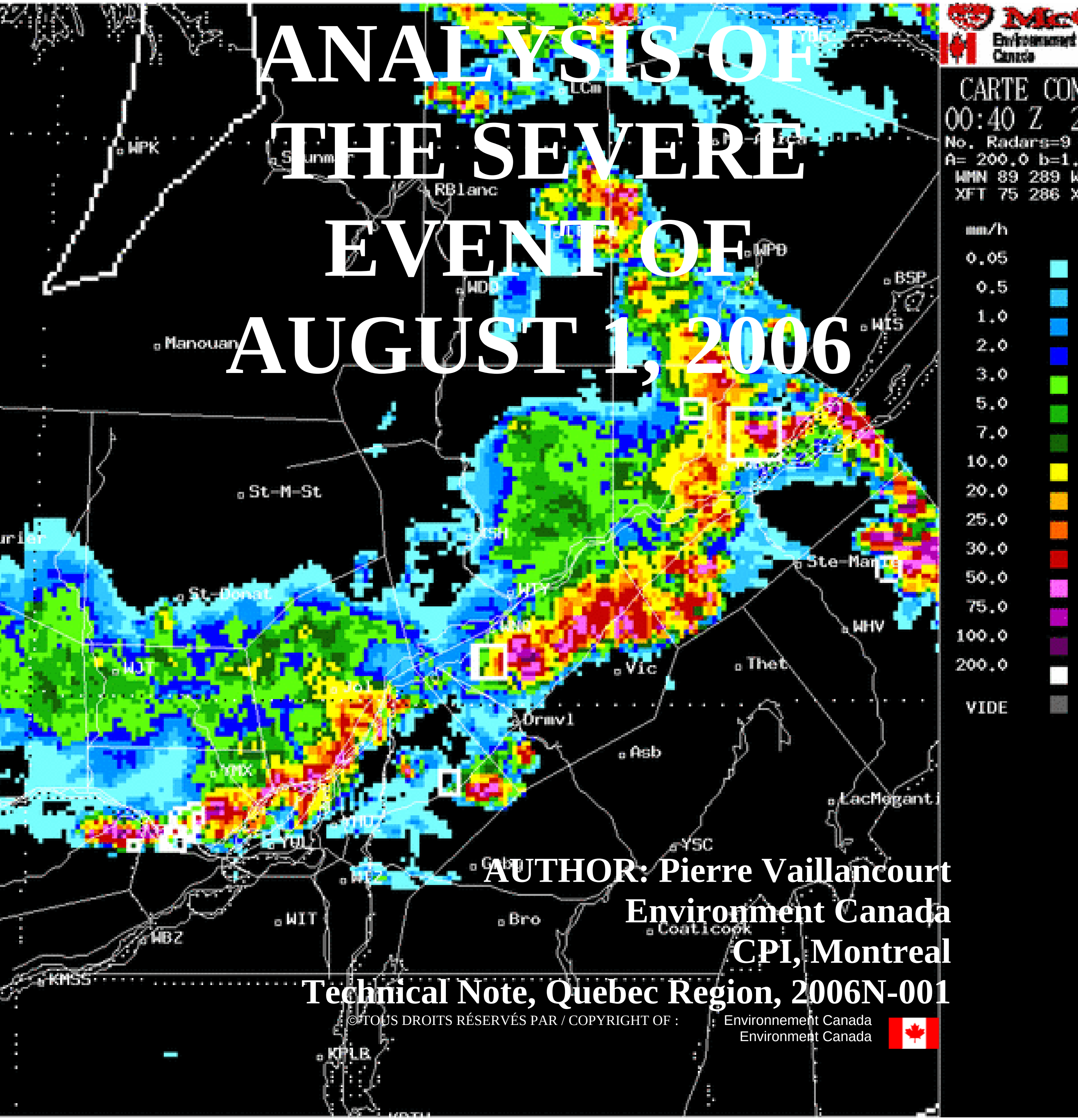
ANALYSIS OF THE SEVERE EVENT OF AUGUST 1, 2006



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INTRODUCTION

Some of the most intense convective activity of the summer of 2006 occurred on August 1. Storms developed in the Abitibi region in the early afternoon and quickly became organized into a line of thunderstorms, which headed toward the St. Lawrence valley, where it arrived around 10:00 pm EDT. By then, the line extended a distance of 300 km and had caused wind damage along its entire path. It would move on toward the U.S. coastline before dissipating around midnight. Over this period of time, isolated storms in the Estrie-Beauce region developed into supercells and produced two tornadoes.

In this note, I will describe the weather picture that existed that day and the forecast guidance products that made it possible to issue a series of watches and warnings to alert the population. In particular, I will describe the output of the GEM numerical forecast model used at the Canadian Meteorological Centre (CMC), which has a fine-scale version (2.5-km resolution) that simulates deep convection more effectively.

Reports of damage were received from volunteer observers and MSC stations and partners, the media and certain MSC employees like André Giguère. According to Hydro-Québec, over 400,000 homes[1] were left without power, and damage to trees and structures was severe and extensive. According to our stations, winds varied from 80 to 107 km/h, while Société Radio-Canada reported winds of 150 km/h.[2] Two deaths were also reported by the media: a tree fell on an automobile, killing the driver in Montreal, and a man was struck by lightning and killed in Saint-Alexis-des-Monts in the Mauricie region.

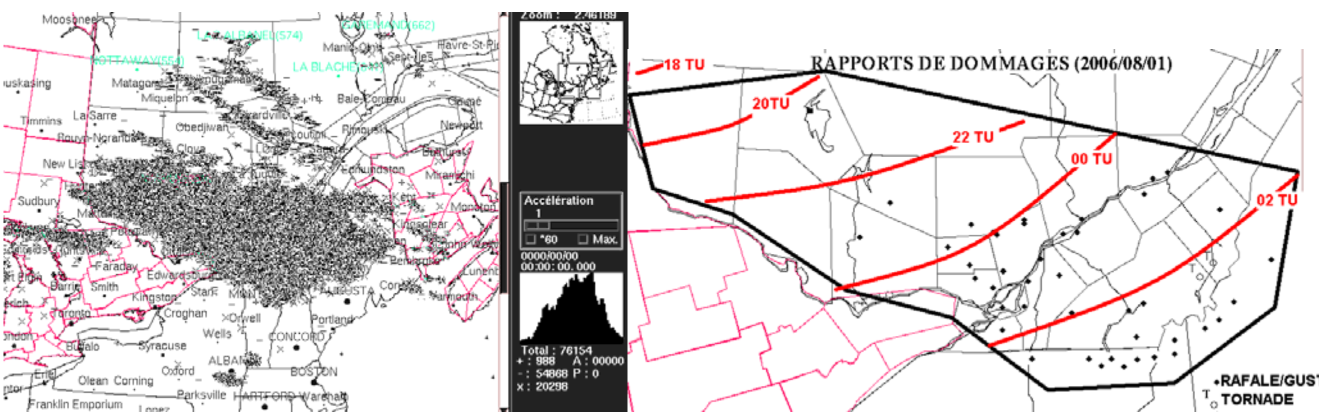


Figure 1: The image on the left shows lightning strikes between 18 UTC on August 1, 2006, and 04 UTC on August 2, 2006 (76,000+). The image also shows the wide corridor affected by the storms. The graph inserted on the center of the image shows the temporal variation in the rate for the period. The image on the right shows the area of thunderstorms superimposed on reports of damage caused by the wind and the two tornadoes. It should be noted that reports came primarily from heavily populated areas and that they represent only a small portion of the actual damage.

[1] August 2006 Climate Summary, CRIACC (http://www.criacc.qc.ca/climat/suivi/200608_e.html)
[2] Article from the Radio-Canada site, appended, dated Sunday, August 6, 2006, 7:19 am (http://www.radio-canada.ca/nouvelles/regional/modele.asp?page=/regions/Montreal/2006/08/03/001-pannes-electricite.shtml)

DATA SOURCES

Radar data:

- Weather radars - Villeroy (WVY), Landrienne (XLA), Britt (WBI), Lac Castor (WMB) and Franktown (XFT), Environment Canada (EC)
- Weather radar - McGill (WMN), McGill University, Montreal
- Data processed using the RAPID software developed by McGill University's J.S. Marshall Radar Observatory in collaboration with EC, Quebec Region.

Lightning data:

- Canadian Lightning Detection Network, EC

Modelled data:

- GEM (Global Environmental Multiscale)-LAM (Limited Area Model), 2.5-km horizontal resolution, developed by EC, with daily outputs from adapted radar algorithms: a collaboration of the severe weather meteorology laboratory in Montreal and the CMC.
- These data displayed using the MAX software developed by EC.
- Radiosonde data displayed using STRATUS, software developed for EC by the CRIME.
- Surface and upper-air charts by NCEP/NCAR.

Others:

- The data include several videos that include the tornado funnel at Lac-Drolet.
- The two tornadoes and other locations where damage occurred were investigated by André Cantin, MSCM, based in Quebec City. Mr. Cantin took several shots and wrote a report that included maps of the damage corridors.
- A summary of the events, representative photographs and articles written on the subject are appended.
- Damage report from the Storm Prediction Center in Norman, Oklahoma, which is part of the U.S. National Weather Service.

SYNOPTIC SITUATION

A major surface low was observed near James Bay, with a cold front extending toward Lake Superior at 12 UTC, and a warm front toward the Appalachians. The low reached the La Grande IV region by 00 UTC on August 2, when a wave became detached near Lake Saint-Jean. The warm front remained almost stationary, and the cold front now stretched from the wave to Georgian Bay (Figure 2). The maritime warm sector that covered the south of the province did not move very much during the day on August 1 because the upper flow (Figure 3) was zonal and much further north than the St. Lawrence valley except for the passage of the cold front.

The jet stream supported the low in northern Quebec quite well, but provided little support for the wave. It was the low-level jet that would cause convergence toward the associated cold front and focus convection.

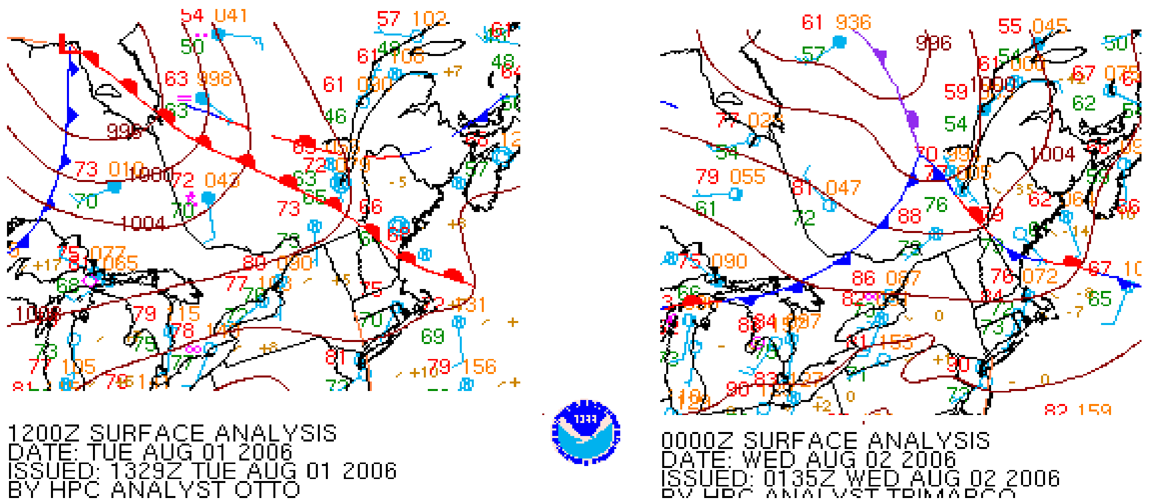


Figure 2 : Surface analysis by NOAA at 12 UTC on August 1 and 00 UTC on August 2.

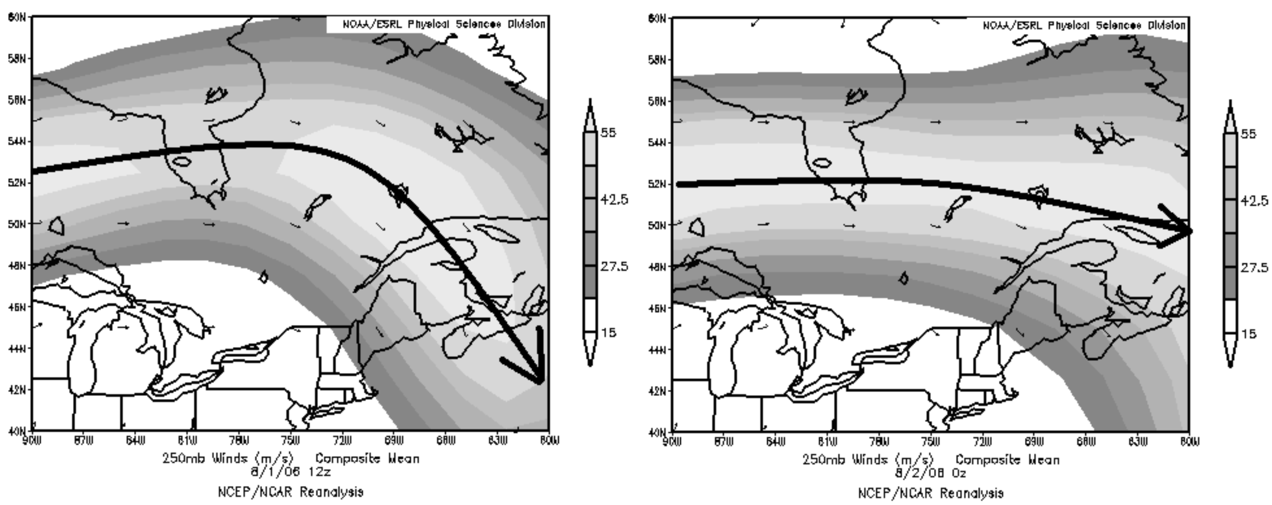


Figure 3: 250 mb winds show the movement of the jet stream between 12 UTC on Aug. 1 and 00 UTC on Aug. 2, 2006 (Source NCEP/NCAR).

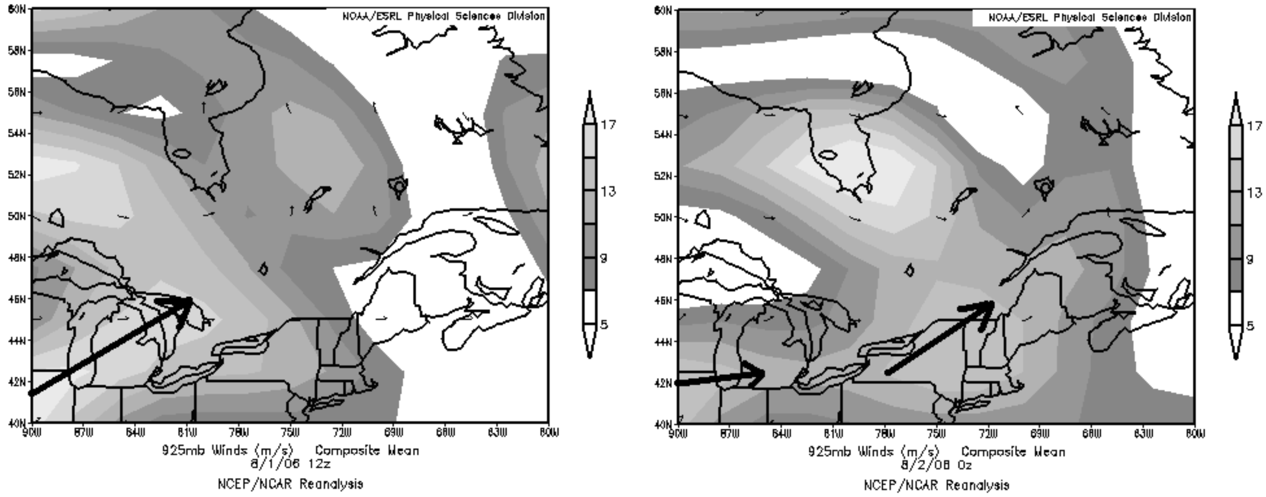


Figure 4 : 925 mb winds show the movement of the low-level jet between 12 UTC on Aug. 1 and 00 UTC on Aug. 2, 2006 (Source NCEP/NCAR).

This synoptic situation had developed slowly in the previous days. The zonal flow between northern Ontario and northern Quebec was stable, and a north-south ridge covered the Great Lakes region at all levels. As a result, there had been lines of intense storms along the cold front, from the Dakotas to the Lake Superior region during the two previous days. The lines moved slowly, causing a high rate of lightning activity and severe weather.

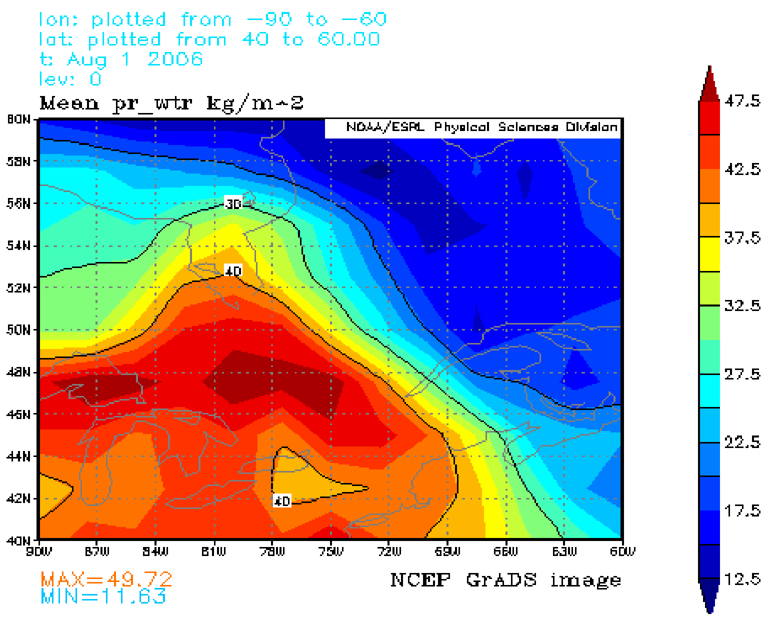


Figure 5: Available moisture throughout the day of August 1, 2006. As the figure shows, the maximum reached 50 mm and the entire maritime warm sector from Timmins, Ontario, to Montreal, was above 40 mm.

The ridge began to break down on August 1, as shown in Figure 2. By July 31, both the U.S. (NAM) and Canadian (GEM-15 km) models were showing that the maritime warm sector would move down toward the west and the centre of Quebec during the day on August 1. By producing a map of the synoptic triggers, we could see the passage of a warm sector with over 40 mm (Figure 5) of precipitable water and a low-level jet over the regions north of the river between the Abitibi and Quebec City areas. South of the river, between the region north of Montreal and the Beauce, we saw the same air mass without a strong trigger, merely the presence of the relatively stationary warm front.

THERMODYNAMICS

The tephigram for Maniwaki (WMN), in the warm sector but south of the low-level jet, showed a very unstable air mass. The analysis performed that morning showed a maximum of 33C and dew point of 21C resulting in cumulonimbus clouds (CB), with tops at 50,000 feet, and a convective available potential energy (CAPE) of 2,000 J/kg—conditions that were more than enough to produce violent storms. By raising the temperature to 34C and the dew point to 22C—common conditions that day—a CAPE of as high as 2,900 J/kg was reached.

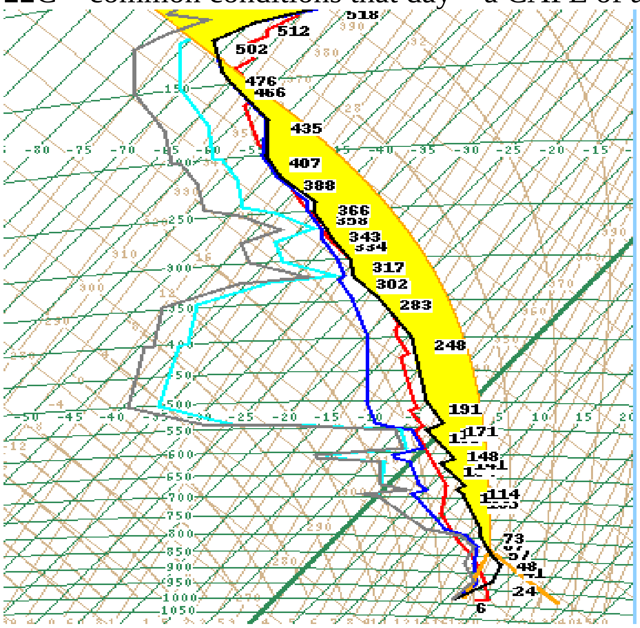


Figure 6: Tephigram for Maniwaki, QC (CWMN) at 12:00 UTC on August 1, 2006. The black line is temperature (T), the grey line represents the dew point (Td), the blue line is the wet-bulb temperature (Tw), and the red line the temperature at 00:00 UTC. The yellow area represents the convective available potential energy (CAPE = 2,894 J/kg) for T = 34C and Td = 22C, conditions that were typical of the air mass that afternoon.

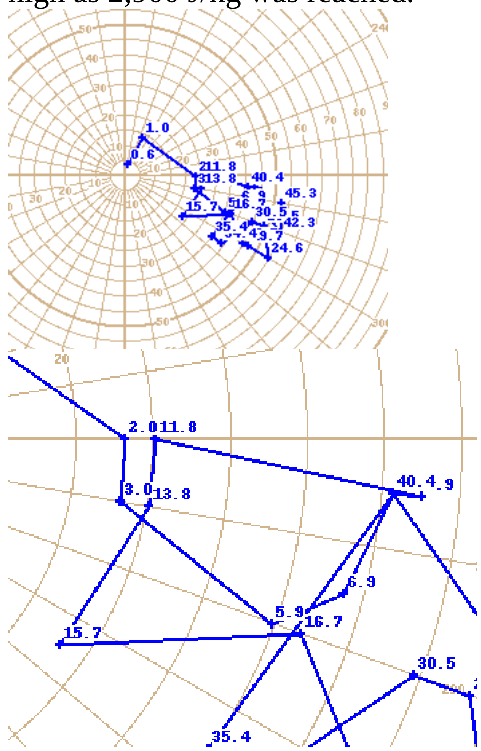


Figure 7: Hodograph for Maniwaki, QC (CWMN) at 12:00 UTC on August 1, 2006. The total shear under 6 km is 1.15 x 10^{-2}/s and a loop is noted between 3,000 and 14,000 ft. Combined with the CAPE, this shear gives a storm severity index (SSI) of 135, indicating that severe storms are highly probable, with torrential rains, severe wind gusts ($\Delta\theta_e$=22C) and/or tornadoes (EHI=3.6).

The difference in potential temperature ($\Delta\theta_e$) between the environment and the uplifted air parcels was 22C, exceeding the 19C that is the critical threshold for violent downbursts.

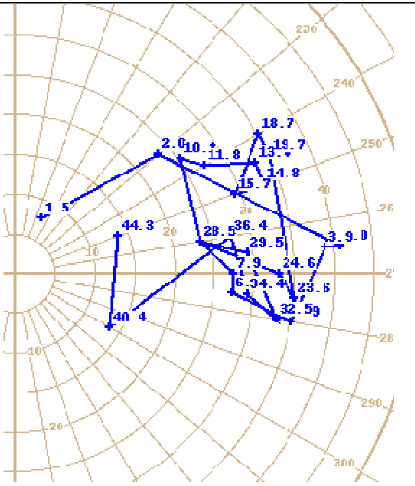


Figure 8 :The hodographe for KAPX in northern Michigan at 12:00 UTC on Aug. 1 is very typical of the winds near the cold front.

The hodograph (Figure 7) showed a lower-level shear in the shape of a loop, foreshadowing a possible tornado, which was confirmed by an energy helicity index (EHI) of 3.6. The shear was 48 knots between the ground and an altitude of 5 km. However, the wind was 20 knots or less in the first 3,000 feet. The hodograph for KAPX (Figure 8) was fairly similar to the one for Maniwaki, except the low-level wind was much stronger, reaching about 40 knots at 3,000 feet and then decreasing at higher levels, reflecting the presence of the low-level jet.

All these data yielded high convective indices. The severe storm index (SSI) reached or exceeded 120, well above the critical threshold of 100. Since WMN was in the warm sector but far from the dynamic triggers, the most likely weather in this sector would be supercell storms with torrential rains (PT) and tornadoes (T) along the warm front. Conversely, between the cold front and the low-level jet, the most probable weather would be lines of thunderstorms with PT and violent downbursts because of the organization provided by these triggers according to KAPX.

Severe weather forecast maps (Figure 9) produced the day before and the morning of the events therefore showed possible PTs and Ts for much of southern Quebec. It should be noted that the forecast map produced on the morning of August 1 covered the period until 22:00 EDT (02:00 UTC), or two hours past the map produced the day before. It also added the possibility of severe weather south of the river in the areas around Montreal and in Estrie (Eastern Townships).

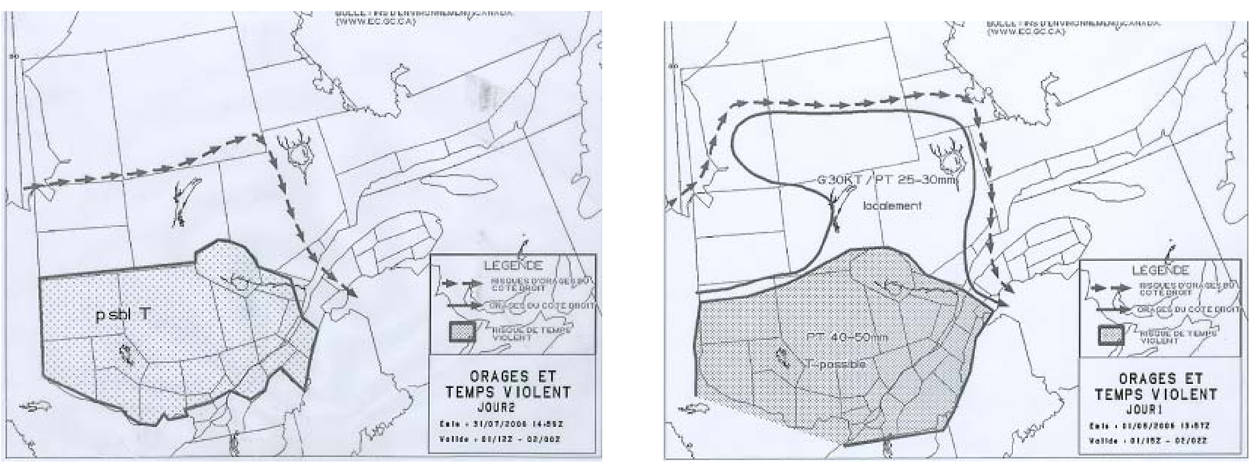


Figure 9: Forecast for areas at risk of severe weather for August 1, 2006. On the left is the forecast prepared on July 31, and on the right, the forecast produced on the morning of the events. The possibility of tornadoes (T) is indicated.

MODEL vs. REALITY

Throughout the summer of 2006, the Canadian Meteorological Centre (CMC) ran a mesoscale model on a window covering southern and eastern Ontario and western and central Quebec. The model (GEM-LAM) has a horizontal resolution of 2.5 km and 58 vertical levels. At this resolution, it is possible to use explicit parameterization of deep convection, thereby generating three-dimensional output similar to what a radar would see for thunderstoms that are 10 km or more in diameter. Figure 10 and Figure 11 show on the left the evolution of radar echos superimposed over clouds from satellite photos, and on the right, the corresponding GEM-LAM forecasts.

Squall line

It was initially observed that the sky was very clear in the sector of interest, allowing for maximum warming. At 18:15 UTC, in the upper left corner of the satellite image, the cold front stretching from the northeast to the southwest could be seen very clearly in the dissipation of the cumulus clouds. The start of convection was also seen in the sector from Earlton (YXR) to Rouyn (YUY), along with isolated echos in central Quebec (near WTY). In the corresponding model image, similar zones of convection were seen, but offset slightly to the west.

The next images show the change in radar echos and the progress of the thunderstorms that were organizing in lines across northwestern Quebec and moving toward the St. Lawrence valley. These storms crossed the river between 20:00 and 21:00 EDT (00:00 to 01:00 UTC), reaching Maine (U.S.) after 22:00 EDT. The radar echos (lower right part of radar images) also showed large cells forming along the warm front in the Estrie-Beauce area. Our analysis was confirmed by the presence of large, somewhat isolated cells along the warm front, at the edge of the cloud, and a line of thunderstorms between the cold front and the low-level jet.

The parallel GEM-LAM simulation showed a similar progression, but with a slight delay in time and space. In addition, the simulated line did not develop over as great a distance as the actual line. Specifically, it never reached the Montreal area and the Laurentian region (south-western part), which were actually among the regions most affected by the thunderstorms. The colours indicated pseudo-reflectivity, as on a radar display, and showed the arched form of the line.

The report on the damages recorded that day is appended. As the storm line passed, downbursts caused systematic damage all along the thunderstorms track: uprooted trees, broken hydro poles, wind gusts of over 90 km/h at weather stations and over 400,000 homes left without power. The hardest-hit areas were the Laurentians and Quebec City. A zoom (Figure 12) shows undulations on the back of the line of thunderstorms, indicating the descent of the jet stream from the mid level behind the line. The jet combined with the downbursts to intensify them.

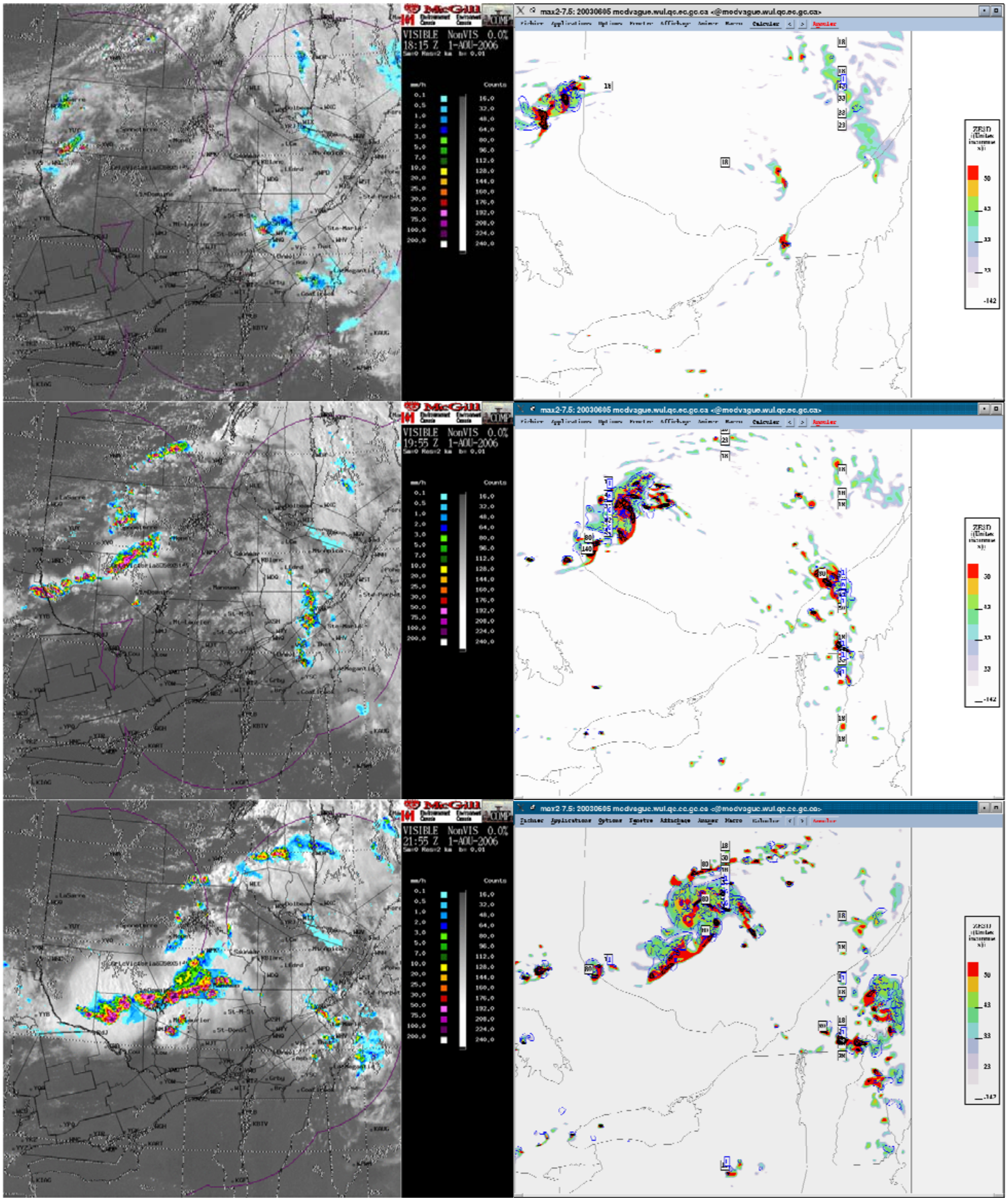


Figure 10: On the left, a series of visible satellite images on which the radar echoes (CAPPI at 1.5 km altitude) from 18:15 to 21:55 UTC (14:15 to 17:55 EDT) are superimposed. On the right, the simulated reflectivities predicted by GEM-LAM for the same times with the thin blue lines representing zones where reflectivity at upper levels is stronger (overhang); and the black lines indicating the potential for gusts of over 80 km/h.

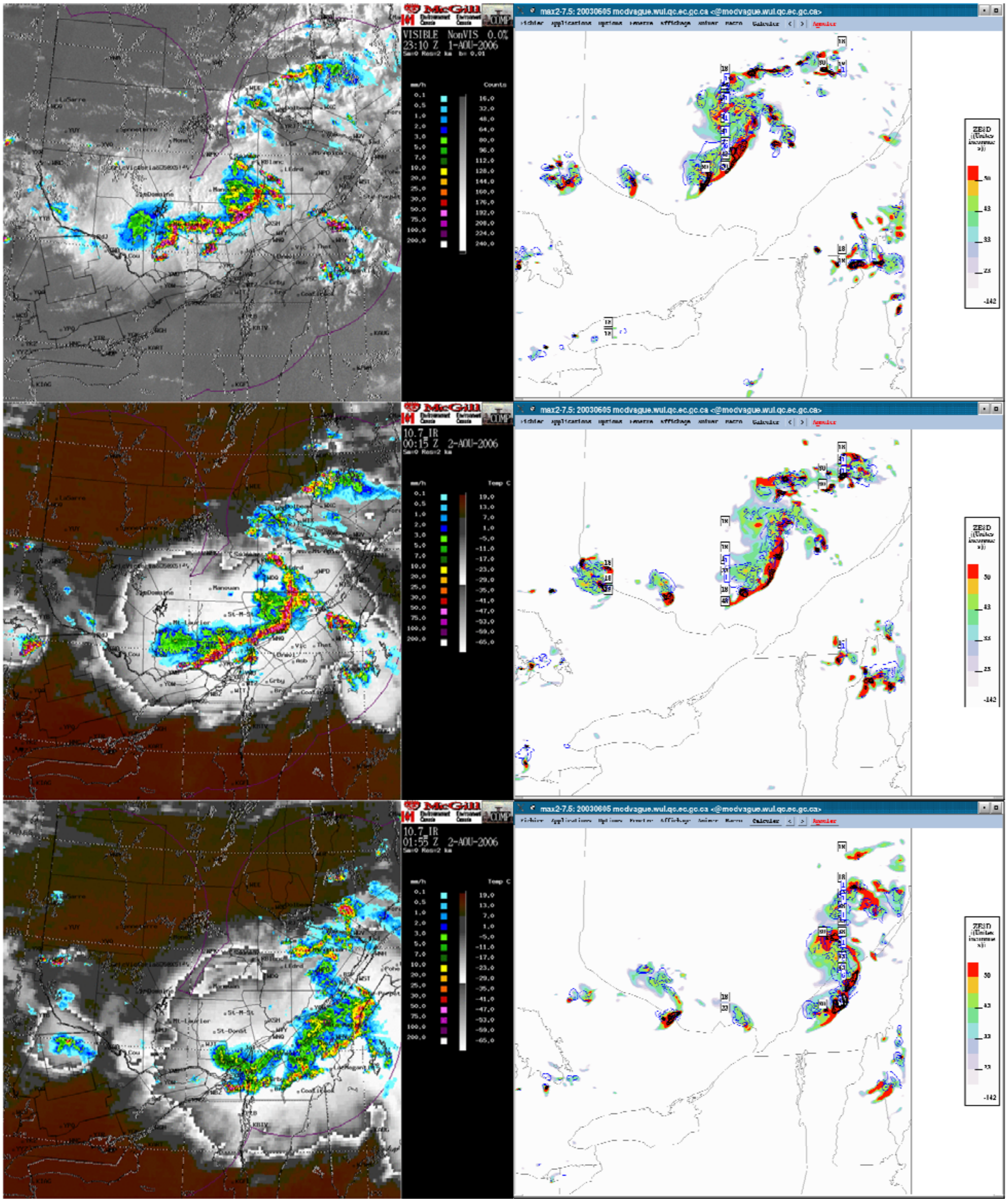


Figure 11: On the left, series of visible and infrared satellite images on which the radar echoes (CAPPI at 1.5 km altitude) from 23:10 UTC on the 1st to 01:55 UTC on the 2nd (19:10 to 21:55 EDT) are superimposed. Note that the line seems to weaken and break up in the last radar image, but this is due to the loss of the McGill radar (WMN) and the attenuation of the Villeroy radar (WVY), which has a 5-cm wavelength. On the right, the corresponding GEM-LAM outputs.

The very pronounced arch called a “bow echo” was seen in the southwest part of the line, and it was in this sector that the most severe damage occurred. In confirmation of our analysis of the line, the vertical cross-sections of reflectivity (Figure 13) across the line were typical of an intense squall line system with a trailing stratiform region. The sections also showed that redevelopment was still occurring ahead of the main convection area. This was evidence of the presence of the gust front that was confirmed by the Doppler data (in storm-relative velocities, right side of Figure 12), which show the gust front in yellow/orange at the front of the line. The winds were moving away from the storm at over 14 m/s (60 km/h).

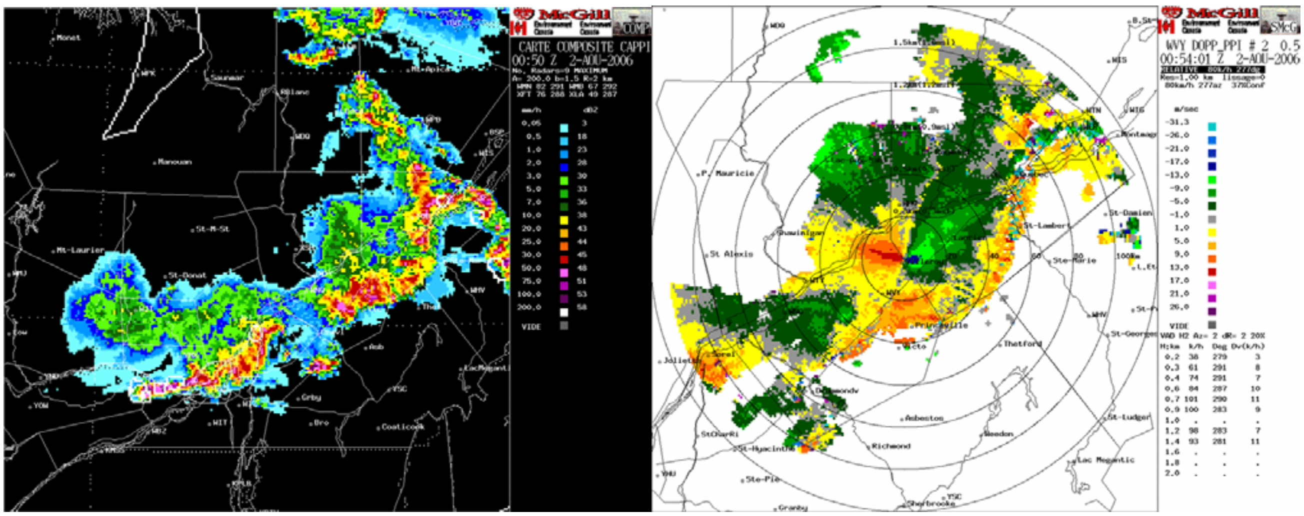


Figure 12 : Zoom of the line of storms at 00:54 UTC (left), showing undulations in the reflectivity and the gust front in the Doppler data (right).

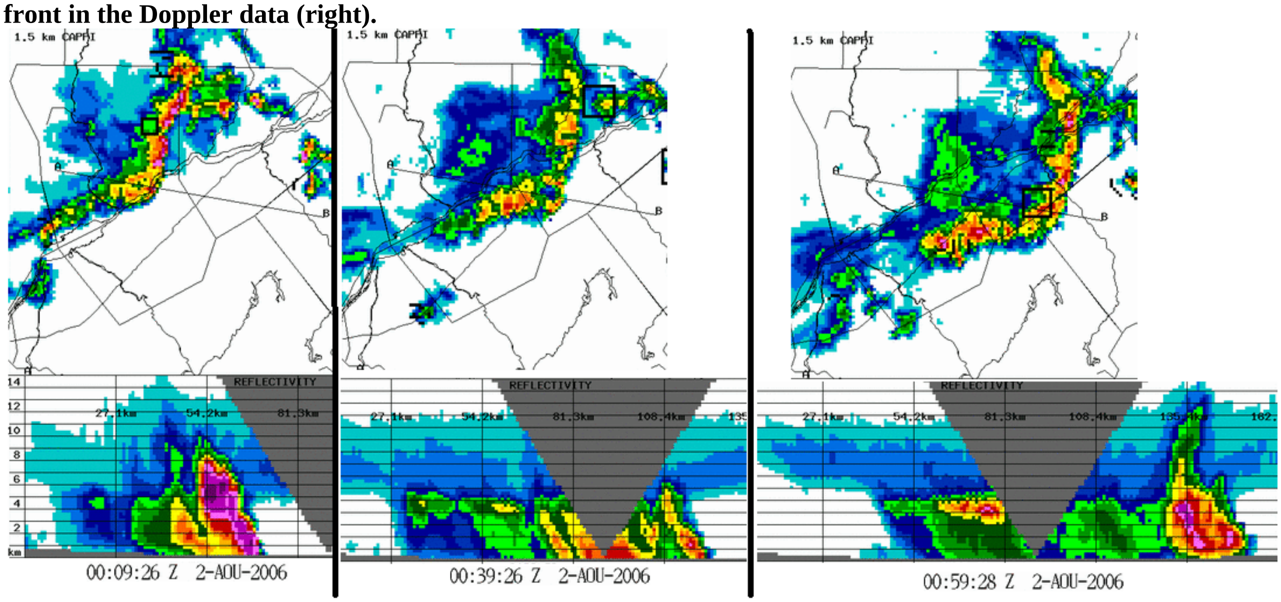


Figure 13: Series of cross-sections showing the typical structure of a squall line, with areas of convection in front (with back slope) and a trailing stratiform region.

From one side of the radar (centre of the Doppler image) to the other, velocities changed from yellow to green, with a centre that was typical of a low-level jet. The jet was higher on the west than on the east, showing that it was descending, as noted earlier.

Severe weather detection algorithms were developed for the GEM-LAM model. Figure 14, shows a zoom of the line of thunderstorms as it reached the north shore of the St. Lawrence River. The outputs show simulated reflectivity at low levels in colour, and the black lines represent the possibility of strong wind gusts on the front part of the line of thunderstorms. The maximum speeds averaging over 130 km/h, and reaching as high as 192 km/h in this image. Widespread overhangs were predicted toward the back of the line of storms (blue lines). The arched shape and the notches behind the line are clearly visible.

This description is consistent with the features expected in the case of a squall line. The tops of the simulated echos were at 7 km and, based on Figure 13, those of the actual line reached an average of 10 km.

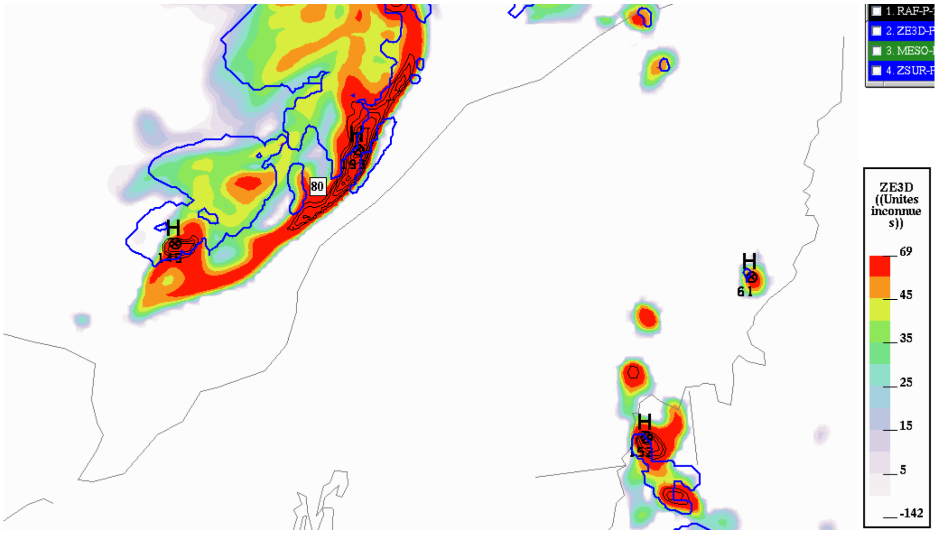


Figure 14 : Zoom of the line of storms on GEM-LAM at 01:00 UTC, August 2, with reflectivities in colour; the blue lines indicate overhang, and the black lines gusts of over 80 km/h, with maximums indicated.

Tornadoes

Two tornadoes were reported in Beauce/Estrie regions, with isolated cells along the warm front. There were few reports of PT or hail. The following images (Figure 15) show thunderstorm cells ahead of the warm front that gave rise to the tornadoes. On the left, the 1.5 km CAPPI image at 22:19 UTC shows an overhang (black circle) detected on two cells. Intensities were greater on the westernmost cell, but both had a small “hook” or “comma” shape, as is typical of tornadic thunderstorms. The shape can be explained by the descent of the mid-level jet stream behind the thunderstorm, drying the lower levels and thereby causing the radar echos to disappear in the right rear sector.

At 22:49 UTC, when the tornadoes struck, the cells seemed weaker at 1.5 km, but an overhang was still detected on the western cell, which was passing over Lac-Drolet.

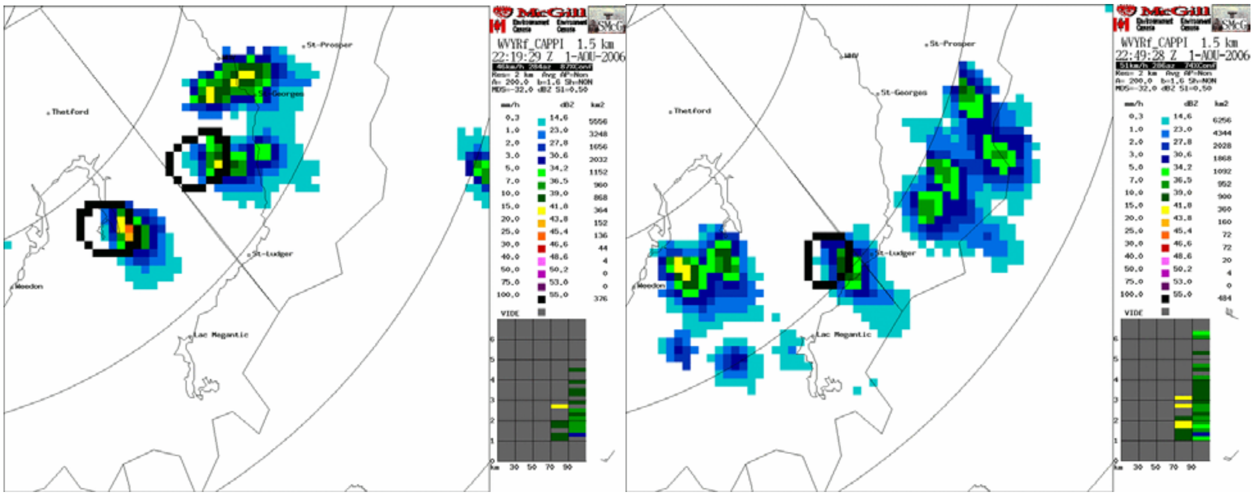


Figure 15: Mini-supercells that spawned two tornadoes (Lac-Drolet and St-Gédéon). On the 1.5 km CAPPI image on the left, two black circles indicate overhangs, and a hook shape can be seen in the cell reflectivities. At 22:49 UTC, the image on the right shows that the overhang remains on the cell west of Saint-Ludger, while the other cell appears more benign.

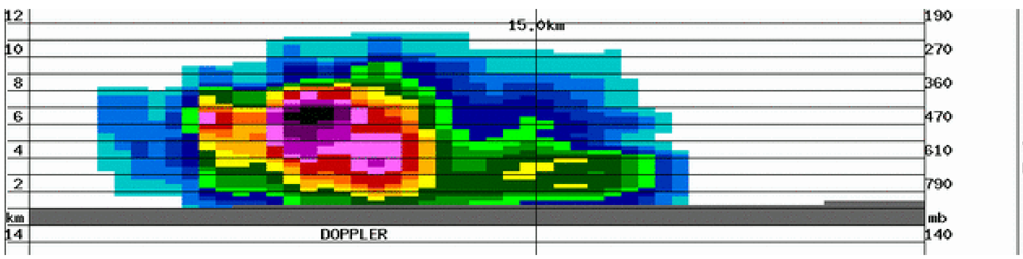


Figure 16: Vertical cross-section of the Lac-Drolet tornadic cell

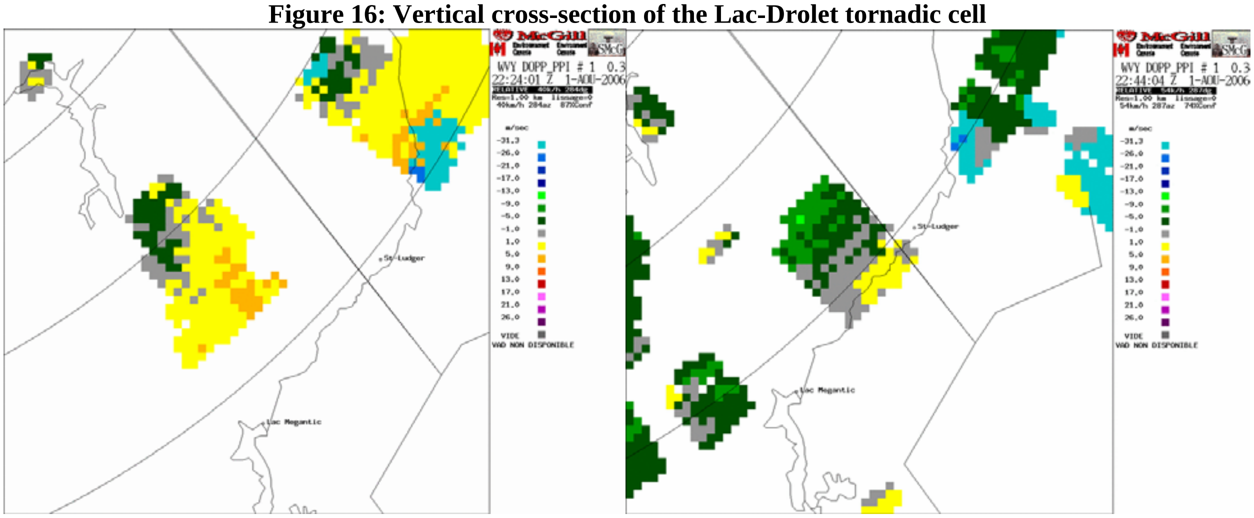


Figure 17: The Doppler wind speed data show a doublet of velocities at the same times represented by the previous figures. The image on the right uses low-resolution, long-range data (160 km to the radar).

The cross-section (Figure 16) of this cell shows that reflectivities were much more intense at higher altitudes, and the characteristic shape of a supercell with limited vertical development can be seen: echo top at 10 km, intense core at 6 km, echo overhang of 6 km relative to those at low levels. The cell east of Saint-Ludger, which had just passed over Saint-Gédéon, was similar, but the overhang was at a lower altitude, hence the algorithm was not triggered. Both cells had overhangs and each one spawned a tornado: one at Lac-Drolet and one at Saint-Gédéon de Beauce.

The Doppler velocity images for the thunderstorm, even those at long range, show velocity doublets for the lowest elevation angle (0.3 degree) at less than 1.5 km from the ground. At 22:24 UTC, Figure 17 (left side) shows a yellow-green doublet in the westernmost cell (zero line in grey) that was fairly circular and oriented as expected in a mesocyclone, whereas the doublet for the eastern cell had a more east-west orientation, perpendicular to the radial to the radar, as in the case of a microburst.

The same figure (right side) shows the Doppler velocities at 22:44 UTC, when the tornadoes struck. Only one doublet remains, but the limit between short- and long-range data had been reached, making detection more difficult because of the low Doppler resolution. The zero velocity line (grey) had become perpendicular to the radial to the radar, suggesting that it was now an area of wind divergence (yellow outbound and green inbound). However, near the eastern edge (Saint-Ludger), the doublet had a more radial orientation, which could still be an indication of a mesocyclone.

The doublet was visible at several angles between 22:00 UTC and the time the tornado struck, but it was still fairly weak and was detected only once by the mesocyclone detection algorithm, at 3.5 degrees elevation on 22:34 UTC (7 km altitude at this distance). The various elements provided by the radar could therefore be combined to issue an alert, although those elements were very marginally typical. Moreover, the tornado occurred shortly after the thunderstorm developed.

Turning now to the zoom of the simulation (Figure 18) around 22:00 UTC, we see several cells in the Beauce (upper right) and the Estrie (lower part of the image, near the U.S. border with Vermont) regions. The tops of these simulated thunderstorms are at 6 to 7 km, using 18 dBz as the lower limit of reflectivity, whereas the actual echoes were as high as 10 km. The blue lines indicate areas of overhang on the east side of the storms, in the direction of movement. The black lines of the potential gusts are very vertical, with low-level reflectivities, indicating a column of precipitation right at the edge of the overhang area. The maximum value is 117 km/h for one of the Beauce cells, and 198 km/h for the Estrie cells. A few mesocyclone areas have been detected by the algorithm (right side). The algorithms seem to indicate that the supercells developed by the GEM-LAM have fairly limited vertical extension, which was the case in reality.

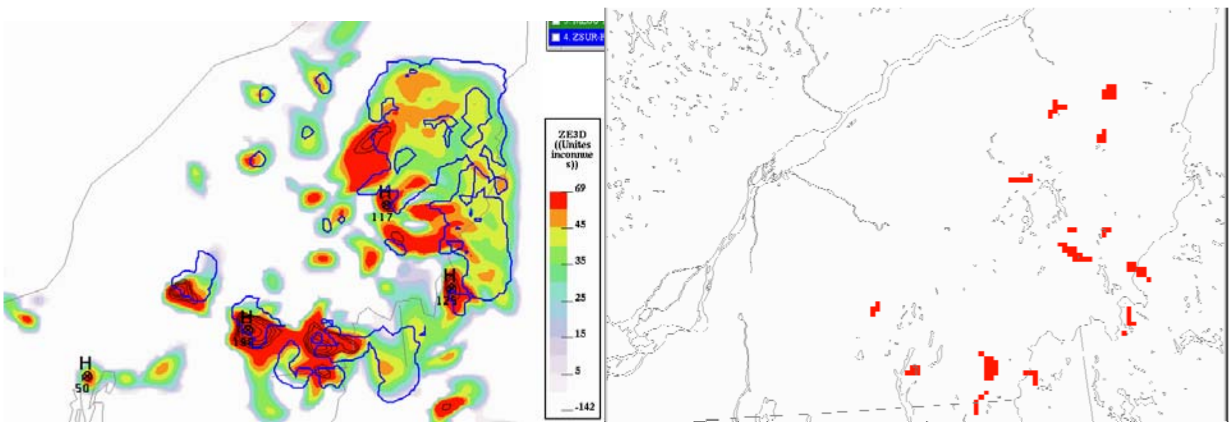


Figure 18: Zoom of the supercells simulated in the Beauce region around 22:00 UTC. Left is the reflectivities in color, overhangs are the blue lines and potential gusts zones are the black lines. Right is the MESO output in red.

Forecast

A severe thunderstorm watch was issued in the morning for most of the regions on the severe weather chart north of the St. Lawrence River. Watches were issued for those on the south shore by mid-day. Warnings were issued as soon as the lines of convection became organized, starting with the Abitibi-Témiscamingue areas. The line of organized thunderstorms was closely monitored.

The individual cells ahead of the warm front that produced the tornadoes were less well covered. The watch was issued early, as mentioned above. The first warning for the Lake Megantic and Weedon areas, including Lac-Drolet, was issued at 22:31 UTC, or 20 minutes before the occurrence that involved the appearance of the overhangs—an excellent result. No warning was issued for the Saint-Gédéon area before the tornado, however, while a number of other sectors in the Beauce region were under a warning for similar thunderstorm cells, clearly demonstrating the marginally typical nature of these particular thunderstorms.

Discussion

Was the long line of convection that developed on August 1, 2006, nothing more than a normal squall line or was it a derecho? The question is a difficult one to answer. The event had all the characteristics of a squall line, with scattered thunderstorms that organized into a line over the Abitibi region around 18:30 UTC. The line included undulations and rear notches where wind damage was the most intense as a result of the descent of the mid-level jet stream.

However, the line eventually expanded to over 300 km in length after 23:00 UTC. Although it moved fairly slowly at first, it ultimately gathered speed, reaching 80 km/h by the time it reached the St. Lawrence Valley around 00:00 UTC. Both these characteristics are associated with a derecho. Moreover, between the time it first appeared, around 18:00 UTC, and the time it dissipated, the line had lasted at least 8 hours, as shown in Figure 19.

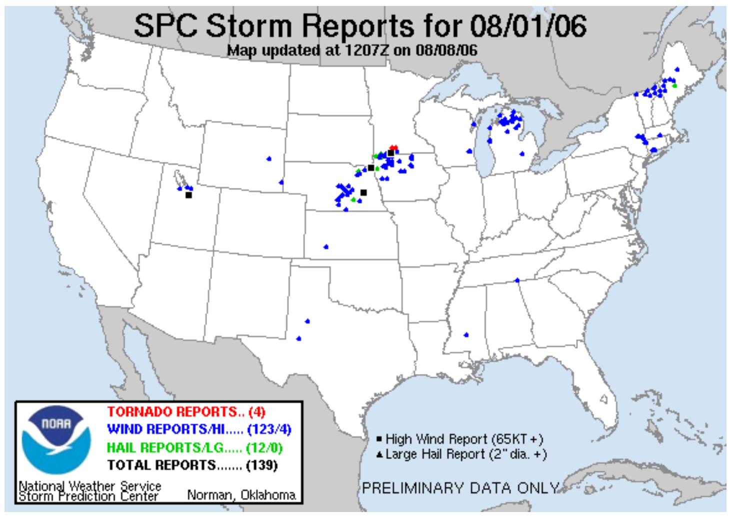


Figure 19: Compilation of damages in the United States on August 1, 2006. Between 00:00 and 02:00 UTC, on August 2, 2006, wind damage is reported to have occurred along the Quebec border in Vermont, New Hampshire and Main (blue points) in association with the line of organized thunderstorms.

Does this mean that any long squall line must be defined as a derecho? In the summer of 1994, several similar events occurred in connection with an active cold front moving from Ontario toward New Brunswick. The site of the U.S. Storm Prediction Centre (SPC) mentioned in the above figure describes the event of July 4-5, 1999, as one of the northern most derechos to have been recorded, and it followed a corridor from the Abitibi region to the Estrie area, slightly south of the path taken by the thunderstorms of August 1 2006.

According to the definitions provided on the SPC site[3] and in the study of the phenomenon by Serge Mainville,[4] there are two types of derecho:

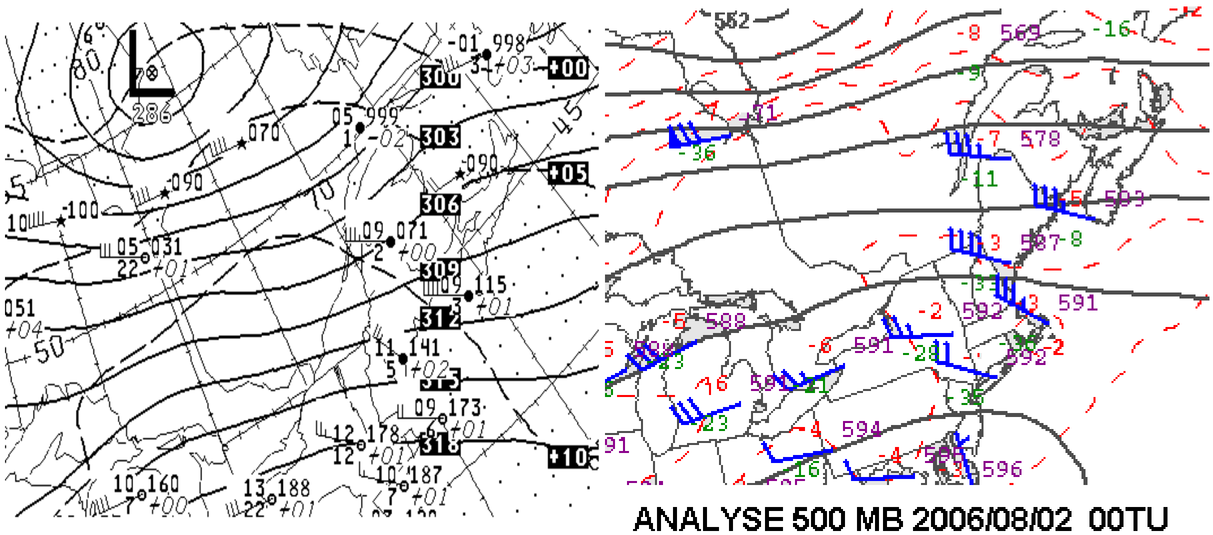
- Serial (or cold-season) derecho:
    - Associated with an extensive squall line accompanied by bow echoes.
    - Presence of a low and a very distinct cold front in a strong upper-level trough.

[3] (http://www.spc.noaa.gov/misc/AbtDerechos/derechofacts.htm)

[4] Mainville, S., 1999: The derecho of 4-5 July 1999 in southern Quebec (http://qww/ibsme/wwwu/Cas_temps_violents/TV_04071999/derechototal.htm)

- o Direction of propagation along upper-level flow, i.e., usually parallel to the cold front.
- Progressive (or warm-season) derecho:
  - o Propagates along a stationary front in an upper-level anticyclonic flow.
  - o Upper jet stream well to the north of the front, and weak low-level jet that is intensified by the night-time radiation inversion.
  - o Follows the zone of maximum humidity.
  - o Speed is <u>greater than</u> that of the mean upper winds.
  - o Often a late-day degeneration of a mesoscale convective complex (MCC) that propagates during the night.

The event of August 1 has certain characteristics of both types of derechos: a low pressure system with a cold front, but with west-east flow, meaning that the derecho line should move toward the east, as in the case of the serial type of derecho. On the other hand, the upper-level jet stream is well to the north of the system, circulation is slightly anticyclonic, keeping the warm front fairly stationary, but not the cold front. The area of moisture is along the track followed by the line of thunderstorms, and the low-level jet is weak and parallel to the cold front, as in the case of the progressive type of derecho.



Analyse 700 mb 2006/08/02- 00 TU Analysis
Source: NOAA/NCEP

ANALYSE 500 MB 2006/08/02 00TU
SOURCE: NOAA

Figure 20: 700- and 500-mb analysis charts for 2006/08/02 at 00:00 UTC. Note the west-northwest winds between 30 and 45 knots above the warm sector at these two altitudes.

Hence, it is more likely that the event is a progressive type of Derecho, but the progression of the line of thunderstorms at 80 km/h is fairly close to the 40 knots (approximately 75 km/h) of the winds at 700 mb and 500 mb (Figure 20). Furthermore, no MCC was involved and the entire event took place during daytime. Finally, the redevelopment that is seen at the gust front is always at a constant distance from the line of convection. This indicates a synchronization between the speed of the line and that of the gusts, showing that the line is not moving more rapidly than the high-level winds.

To clarify the matter, I decided to consult the experts. The authors of a recent climatological study in the U.S.[5] defined a Derecho as any line of thunderstorms, 400 km in length and of several hours duration, that causes significant wind damage along its entire track. This definition does not really cover the formation process and mix phenomena that are not necessarily similar. In this context, the thunderstorm line of August 1 marginally qualifies as a Derecho. Although it caused significant damage along its entire track, at its peak, it measured only about 300 km.

Conclusion

Although the line of thunderstorms has several characteristics of a Derecho, the fact that it travelled at the same speed as the mid-level circulation and ahead of a cold front eliminates it as a candidate for the strict definition of a progressive Derecho. I therefore would conclude that the event was simply a particularly intense squall line.

The GEM-LAM simulation corresponds fairly closely to the actual events, given the development of an intense squall line with a cold front and of thunderstorm supercells with the warm front. However, there was room for improvement in terms of the length of the line and the synchronization of development.

[5] Ashley, W. S., and T. L. Mote, 2005: Derecho hazards in the United States. (http://ams.allenpress.com/archive/1520-0477/86/11/pdf/i1520-0477-86-11-1577.pdf)

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APPENDIX

AWCN60 CWUL 020143

SUMMARY OF SIGNIFICANT WEATHER EVENTS
FOR THE PROVINCE OF QUEBEC ISSUED BY ENVIRONMENT CANADA MONTREAL
AT 11:00 AM EDT TUESDAY 1 AUGUST 2006.

DATE/TIME (LCL)	REGION(S)	LOCALITY(IES)	EVENT(S)
01/6-8 PM	MONT-LAURIER	MONT-LAURIER	R POSS (FALLEN TREES)
01/7-9 PM	HAUTE GATINEAU	MANIWAKI-LOW	R POSS (FALLEN TREES)
			G POSS(1/2-1) CM
01/9:53 PM	HUNTINGDON	NAPIERVILLE	R (93 KM/H)
01/9-10 PM	MONTREAL	DORVAL	R (94 KM/H)
01/8:52 PM		ST-HUBERT	R (93 KM/H)
01/8:43 PM	VALLEE DU RICHELIEU	VARENNE	R (107 KM/H)
01/8:10 PM		CONTRECOEUR	R POSS (110 KM/H)
01/9 PM		ST-HYACINTHE	R POSS (87 KM/H)
01/7-8 PM	LAURENTIDES	ST-JOVITE	PT POSS (24 MM)
		ST-SAUVEUR	R POSS (BROKEN TREES)
		ST-AGATHE	R POSS (BROKEN TREES)
01/7-8 PM	LANAUDIERE	ST-LIN	R POSS (76 KM/H)
		MANDEVILLE	R POSS (BROKEN TREES)
		ST-DONAT	R POSS (BROKEN TREES)
01/9 PM	LACHUTE-ST-JEROME	BLAINVILLE	R POSS (BROKEN TREES)
01/8:30 PM	MAURICIE	TROIS-RIVIERES	G POSS(1/2-1 CM)
01/8:22 PM		LAC-ST-PIERRE	R POSS (85(KM/H)
01/8:34 PM	DRUMMONDVILLE	NICOLET	R (90 KM/H)
01/6:50 PM	ESTRIE	LAC-DROLET	T (F2)
01/9:53 PM		LENNOXVILLE	R (100 KM/H)
01/9:52 PM		SHERBROOKE	R (89 KM/H)
01/9:42 PM		STE-SABINE	R POSS (78 KM/H)
01/9-10 PM		COATICOOK	R POSS (BROKEN TREES)
01/9-10 PM		GRANBY	R POSS (BROKEN TREES)
01/6:50 PM	BEAUCE	ST-GEDEON	T (F1-F2)
01/9-11 PM		LAC ETCHEMIN	R POSS (BROKEN TREES)
01/9-11 PM		STE-JUSTINE	G POSS (1-2 CM)
			PT POSS (FLOODED BASEMENTS)
01/8:49 PM	QUEBEC	VILLE QUEBEC	R (90 KM/H et ARBRES CASSES)
01/8:40 PM		ISSOUDUN	R POSS (BROKEN TREES)
		ST-AUGUSTIN	R POSS (BROKEN TREES)
01/8:41PM	LAC-ST-JEAN	ST-GEDEON	R POSS (76 KM/H)

CODE:

G= HAIL R= GUST PT= HEAVY DOWNPOURS
PA= HEAVY RAIN T= TORNADO TN= FUNNEL CLOUD
VV= HIGH WINDS POSS= POSSIBLE

Quebec Government News Release

THUNDERSTORMS AND STRONG WINDS, AUGUST 1-3, 2006: IMPLEMENTATION OF THE GENERAL DISASTER FINANCIAL ASSISTANCE PROGRAM

QUEBEC CITY, Sept. 6 /CNW Telbec/ - The Minister of Public Security, Jacques P. Dupuis, announced that 19 municipalities would receive compensation under the General Disaster Financial Assistance Program for damages suffered during the violent thunderstorms and winds that occurred between August 1 and 3, 2006.

The minister gave assurances that the Quebec government supports the efforts of local authorities and that it will come to the assistance of residents who were victims of the storm to ensure that life returns to normal as quickly as possible. Everything is being done to ensure the safety of those affected by this disaster.

The General Disaster Financial Assistance Program is being implemented today to provide assistance, as a last resort, to cover damages sustained to principal residences and municipal infrastructures. Companies and agencies may also be eligible under the program if their core assets have been damaged. Representatives of the Department of Public Security have already contacted municipal authorities. Information on the program, as well as claim forms, are available electronically at the following address: www.msp.gouv.qc.ca.

Finally, the Minister stressed that a disaster of this nature demands a concerted effort on the part of stakeholders—not only those in the area of emergency management, but many other partners as well—hence the importance of emphasizing their work and reminding residents of Quebec that they can rely on their cooperation, regardless of the nature of the disaster they face.

The following municipalities are eligible for compensation under the General Disaster Financial Assistance Program because of the violent thunderstorms and winds that occurred between August 1 and 3, 2006:

Municipalities	Electoral Ridings
Abercorn	Brome-Missisquoi
Denholm	Gatineau
Dixville	Mégantic-Compton
Frelighsburg	Brome-Missisquoi
Lac-Drolet	Mégantic-Compton
La Minerve	Labelle
La Pêche	Gatineau
Rosemère	Groulx
Sainte-Justine	Bellechasse
Sainte-Marthe	Soulanges
Sainte-Mélanie	Berthier
Sainte-Sabine	Bellechasse
Saint-Armand	Brome-Missisquoi
Saint-Hubert-de-Rivière-du-Loup	Rivière-du-Loup
Saint-Lazare	Soulanges
Saint-Théophile	Beauce-Sud
Saint-Ulric	Matane
Sutton	Brome-Missisquoi
Très-Saint-Rédempteur	Soulanges

Radio-Canada Article

(Updated on Sunday, August 6, 2006, 7:19 a.m.)

5,000 homes still without power

Latest news

Some 5,000 homes are still without power in Quebec in the wake of the violent thunderstorms of Tuesday evening.

Linemen from the United States, New Brunswick and Ontario have arrived to lend a hand to their colleagues in the public utility.

Most of the victims of power outages are located in the Laurentians. Some may have to wait until Monday evening before power is restored.

Municipalities where residents are still without power are making arrangements to provide them with assistance. Some have opened temporary shelters, and agencies have offered to store residents' food in refrigerators.

At the height of the thunderstorms, around 11:00 p.m. on Tuesday evening, some 470,000 Hydro-Québec customers were without power.

The storms, accompanied by winds of up to 150 km/hr, were responsible for the deaths of two people. Hundreds of trees were downed, many of which struck power lines and transformers.

Source: http://www.radio-canada.ca/nouvelles/regional/modele.asp?page=/regions/Montreal/2006/08/03/001-pannes-electricite.shtml

PHOTOGRAPHS OF DAMAGE

Figure 21: The Laurentians north of Montreal, in the La Minerve area, where blowdowns caused by a downburst can learly be seen.

Figure 22: This tree, felled by wind in Terrebonne near Montreal, is typical of the damage left along the entire path of the line of organized thunderstorms.

Figure 23: Damage on Père Marquette Street in Quebec's upper town. The location of the downed trees is indicated on the map at the top, and the manner in which they were broken provides a clear indication of the nature of the downburst.

Figure 24: The upper left image clearly shows the tornado funnel that occurred at Lac-Drolet, northeast of Lac-Mégantic in the Estrie area. The damage, including this overturned automobile and flattened home, are consistent with a tornado of F2 strength. The diagram shows the path of the tornado, based on the location of the damage.

[Translation of text in lower right image]

TORNADE DU LAC DROLET - 1 AOUT 2006 - F2 sur échelle Fujita: Lac-Drolet tornado - August 1, 2006, F2 on the Fujita scale

Chablis sur 2 km x 300 m: Blowdowns over an area 2 km x 300 m

Maison détruite: House destroyed

Portion de toiture arraché - arbres cassées: Part of a roof torn off - broken trees

Position approximative du Lac Drolet – Approximate location of Lac-Drolet

Témoin rapporte avoir vu la tornade quitté le sol - fin des dommages apparents: Witness reports seeing the tornado leave the ground - end of obvious damage

Trajectoire totale environ 7.5 à 8 km: Total length of path approximately 7.5 to 8 km

 

Figure 25: Damage caused by the type F1-F2 tornado at Saint-Gédéon-de-Beauce; over 1,000 trees were downed.

TABLE OF FIGURES