

# Freezing Precipitation Events Impacting Manitoba

Global Water Futures - Climate-Related Precipitation

Extremes Group

March 26, 2019

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# Motivation

- Freezing rain and wet snow are hazardous precipitation types, causing damage to vegetation and infrastructure, and are generally disruptive to society
- Under future warming climatic conditions, the spatiotemporal characteristics of these types of precipitation may change
- However there is considerable uncertainty regarding these changes
- Transmission and distribution lines may be adversely affected

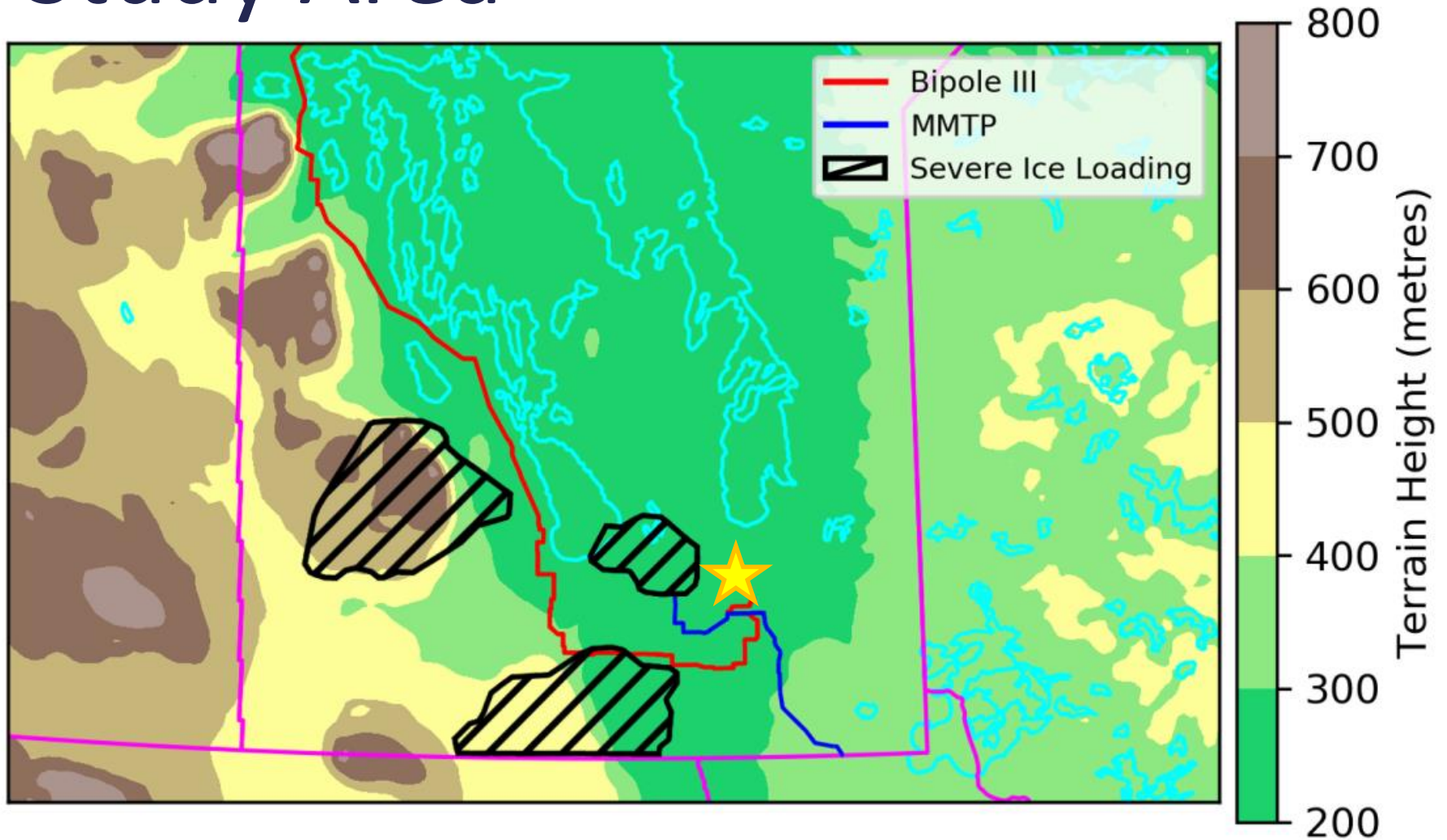


Damaged power lines in eastern Manitoba on October 6, 2012

# Objectives

- Characterize several freezing rain and wet snow events that affected the province of Manitoba
- Examine changes in these precipitation types in a future warming climate, using a pseudo global warming approach

# Study Area



# Event List

- 10 events with various types of hazardous precipitation, as well strong winds, courtesy of Michael Vieira

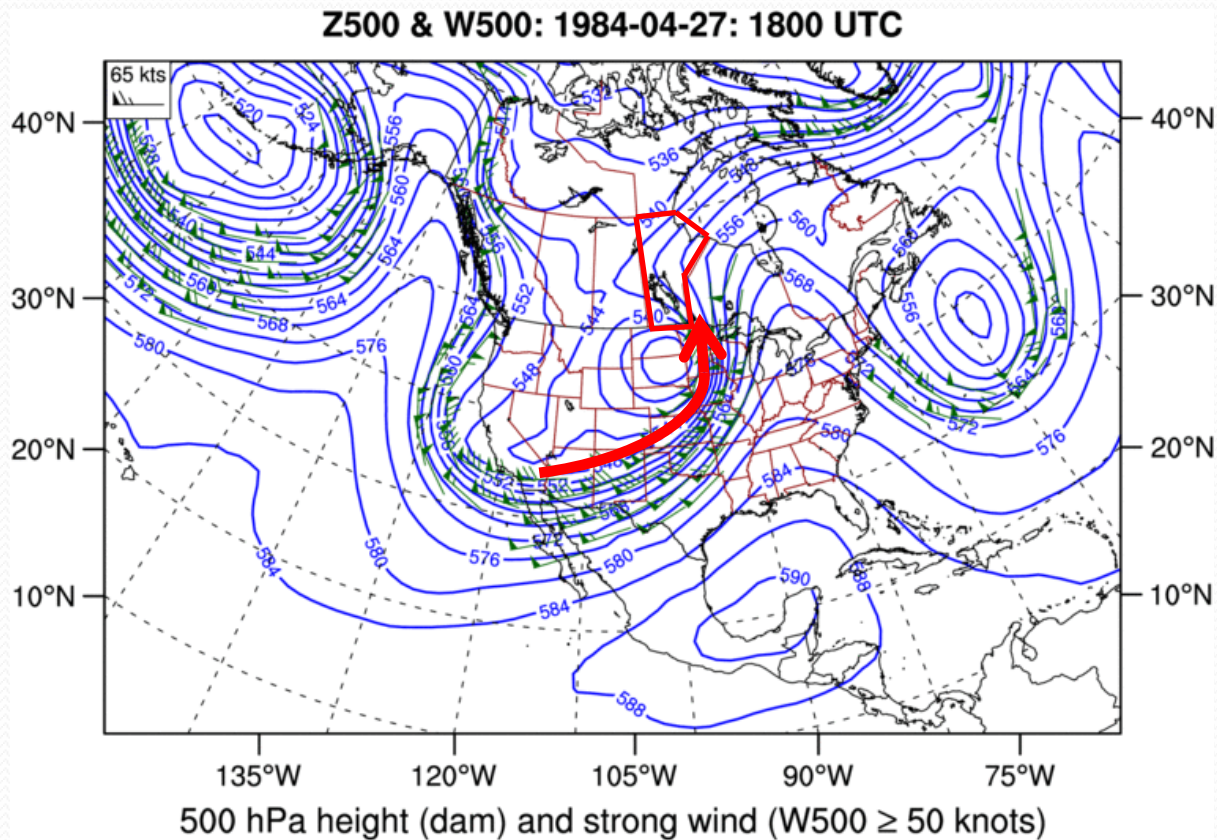
| Date                 | Hazards                                  |
|----------------------|--|
| April 27, 1984       | Rain, freezing rain, ice pellets         |
| November 6-12, 2000  | Rain, wet snow, ice pellets, strong wind |
| May 11, 2004         | Heavy rain and snow, strong wind         |
| October 5, 2005      | Wet snow, strong wind                    |
| December 14-19, 2005 | Snow                                     |
| December 28, 2005    | Snow, rain                               |
| January 12-18, 2006  | Mostly snow, some rain                   |
| October 13, 2006     | Wet snow, freezing rain, strong wind     |
| October 4/5, 2012    | Rain, wet snow                           |
| March 8, 2017        | Wet snow                                 |



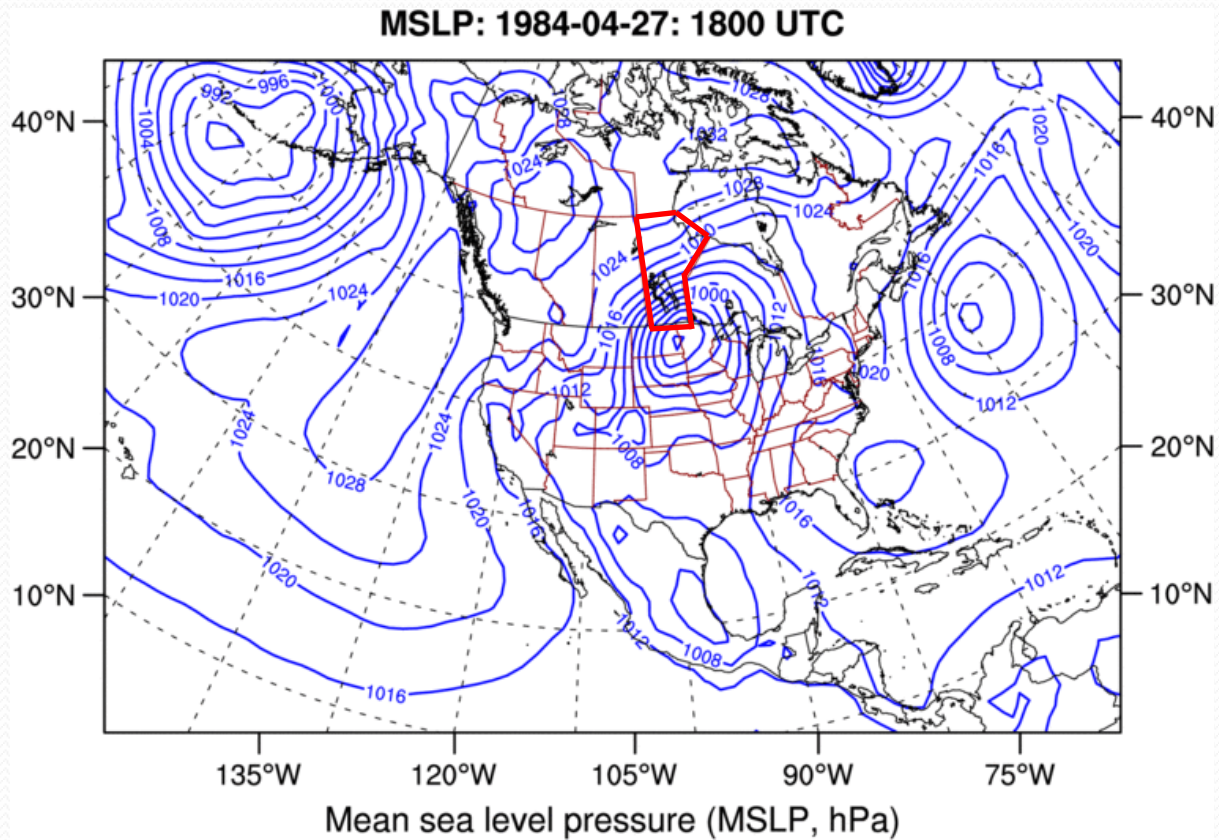
# Datasets

- Sources of data for this study include:
  - National Center for Atmospheric Research (NCAR) Weather Research and Forecasting (WRF) Contiguous United States (CONUS) control (CTRL) and pseudo global warming (PGW) simulations
    - October 2000 – September 2013
  - Japanese 55-year Reanalysis (JRA-55)
  - Environment and Climate Change Canada surface station data, synoptic maps, soundings, and radar data

# Large Scale Dynamics

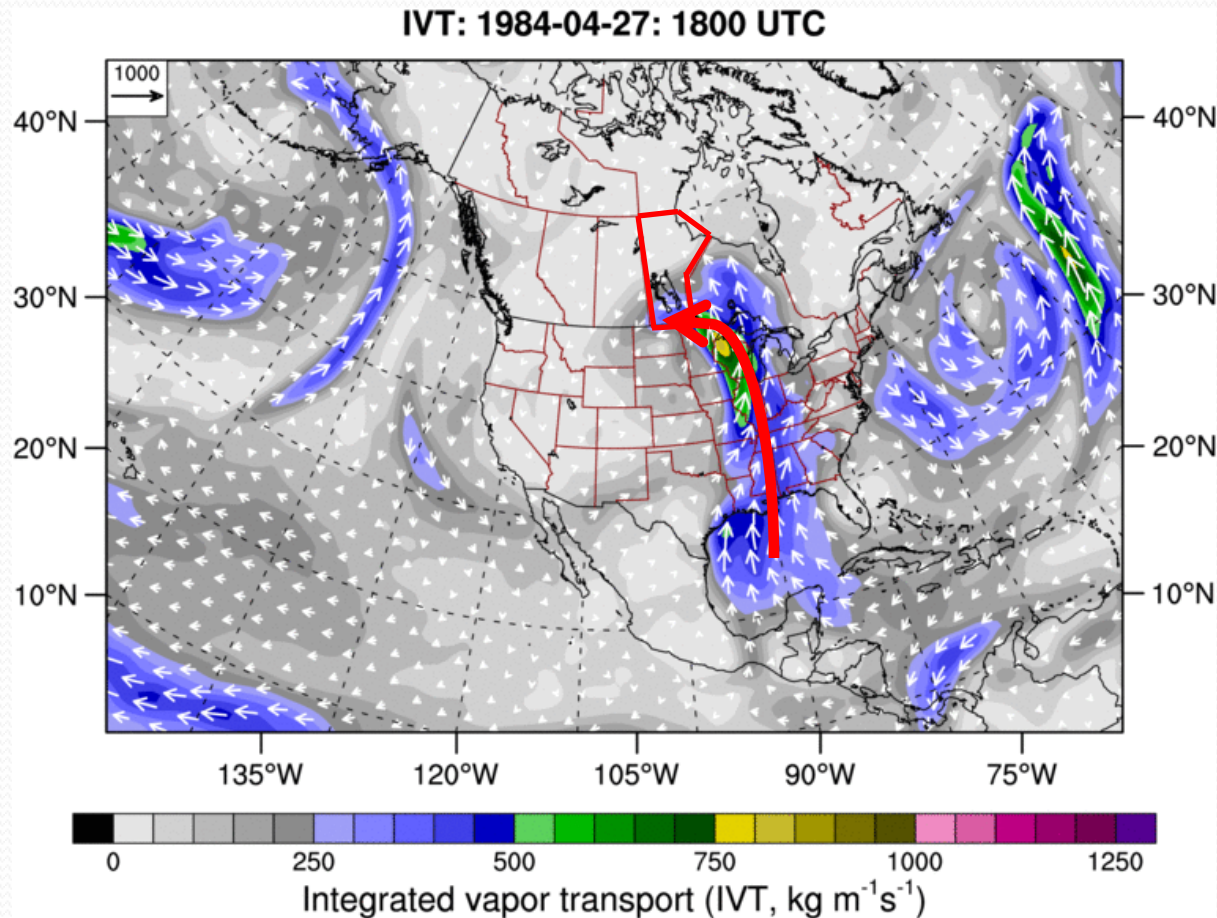


# Large Scale Dynamics



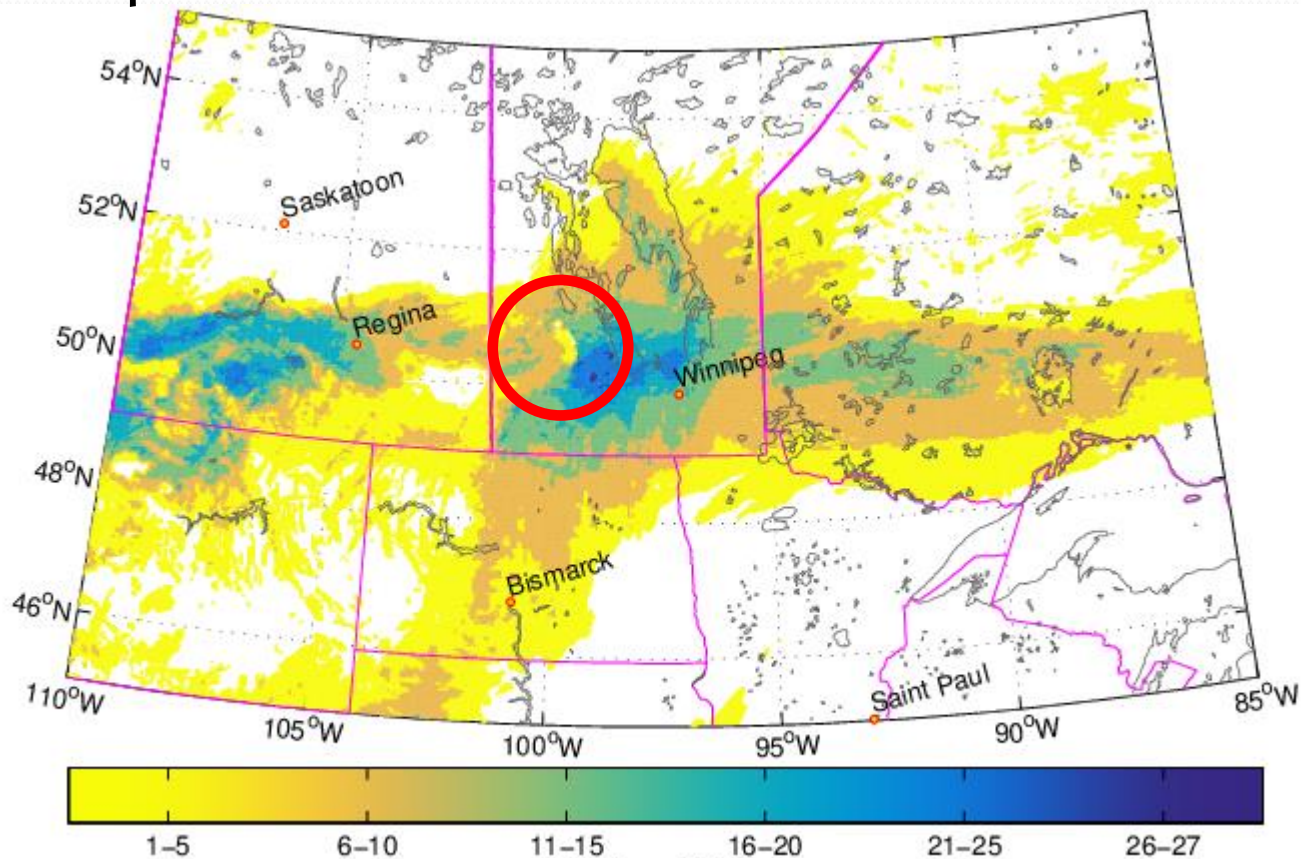


# Large Scale Dynamics



# Terrain Interaction

May 11, 2004: wet snow event



Minimum = 1

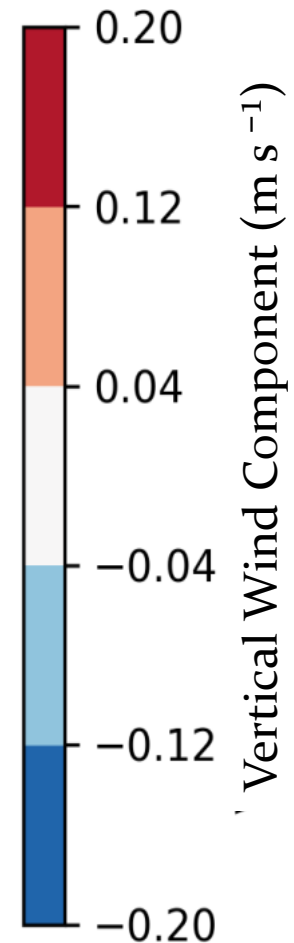
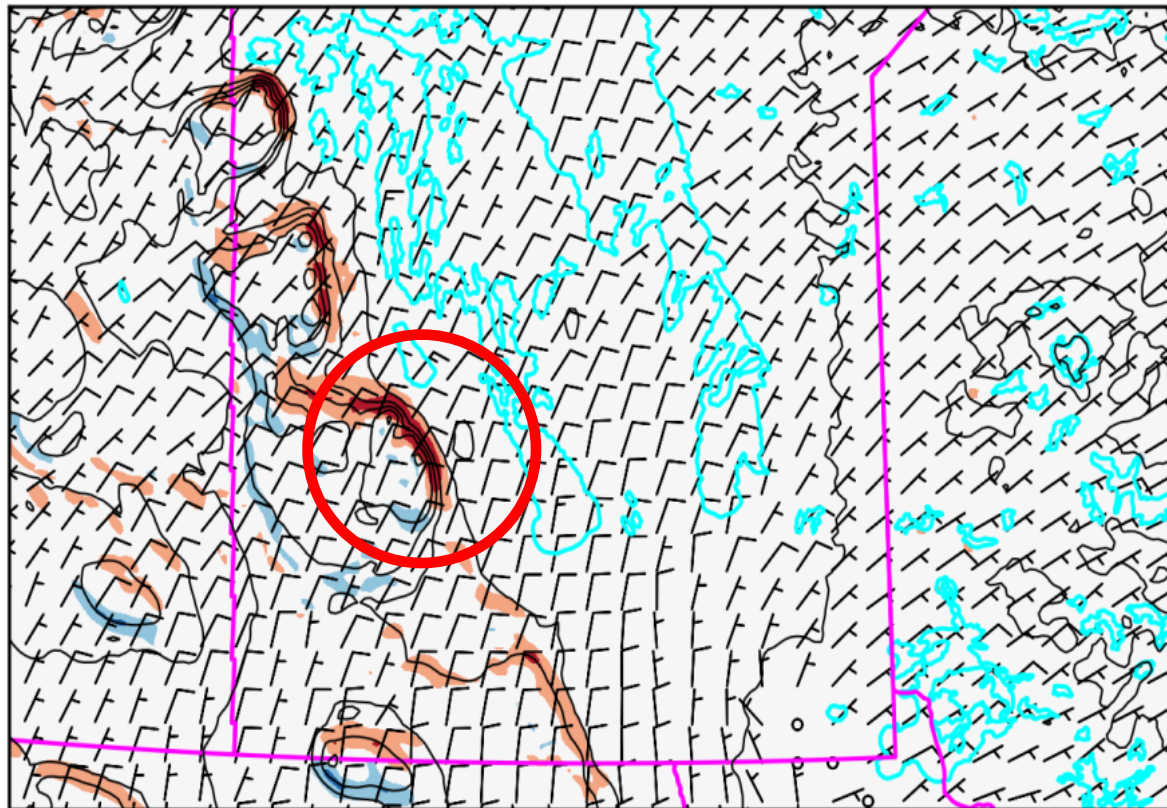
Number of hours

Maximum = 27

# Terrain Interaction

May 11, 2004: wet snow event

Plot time is May 12, 2004 20 UTC

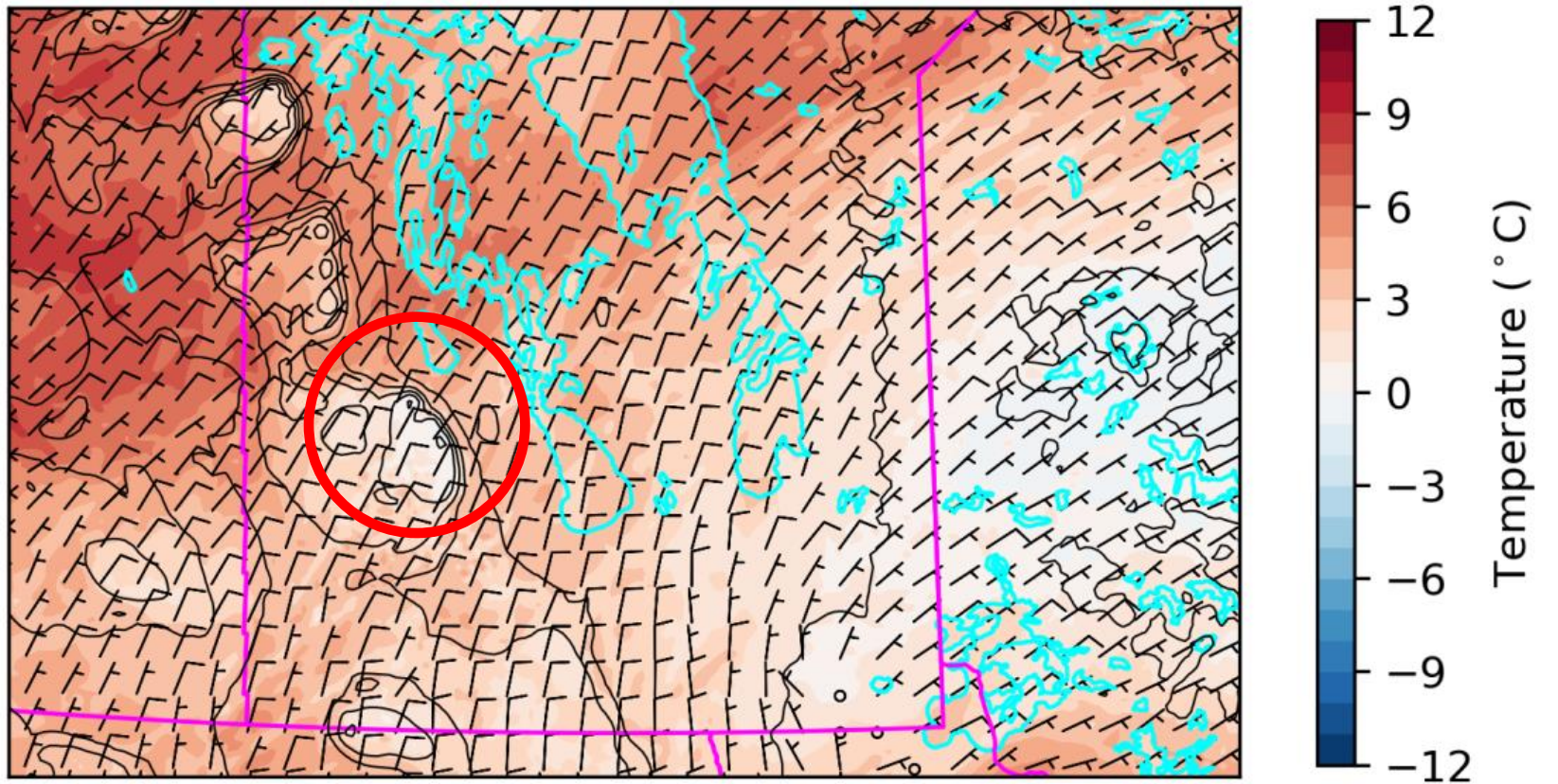




# Terrain Interaction

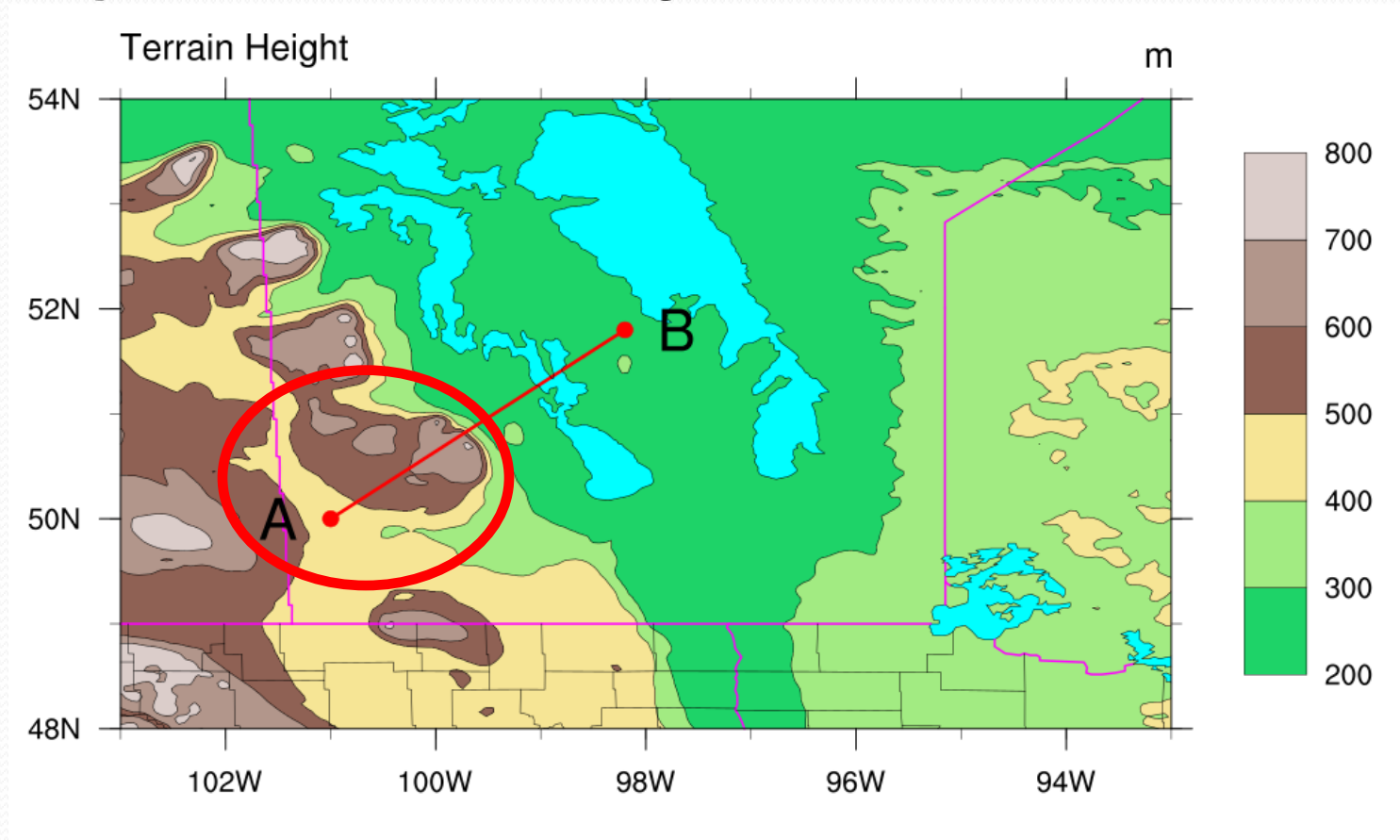
May 11, 2004: wet snow event

Plot time is May 12, 2004 20 UTC



# Terrain Interaction

January 12-18, 2006 freezing rain event





# Terrain Interaction

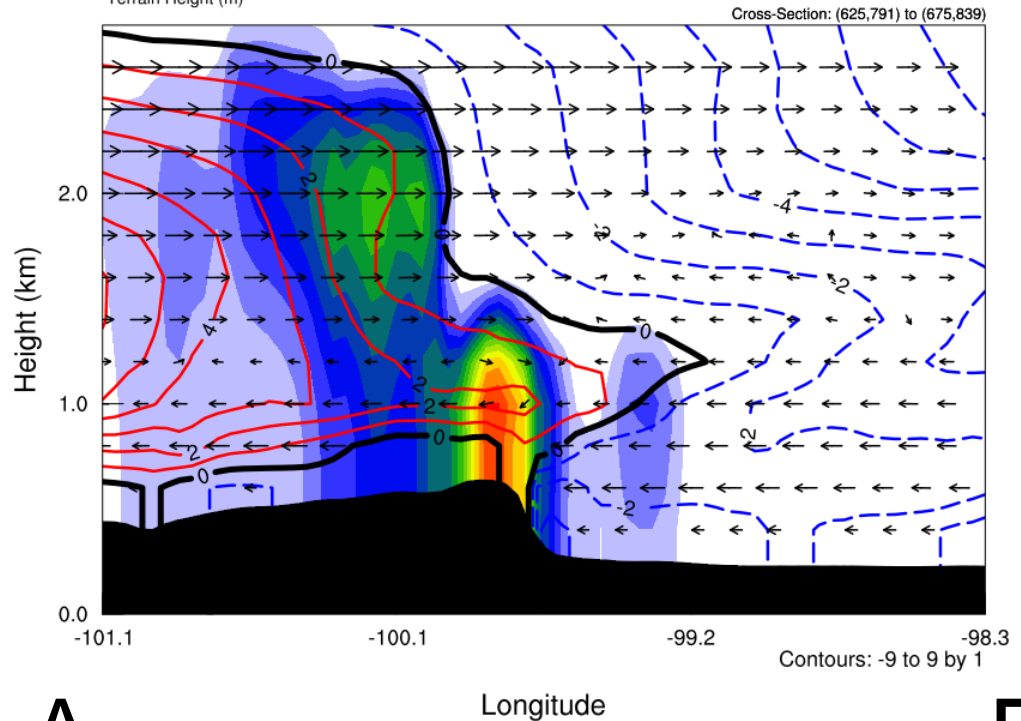
January 12-18, 2006  
freezing rain event  
in the PGW simulation

Image date and time:  
Jan 14, 2006 12 UTC

PGW: January 14, 2006

Init: 2000-10-01\_00:00:00  
Valid: 2006-01-14\_12:00:00

Wind along cross section ( $\text{m s}^{-1}$ )  
Temperature ( $^{\circ}\text{C}$ )  
Rain mixing ratio ( $\text{g kg}^{-1}$ )  
Terrain Height (m)

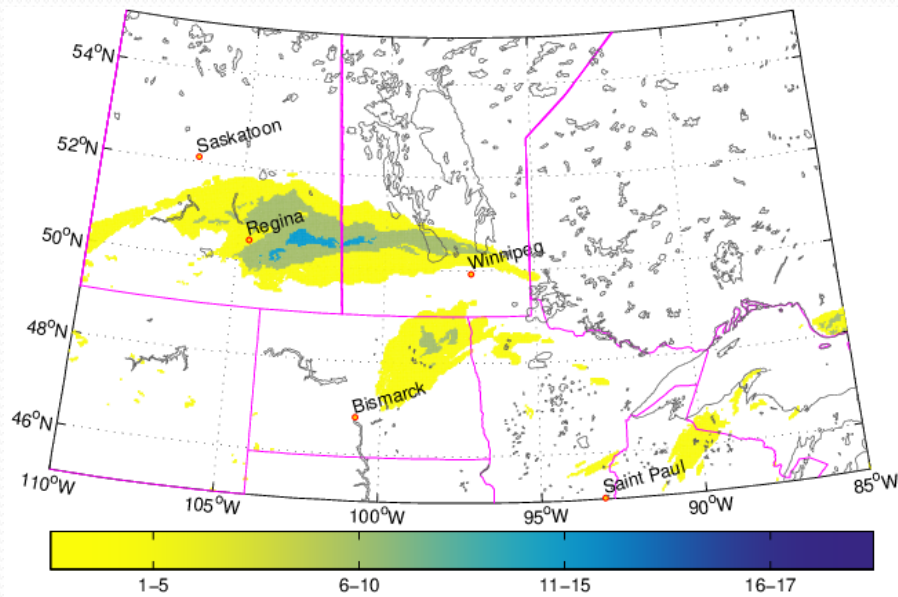


A

B

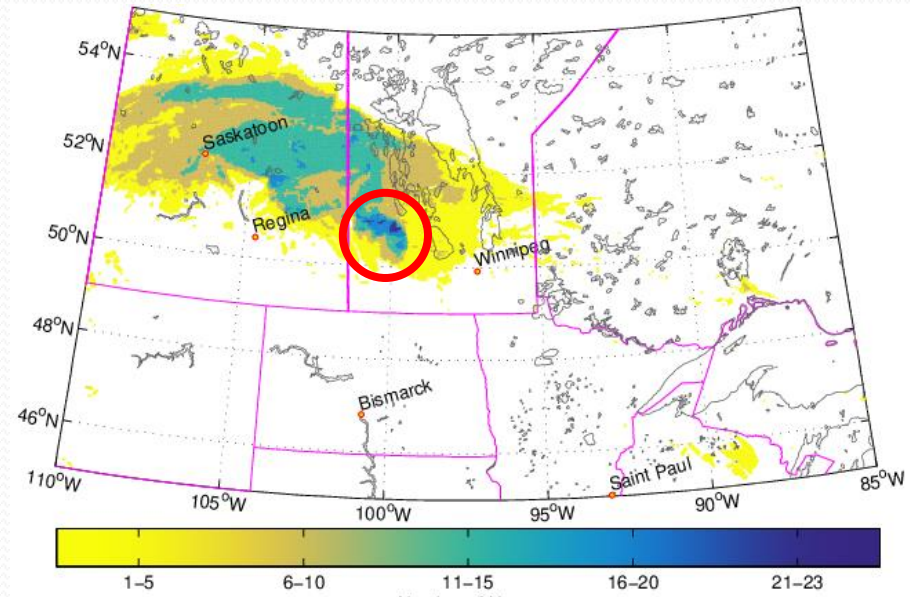
# PGW Enhancement of Freezing Rain

January 12-18, 2006 CTRL



Minimum = 1      Number of hours      Maximum = 17

January 12-18, 2006 PGW

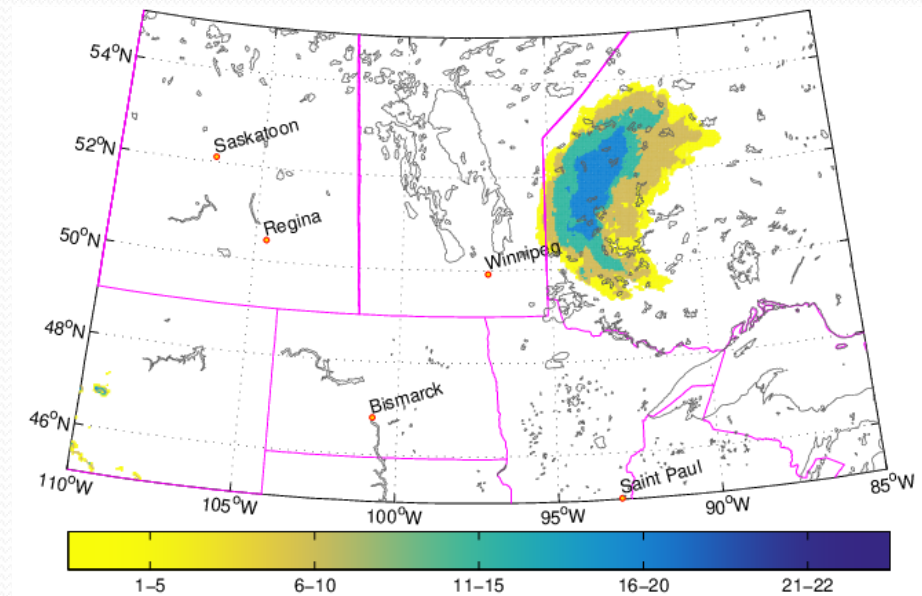
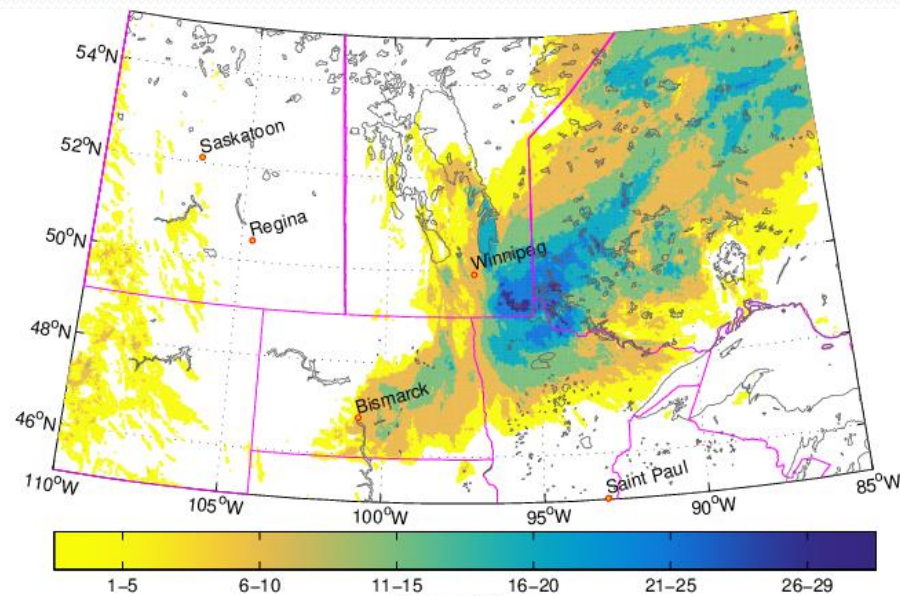


Minimum = 1      Number of hours      Maximum = 23

# PGW Reduction of Wet Snow

October 4/5, 2012 CTRL

October 4/5, 2012 PGW



Minimum = 1      Number of hours      Maximum = 29

Minimum = 1      Number of hours      Maximum = 22

# Conclusions

- Manitoba occasionally experiences significant impacts from freezing rain and wet snow events
- Some of the severe ice loading areas are correlated to the elevated terrain in the province
- 9/10 events showed very apparent large scale forcing
  - Midlatitude cyclone with 500 hPa trough and jet exit enhancing lift, low surface pressure centre nearby, and an atmospheric river
- Topography affected 3 or 4 of the events, by altering the low level temperature and wind fields
- Duration and/or extent of the event increased in 3/5 cases of freezing rain and 5/8 cases of wet snow
  - All other events decreased in duration or extent, or ceased to exist entirely