THE STRUCTURE AND EVOLUTION OF SEVERE WINTER STORMS OVER SOUTHERN BAFFIN ISLAND

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1. BACKGROUND

Hazardous winter storms affect all regions of the Arctic. The two most hazardous components of Arctic winter storms are heavy snowfalls and strong boundary-layer winds. Dangerous wind chills, storm surges, and blowing snow are also associated with winter storms. In addition, surface infrastructure can be damaged due to strong winds and snow accumulation.

In Nunavut, no detailed observations have been made of the structure of these weather systems. Therefore, given their current significance and the concern that the occurrence of severe storms may change in the future, a better understanding of such hazardous weather events is critical.

2. OBJECTIVE

A small pilot project was conducted in Iqaluit between October 17th and November 28th 2005. The main focus was on local and large scale conditions associated with severe winter storms affecting the region. The effects of land-sea differences and sea ice conditions on these storms and their interaction with topography were also studied.

This pilot project may serve as a step towards developing future scenarios for the occurrence of local hazardous weather events in the Arctic and their relationship to cyclonic storm systems.

3. METHODOLOGY

Detailed measurements were taken during 5 separate storms that affected the region between October 17th and November 28th 2005. Data was collected at the upper air observing site located at the Iqaluit airport. Rawinsondes were launched into the storm systems at 3 - 4 hourly intervals. Precipitation measurements including the photographic identification of ice particles, and the bulk properties of the snow pack including the snow temperature, accumulation, and density were also made.

In addition to the measurements taken at the airport, a mobile automatic weather station, located on a ridge 10 km northeast of Iqaluit, was used to take measurements.

Results from 2 storm systems that affected the region between November 23rd and 26th will be analyzed here.

4. STORM BACKGROUND

Between 19 LST on November 23rd and 19 LST November 26th, 2 storm systems impacted Baffin Island. Dramatic temperature shifts, high winds, heavy snowfall, blowing snow, and rain were observed in Iqaluit.

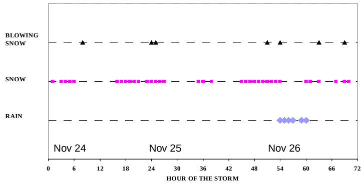

Figure 1 Precipitation observed at Iqaluit from 19 LST on November 23rd to 19 LST on November 26th.

Surface observations during the 72 hour period at locations in the eastern Canadian Arctic

- Freezing drizzle and above freezing temperatures were observed at Clyde River.
- Rain and freezing drizzle were observed at Qikiqtarjuaq.
- Temperatures of 7.1°C were recorded at Pangnirtung.
- Sustained surface winds up to 69 km/h were observed at Pangnirtung.
- Sustained surface winds up to 65 km/h were observed at Cape Dorset.
- A maximum wind gust of 104 km/h was observed in Iqaluit.

5. SYNOPTIC OVERVIEW

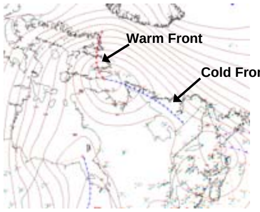

Figure 2 Surface weather map from 19 LST on November 23rd 2005 showing the first storm system to impact Iqaluit.

- The surface pressure is depicted by the red lines (isobars).
- The low pressure center is centered near Kimmirut.
- A warm front is approaching Iqaluit.

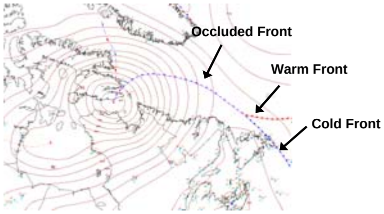

Figure 3 Surface weather map from 04 LST on November 26th 2005 showing the second major storm system to impact Iqaluit.

- The tightly packed isobars indicate that strong surface winds were associated with the system.
- Sustained surface winds as high as 72 km/h and gusts as high as 104 km/h were observed at Iqaluit.

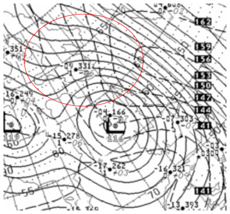

Figure 4 850 mb height and temperature map from 19 LST on November 25th 2005. The area circled indicates warm air advection.

- Between 23 LST on November 25th and 06 LST on November 26th surface temperatures at Iqaluit rose to 4.7°C and to 7.1°C at Pangnirtung.
- The warm temperatures may be due to low-level warm air advection as the crossing of the height and temperature lines indicate the advection of warm air into the region.

6. RAWINSONDE DATA

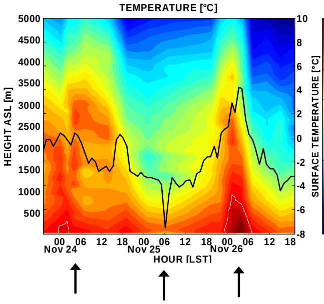

Figure 5 Temperature versus height between 19 LST on November 23rd and 19 LST on November 26th. The black line indicates the surface temperature at Iqaluit.

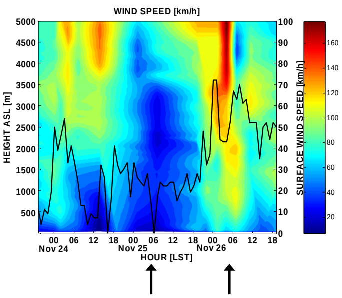

Figure 6 Wind speed versus height between 19 LST on November 23rd and 19 LST on November 26th. The black line indicates the surface wind speed at Iqaluit.

- At 00 LST on the 24th, the warm temperatures at both the surface and aloft were due to the passage of a warm front associated with first storm system.
- At 06 LST on the 25th, a large decrease in the surface temperature as well as calm conditions were observed. Calm conditions and clear night skies would have allowed for radiational cooling. The radiational cooling coupled with katabatic winds off the surrounding ridges explain the sharp decrease in surface temperature.
- As the second low approaches, warming of both the surface temperatures and the air aloft is noted around 00 LST on the 26th. The surface temperature reaches a maximum of 4.7°C at this time. Rain was observed in Iqlauit at this time.
- The strongest surface winds are also noted around 00 LST on the 26th. These winds were correlated with blowing snow at the surface and winds in excess of 160 km/h aloft.
- After 06 LST on the 26th, surface temperatures cool off as the low passes to the northwest of Iqaluit.

7. ICE CRYSTAL IDENTIFICATION

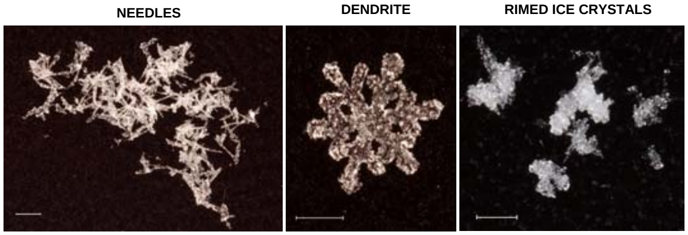

Figure 7 Photographs of the various ice particles observed during a winter storm in Iqaluit. The scale bars are 1 mm in length.

- Numerous types of snow crystals are commonly observed over the duration of a single winter storm in the Arctic.
- Crystal types are dependent both on the temperature and the moisture of the air where they form.
- Simple crystal shapes occur at a low relative humidity and more complex shapes occur at a higher relative humidity.
- Rimed crystals indicate that cloud droplets froze to the snow crystal during its descent.

8. CONCLUSIONS

Arctic winter storms are associated with numerous hazardous conditions. These include rain, heavy snow, high winds, blowing snow, and rapid changes of surface temperature. Low pressure systems commonly occlude before reaching southern Baffin Island. In addition, a variety of snow crystals are observed within single storms.

9. ACKNOWLEDGEMENTS

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