

The Great Maritimes Blizzard of February 18-19, 2004

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Introduction

On 18 February 2004 an intense low pressure system formed well south of Nova Scotia as cold air from eastern North America clashed with the relatively warm waters of the Gulf Stream. The storm moved northeastward passing south of Nova Scotia and over Sable Island. A vast area of heavy snow and high winds swept across Nova Scotia, Prince Edward Island and southeast New Brunswick bringing blizzard conditions and record snowfalls. Widespread amounts of 60 to 90 cm (24 to 36 inches, 2 to 3 feet) were experienced bringing Nova Scotia and Prince Edward Island to a standstill. States of emergency were put into effect across these provinces in order for emergency officials to perform their duties and clean up the mammoth snowfall. It took days for many urban streets and highways to be cleared.

1. The Synoptic Situation

A storm track map is shown in Fig. 1 with a time series of minimum sea level pressure in the inset based on analyses at the Maritimes Weather Centre in Halifax, Nova Scotia. The storm formed approximately 200 km southeast of Cape Hatteras, NC at 00 UTC 18 February. It then moved to the northeast at 35-40 km/h, attaining its lowest sea level pressure of 959 mb at 18 UTC 19 February 250 km southeast of Halifax, NS (Fig. 2).

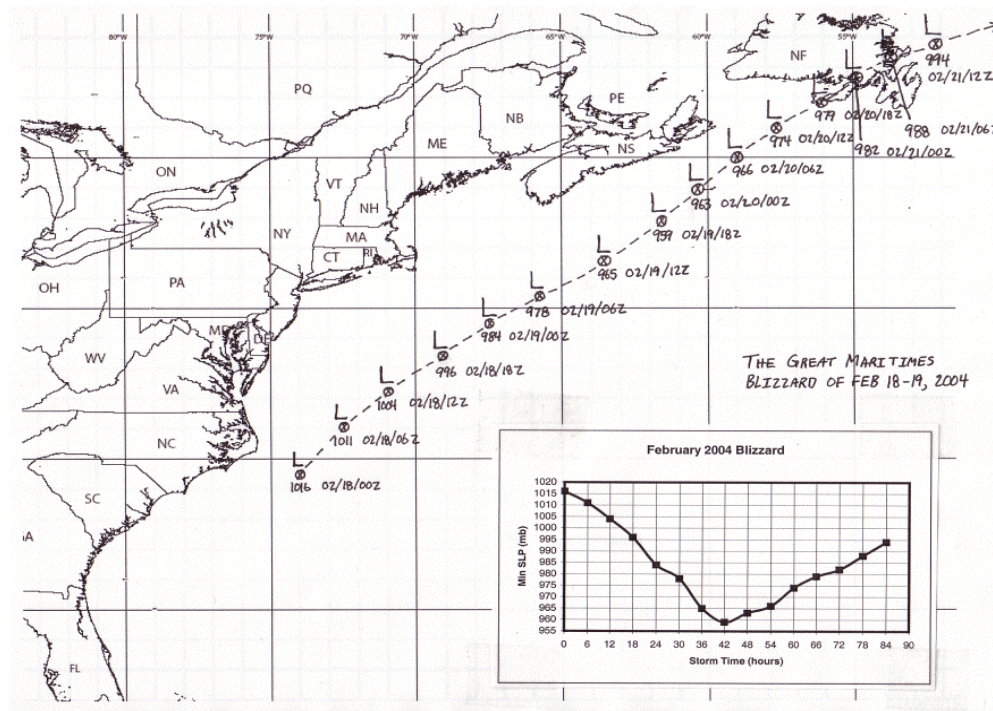


Fig. 1. Storm track and time series of minimum sea level pressure.

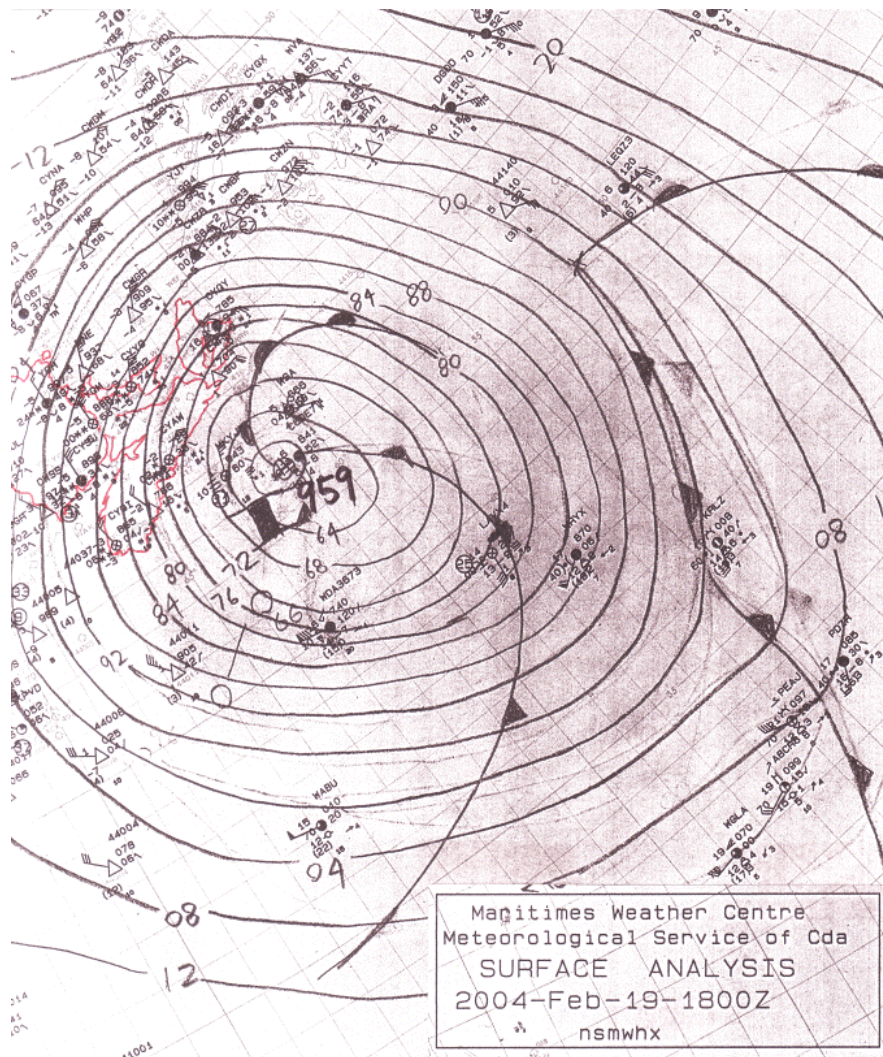


Fig. 2. Sea level pressure analysis of the storm at maximum intensity.

The total (maximum) 24-hour deepening between 18 UTC 18 February and 18 UTC 19 February was 37 mb. The minimum requirement for a storm to be dubbed as a meteorological “bomb” is commonly accepted as 24 mb in 24 hours, so this system exceeded the criterion by a factor of 1.5. After achieving the lowest sea level pressure, the storm moved more slowly toward the northeast at approximately 27 km/h. It then moved across the Burin Peninsula of Newfoundland and exited Newfoundland as a 990-mb low on 21 February. The 500 mb geopotential height and vorticity analysis is shown in Fig. 3 valid at 12 UTC 19 February. The surface low was very near the location of the 500-mb low centre at this time, which offers an explanation to why the storm was moving so slowly when compared to other storms of this intensity and based on experience.

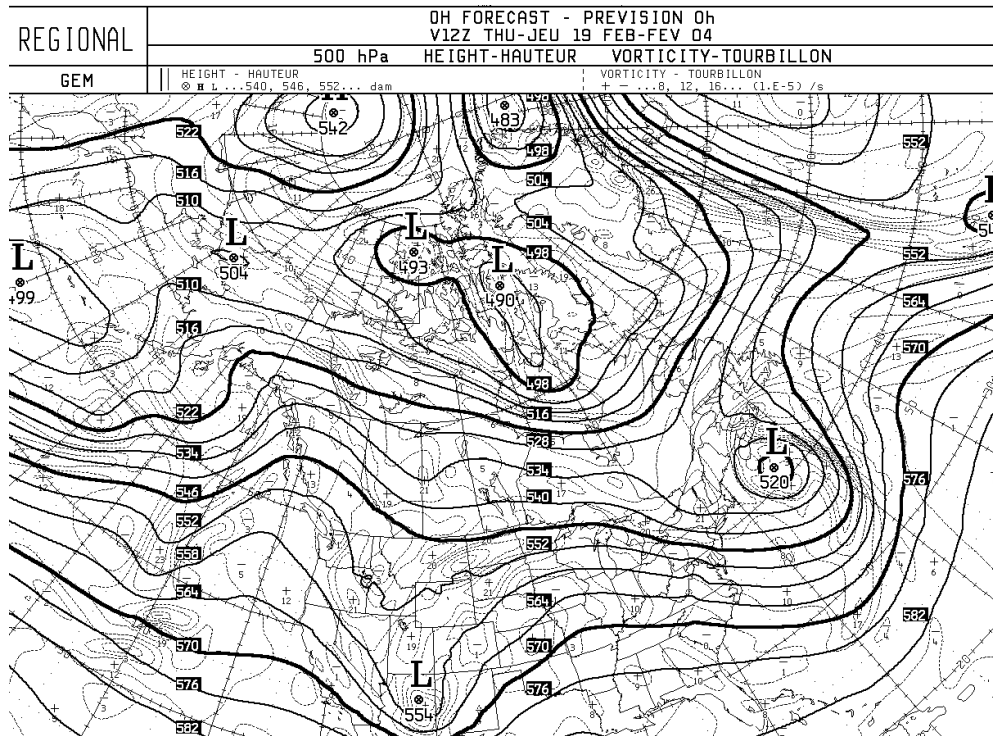


Fig. 3. 500 mb geopotential height and vorticity from the GEM regional 00 HR forecast.

Visible and infrared GOES satellite imagery is shown in Fig. 4 depicting the storm at different stages during the rapid deepening period. At 18 UTC 18 February the cloud pattern is typical of a cyclone in its formation stage with a broad cloud shield and cirrus deck over-running Nova Scotia and a strikingly sharp cold front extending southward into the Bahamas. Overnight on 19 February the cyclone developed a comma-shaped cloud pattern as shown in Fig. 4b and Fig. 4c. During this period very heavy snow had spread across Nova Scotia. The visible image in Fig. 4d shows the most intense stage of the mature low with cloud wrapping around to the north and west. This cloud region continued to bring heavy snowfall for an extended period of time to the Maritime Provinces.

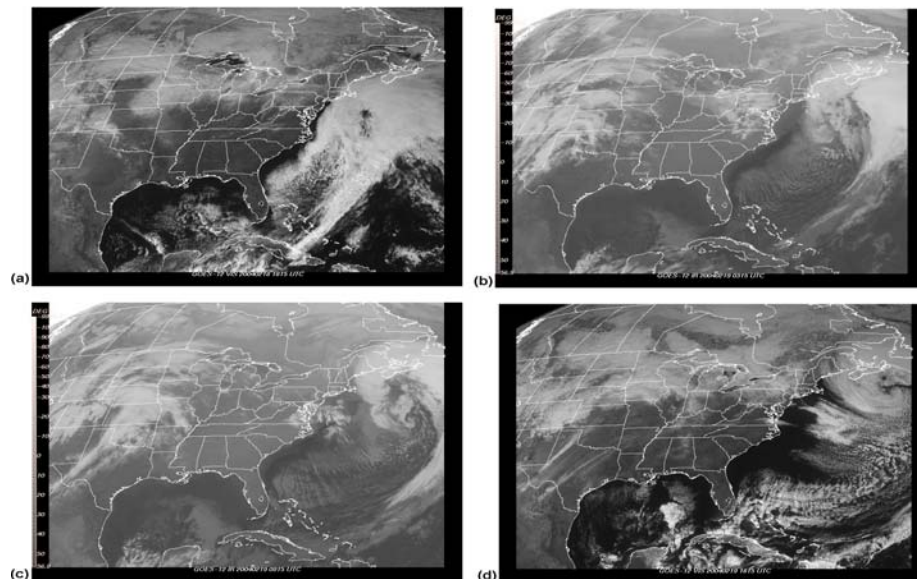


Fig. 4. GOES satellite imagery showing the evolution of the storm.

When the snow arrived it came as a solid band of radar reflectivities as indicated in Fig. 5. On the south side of this leading band was more convective-type precipitation, which appears in the image approaching the Atlantic coastline of Nova Scotia. The storm also brought some freezing rain, ice pellets and rain over Guysborough, Richmond and Cape Breton Counties in eastern Nova Scotia. Snowfall rates were much higher than the radar imagery indicated. For example, in Fig. 5 the maximum snowfall rate is 2 to 3 cm/hr according to the scale, while in reality this would have corresponded to rates near 5 cm/hr.

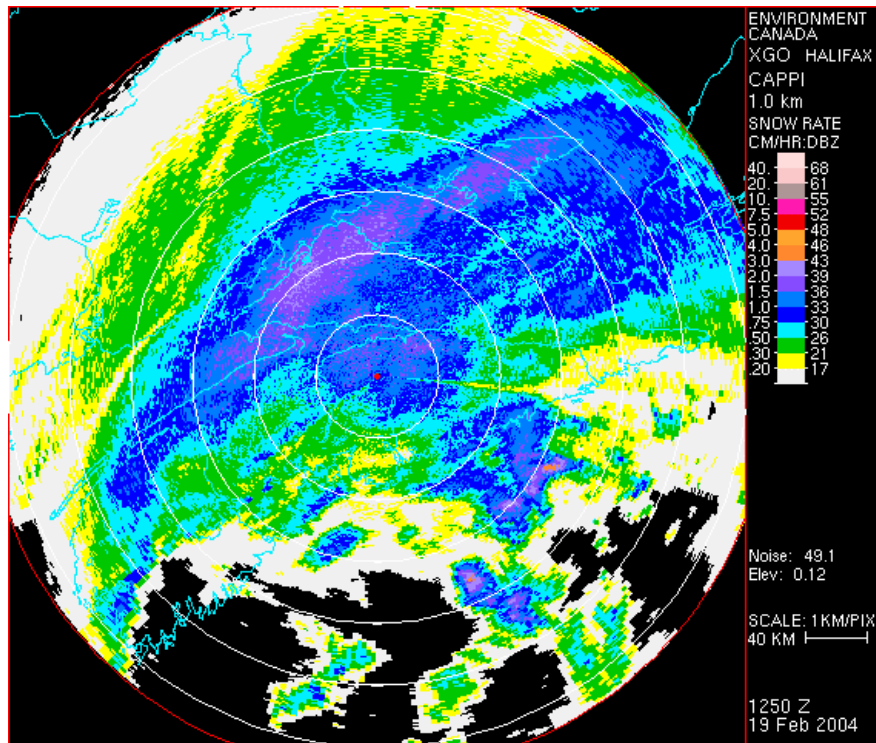


Fig. 5. Radar image from Gore, Nova Scotia showing intense snow band over the province.

2. The Snowfalls

Every storm has a story. For this one, it was the mammoth snowfall and blizzard. A wide swath of 60+ cm (2+ feet) snowfalls was measured over central Nova Scotia, Prince Edward Island and extreme southeast New Brunswick as shown in Fig. 6. The analysis is subjective and represents an estimate of the general pattern. Data are taken from principle airport stations, volunteer climate observers and amateur weather observers. A few points should be noted when interpreting this analysis. For one, the amounts themselves (shown in red in cm) are estimates. Errors in measurements are due to many factors, but the most problematic is taking measurements when there is extensive blowing snow. If snow is melted using a Nipher snow gauge as is done at the airports, errors may also come about when using the simple 10:1 snow/water ratio. A couple highly suspect amounts in the analysis (including Shearwater's 95 cm) are flagged with a question mark and the contour lines are not fit to the data. The main reason for the suspicion of these data was a persistent inconsistency between observed snowfall intensities and measured snowfall rates during the blizzard. In some instances, hourly accumulations of 7 cm were being reported while snow was falling at a moderate pace. Normally moderate snow will give 2 or 3 cm hour. I personally took observations of snowfall intensities, visibilities and snowfall rates. The snowfall rates/amounts I measured were consistent with the reduced visibility due to the falling snow. My total estimate for the Clayton Park area of Halifax was 70 cm.

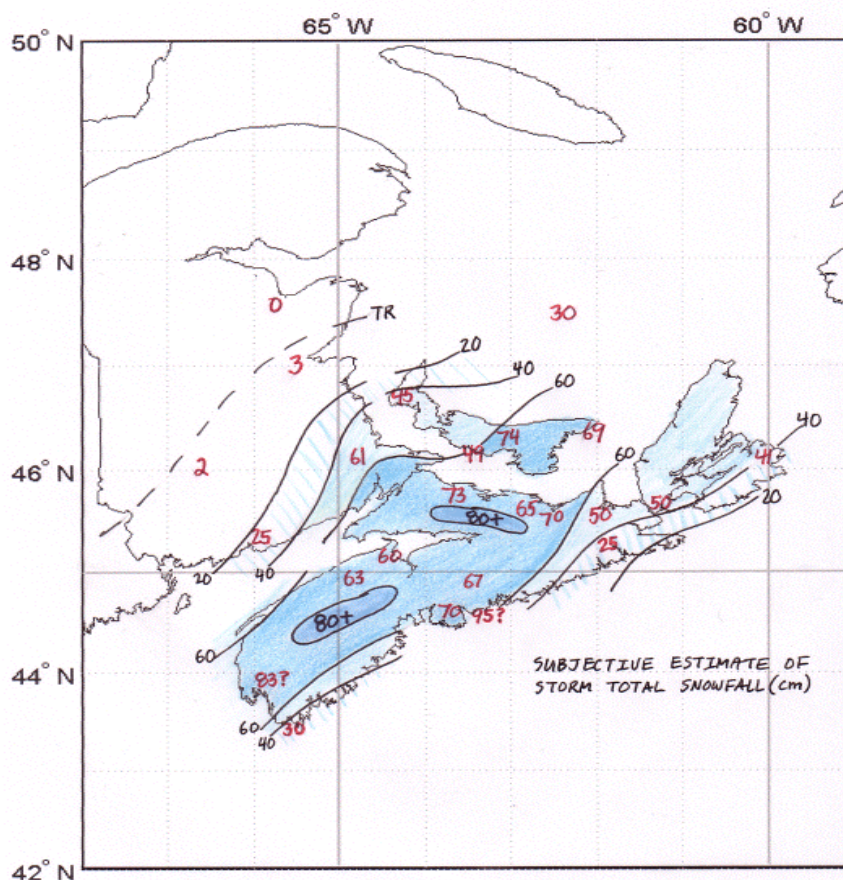


Fig. 6. Subjective analysis of storm total snowfall estimates.

The 80+ cm pockets in the analysis are estimates based on the likelihood that snowfalls would be higher in those areas consistent with elevated terrain and upslope airflow. The sharp drop-off in amounts over southeastern New Brunswick marks the northwest side of the storm. The gradient in amounts over southwestern Nova Scotia denotes the area south of the most intense snow belt. The lighter amounts over eastern and southeastern Nova Scotia represents where snow changed to rain and ice pellets or where the storm's dry slot was forming.

It is interesting to note that although the track of the low was well south of mainland Nova Scotia (over Sable Island), the weather was very intense. Of course this is no surprise knowing the structure of these storms where the heaviest precipitation occurs well to the left of the storm's track. In this case, *the axis of maximum snowfall averaged 300 km away from and parallel to the storm track*. The band of heaviest snow (60+ cm) was very wide however, averaging 150 km.

The excessive amounts of snow were partly attributed to the slow forward motion of the storm. During the storm's rapid deepening period, it was only moving northeastward at a maximum of 40 km/h. Typically we observe intense storms in this area to move at least 60 km/h during their deepening phase.

Many snowfall records were broken with this storm including largest one-day/one-storm snowfall for Halifax. This is based on the - what I believe to be - dubious 95 cm Shearwater value. The previous record snowstorm for Halifax city was 73 cm in February 1960. If my estimate of 70 cm is representative for the area, then one may be lead to believe this storm's snowfall very similar to the 1960 storm. However, given the challenge of snow measurements in high wind situations, we will never know for sure!

3. The Weather Conditions

Blizzard conditions persisted for close to 24 hours in the Halifax area. Visibilities were generally around 1/8 to 1/4 mile with frequent whiteouts producing zero visibility. Wind gusts were generally 80 to 100 km/h with near 120 km/h wind gusts in exposed areas, like McNab's Island in Halifax Harbour which registered a peak wind gust of 124 km/h (67 knots) in the north-northwesterly winds as the storm was departing Thursday evening. Winds were blowing a steady 80 km/h (43 knots) during the height of the storm. At Shearwater, winds were steady at 65 km/h (35 knots) gusting to near 90 km/h (50 knots) at the height of the blizzard Thursday evening. The fact that the sustained winds were so high is indicative of a powerful storm. The intensity of the snow during the blizzard was also very heavy, so the formation of drifts was relentless and there seemed to be no way for snowplough operators to keep up with the sheer volume of snow. They had to be taken off the roads for the simple fact that they could not even see where the streets were or where they were going! A photograph of conditions during the early morning hours of 19 February is shown in Fig. 7.



Fig. 7. *The blizzard rages on. At daybreak on 19 February drifts were already burying cars.*

4. The Impacts

Some called this storm “White Juan”, and it certainly brought back some memories of the last major disaster to hit the same area in September 2003 – Hurricane Juan. Similarities include the problem of power outages (although not nearly as widespread in the blizzard), difficulty traveling after the storm and the fact that both events brought the region to a standstill as businesses, schools and shopping malls shut down for an extended period of time. A province-wide state of emergency was declared and the city of Halifax had to issue traffic curfews to keep motorists and pedestrians off the streets so they could be cleared.

The biggest problem was the massive amounts of snow, which clogged city streets and other roadways. The snow came too fast and there was too much drifting for snowplough operators to keep up with it. There was too much snow to simply push off to the side of the road; it had to be bulldozed in many areas. Roads were impassable during the storm and remained that way for several days in the case of side streets. Many streets were reduced to one lane. Highway exit ramps were hazardous because of reduced visibility due to large snow banks and because the banks occasionally jutted out into traffic lanes.

The clogged roadways made it difficult for power crews to access those areas that experienced power outages. A few aftermath photographs are shown in Fig. 8.



Fig. 8. Images from after the storm in Clayton Park, 20 February 2004.

Storm Surge

The strong northerly winds blowing across the Gulf of St. Lawrence and Northumberland Strait produced a significant storm surge that caused some flooding. There were reports of flooding in Prince Edward Island, southeast New Brunswick and northern Nova Scotia. The surge waters came near high tide on the night of 19 February. Based on observations in the Pictou County area of Nova Scotia, the surge may have been on the order of 1.5 m (5 feet) because there was flooding in areas that do not normally flood in a more “typical winter storm surge” of 1 m in this area. A high resolution MODIS satellite image (Fig. 9) the day before the storm arrived showed dense ice along the Northumberland Shore of Nova Scotia but this did not appear to damp-out the surge effects as some believe. The numerical storm surge prediction model (which does not include sea ice effects) used at the weather office predicted a surge of near 1.5 m. There are many things we do not understand about the impact of sea ice on storm surge. Nonetheless, the office issued storm surge warnings and the provincial Emergency Measures Organizations were alerted to the potential for surge related flooding.

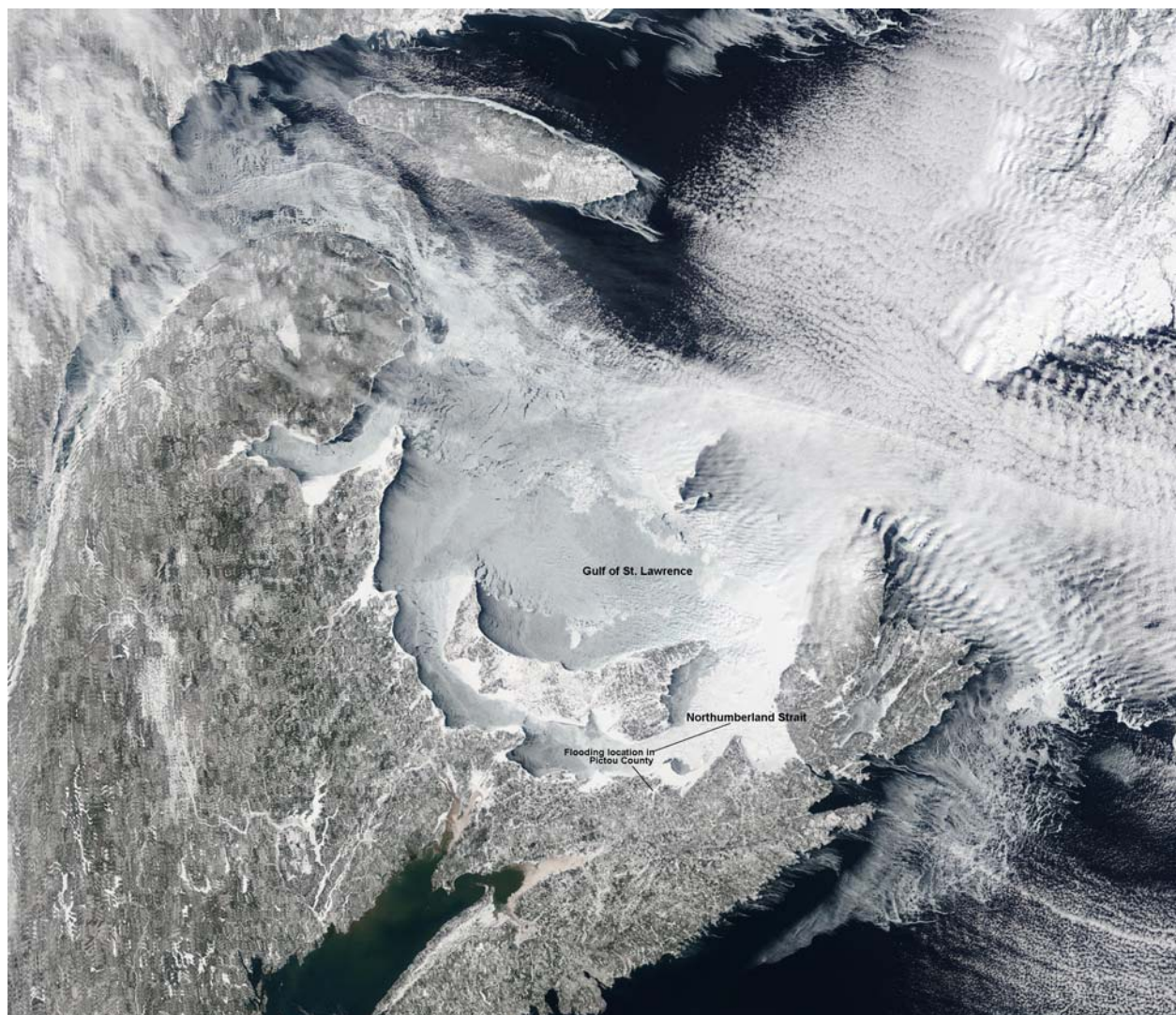


Fig. 9. Ice cover in the Gulf of St. Lawrence and Northumberland Strait prior to the blizzard. Image from MODIS satellite at 1505 UTC 17 February 2004.

5. Summary

From a forecasting perspective, all the atmospheric ingredients were in place to indicate a major blizzard. The public was warned appropriately that a heavy snowfall with high winds was to be expected with snowfall amounts on the order of 50 cm. Numerical guidance did suggest upwards of 80 cm of snow, but it is often the case that numerical guidance overestimates snowfalls in this region. In addition, it is very unlikely that a meteorologist will write a perfect forecast for a 50- or 100-year event. There have been three such events in Nova Scotia during the span of one year: the heavy spring flooding of March 31, 2003 that washed out several major bridges in the province, Hurricane Juan of September 29, 2003 cut a swatch of destruction through the centre of the province, and the Great Maritimes Blizzard of February 19, 2004. These events were all forecast well in the sense that weather warnings were issued in advance and close collaboration with emergency measures departments was maintained. What was surprising were the *impacts* of these weather disasters, and this highlights the fact that we as meteorologists should work more on understanding and conveying the impacts of severe weather on society and infrastructure.

For comments or questions on this report, email [hurricane\(at\)hfx.eastlink.ca](mailto:hurricane(at)hfx.eastlink.ca)

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February 22nd, 2004