological factors and the resulting fuel mixture created a fire climate in the Fort Frances area in late May that would support extremely fast fire growth and spread.

The fire was detected on May 20, 1981, burning in logging slash about 45 km north-northeast of Fort Frances. On May 20 and 21, 1981 (Figure 2) a surface low-pressure system over southwestern Canada strengthened and moved slowly eastward across the Northern Plains of the United States. At the same time, a surface high-pressure system encompassing the Great Lakes remained almost stationary. This relative positioning of weather systems was responsible for the fire escaping the initial firefighting efforts and growing to about 900 hectares, mainly in cutover, by the evening of May 20. The motion of the western low-pressure centre relative to the Great Lakes high-pressure cell produced a tightening of the surface pressure gradient and a strengthening of the winds over the area between the two systems. In addition, the east-west air temperature gradient in the lower layers over the central United States, set up by surface heating of the air over the region, produced very dry conditions and increased the fire's aggressiveness.
Figure 2 Surface weather map valid for May 21, 1981 at 1700 CST. The location of Fort Frances in Ontario is indicated on the map by a stylized flame.

Figure 3 Photograph of a forest fire burning in northwestern Ontario (Photo: L.G. Huberdeau).

FURTHER READING
Rowe, J.S., 1972: Forest Regions of Canada. CFS Publication No. 1300, Department of the Environment, Ottawa, Ont.

Roger Street is the Superintendent of the Bioclimatic Section of the Canadian Climate Centre and is responsible for applications and climate studies related to forest and agricultural meteorology.

RÉSUMÉ. La fréquence des incendies de forêt au Canada demande des chefs de forêt une compréhension des facteurs qui affectent l'apparition et le comportement de ceux-ci. Les conditions météorologiques jouent un rôle dominant parmi les facteurs (météo, topographie et combustible) qui contrôlent les incendies. Cette étude démontre comment la météo influence les incendies de forêt. Les conditions critiques responsables (vent fort, basse humidité relative, température élevée et manque de pluie) d'une propagation rapide des incendies sont normalement associées à des systèmes météo de surface et des configurations d'altitude caractéristiques. Par exemple, un front froid sec et une zone de haute pression sont favorables au développement d'incendies majeurs; par contre, les configurations de vent transporteur d'humidité provenant des sources océaniques ne le sont pas. L'instabilité atmosphérique est habituellement associée aux propagations les plus importantes. On examine l'historique d'un incendie en fonction des conditions météo associées afin d'illustrer la force du rapport incendie de forêt-conditions météorologiques.
The tragic Edmonton tornado of July 31, 1987 was the worst experienced in the city during 97 years of observations. The death toll was 27 and damage was estimated at $250 million.

The last ten days of July 1987 were exceedingly hot and humid in Alberta. Record highs from 31 to 37°C were set at several sites. The dew-point temperatures — a basic measure of humidity, which averages 10°C in an Alberta summer — were reaching the 17 to 21 range during the last week of July. The Alberta Weather Centre had issued severe thunderstorm watches and warnings almost every day for some regions of the province. Subsequent damage reports confirmed the daily development of these storms with damaging winds, large hail, torrential downpours and record levels of lightning.

On Thursday, July 30, two bands of severe thunderstorms developed late in the day and crossed the Edmonton region; the first affected the city and the later one passed to the north during the night. The daily count from the lightning detection system exceeded 40,000 cloud-to-ground strikes, a new record. Arrangements were being made to personally check a report of tornado damage from a weather watcher about 100 km out of Edmonton if Friday's workload would permit.

By Friday morning all watches and warnings had been terminated and skies were practically clear (see weather map, Figure 1). At least one radio announcer scoffed at the 5 a.m. forecast of 80% probability of "thunderstorms at times heavy." After the 7 a.m. shift change, the day shift, which includes the severe weather forecaster, considered the possibility that the worst threat was over since the surface temperatures and dew points were both lower, and the cloud pattern over Saskatchewan suggested that the more dangerous tropical air mass had moved eastward; i.e., that Thursday's action had been related to a weak cold front. However, the usual detailed analysis of the current state of atmospheric stability showed that a good potential for severe thunderstorms remained.

The computer models looked reasonable in pushing a cooling upper trough into southern Alberta late in the day. This development would mean that the high-level jet stream that started the day over eastern British Columbia...
would shift into a south-north core over central Alberta by evening.

At the 10:15 a.m. forecast team consultation, the forecast of thunderstorms was confirmed for most regions, with a large area of severe thunderstorm potential from the southeastern Peace River district to Medicine Hat, including Edmonton, Red Deer and Calgary.

By 11:15 a.m. beeps from the lightning detection unit confirmed that thundershowers had formed over the southern Rockies. A Severe Weather Watch was issued for the Calgary and Red Deer regions.

After the lightning developed northward, and weather radar and satellite imagery confirmed cumulonimbus development oriented NNW–SSE over the foothills north of Sundre, confidence rose that the severe thunderstorms forecast earlier were likely to materialize (weather map, Figure 2).

Though low-level wind flows showed an increasing southerly flow, the radar showed motion of the cells from a southwesterly direction at the surprisingly high speed of 60 to 70 km/h. That would bring them near Edmonton.

By 1:40 p.m. when the radar echoes showed tops approaching 10 km and a sustained echo strength at the second highest value, the weather watch was extended to Edmonton and adjoining regions.

By 2:45 p.m. an acceleration to 80 km/h and tops rising to 12 km were considered sufficient cause to refine the watch to a Severe Thunderstorm Warning for Edmonton City and the counties to the south and west.

Within minutes a citizen near Leduc reported seeing an apparent rope-like tornado touch down for 10 seconds and disappear (Figures 3 and 4, and back

Tornado damage path, F-scale intensities and times of occurrence at several locations.
cover, upper left). Considering the forecast severe instability and proximity to a major population area, this prompted an immediate Weatheradio Alert for the tornado warning that was composed for hard-copy transmission at 3:07 p.m. That no sooner was done than off-duty brief, Pat Kyle, reported a tornado on the extreme southeast edge of the city. While this was relayed by Weatheradio the first tornado warning update was issued about 3:30 p.m. (Figure 5).

By this time severe-weather assistant Pat McCarthy and others were rushing back and forth to the roof of our office building, relaying visual reports of the tornado's size and direction. Like most other citizens we were mesmerized by this phenomenon and only reluctantly took cover in the basement after all power failed and the tornado passed about 2 km east of our location (Figure 6 and back cover, centre right and lower left; also satellite images on Figures 7 and 8). Before doing so, we had been able to reach the Prairie Weather Centre in Winnipeg by phone to hand over forecast responsibility to them.

We were back again within a half hour and, with emergency power, resumed forecast responsibility and issued further updates, maintaining tornado warning status until 7:00 p.m. while an equally severe thunderstorm complex approached and passed over the central and northern parts of the city. Wind gusts over 110 km/h, rain and more large hail added to the damage in and near the city.

By 8 p.m. all danger was over and warnings and watches were running down. The cold front had indeed swept through, with a vengeance! By morning a cold intermittent rain settled in on the survivors and disaster response teams working their way through the wreckage.

**STORM EFFECTS**

Destruction in the narrow swath swept by the tornado over the eastern edge of Edmonton was literally incredible for a city that had never experienced significant tornado damage before. During its one-hour life span it skipped along a path 37 km long varying in width from 100 to 1000 m (Map; Table 1). Heavy trucks and empty rail cars were reported completely airborne. Mobile homes, houses, and industrial sheds and plants were totally destroyed. Hailstones the size of misshapen softballs penetrated some roofs like cannonballs.

After the survey, this storm was assigned level 4 on the 5-point Fujita scale (Table 2), a value rarely exceeded in Tornado Alley of the US Midwest. In

![Figure 5](image.png) Large-size funnel as observed from Millwoods (photo: Steve Watson).

![Figure 6](image.png) Destructive funnel plowing through the Industrial Area as observed from the roof of the Twin Atria Building, containing the Alberta Weather Centre (photo: Rob den Hartigh).

<table>
<thead>
<tr>
<th>Time (MDT)</th>
<th>Movement/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1455</td>
<td>First known touchdown in the vicinity of Leduc.</td>
</tr>
<tr>
<td>1501</td>
<td>Beginning of the 37-km track, 3–4 km southeast of Beaumont.</td>
</tr>
<tr>
<td>1507</td>
<td>1–2 km northeast of Beaumont.</td>
</tr>
<tr>
<td>1515</td>
<td>Crossing Ellerslie Road between 34 and 17 streets.</td>
</tr>
<tr>
<td>1520</td>
<td>Moving through southeastern Millwoods.</td>
</tr>
<tr>
<td>1530</td>
<td>Northeast of Millwoods.</td>
</tr>
<tr>
<td>1535</td>
<td>Moving through Sherwood Park Industrial Area.</td>
</tr>
<tr>
<td>1540</td>
<td>Moving into the river valley near the Strathcona Science Park.</td>
</tr>
<tr>
<td>1550</td>
<td>Moving through eastern Clareview.</td>
</tr>
<tr>
<td>1553</td>
<td>Hitting farms just southwest of Trailer Park.</td>
</tr>
<tr>
<td>1555</td>
<td>Moving into Evergreen Trailer Park.</td>
</tr>
<tr>
<td>1600</td>
<td>Dissipates northeast of Trailer Park.</td>
</tr>
</tbody>
</table>

Table 1 Tornado chronology, based on eyewitness accounts. Times are the best estimates available (Compiled by Al Wallace).

10 Chinook Winter/Hiver 1988
Figure 7  The near-infrared image taken by the US NOAA-9 satellite at 2149 GMT (1549 MDT or 3:49 p.m.) on July 31, 1987. The image very clearly shows the severe thunderstorm complex over central Alberta extending south into southeastern Alberta and into Montanas and Wyoming. The shadows cast by the towering storms can be readily noticed on the eastern edges of the storms (Courtesy: AES Computing and Telecommunications Services Branch).

Figure 8  The 11-μm image taken by the US NOAA-9 satellite at 2149 GMT (1549 MDT) on July 31, 1987. The image shows the severe, tornado-producing thunderstorms at the same time as the near-infrared image of Figure 7. The amount of 11-μm radiation sensed by the satellite is proportional to the temperature of the emitting surface; the coldest surfaces are mapped as white while the warmest are mapped as black. The image very clearly shows the warm (low to mid-thirties degrees Celsius) Alberta landscape (black) and the very cold (-50 to -60°C) tops of the severe thunderstorms. Both satellite images show excellent examples of the various stages of thunderstorm development: a new development over North Dakota, and well developed complexes over Alberta and eastern Montana (Courtesy: AES Computing and Telecommunications Services Branch).
The two articles dealing with the July 31 tornado disaster in Edmonton (pages 8-14) are supported by some striking pictures. Some of these are reproduced in colour on the back cover.

**Upper Left** The initial touchdown near Beaumont (photo: Tom Taylor; see write-up on page 14).

**Upper Right** Destruction in the Industrial Area at Nault Lumber (photo: Myron Oleskiw).

**Centre Left** The remains of the Evergreen Trailer Park (photo: Pat McCarthy).

**Centre Right** The funnel cloud moving through the Industrial Area and viewed from the roof of the Twin Atria Building, containing the AES Alberta Weather Centre (photo: Rob den Hartigh).

**Lower Left** The full force of the tornado is felt in the Industrial Area (photo: Rob den Hartigh).

**Lower Right** What remains of a house in the Ellerslie Road area, south of Millwoods (photo: Myron Oleskiw).

---

**Table 2** The Fujita Tornado Intensity Scale.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Surface Wind Speed (km/h)</th>
<th>Expected Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F0</td>
<td>64-116</td>
<td>Light</td>
</tr>
<tr>
<td>F1</td>
<td>117-180</td>
<td>Moderate</td>
</tr>
<tr>
<td>F2</td>
<td>181-252</td>
<td>Considerable</td>
</tr>
<tr>
<td>F3</td>
<td>253-330</td>
<td>Severe</td>
</tr>
<tr>
<td>F4</td>
<td>331-417</td>
<td>Devastating</td>
</tr>
<tr>
<td>F5</td>
<td>418-509</td>
<td>Incredible</td>
</tr>
</tbody>
</table>

---

Figure 9 Tornado-ravaged houses in Millwoods (photo: Myron Oleskiw).

Figure 10 View of destruction in the Clareview area (photo: Lub Wotijw).

the past 97 years there have been only seven other documented tornado incidents in Edmonton and these had caused negligible damage.

Twenty-seven deaths were recorded with permanent injury to at least one survivor. Damage was estimated at 250 million dollars including outright destruction and property damage, men and material costs for rescue and repair, and social assistance costs for individuals and business victims. The other severe thunderstorms that day contributed more hail, wind, and rain-related losses to the total bill.

Basically the regular forecasts and watch-warning program worked well. The few radio stations with Weatheradio reacted fastest, but mid-afternoon of the Friday preceding a long weekend is a poor time to reach listeners.

The heaviest workload came after the

*Continued on page 14*
THE PATH OF DESTRUCTION
by Al Wallace

Information on the physical aspects of the tornado is based on a synthesis of eyewitness reports, ground surveys and an aerial survey by Brian Smith of the University of Chicago. Adjustments may be made to the conclusions regarding timing and damage path after more information has been received.

TORNADO PATH
A tornado was sighted near Leduc at 2:55 p.m. on July 31 by a member of the public when a funnel cloud was seen to touch down and then retract (Figures 3 and 4; back cover, upper left). According to eyewitness accounts, the tornado re-formed southeast of Beaumont at 3:01 p.m. It then followed a generally northward track moving to the east of Beaumont, across the eastern fringes of Millwoods, northward to the Sherwood Park Industrial Estates (Figure 6; back cover, centre right and lower left), then to the North Saskatchewan River Valley. It followed the river northward, exiting the valley where it curves eastwards. The tornado crossed the northeastern fringes of Clareview. While crossing 153 Avenue it moved northeast to the Evergreen Trailer Park, then continued northeastward for a few hundred metres and dissipated. The tornado was on the ground for over an hour, from its touchdown at 3:01 p.m., to its dissipate northeast of the trailer park just after 4:00 p.m. (Table 1). Based on the damage surveys, there was only one tornadic event with a path length of about 37 km and an average speed near 35 km/h. The damage path varied in width from less than 100 m to over 1000 m. In the most severely damaged areas, the width of the severe destruction varied from 200 m (Evergreen Trailer Park) to about 700 m (industrial sections).

TORNADO INTENSITY
Surveys of the damage led to this tornado being classified as an F4 on the Fujita Tornado Intensity Scale (Table 2). Along the path of the tornado (Map) varying scales of damage were visible, ranging from F0 to F4 (occasionally). Occurrences of missile damage were evident in many areas.

Beaumont Area – Ellerslie Road: 1455–1515 MDT
Little damage was visible at the funnel’s first contact with the ground. After the tornado had set down again about 3 km southeast of Beaumont, only minor damage was visible. While it moved northward and strengthened, F1–F2 damage was inflicted 2 km south-southeast of Beaumont although the path width was narrow (less than 100 m). About 1.5 km southeast of Beaumont the damage was more severe (F2–F3) with the destruction of several farm buildings. The tornado appeared to have weakened as it continued northeastward then gained strength as it hit the Hilltop Dairy Farm (about 2.5 km northeast of Beaumont) at about F2–F3. Extensive roof damage to 3 new homes east of 34 Street, 1.3 km south of Ellerslie Road, indicates F2 strength. On traversing Ellerslie Road it appeared to maintain F2 strength.

Millwoods: 1515–1525 MDT (Figure 8; back cover, lower right)
When the tornado moved into southeast Millwoods, its damage path was 750–1000 m wide, with the most significant damage about 500 m wide. While the tornado moved north, transmission towers were toppled and trees were damaged (F2). The damage path crossed west of 34 Street at 19 Avenue. Houses along the east side of 34 Street were damaged consistent with an F2 tornado. The main damage track then veered east of 34 Street to the north of 23 Avenue and continued northward. The tornado appeared to weaken to F1 as it passed northeastern Millwoods.

Industrial Area: 1525–1540 MDT (North of Whitemud Freeway to the River Valley, between 34 and 17 streets) (back cover, upper right)
After the tornado crossed the Whitemud Freeway, it gained strength to the F4 level. Damage was extensive and devastating within an area 600–700 m wide, from west of the CPR tracks to about 24 Street. Moderate damage extended about 1000 m wide. Within the more severely damaged zone of 600–700 m, buildings were totally destroyed, cars and trucks were picked up and moved considerable distances or suffered severe damage, steel girders were twisted, and train cars were derailed. On crossing the CNR tracks east of the Imperial Oil Refinery it weakened to F2 when it moved into the river valley near the Strathcona Science Park. (Note the satellite images in Figures 7 and 8 are for 1549 MDT.)

Clareview: 1540–1555 MDT (Figure 10)
The tornado then moved parallel to the river valley at F1–F2 strength causing moderate tree damage, and followed the river valley east of Clareview. Roof damage was evident east of 24 Street between 120 and 137 avenues, tree damage and some structural damage was evident in Hermitage Park and a drive-in theatre was destroyed near 24 Street/137 Avenue (F1–F2). The greatest devastation occurred along 19 Street between 145 and 147 avenues where 3 houses (2-storey) were completely demolished and many others had considerable damage. At this point the tornado was F3 approaching F4. Just to the east of the destroyed houses, 4 large steel hydro towers were twisted and knocked down. To the west (21 Street) F1 roof damage was evident. The general damage width was again up to 1 km wide, while severe damage was limited to about 300 m. The tornado moved northeast from Clareview around 19 Street/153 Avenue and weakened rapidly. Only minor tree damage (F0) was apparent.

Evergreen Trailer Park: 1555–1605 MDT (back cover, centre left)
About 500 m southwest of the Evergreen Trailer Park the tornado once more strengthened (F2–F3) as it struck 3 farms, destroying a mobile home and causing extensive severe damage to buildings, vehicles and trees. The tornado then devastated the trailer park destroying 103 mobile homes and considerably damaging another 39. Frequent missile damage was observed. The path of total destruction was about 200 m wide during this F3 stage. The tornado left the eastern end of the trailer park about 300 m north of the 1 Street/167 Avenue intersection. The tornado quickly dissipated a few hundred metres beyond the trailer park.

Al Wallace joined the Atmospheric Environment Service as an operational meteorologist in 1974. Since that date he has worked as a forecaster in Ontario and an instructor with the meteorologist training course, and has been engaged in applied forecasting research. He is currently the Summer Severe Weather Supervisor at the Alberta Weather Centre in Edmonton, Alberta.
Forecaster Tells Tornado Story
Continued from page 12

event. Supervisors right on up to the regional director spent the weekend and much of the next ten days answering a flood of media enquiries. With no previous experience some local commentators did not comprehend the virtual impossibility of predicting the initiation of an individual tornado. We were pleasantly surprised, though, by many positive comments that began to get publicized from meteorologists in Canada and the United States. This attention also provided the best demonstration that Weatheradio is by far the best way of disseminating tornado warnings and updates for the major urban centres that it serves. Those commercial radio stations who monitor Weatheradio were clearly in the forefront with the warnings and updates. Sales to the other broadcast media and local emergency response centres should escalate.

FURTHER READING

RESUMÉ
Au cours de l'après-midi du 31 juillet 1987 une tornade dévastatrice frappa la ville d'Edmonton. Cette violente tempête causa la mort de 37 personnes et blesse des centaines d'autres; en plus, elle provoque des dommages matériels s'élevant à plus de 300 millions de dollars.

D'une force F-4 selon l'échelle Fujita, la tornade produisit des vents s'élevant jusqu'à 417 km/h et entraîne une destruction incroyable dans l'extrême est de la ville. Elle dure près d'une heure et se déplace sur une distance d'environ 37 km; sa trajectoire est large de quelques centaines de mètres à 1300 m; elle apparait sous plusieurs formes et produit de nombreux tourbillons. En plus de la tornade, la violente tempête produisit une large bande de grêle qui endommage maisons et véhicules; le plus gros grêlon mesure à un diamètre de 10 cm.

Durant la dernière semaine de juillet, le temps est orageux. La masse d'air chaud et humide sur l'Alberta provoque des orages qui se développent très rapidement en se déplaçant vers Edmonton, on émet un avertissement de temps violent pour alerter le public du danger imminent. On reçoit le premier rapport d'une tornade, près de Leduc, vers 15 h 00, ce qui entraîne la diffusion immédiate d'un avertissement de tornade. La tornade continue vers le nord à une vitesse de 35 à 40 km/h, détruisant tout sur son passage jusqu'à sa dissipation, passant à l'emplacement de l'Evergreen Trailer Park, aux environs de 16 h 00.

Plus tard, une deuxième ligne d'orages, accompagnée de vents destructeurs de 110 km/h et de nuages en entonnoir, passe au-dessus d'Edmonton à 18 h 00. Le même jour, en plus de la tornade d'Edmonton, on compte 4 autres tornades dans le centre de l'Alberta. Celles-ci, ainsi que celles survenues plus tôt dans le mois, sont relativement faibles et frappent des régions rurales peu peuplées.

La période estivale albertine est souvent marquée par la présence d'orages violents. Quoique moins fréquentes, on a quand même observé une moyenne annuelle de 18 tornades au cours des cinq dernières années.

TOM TAYLOR, TORNADO HERO

One of the heroes of the Edmonton tornado was Tom Taylor, a pharmacist from Leduc, Alberta, about 24 km southeast of the afflicted city. Mr. Taylor had just come in from feeding his black retrievers in the kennel outside when he saw thick, black rain clouds over his house. For fifteen seconds from the loft of his house, which stands on an archeological site high on a hill, he saw a low-hanging cloud to the southwest with a "snake-like" funnel pointing towards the ground. At the same time high winds were kicking up debris. Taylor, trained to be observant in his job (he sometimes files narcotics reports for the police), picked up the phone and called the Alberta Weather Centre informing them "things are pretty hectic right now". He told them that the cloud's funnel had just hit the ground. The time was approximately 2:55 p.m. The Weather Centre, which had been expecting severe weather, immediately put out a tornado warning. Half an hour later, the full fury of the tornado pounded one of Edmonton's principal industrial districts.

Tom spent most of his time in the loft. He didn't have time to head for the basement. But if he had to do it all over again he would have used the below-ground extension phone. His wife and children were in Edmonton. They felt the full force of the tornado. Little did they know that Mr. Taylor had been the first person to spot the tornado and report it promptly to the Weather Centre.

Naturally AES staff were delighted with Mr. Taylor's prompt action. Says AES Western Region director Brian O'Donnell "It was on the basis of Mr. Taylor's report that the tornado warning was issued for Edmonton. His quick action resulted in more warning time for the citizens of the city." Mr. Taylor has now agreed to become a volunteer under the AES Severe Weather Watch program.

Taylor says he has been interested in weather since he was a child. He has a close friend who works with the Alberta Hail Program. He listens to weather forecasts at least three times a day and has a Weatheradio Canada receiver. "I'm a country person. Call me a farmer with a weather eye if you wish".

On November 26, 1987 the federal Minister of the Environment, The Honorable Tom McMillan, presented Mr. Taylor with a framed letter of appreciation for his superb initiative. One of Mr. Taylor's photographs was awarded a prize in the AES Canadian Weather Trivia Calendar contest.

This article is reprinted from Zephyr, October 1987, published by the Atmospheric Environment Service.
Until recently, the debate about how humans are changing the structure and composition of the earth's atmosphere has been a scientific one. Now, year by year, as our understanding of the related implications for society and its future welfare slowly improves, the issue is becoming a major concern of policy makers. Recent research activities, both internationally and nationally, have contributed substantially to this awakening.

THE EARTH'S ATMOSPHERE: Are We Changing Its Composition?
Evidence of the effects of human society and its activities on the earth's atmosphere continues to accumulate; for example:

- Atmospheric concentrations of the most abundant greenhouse gas, carbon dioxide (CO₂), are increasing by 0.4% a year. CO₂ emissions from the burning of fossil fuels for energy, the primary source for its increased atmospheric concentrations, appear likely to escalate at an average annual rate of about 1% until at least A.D. 2050. The energy policies of the international community will be a major factor in determining the magnitude, and even the direction, of such trends, particularly beyond A.D. 2050.

- Atmospheric methane, a secondary but very effective greenhouse gas, is increasing annually at about 1% and has almost doubled in concentration during the past several centuries. Increasing trends in the global population of domestic animals and increases in the land area covered with rice paddies, both important sources of methane, suggest the atmospheric concentrations of this gas will continue to rise unabated.

- Other trace gases, lower in concentration but of significant importance to global climates, are increasing at annual rates of up to 6%. These include nitrous oxide, surface ozone and chlorofluorocarbons (freons).

- Winter concentrations of aerosols in the lower levels of the Arctic atmosphere are increasing, affecting the heat energy balance of the Arctic climate. The long-range transport of air pollutants from Europe appears to be the primary cause.

CLIMATIC RESPONSE: How Will Changing Atmospheric Composition Affect Climate?
Changes in the atmospheric composition, as described above, are expected to cause major alterations to the earth's climate. Recent studies suggest that:

- A doubling of atmospheric CO₂ concentrations, or its equivalent, may increase average surface temperatures of the earth by 3.5 to 4.2°C, well into the upper range of earlier projections. Such a warming would be larger than any climate change experienced on earth during the past 10,000 years (Figure 1).

- An increase of 1°C over the temperatures during the nineteenth century could occur by A.D. 2000. Global climate records suggest that a warming of 0.3–0.7°C has already happened, with the three warmest years on record occurring during the 1980s.

- Warmer climates are likely to reduce mid-continental cloudiness over North America in summer, thus amplifying summer warming and dryness. Within the next half century, central Canada could experience a midsummer warming of as much as 9°C, with a corresponding 50% reduction in soil moisture.

- Past climates indicate that the primary consequence of a major global warming is likely to be a large-scale redistribution of global freshwater resources.
La projection des émissions futures de CO$_2$ dans l'atmosphère semble indiquer au minimum le doublement ultérieur de la concentration de CO$_2$ dans l'atmosphère par rapport aux niveaux pré-industriels. Toutefois, l'époque où surviendra un tel doublement est difficile à établir, car le comportement humain à long terme en matière de consommation d'énergie est en grande partie imprévisible. En outre, il est probable que la concentration des autres gaz de serre s'accroîtra de beaucoup au cours des futures décennies, d'un renforcement des effets climatiques de la hausse des niveaux de CO$_2$. Un effet combiné sur le climat qui équivaudra au doublement de CO$_2$ se manifestera sans doute dès l'an 2050 et, fait très probable, d'ici à l'an 2060.

Les scientifiques de l’atmosphère avancent maintenant que les changements susmentionnés entraîneront sans doute un réchauffement climatique mondial supérieur à tout changement jamais observé par l’humanité. Il est probable qu’un tel réchauffement s’accompagnera des phénomènes suivants : réchauffement amplifié aux régions de haute latitude en automne et en hiver; été plus sec aux latitudes moyennes de l’hémisphère nord; augmentation de l’humidité disponible dans les régions polaires; hausse éventuelle de 0,2 à 1,4 m du niveau moyen de la mer à l’échelle mondiale.

Des études préliminaires des implications d’un réchauffement climatique important appuient cette conclusion : existence de profondes répercussions sur les écosystèmes, l’agriculture, les ressources en eau et la glace de mer du globe. Les pays appauvris du monde en voie de développement sont moins aptes à répondre à un tel changement et, de ce fait, plus vulnérables aux conséquences catastrophiques éventuelles. De grands secteurs de la population du monde seront aussi touchés par une hausse de 1 m du niveau de la mer. Au sein du Canada, l’agriculture bénéficiera beaucoup de saisons de croissance plus chaudes et plus longues, en particulier dans les régions du sud : les effets directs d’une quantité accrue de CO$_2$ pourraient accroître de 15 p. 100 la croissance des cultures de plein champ; l’agriculture des régions du sud pourrait être très touchée par une augmentation de la fréquence et de la gravité de la sècheresse; les saisons des glaces des Grands Lacs disparaîtront peut-être; la baisse du ruissellement des eaux du bassin des Grands Lacs pourrait réduire de 20 cm le niveau des lacs; de grands marécages d’intérêt écologique, comme celui de Point Pelee, disparaîtraient ou seraient profondément modifiés; on pourrait assister à la fin des saisons de neige fiables dans le sud de l’Ontario.
The season was anything but placid and one to be long remembered across Canada.

The summer of 1987 (June-July-August) set some long-term records. The heat wave that covered southern Ontario and Quebec brought back memories of the heat waves in the 1940s and 1950s. Canada's worst natural disaster surprised Edmontonians when a violent tornado slashed a vicious trail of death and destruction through their city on July 31. Scanty rainfall resulted in less than half of normal in the Atlantic Provinces, where water rationing was imposed in some communities. July rains averted an onset of drought on the Prairies; further it was excessively dry on the West Coast.

**TEMPERATURE**
A vast stretch of the country from the British Columbia Coast to the St. Lawrence Valley and the High Arctic enjoyed temperatures about a degree above normal. Southern Alberta and southern Saskatchewan experienced a slightly below normal summer. Most of the Maritimes and the Territories had readings from near normal to 1°C below normal. Southern Ontario sweltered through two heat waves during June and July, when maximum temperatures climbed above 30°C and the humidex registered an uncomfortable 40°C on 14 days.

The highest and lowest temperatures occurred in June: 39.1°C at Lytton, B.C.; -14.2°C at Cambridge Bay, N.W.T.

**PRECIPITATION**
Areas from eastern Ontario to the East Coast experienced a drier summer than usual. Summer precipitation was less than 75% of normal in the Atlantic Provinces, in some southern Newfoundland communities amounting to less than half of normal. Charlo, Moncton and Fredericton received record-low July precipitation, from 20 to 40 mm. At Sydney, it was the driest July since 1897. The West Coast, the northern interior valleys of British Columbia and the Mackenzie Valley were also dry. Communities in these areas had from one half to two thirds of their normal summer rainfalls.

Most of the Prairies, Ontario and the Territories had ample rainfall. Precipitation was from 100 to 150% of normal. Deluges (200 to 300 mm) inundated the Grande Prairie and Edson Forest Districts during the last two days of July. During mid-August, southwestern Manitoba received a "once-in-a-lifetime" rainfall when 120 to 140 mm fell in a 24-hour period.

**SIGNIFICANT CLIMATIC IMPACTS**
The unusually dry summer created problems in the Atlantic Provinces when wells dried up and lake and river water dropped to record, low levels. Travel in the woods was banned in western Nova Scotia, and owing to the heightened fears of forest fires a permit was required to camp and picnic. Sheep farmers found their herds vulnerable to coyote attacks while sheep roamed farther afield in search of watering holes and grass. In Newfoundland, 1,500 workers were laid off in the forestry industry after the forest fire hazard index rose to extreme levels.

Throughout most of July, central Canada baked during a record-breaking heat wave, when daytime temperatures soared above 30°C. Ontario had its hottest July in 33 years while a tropical brand of air mass covered the Province. Maximum temperatures exceeded 30°C on 14 occasions in Toronto – its greatest number of "hot days" in 67 years. Moreover, the extensive use of air conditioners set a record for daily electrical consumption in the city. Toronto experienced its sixth warmest summer since the start of records in 1840. The heat was beneficial for most Ontario crops, particularly corn and soybeans. After a dismal summer in 1986, farmers were reaping a bumper crop by the end of summer.

On several occasions, a clash between the hot and humid air from the south and the cooler and drier air from the north resulted in outbreaks of violent summer thunderstorms and tornadoes in southern Ontario and southern Quebec. On July 14, a series of intense thunderstorm cells dropped over 100 mm of rain in a 2-hour period on Montreal. Main expressways and basements were flooded throughout the city. Some roads were submerged under 4 metres of water and motorists had to be rescued from their vehicles. Damage estimates from the flooding exceeded $200 million. On July 24, a wave of destructive thunderstorms lashed southern Ontario, where lightning hit a YMCA camp near Bala (north of Orillia) and 15 campers were sent to hospital. Tornadoes at Sebright and in Missis-
sauga caused extensive structural damage to buildings the same day.

The warm and dry weather helped to lower the record-high water levels in the Great Lakes. The declining lake levels significantly reduced the risk of fall flooding along the shorelines.

After a very dry spring on the Prairies, July rains provided much needed moisture for crop growth. The rains averted what had been shaping up as yet another catastrophic growing season for the Prairie farmers. Hailstorms, damaging winds and sudden downpours are common in summer on the Prairies. This year was no exception. On July 6, two tornadoes touched down in the southern part of Winnipeg. The winds caused considerable damage, and over 40 mm of rain in 2½ hours caused flash floods. Heavy rains in the 200 to 300 mm range inundated the Grande Prairie and Edson Forest Districts during the last two days of July. Rain-swollen rivers washed out roads and bridges, and huge tracts of farmland were waterlogged. The most destructive summer weather was a killer tornado that struck Edmonton on July 31, the second worst tornado disaster in
Many cars were stalled by floods, but this one was smacked by a tree on Décarie Blvd. Gazette, James Seeley.

Canadian Coastguard icebreaker Labrador navigating in Arctic waters.

Canada (the Regina cyclone in 1912 had claimed 28 lives). It slashed a vicious trail of death and destruction in the agricultural, industrial and residential areas of Strathcona County and in Edmonton’s eastern subdivisions. The Evergreen Mobile Home Park in northeastern Edmonton felt the brunt of the storm when the tornado ripped through the park turning it into a field of chipwood and mangled metal. In all, 27 people lost their lives, over 200 were injured and property damage exceeded $250 million.

Sunshine abounded on the West Coast, where Victoria received a record 348 hours of bright sunshine during August. Although many West Coast residents enjoyed the long stretches of sunny and dry weather, residents on Galiano and Gabriola Islands, located between Vancouver Island and the mainland, saw their wells dry up, even forcing them to ration their bath water.

The warm weather and favourable winds sped up the ice breakup and allowed crews to drill for oil in the Beaufort Sea.

Amir Shabbar is a research meteorologist in the Canadian Climate Centre with a special interest in climate prediction.