FREEZING RAIN IN THE EASTERN CANADIAN ARCTIC

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1. BACKGROUND

Freezing rain is an extreme, although uncommon, form of precipitation in the Canadian Arctic. It can lead to hazardous impacts on transportation and surface infrastructure and it can also cover the ground with ice and limit the ability of wildlife such as caribou to reach their food source. Freezing rain frequently occurs in combination with other hazards, including visibility reduction due to fog and high winds, and this increases its impact. Given its current significance as well as its possible increase in the future, a better understanding of this phenomenon is critical.

2. OBJECTIVE

The main objective of this study is to conduct an analysis of surface, upper air, and synoptic data when freezing rain and ice pellets were observed in the eastern Canadian Arctic between 1980 and 2004.

3. DATA AND METHODOLOGY

1. Numerous data sets were utilized in this study that covered the years from 1980-2004.
    1. Hourly surface observations
    2. Model re-analysis data
    3. Rawinsonde data

2. 4 observing sites in Nunavut were chosen for this study including Iqaluit, Baker Lake, Coral Habour, and Hall Beach.

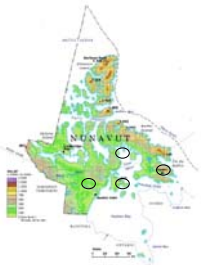


Figure 1 shows Nunavut and the location of the 4 observing sites included in this analysis are circled.

3. Hourly surface observations for 645 observations of freezing rain and 401 observations of ice pellets were analyzed. In addition, rawinsonde data and model-reanalysis data were examined for 43 freezing rain events and 40 ice pellet events.

4. FORMATION MECHANISMS

Typically freezing rain and ice pellets form through one of two processes, the melting process or the supercooled warm rain process.

During the melting process, ice particles fall through a layer in which the temperature exceeds 0°C and subsequently melt. Freezing rain is observed when the liquid particles then enter a subfreezing layer, supercool and freeze upon contact with the surface. Ice pellets will occur if the drop refreezes before reaching the surface.

Although not as common, freezing rain and ice pellets can also form through the supercooled warm rain process in which precipitation originates as supercooled liquid.

5. RESULTS

5.1 AVERAGE MONTHLY OCCURRENCE

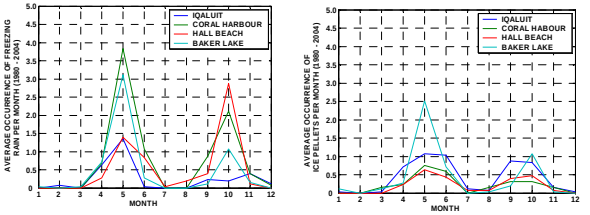


Figure 2 shows the average number of observations of ice pellets and freezing rain during each month.

- Spring and autumn are the preferred seasons for the occurrence for both types of precipitation coinciding with the 2 main storm seasons.
- Freezing rain is observed most often during the spring at Coral Harbour and during the autumn at Hall Beach.
- Ice pellets are more common at Baker Lake than at the 3 other sites.

5.2 OBSERVED SURFACE TEMPERATURE

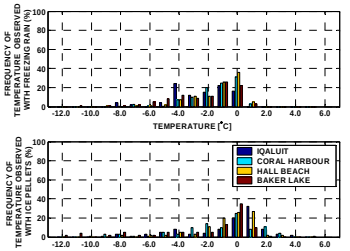


Figure 3 shows the observed surface temperature when freezing rain and ice pellets were observed at each of the 4 sites.

- A wide range of surface temperatures, ranging from -12°C to +6°C, are observed.
- Warmer surface temperatures are correlated with observations of ice pellets in comparison with observations of freezing rain.
- Although not shown, surface temperatures are generally colder when freezing rain occurs with ice pellets than when either are individually observed.

5.3 OBSERVED WIND SPEED

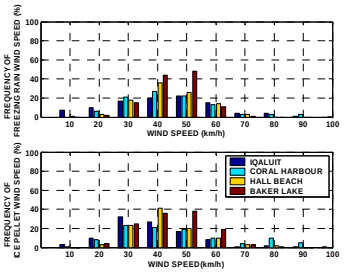
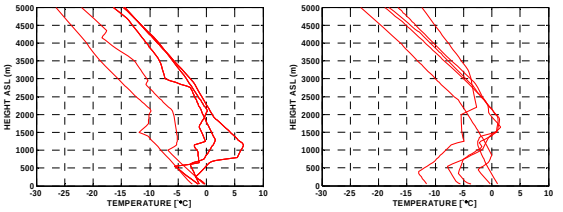


Figure 4 shows the observed wind speed in km/h when freezing rain and ice pellets were observed at each of the 4 sites.

- A wide range of wind speeds are observed, ranging from 10 km/h to 100 km/h.
- On average, wind speeds > 40 km/h are more common during observations of freezing rain.

5.4 RAWINSONDE DATA



FREEZING RAIN ICE PELLETS

Figure 5 shows several of the temperature profiles when freezing rain and ice pellets were observed.

- The melting layer aloft is not as deep and is observed higher in the atmosphere during observations of ice pellets events in comparison with observations of freezing rain.
- The radiosonde data shows that it is not uncommon for freezing rain and ice pellet cases to have no melting layer aloft. This implies that liquid supercooled processes were occurring.

5.5 STORM TRACKS

Figure 6 shows the tracks of the storms which produced freezing rain or ice pellets over the eastern Canadian Arctic.

- Parent storm systems come from diverse locations.
- Storm systems affecting the eastern Canadian Arctic developed over the central United States, off the east coast of Canada and the United States, over the Canadian Prairies, over southern Quebec and Ontario, and even over the Northwest Territories.

6. CONCLUSIONS

In summary the following can be concluded concerning freezing rain and ice pellets in the eastern Canadian Arctic :

1. Freezing rain and ice pellets predominantly occur during the two main storm seasons in autumn and spring.
2. Both freezing rain and ice pellets are observed to have wide range of surface temperatures and wind speeds.
3. The rawinsonde data shows that it is not uncommon for freezing rain and ice pellet cases to have no melting layer aloft. This implies that liquid supercooled processes were occurring.
4. The storm systems that produced freezing rain and ice pellets developed in diverse locations.

7. ACKNOWLEDGEMENTS

We would like to thank ArcticNet for financial support.