Rain-on-snow and ice layer formation detection using passive microwave radiometry: An arctic perspective

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Remote Sensing of the Cryosphere I, Wednesday Dec. 16th 2015  
American Geophysical Union Fall Meeting
Rain-on-snow and ice layer formation detection using passive microwave radiometry: An arctic perspective

Outline

PART I: Arctic context
   1. Motivation and study sites
   2. Algorithm development

PART II: Some occurrence numbers 1979-2011
   3. Rain-on-snow
   4. Ice layers
   5. Perspective
PART I: Arctic context

1. Motivation and study sites

- increased occurrence of rain-on-snow
- increased occurrence of strong wind events 
  ➔ both leading to snow densification

- Changing rapidly, with significant consequences:
  • Grazing conditions under ice for ungulates;
  • Changes in snow cover affects permafrost and sea ice regimes.

- Need for global information of snow information
  • Passive microwave remote sensing;
  • Snow modeling / climate model coupling.

ROS events are projected to be more frequent over a wider spatial extent (Semmens et al., 2013): need for a satellite-based detection approach
PART I: Arctic context

1. Motivation and study sites

- Peary caribou population affected by snow conditions:

Need to develop ROS and ice tracking approaches in the Arctic…

Ouellet et al., 2015
PART I : Arctic context

2. Algorithm development: ROS

- Empirical approach from case study: January 30th – February 2\textsuperscript{nd} 2013:

\textbf{Figure 5: General scheme of the snow microwave response; (1) basic snowpack, (2) snowpack with ice crust or wet snow}

Dolant et al., 2015
PART I: Arctic context

2. Algorithm development: ROS

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PART I: Arctic context

2. Algorithm development: Ice Detection Index (IDI)

Polarization ratio (PR):

\[ PR(f) = \frac{T_B(f, V - Pol) - T_B(f, H - Pol)}{T_B(f, V - Pol) + T_B(f, H - Pol)} \]

Horizontal polarization more sensitive to ice layers and vertical dielectric contrast, threshold established from the following (PR simulated with ice vs PR without ice):
PART I: Arctic context

2. Algorithm development: Ice Detection Index (IDI)
PART II: Occurrence numbers
### PART II: Occurrence numbers

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PART II: Occurrence numbers

93-94: BI, BP
98-99: BM, LI, CI, HI
02-03: AH, Em

2002-2003
Islands with most combined occurrences:

- Boothia Peninsula (Ouellet et al., 2015 – SNOWPACK)
- Axel Heiberg
- Byram Martin
- Lougheed + Cornwallis
- Banks + Victoria
Future outcome and concluding remarks

- More on GRP threshold, with observed events:

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<th>Latitude</th>
<th>Longitude</th>
<th>Altitude</th>
<th>Year available</th>
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Future outcome and concluding remarks

Plans for 2016:

- Dystrometer installation in Cambridge Bay along with passive microwave radiometers (19-37-89 GHz);

- More on climatology assessment, tracking origin of ROS and LPDs;

- New PhD student working on the modeling of ROS-snow interactions using the SNOWPACK model.
Acknowledgements

Funding and logistics:

Environment Canada
Parks Canada
Canadian High Arctic Research Station
Natural Sciences and Engineering Research Council of Canada (NSERC)
Canada Foundation for Innovation
National Search and Rescue Secretariat (SAR-NIF)
Centre d’études nordiques (CEN)
National Aeronautics and Space Administration (NASA)
Mitacs scholarship program
Hydro-Québec
Polar Continental shelf Program