https://ntrs.nasa.gov/search.jsp?R=20160005240 2019-08-31T03:19:31+00:00Z

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Groupe de Recherche Interdisciplinaire en Télédétection Polaire

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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

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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

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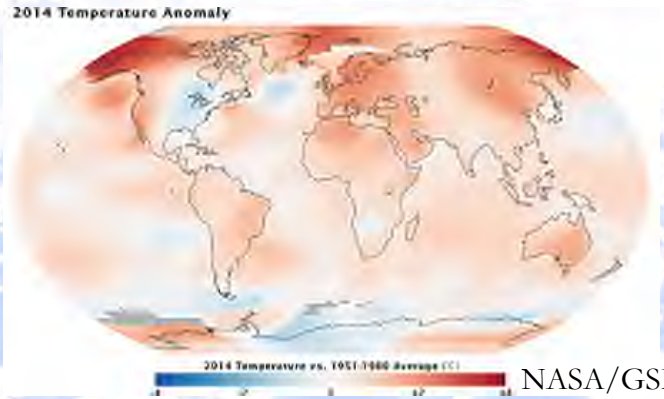
PART I :Arctic context



NASA/GSFC

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

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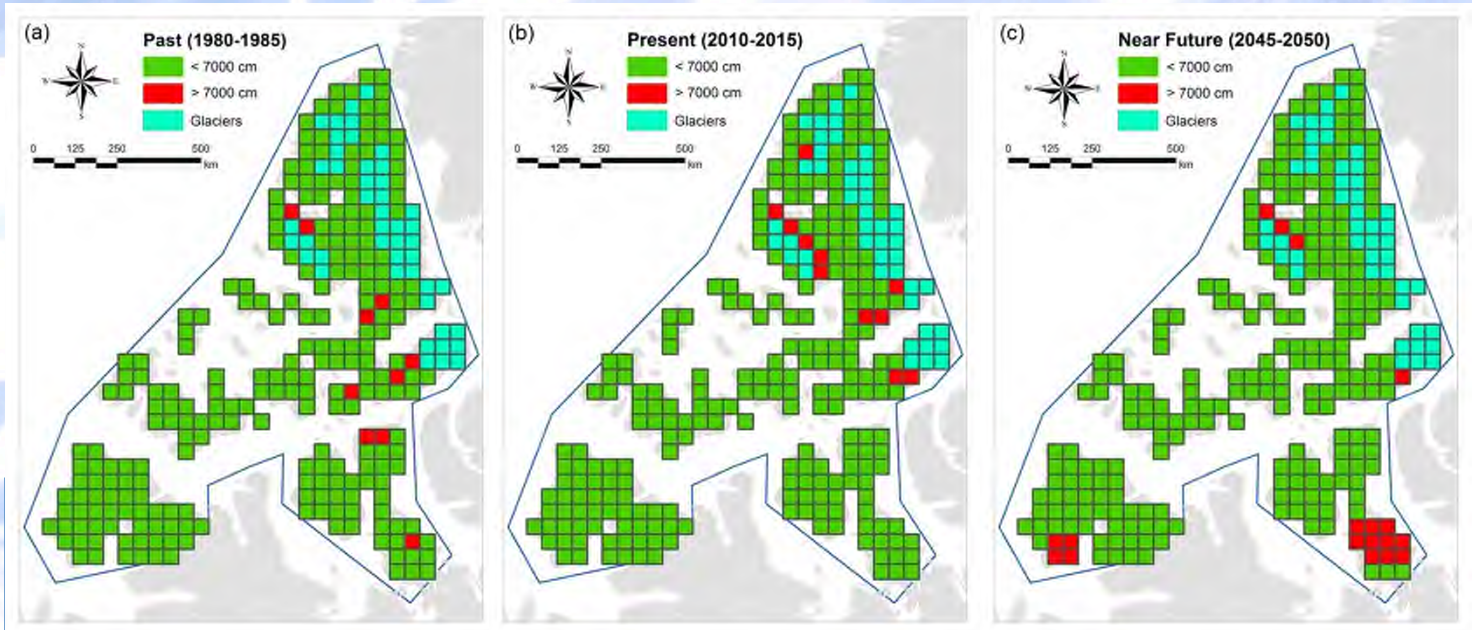
PART I :Arctic context

1. Motivation and study sites

- Peary caribou population affected by snow conditions:



Ouellet et al., 2015

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

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PART I :Arctic context

2. Algorithm development: ROS

- Empirical approach from case study: January 30th – February 2nd 2013:

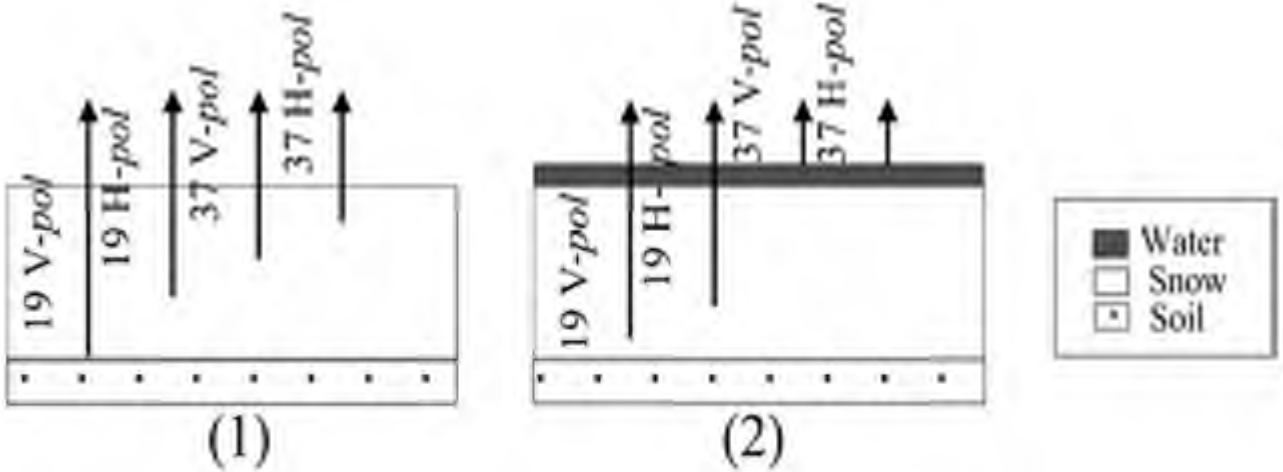

Figure 5: General scheme of the snow microwave response; (1) basic snowpack, (2) snowpack with ice crust or wet snow

Dolant et al., 2015

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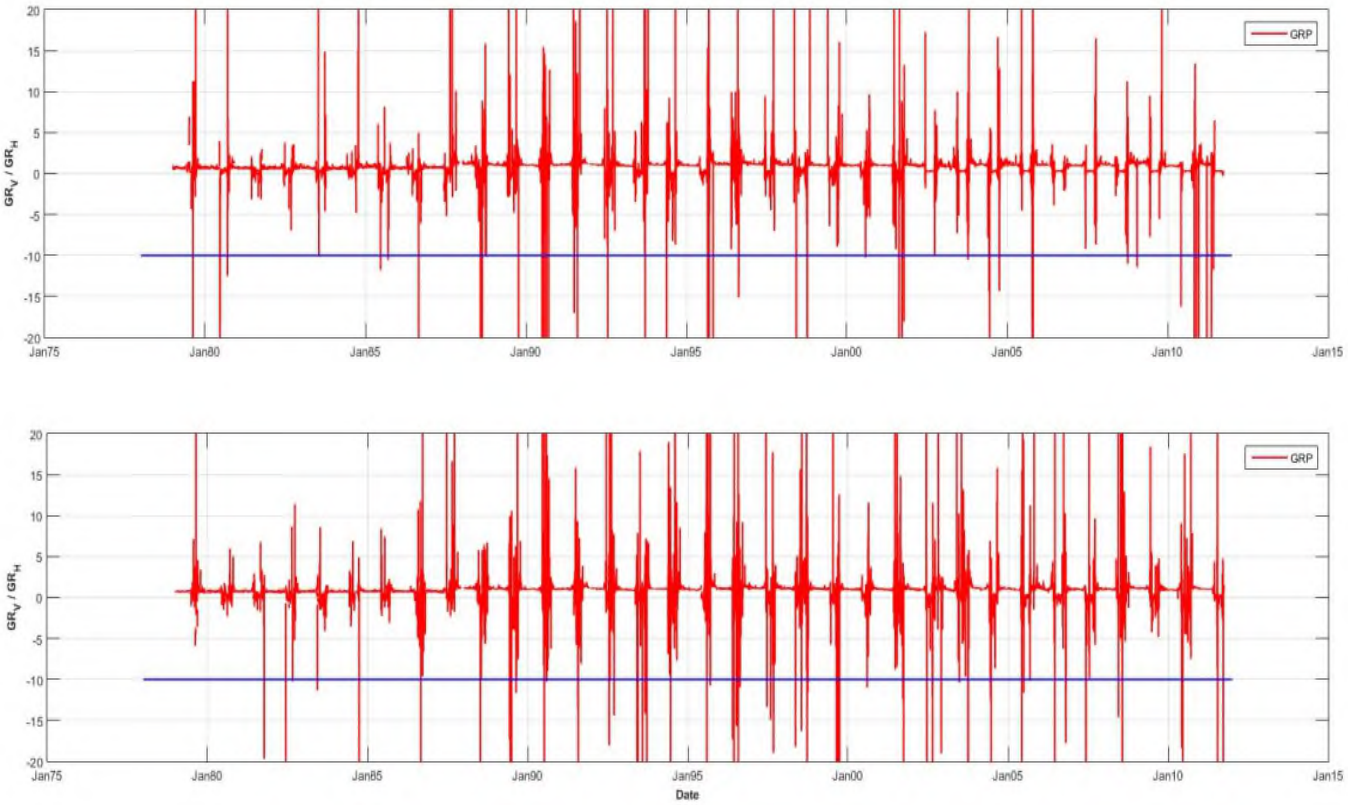
PART I: Arctic context

2. Algorithm development: ROS



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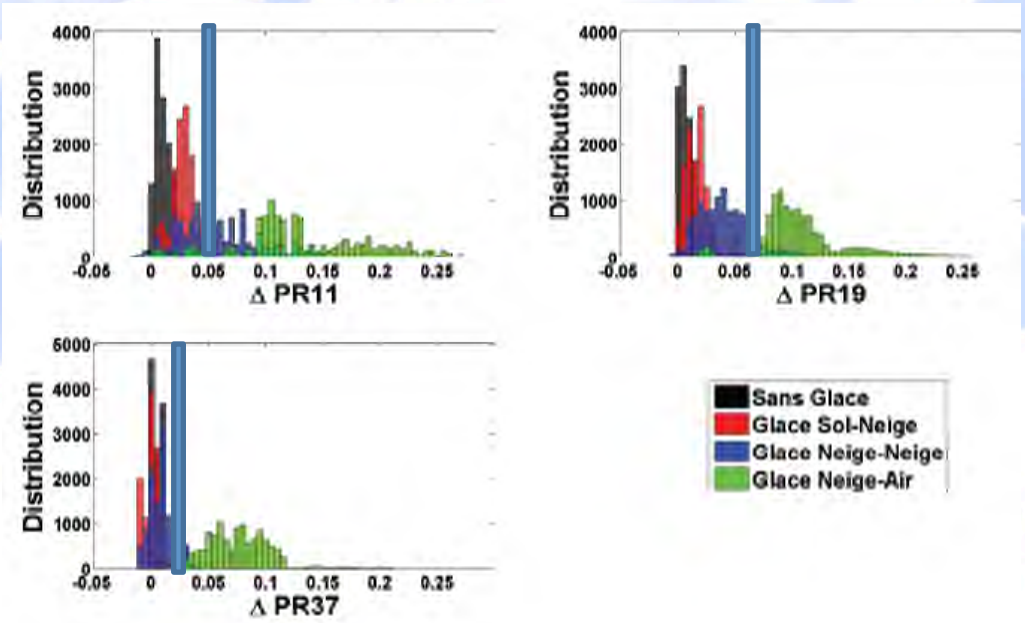
PART I: Arctic context

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):



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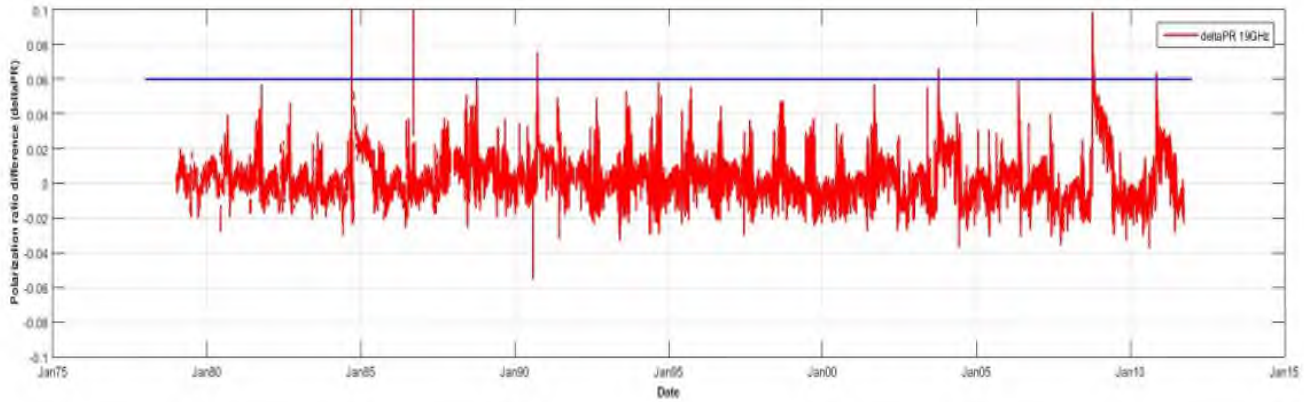
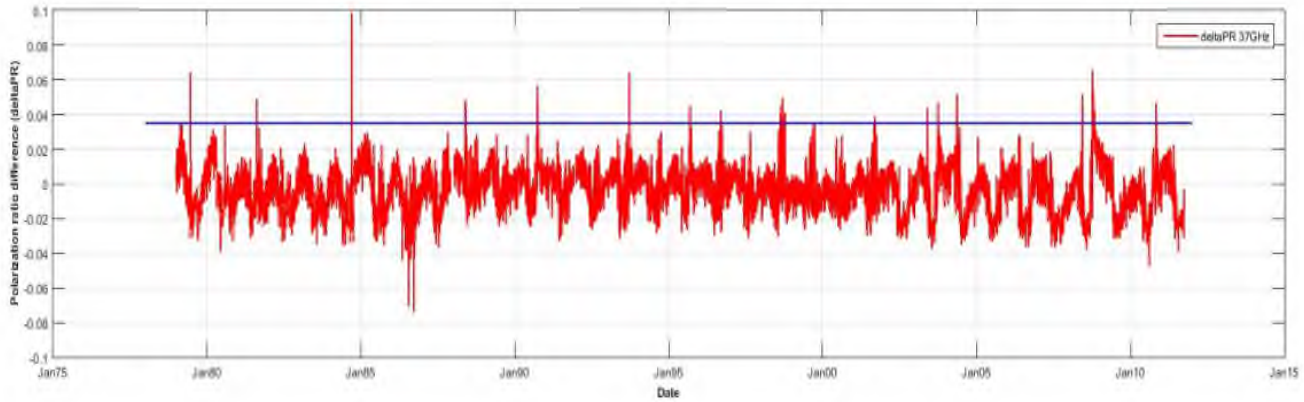
PART I: Arctic context

2. Algorithm development: Ice Detection Index (IDI)





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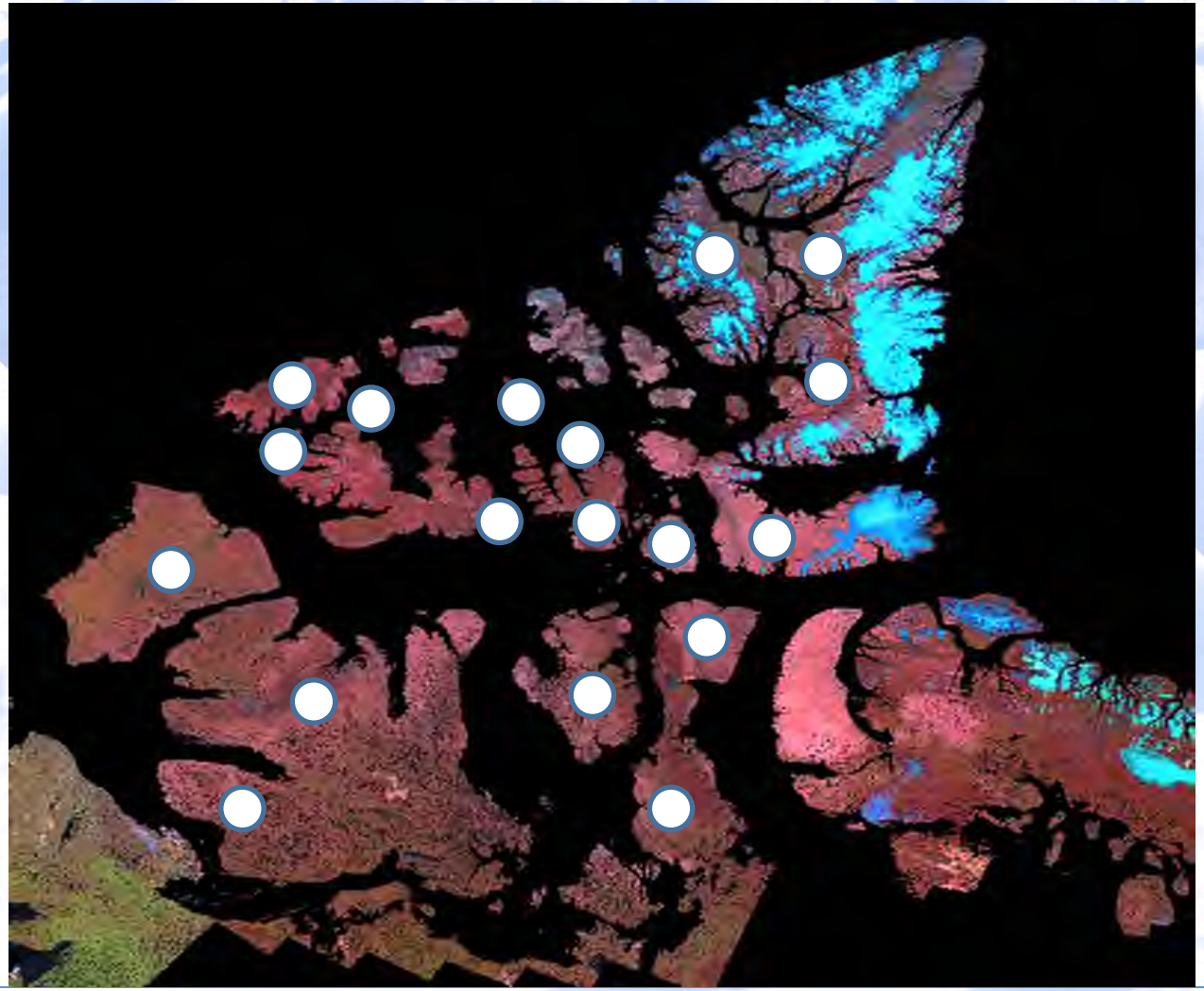
PART II: Occurrence numbers



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PART II: Occurrence numbers

	79-80	80-81	81-82	82-83	83-84	84-85	85-86	86-87	87-88	88-89	89-90	90-91	91-92	92-93	93-94	94-95	Totals 79-95
BPI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	12	0	13
PWI	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0	4
SII	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	5
AHI	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
SEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2
CEI	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
MII	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
PPII	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
EgII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EmII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BMII	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
DII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CII	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	3
HII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BICI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BII	0	0	0	0	0	0	0	0	0	1	0	0	0	0	12	0	13
VII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals	0	0	0	0	0	1	0	0	0	18	1	1	1	0	33	0	56

	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	Totals 95-11	1976-2011
BPI	0	0	2	2	0	0	0	0	0	0	0	0	13	0	0	0	19	32
PWI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
SII	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
AHI	0	0	0	0	0	0	0	10	0	7	0	0	0	0	0	0	17	19
SEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
CEI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
MII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
PPII	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
EgII	0	0	0	0	0	0	0	1	1	0	0	0	0	3	0	0	5	5
EmII	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	0	6	6
BMII	1	3	0	20	0	1	3	0	0	0	0	0	0	0	0	0	28	30
DII	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	2
LII	0	0	0	13	0	0	0	0	0	0	0	0	0	4	0	3	20	20
CII	0	2	0	4	5	0	3	0	0	0	0	0	0	5	0	0	19	22
HII	0	0	0	6	0	0	1	0	0	0	0	0	0	0	0	0	7	7
BICI	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1
BII	0	0	2	2	0	0	0	0	0	0	0	0	0	3	0	0	14	27
VII	0	0	0	0	0	0	0	0	8	0	2	6	0	10	0	1	27	27
Totals	1	6	5	51	5	1	7	11	17	7	2	6	13	25	0	4	146	232

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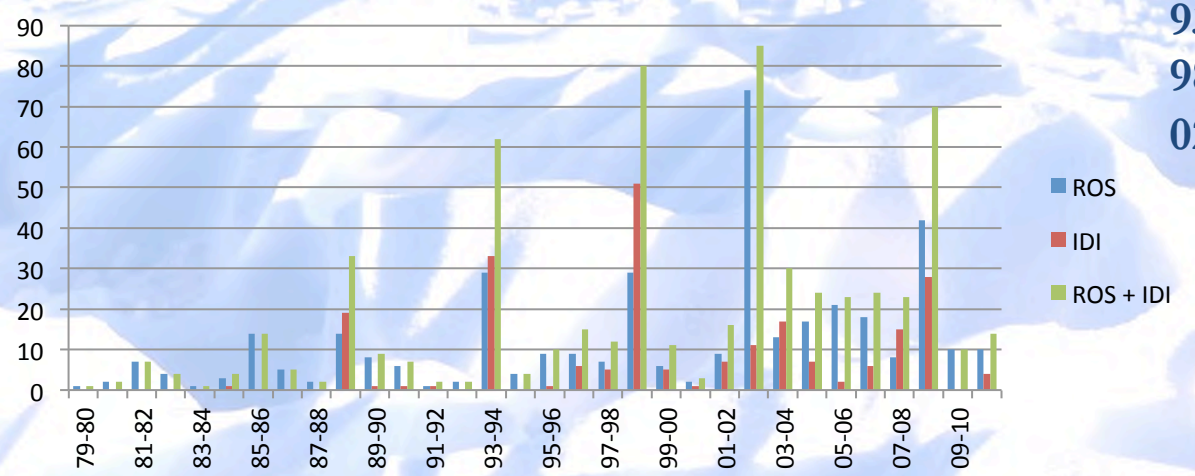
PART II: Occurrence numbers



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

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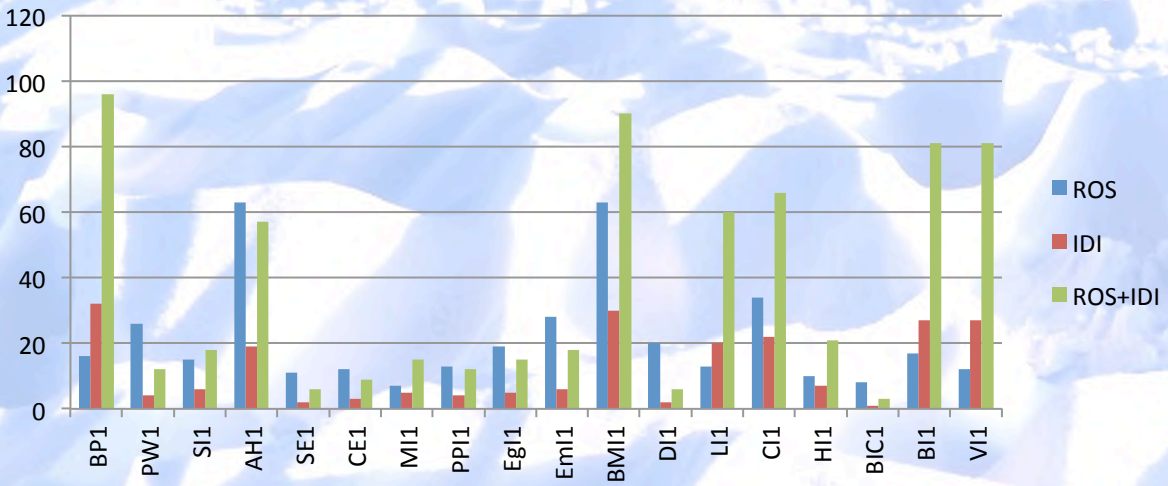
PART II: Occurrence numbers



Islands with most combined occurrences:

- **Boothia Peninsula (Ouellet et al., 2015 – SNOWPACK)**
- **Axel Heiberg**
- **Byram Martin**
- **Lougheed + Cornwallis**
- **Banks + Victoria**

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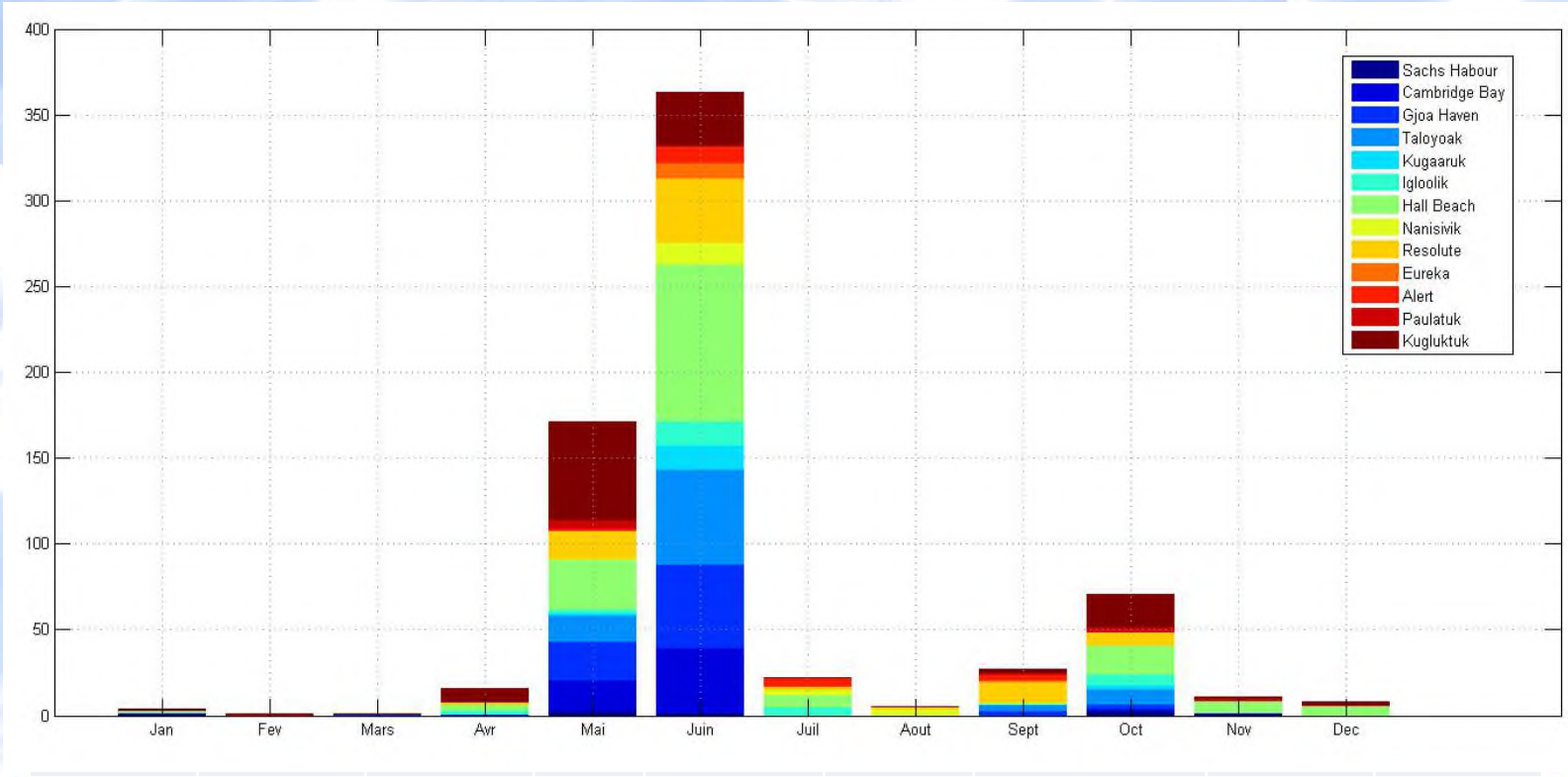
Future outcome and concluding remarks

- More on GRP threshold, with observed events:



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Future outcome and concluding remarks

Plans for 2016:

- Dysdrometer 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.

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National Aeronautics and Space Administration (NASA)
Mitacs scholarship program
Hydro-Québec
Polar Continental shelf Program