Meteorological factors and icing on structures

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Background

•Water supply is fundamental to the electrical utilities sector and is determined by climate.

•Power generation, transmission and distribution are susceptible to drought, precipitation extremes as well as freezing rain and wet snow.

•Electrical utilities across Canada are exploring climate change opportunities, risks and adaptation across their corporations and need better insights on such extremes.

Objective

The objective of this presentation is to give an overview of atmospheric conditions of storms that lead to major power outages.

Weather conditions and impacts on infrastructure

- Freezing precipitations (ex: freezing rain and freezing drizzle) and wet snow
- Wind speed and direction

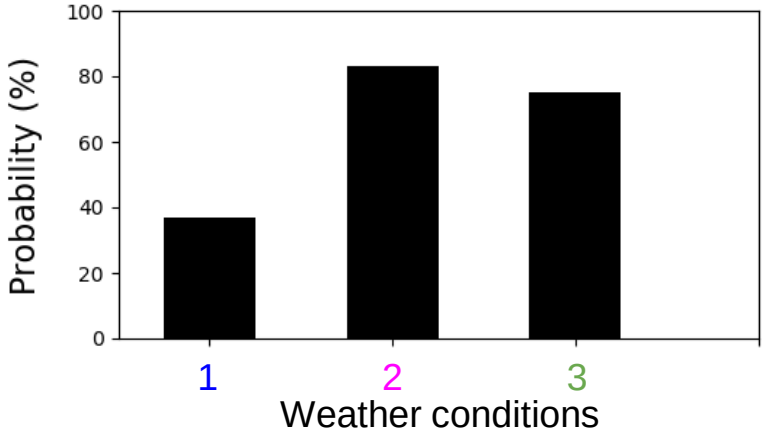
Wet snow accumulation, PEI

Ice storm, NB

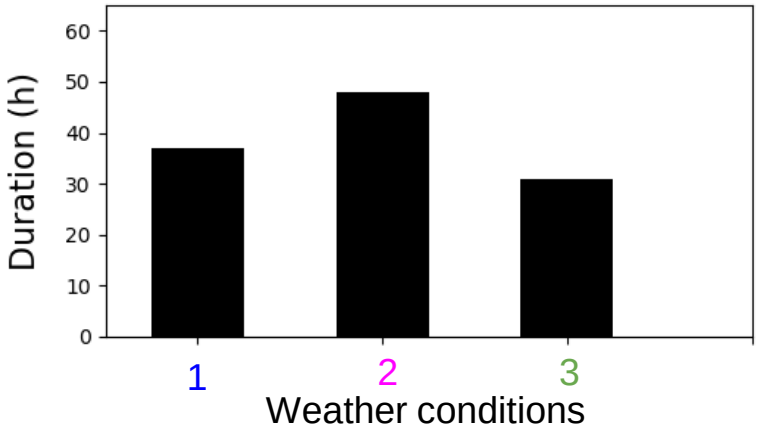
Damages due to strong winds, Manitoba

Weather-related power outages

Probability of power outage associated with a given weather condition



Maximum mean duration of power outages associated with a given weather condition



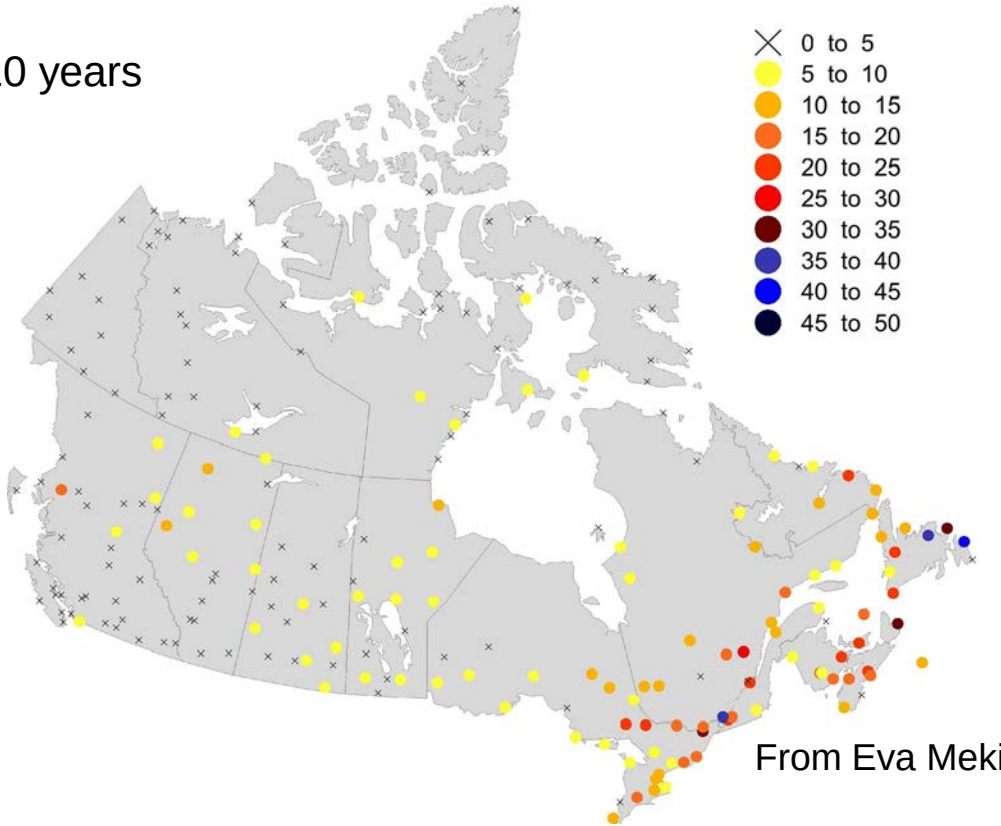
Legend:

1	Snow [Amount > 25 cm]
2	Precipitation + events associated with accretion
3	Precipitation + T~0°C [-3°C < T < 3°C and amount > 15 mm]

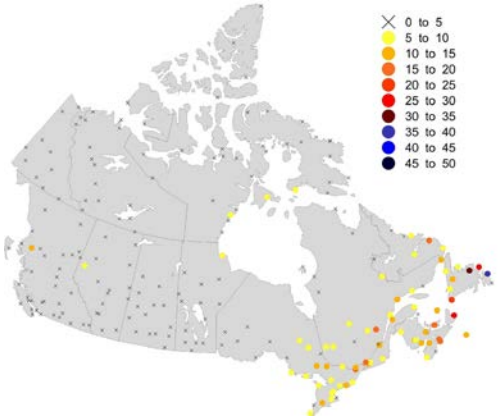
Source : Internal report, Ouranos

Occurrence of freezing rain in Canada

Period: 1981 – 2015, minimum 10 years



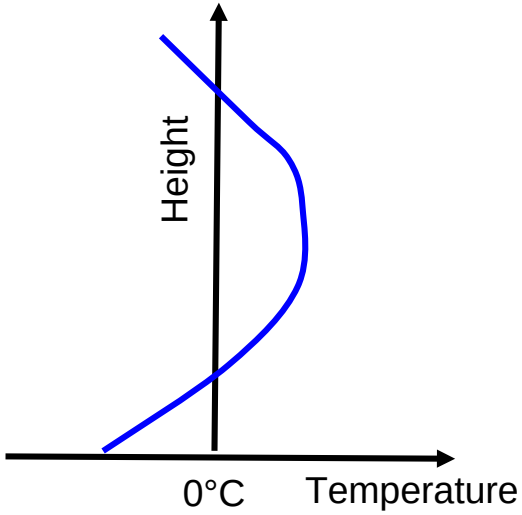
Within -2°C ≤ T ≤ 2°C limit the numbers a bit smaller:

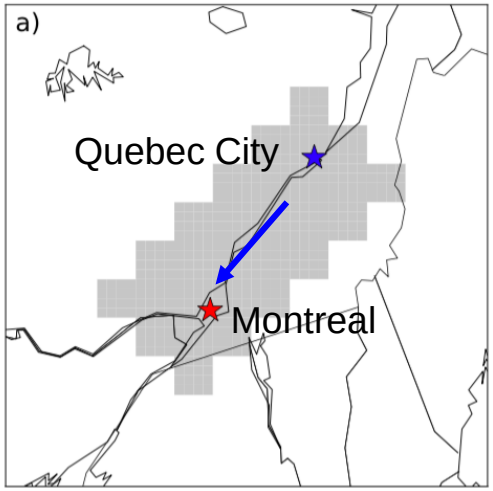


From Eva Mekis

Local effects

- Wind channeling in the St Lawrence River Valley, Qc





- Effects of topography exist in Manitoba as well - Poster from B. Tropea

High impact events and climatology

There is a need to improve our understanding of atmospheric conditions leading to high impact events and how they will change in the future.

Manitoba Hydro and NB Power have a list of events that impacted their infrastructure.

These events are being studied in detail using observations, atmospheric models and convection-permitting climate model simulations.

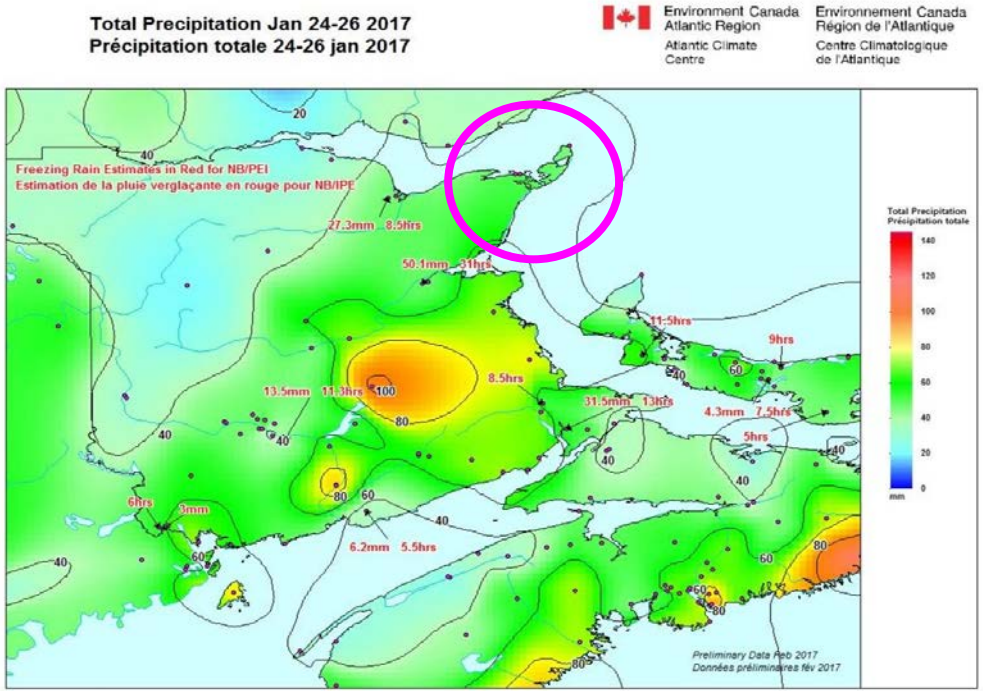
A recent extreme event over the province of N.B. has been studied (Poster V. McFadden).

Ice storm in N.B.

- Total accumulated precipitation of up to 100 mm from 22 to 24 January 2017

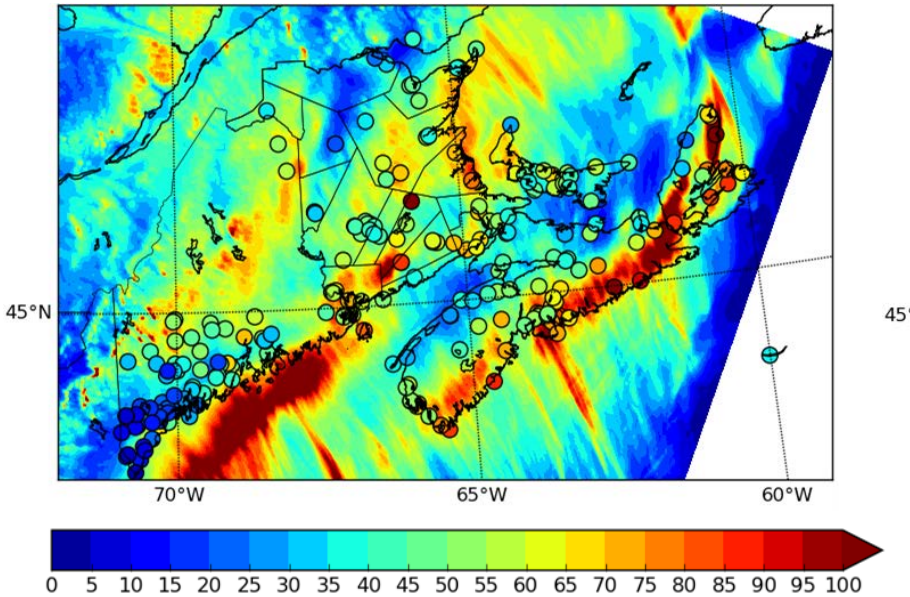
- Up to 50 mm of freezing rain in some areas (Miramichi) over 31 h.

- 133 000 customers without power, in particular in the Acadian Peninsula where 28 mm of freezing rain was reported over 11.3 h.



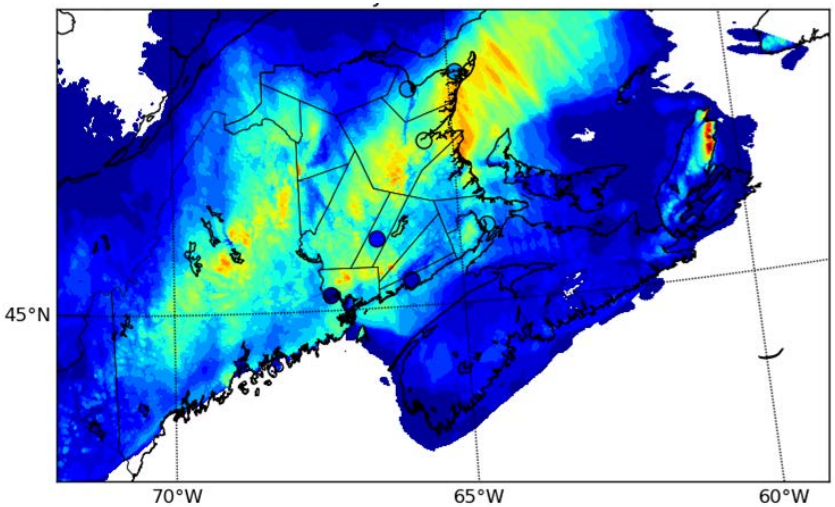
Accumulated precipitation

Total accumulated precipitation



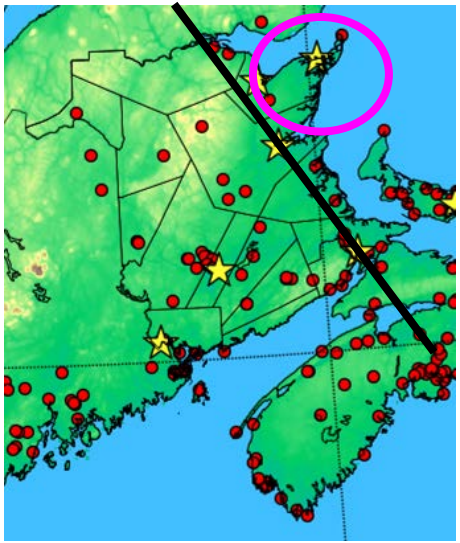
Observations d'ECCC

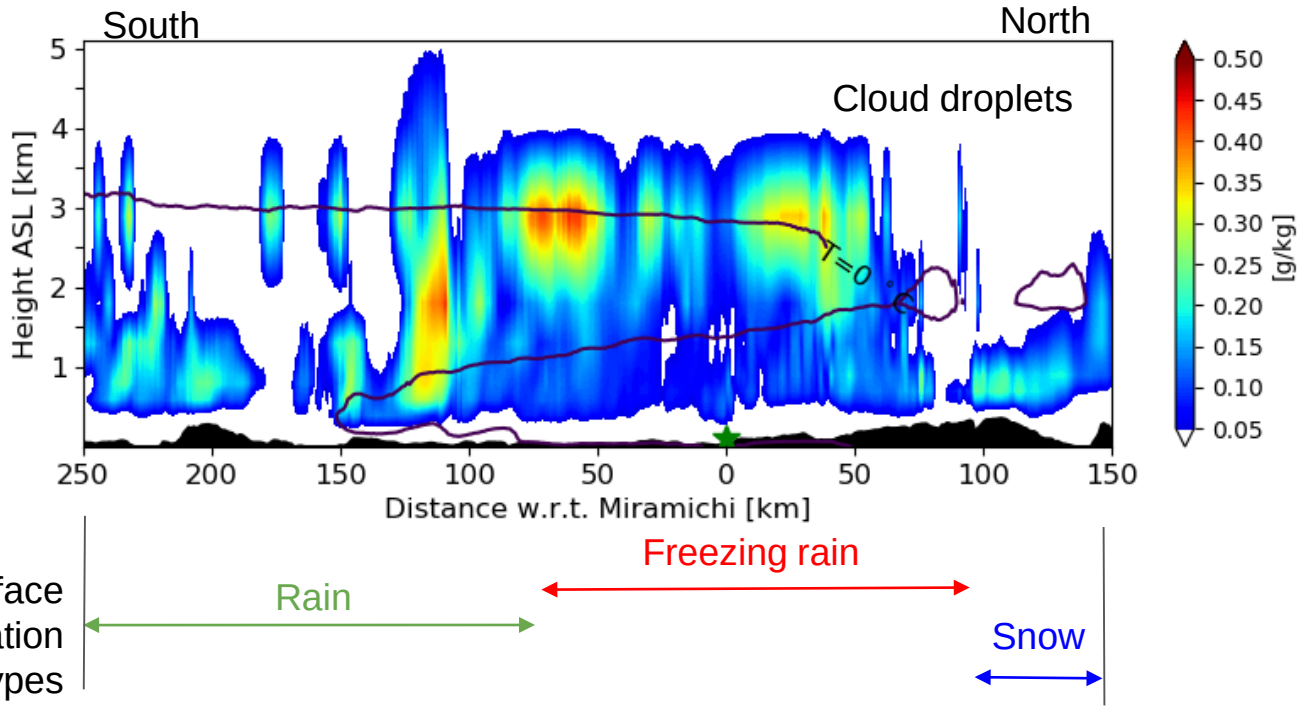
Accumulated freezing rain



Clouds and surface precipitation types

09 UTC Jan 2017





Maximum amount of freezing rain

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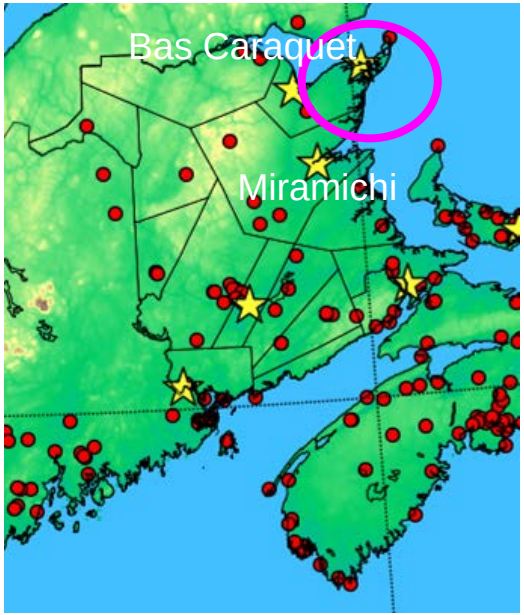
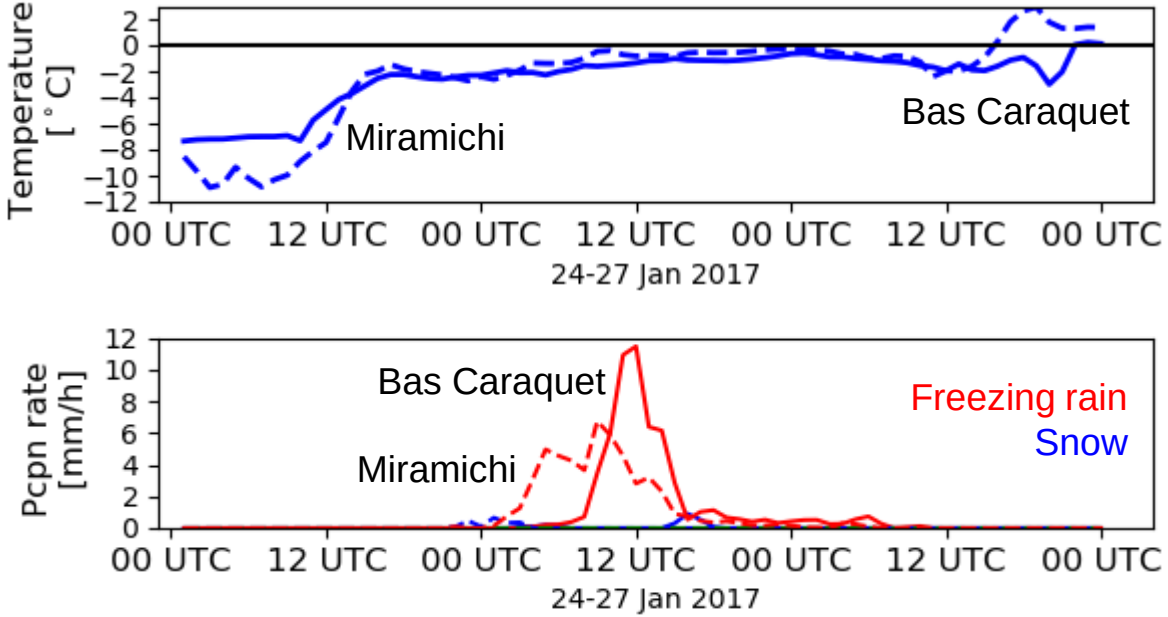


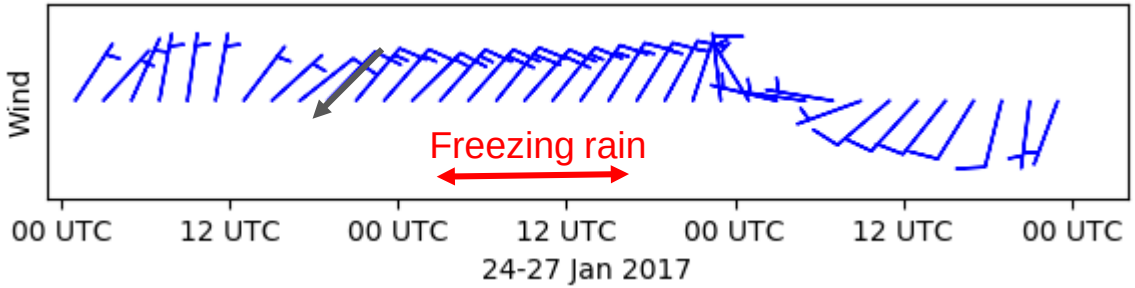


- Major power outage in the Acadian Peninsula
- Peak in freezing rain rate in Bas Caraquet (~12 mm/h) and Miramichi (~8 mm/h)
- Accumulated freezing rain simulated in Bas Caraquet is 58 mm and Miramichi is 53 mm

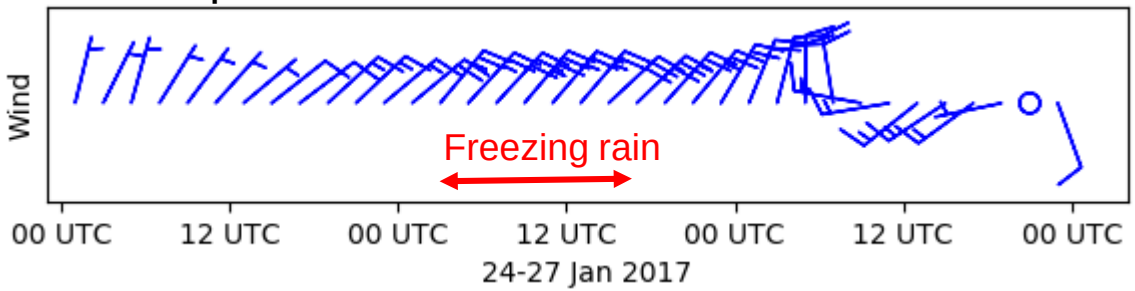
Impact of the wind

Miramichi

09 UTC Jan 2017



Bas Caraquet



Short line = ~10 m/s; longer line = ~20 m/s

- Higher amount of freezing rain reported in Miramichi but weaker winds (~40 km/h)
- Lower amount of freezing rain reported in Bas Caraquet but stronger winds (~60 km/h)
- This suggested that the difference in wind speed would have been the key factor responsible of the power outage

Summary

•Freezing precipitation and wet snow are a critical issue across Canada with many impacts.

•During the 2017 ice storm in N.B., the wind speed was a key factor causing the major power outage.

•Further extreme events and their climatology will be studied using the WRF 4 km simulations to better characterize thresholds leading to damages to electrical infrastructures. This approach is being extended to Manitoba and, possibly, other provinces.

List of high-impact events

List of Manitoba Events:

1. April 27, 1984 - Rain, Freezing rain
2. November 6-12, 2000 - Rain, Wet snow
3. May 11, 2004 - Heavy rain and snow
4. October 5, 2005 - Wet snow
5. December 14-19, 2005 - TBD
6. December 28, 2005 - TBD
7. January 12-18, 2006 - TBD
8. October 13, 2006 - Wet snow and freezing rain
9. October 4/5, 2012 - Rain and wet snow
10. March 8, 2017 - Wet snow

Examples of recent NB Events:

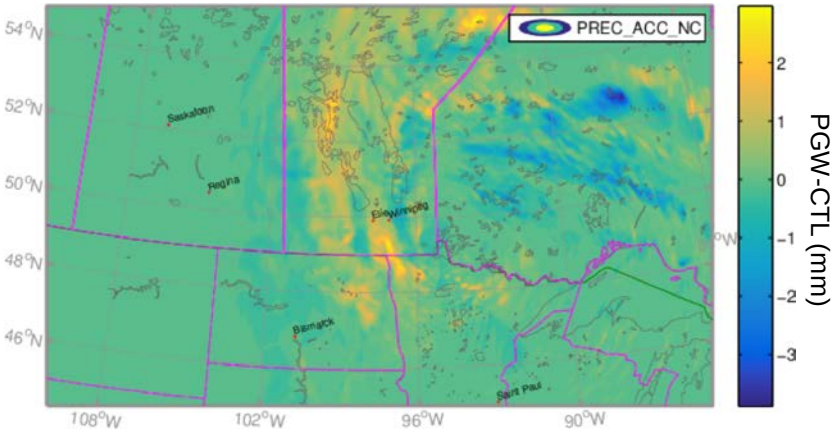
1. December 2010 - Heavy Rain
2. December 2010 - Wet snow
3. December 2013 - Freezing rain
4. November 2014 - Wet snow
5. January 2017 - Freezing rain

Note that the events in blue are included in the time period of the WRF 4 km simulations.

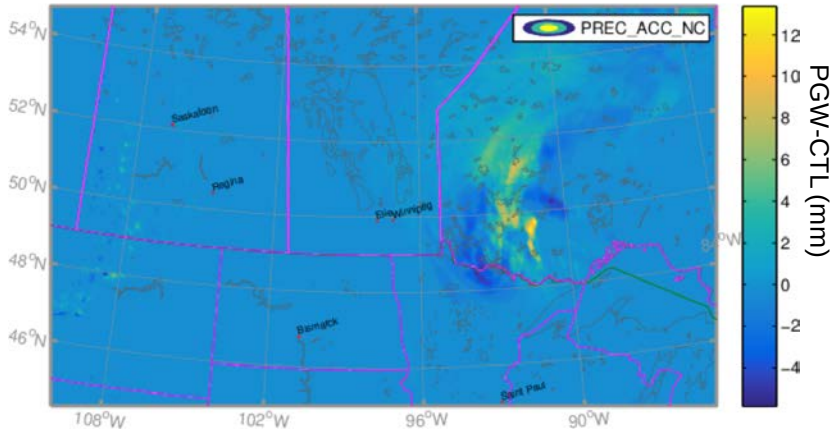
Example of precipitation changes in Manitoba

- Difference in total precipitation between warmer conditions (WRF-PGW) and the historical event (WRF-CTL)

November 6-12, 2000 - Rain, Wet snow



October 4/5, 2012 - Rain and wet snow



- Even if both events are associated with the same type of precipitation, the changes in precipitation vary.

Poster from B. Tropea

Thank you