Storm Studies in the Arctic (STAR)

CFCAS Network

www.starnetwork.ca

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Iqaluit, NU
November 14, 2007

Outline

- Importance
- STAR Network
- Objectives & Tasks
- Tools & Data
- Themes
- Long-Term Goals
- Collaborations & Users
- Timing of STAR

Importance

- Eastern Arctic has some of the most extreme storms
- Loss of life and/or injury, especially during blizzards
- Stress on industry, infrastructure, transportation, hunting, recreation and landscape
- Nunatsiaq News (April 5, 2005) – more hunters are being stranded on the land (including ice)
- Weather is more unpredictable, more fierce storms in Fall
- Some evidence of increased storm activity – future increases as well
- Northern Climate Exchange and Artic Climate Impact Assessment (ACIA) both highlight a critical need for better knowledge
- Forecasting / prediction challenges

What is STAR?

- Network of:
  - 6 investigators based at 5 universities
  - 8 collaborators from 5 divisions of Environment Canada and National Research Council
  - Several students
- Investigators have backgrounds in many atmospheric science fields, sea ice, climate science
  - Many years of different field experience (polar / other)
- Collaborating with other IPY projects
- Working with NRI, INAC, Qulliq Energy

Team

- Co-Leads:
  Hanesiak (UM), Stewart (McGill)

- Co-Investigators:
  Barber (UM), McBean (UWO), Moore (UT), Taylor (YU)

- Collaborators:
  Bilan-Wallace (EC), Goodson (EC), Hudak (EC), Kochtubajda (EC), Gravel (EC), Strapp (EC), Nitu (EC), Wolde (NRC)

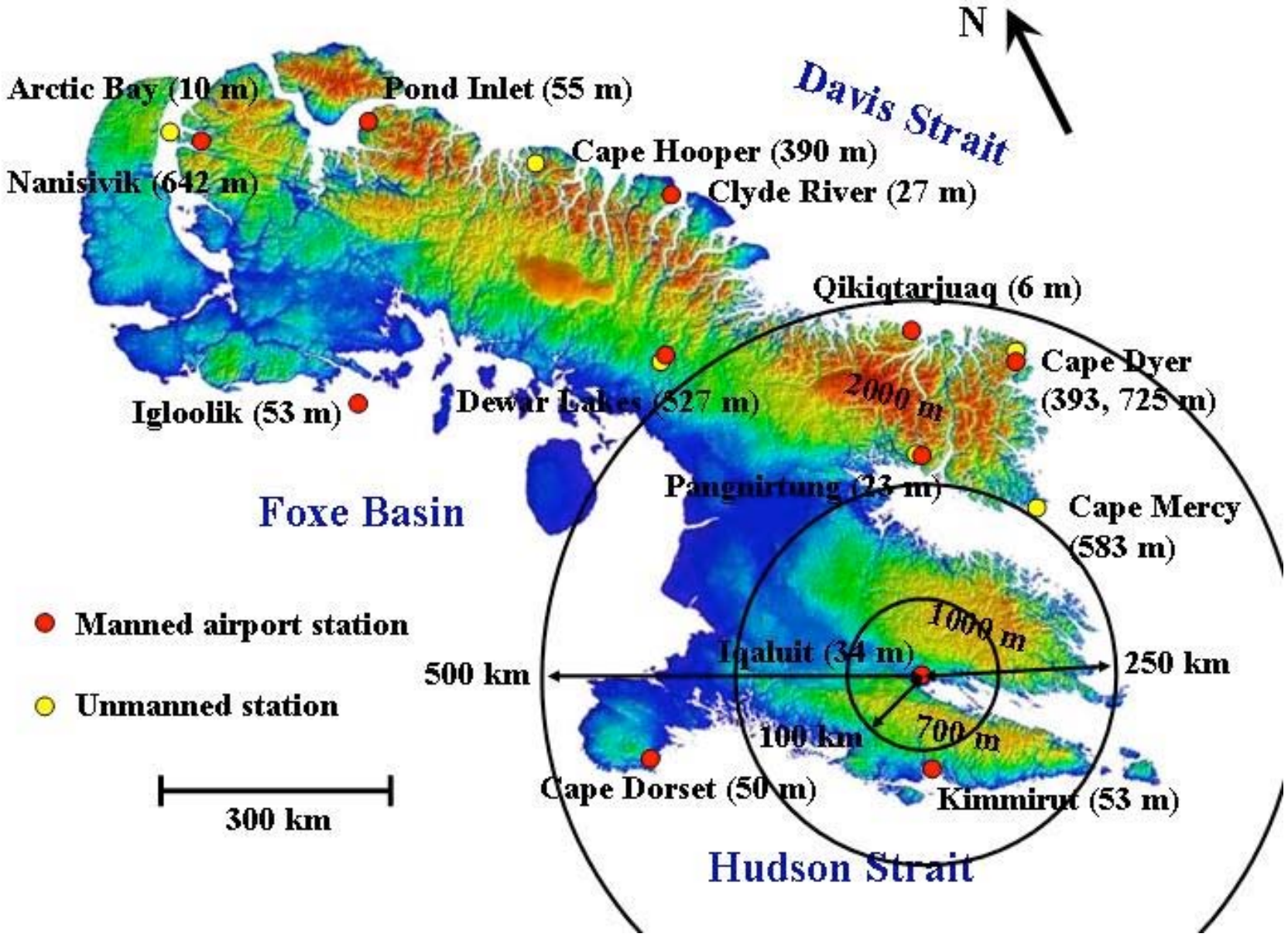
Objective

- To better understand severe Arctic storms and their associated hazardous conditions, and contribute to their better prediction
  - Realized through 4 main themes
  - Blowing snow, strong winds, low vis & fog, precipitation, sea ice

Key Tasks

- Major field experiment (data for diagnostic and computer modeling studies) Oct 10 - Dec 5 2007 ; snow and blowing snow Feb 2008
- Determine physical factors that create hazardous weather
- Contribute to the improved computer simulation & prediction of storms
- Optimize science by engaging communities

Geography

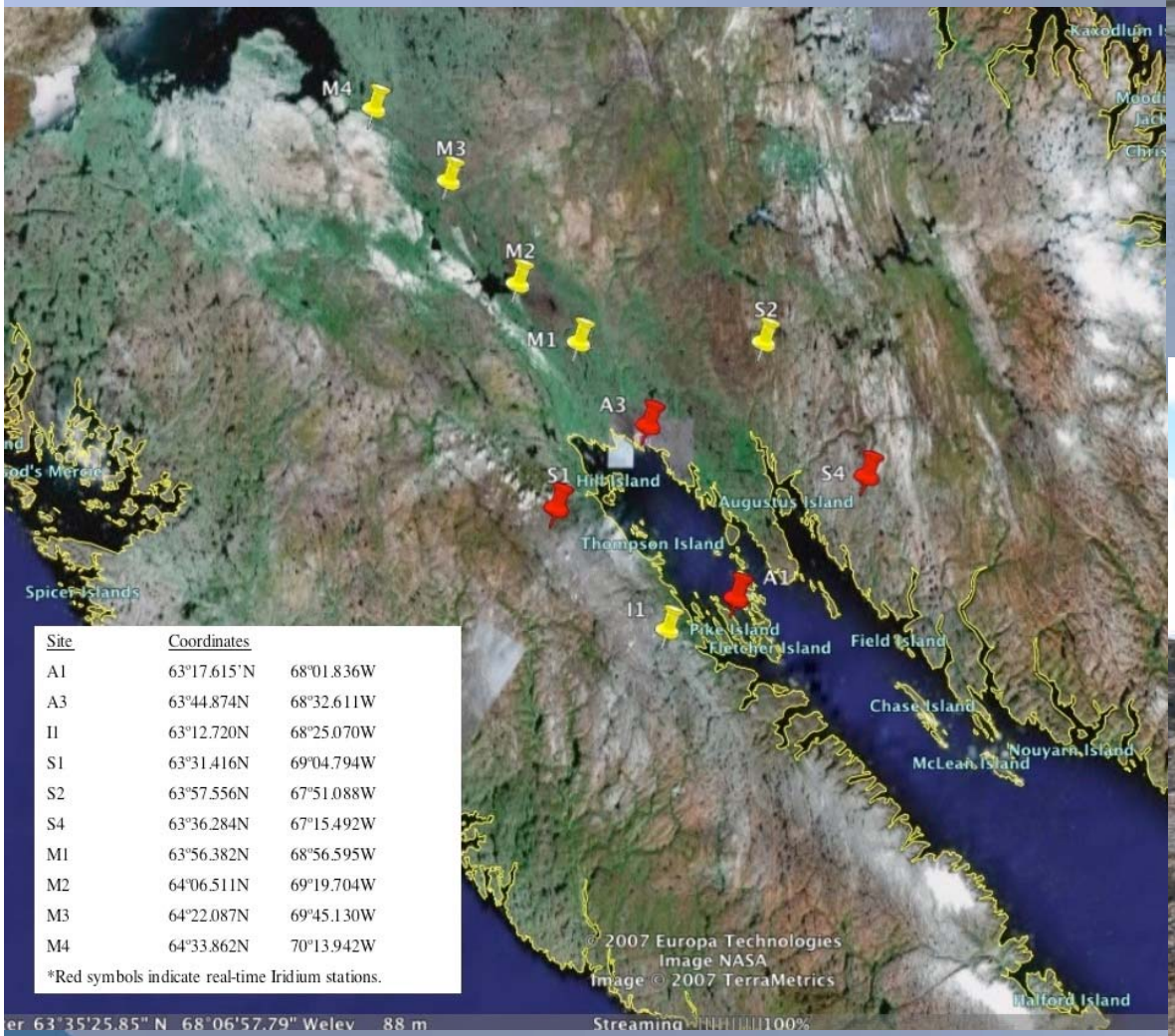

N
Arctic Bay (10 m)
Pond Inlet (55 m)
Davis Strait
Cape Hooper (390 m)
Nanisivik (642 m)
Clyde River (27 m)
Qikiqtarjuaq (6 m)
Cape Dyer
(393, 725 m)
2000 m
Igloolik (53 m)
Dewar Lakes (527 m)
Pangnirtung (23 m)
Foxe Basin
Cape Mercy
(583 m)
Manned airport station
Unmanned station
1000 m
Iqaluit (34 m)
500 km
250 km
100 km
700 m
Cape Dorset (50 m)
Kimmirut (53 m)
300 km
Hudson Strait

Tools

- Research aircraft & onboard radars
- Enhanced weather balloon launches
- Weather Radar
- Mesonet & special weather observations
- Surface remote sensing (sodar, radiometer, surface precipitation)
- Detailed blowing snow measurements
- Computer Models & Analyses Products
- Satellite technology (e.g. CloudSat)

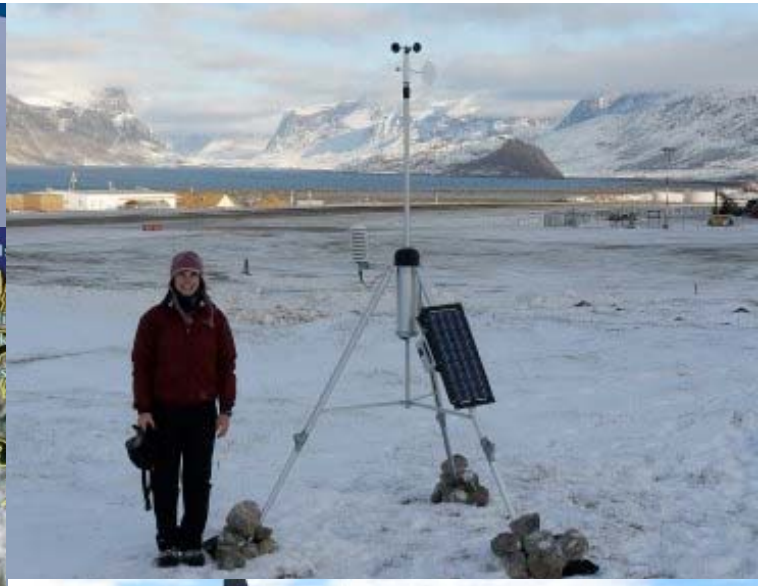
Surface-Based Measurements

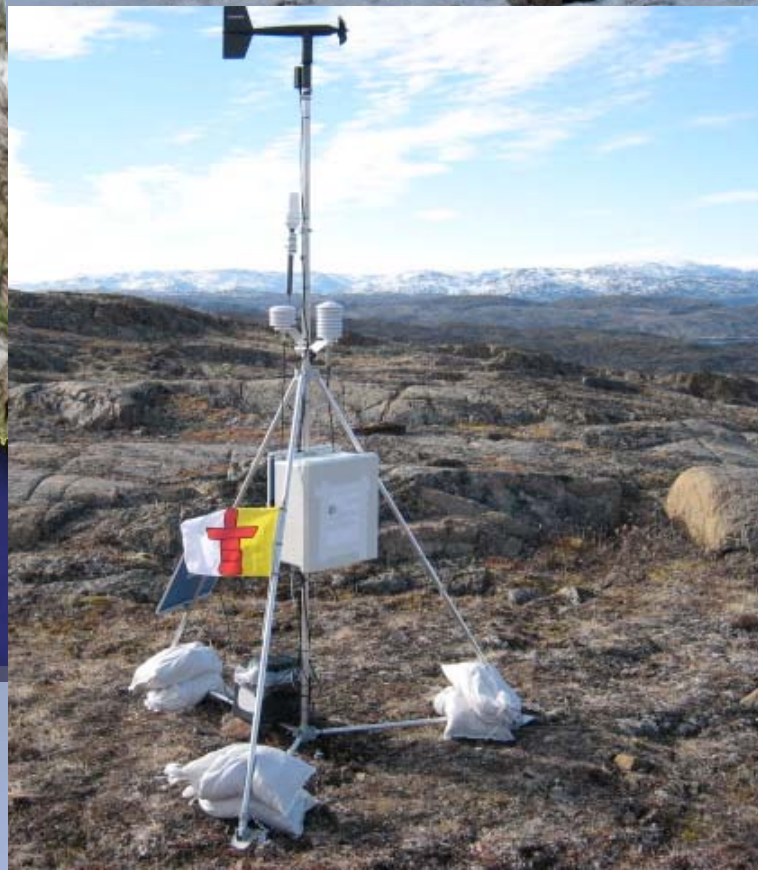
Surface-based Measurements



Site	Coordinates	
A1	63°17.615'N	68°01.836W
A3	63°44.874N	68°32.611W
I1	63°12.720N	68°25.070W
S1	63°31.416N	69°04.794W
S2	63°57.556N	67°51.088W
S4	63°36.284N	67°15.492W
M1	63°56.382N	68°56.595W
M2	64°06.511N	69°19.704W
M3	64°22.087N	69°45.130W
M4	64°33.862N	70°13.942W

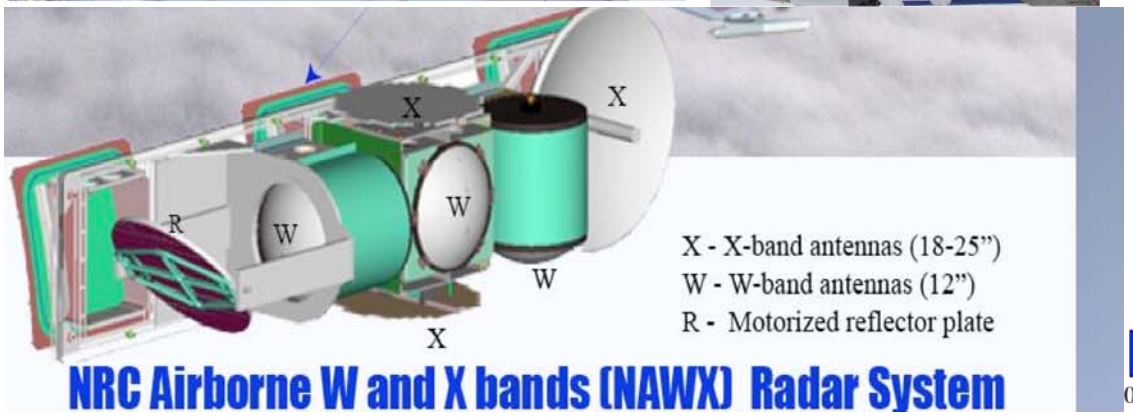
*Red symbols indicate real-time Iridium stations.

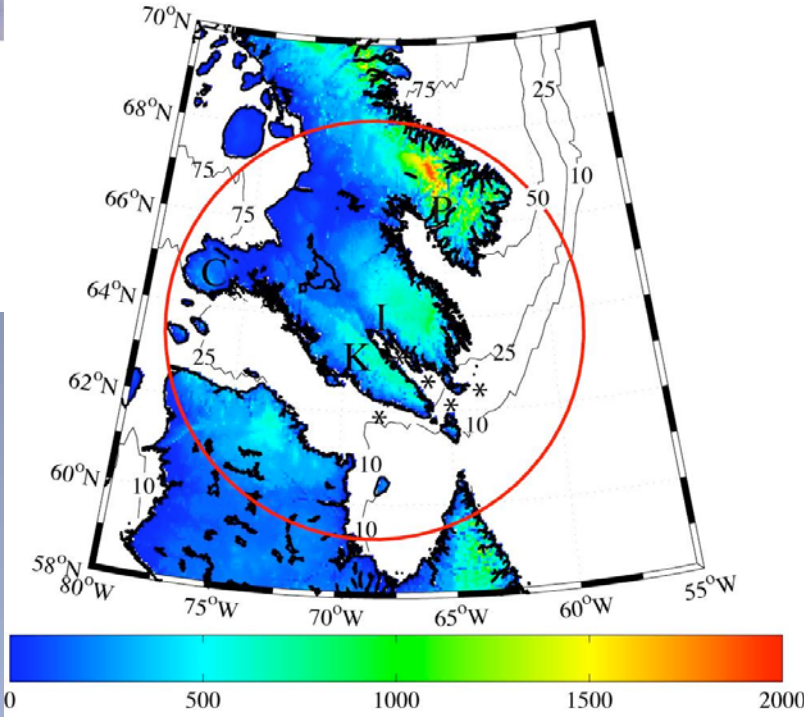




Research Aircraft (NRC Convair-580)

- 3 types of radars looking in various directions
- dropsondes

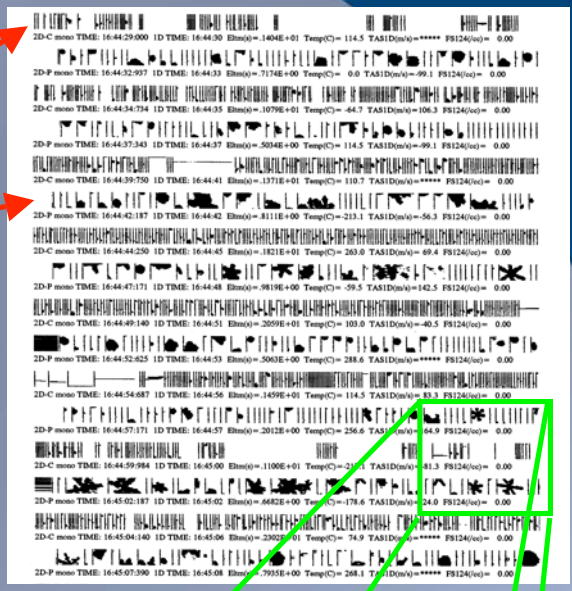


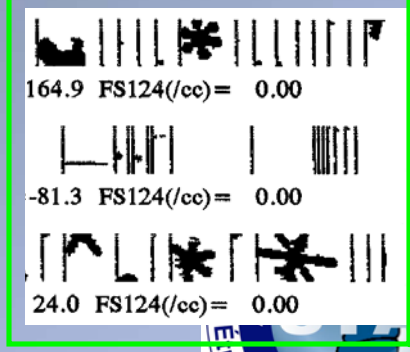


CONVAIR-580 CLOUD MICROPHYSICS

Under-wing particle probes

Standard PMS 2D Imagery





- Bulk Microphysics Probes for LWC, TWC, and IWC
- Cloud spectrometers
- Additional pylon on other wing with 3 other particle probes and wind/gust measurement system

COUNTERFLOW VIRTUAL IMPACTOR (CVI) TWC SYSTEM

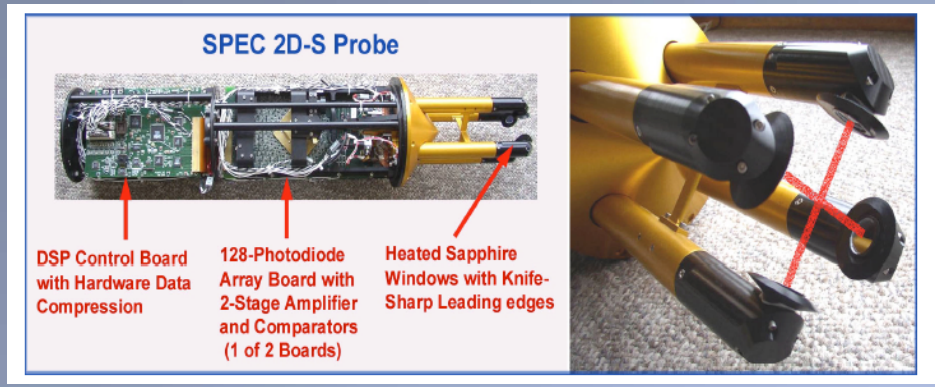
•***NEW FOR CLOUDSAT***

• being purchased specifically to improve accuracy of IWC measurement

• this instrument should provide accurate estimates of IWC even at very low values (0.005- 0.05 gm-3)

• used for STAR CloudSat

SPEC 2D-S (STEREO) SPECTROMETER



• improves accuracy of small ice particle measurement, and absolute spectral definition below 100 um

• used for STAR CloudSat

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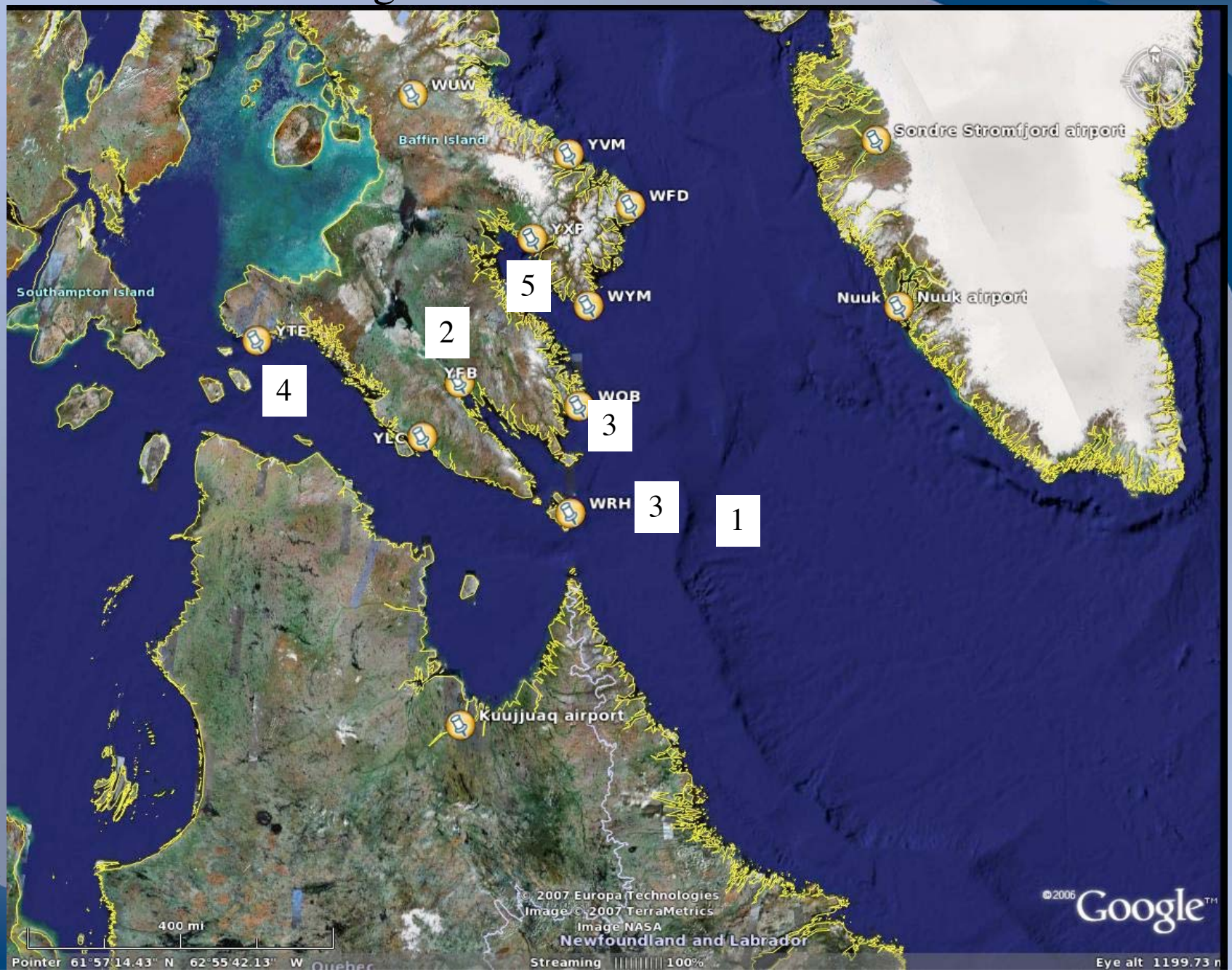
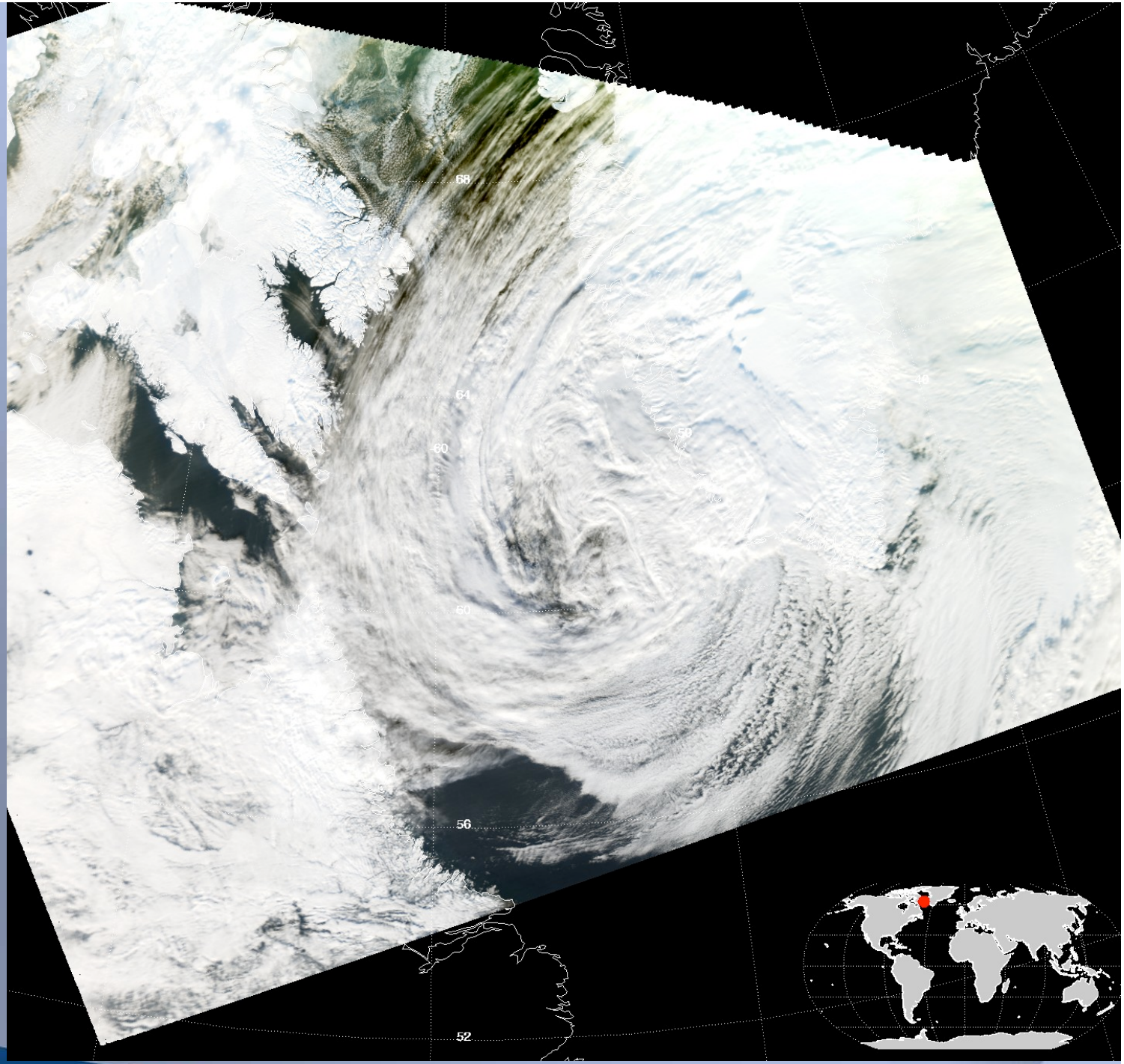
Études des Tempêtes dans l'Arctique

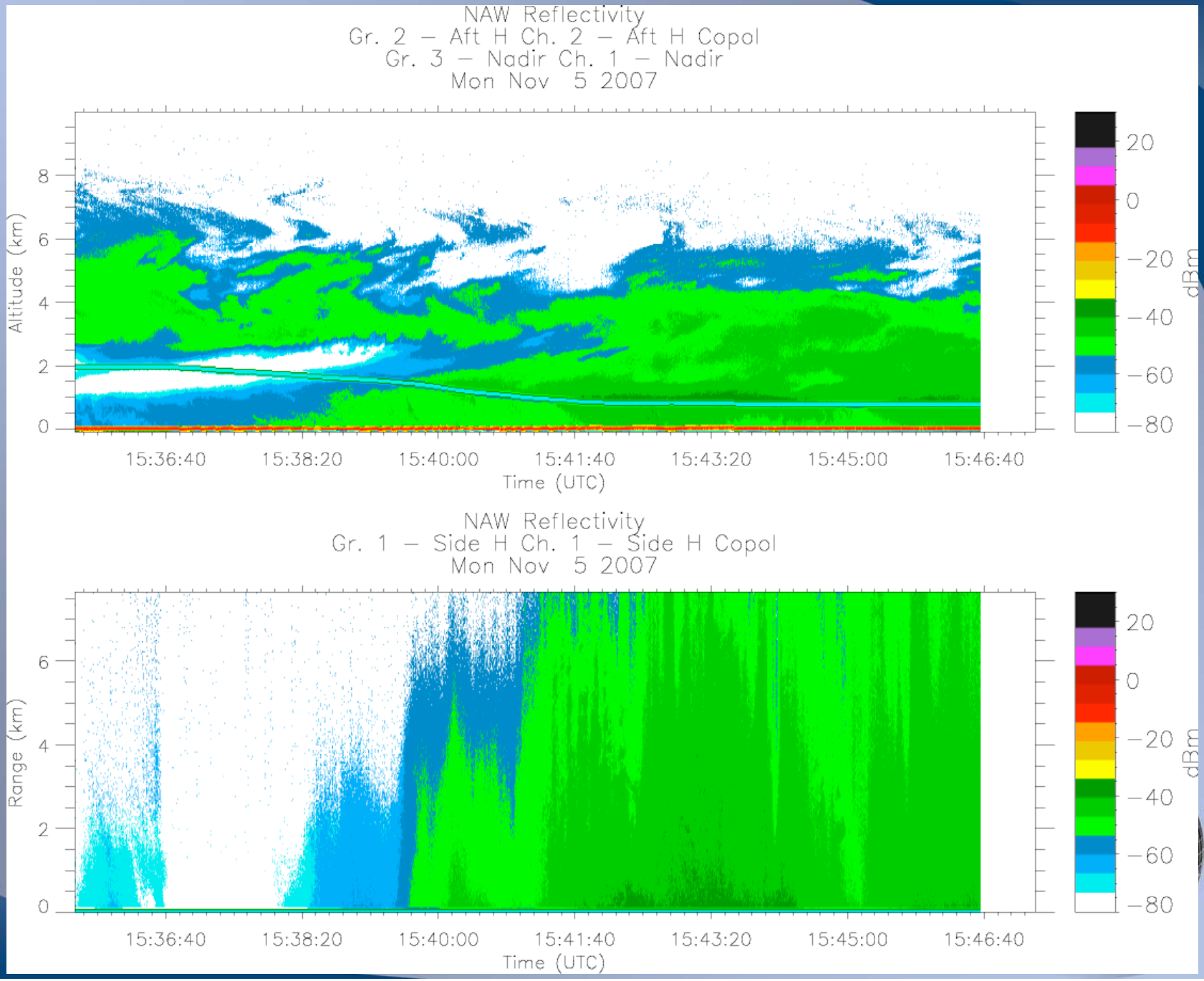
STAR Research Flights thus far



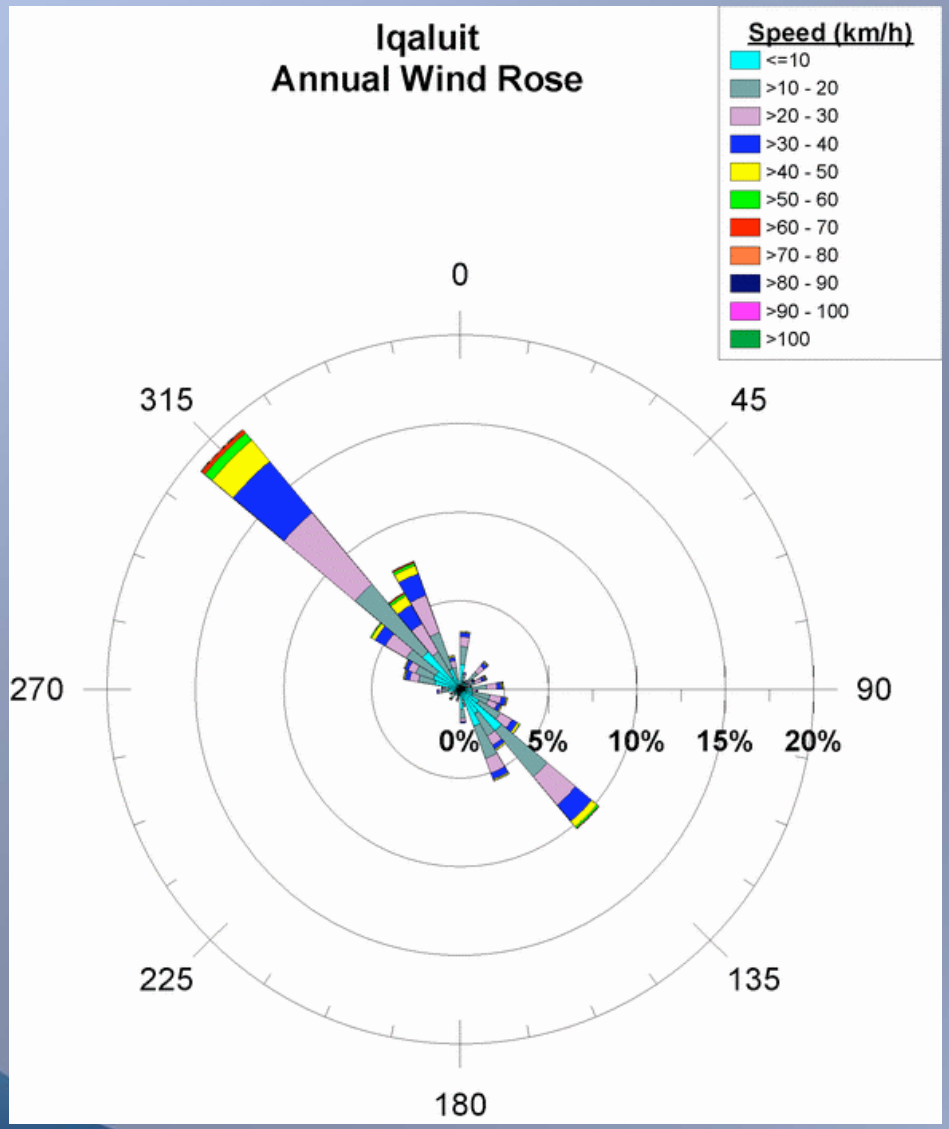
Remnants of Hurricane Noel

1620Z
Nov 5



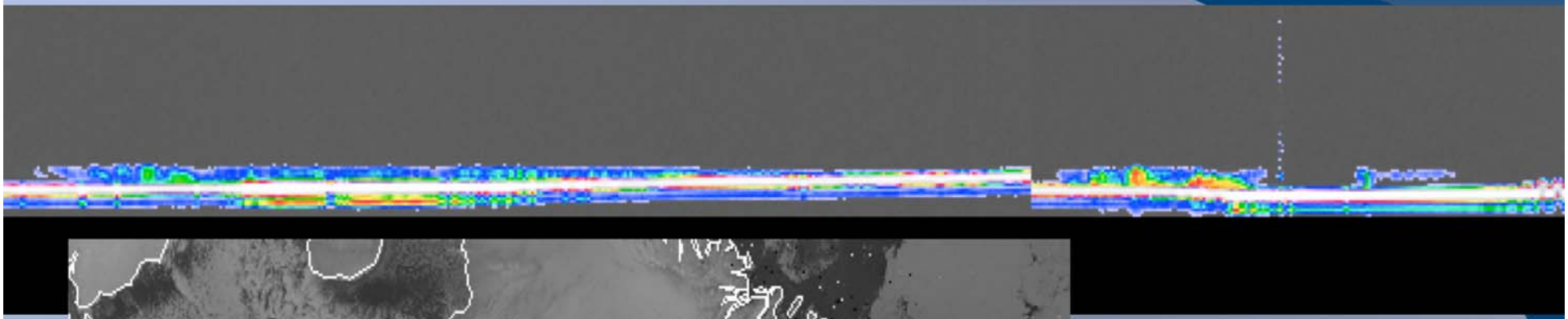

NAW Reflectivity
Gr. 2 – Aft H Ch. 2 – Aft H Copol
Gr. 3 – Nadir Ch. 1 – Nadir
Mon Nov 5 2007
Altitude (km)
0
2
4
6
8
15:36:40
15:38:20
15:40:00
15:41:40
15:43:20
15:45:00
15:46:40
Time (UTC)
20
0
−20
−40
−60
−80
dBm
NAW Reflectivity
Gr. 1 – Side H Ch. 1 – Side H Copol
Mon Nov 5 2007
Range (km)
0
2
4
6
15:36:40
15:38:20
15:40:00
15:41:40
15:43:20
15:45:00
15:46:40
Time (UTC)
20
0
−20
−40
−60
−80
dBm

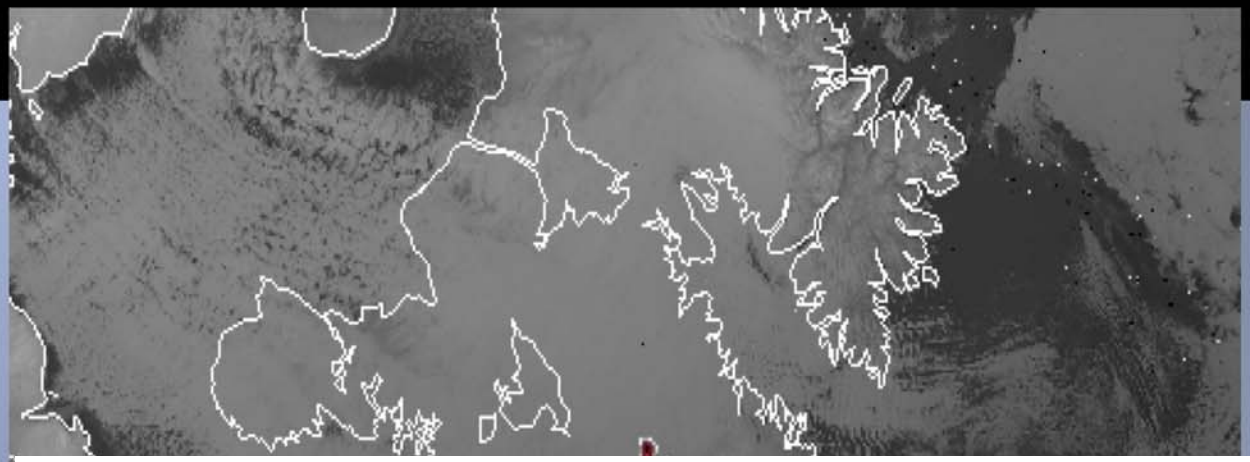
Theme 1 (Iqaluit Area)

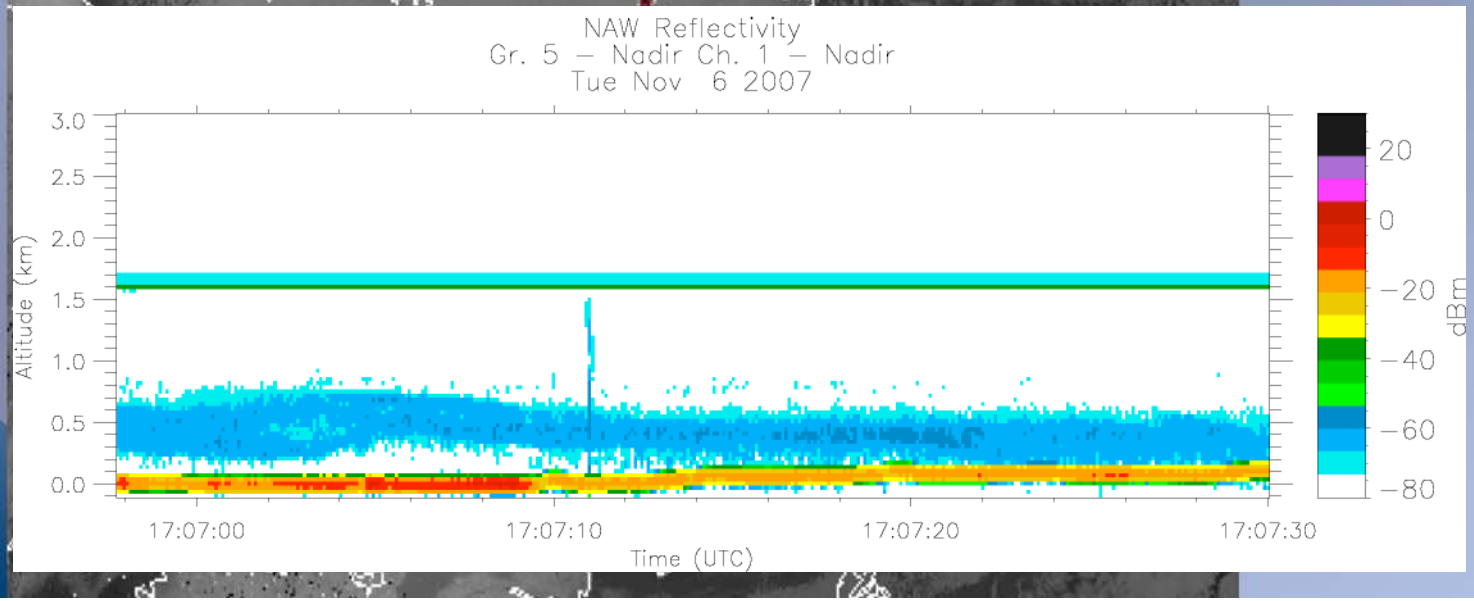


- How are hazardous weather conditions produced at Iqaluit & near-by areas?
- Detailed analysis & understanding for local area using a variety of data
- CloudSat validation

CloudSat







Flight 2:
Nov 6 16:53 - 19:38 Z

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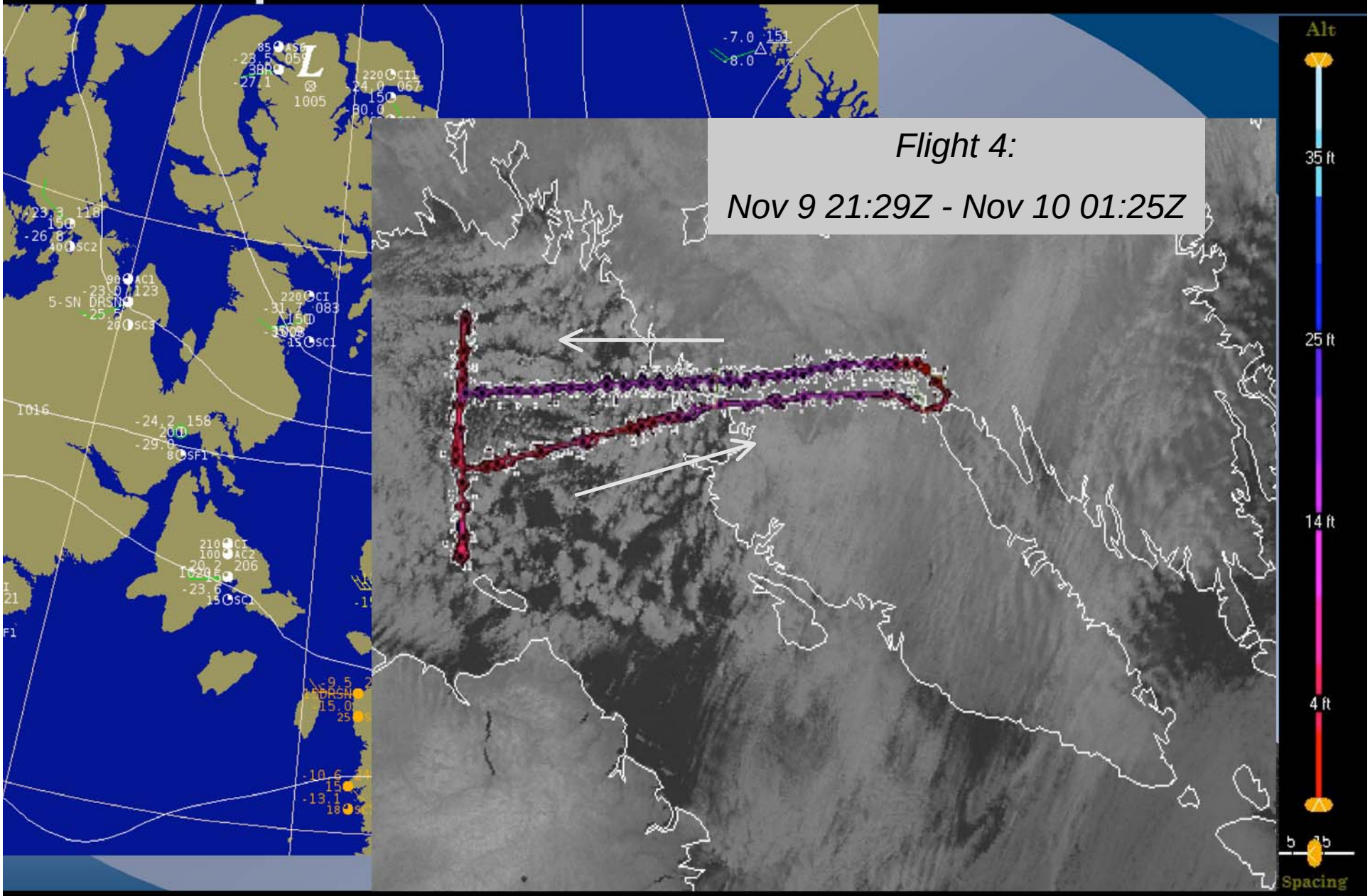
Theme 2 (Regional Weather & Sea Ice)

- How is Iqaluit weather similar/dissimilar to other communities (transferability)?
- How is sea ice affected by storms?
- How does the MIZ affect the atmosphere?

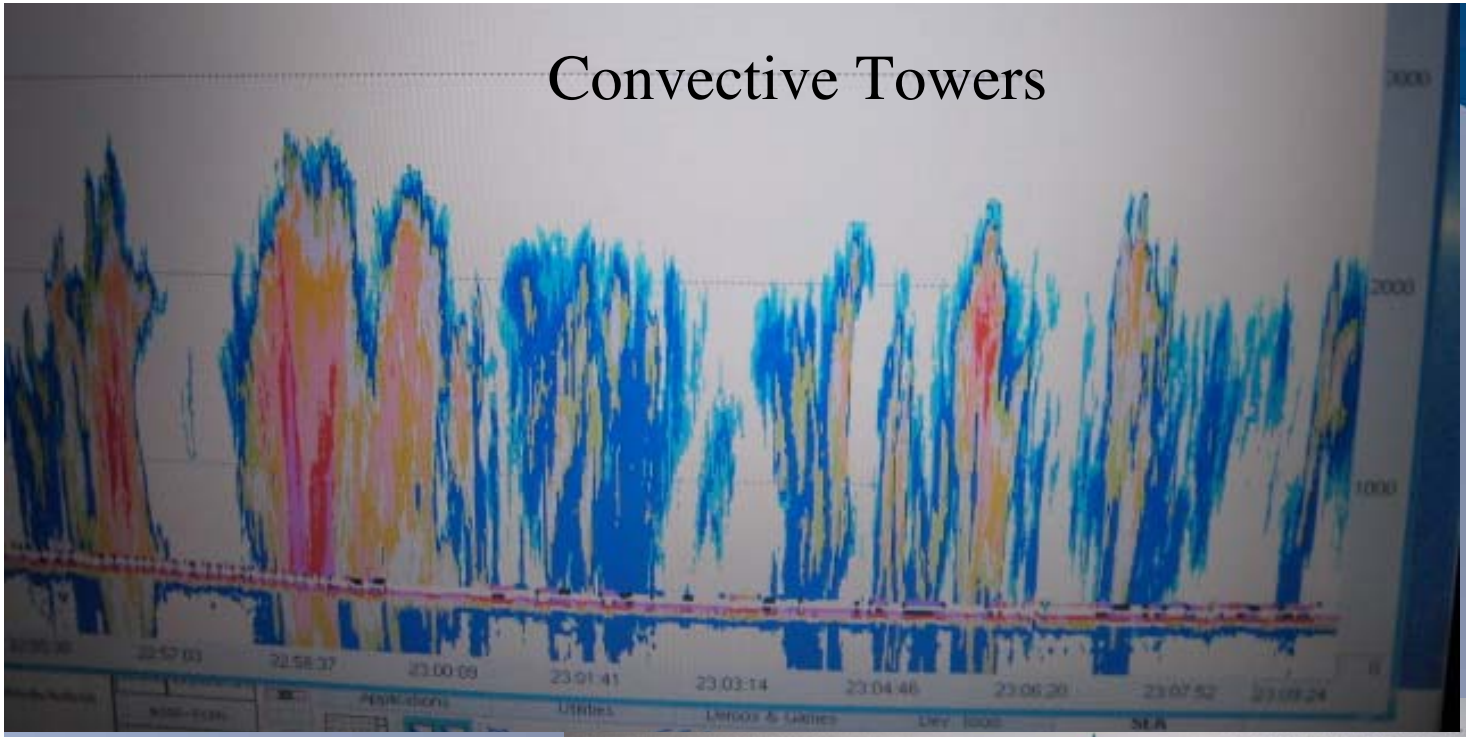
- Broadens the knowledge of Theme 1
- Can explain the larger scale conditions affecting Iqaluit
- Special observations: aircraft & mesonets

Unexpected Snow in YFB 11 November 2007

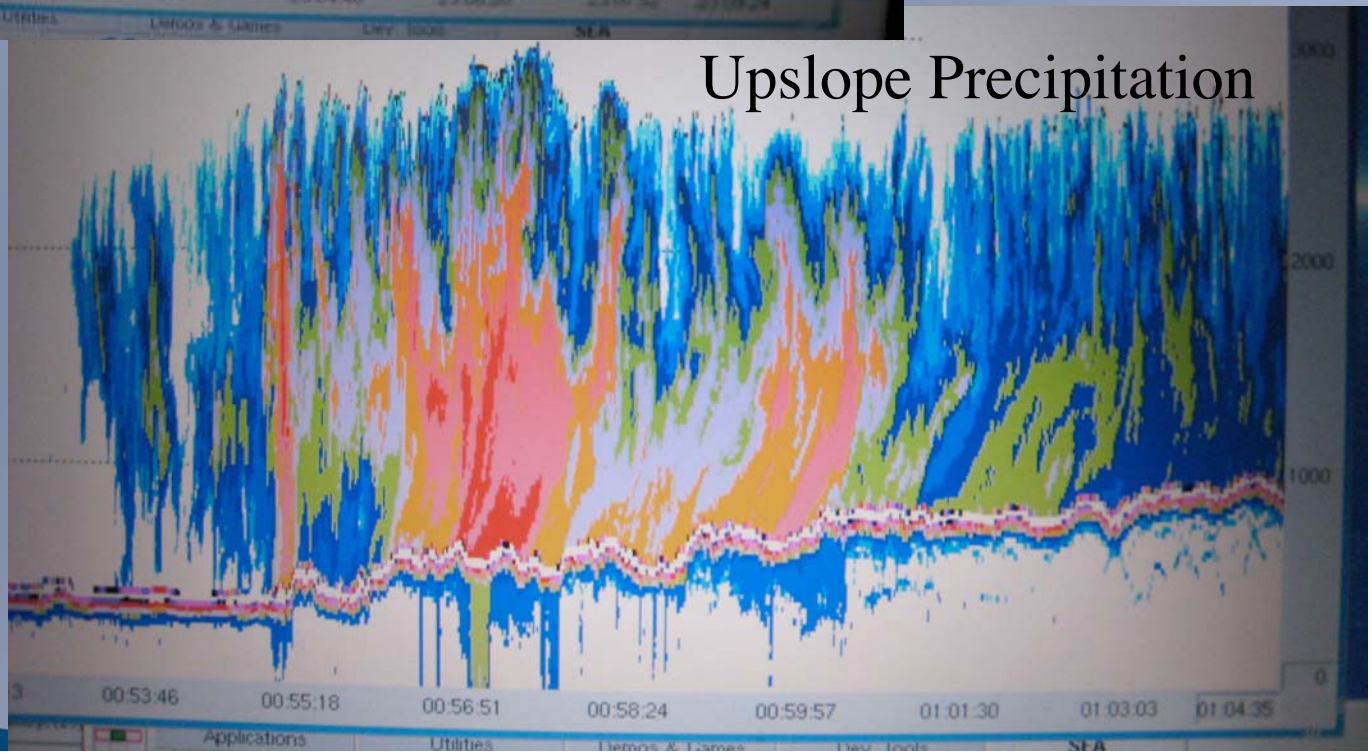


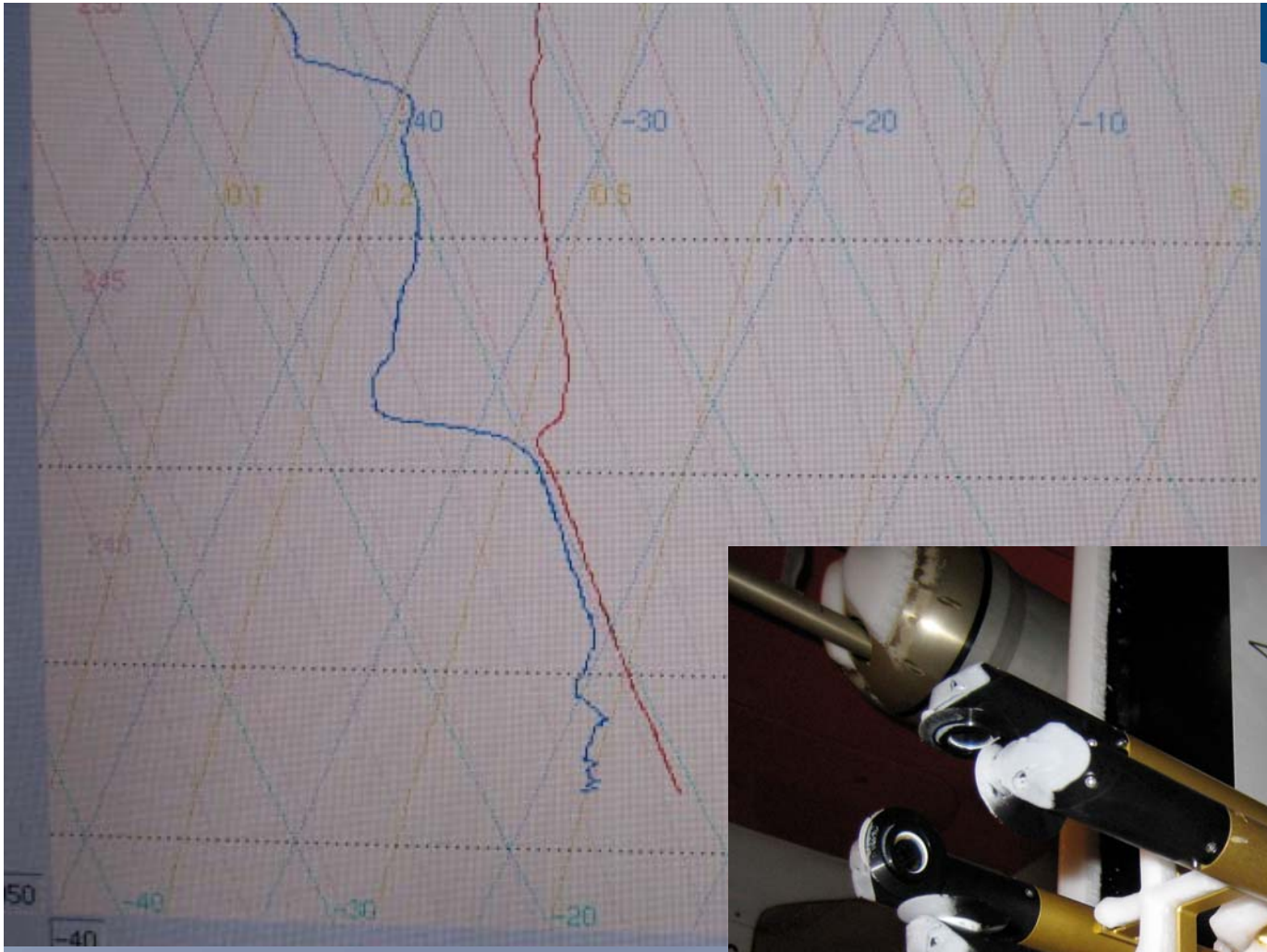
Convection in Hudson Strait

Convective Towers



Upslope Precipitation

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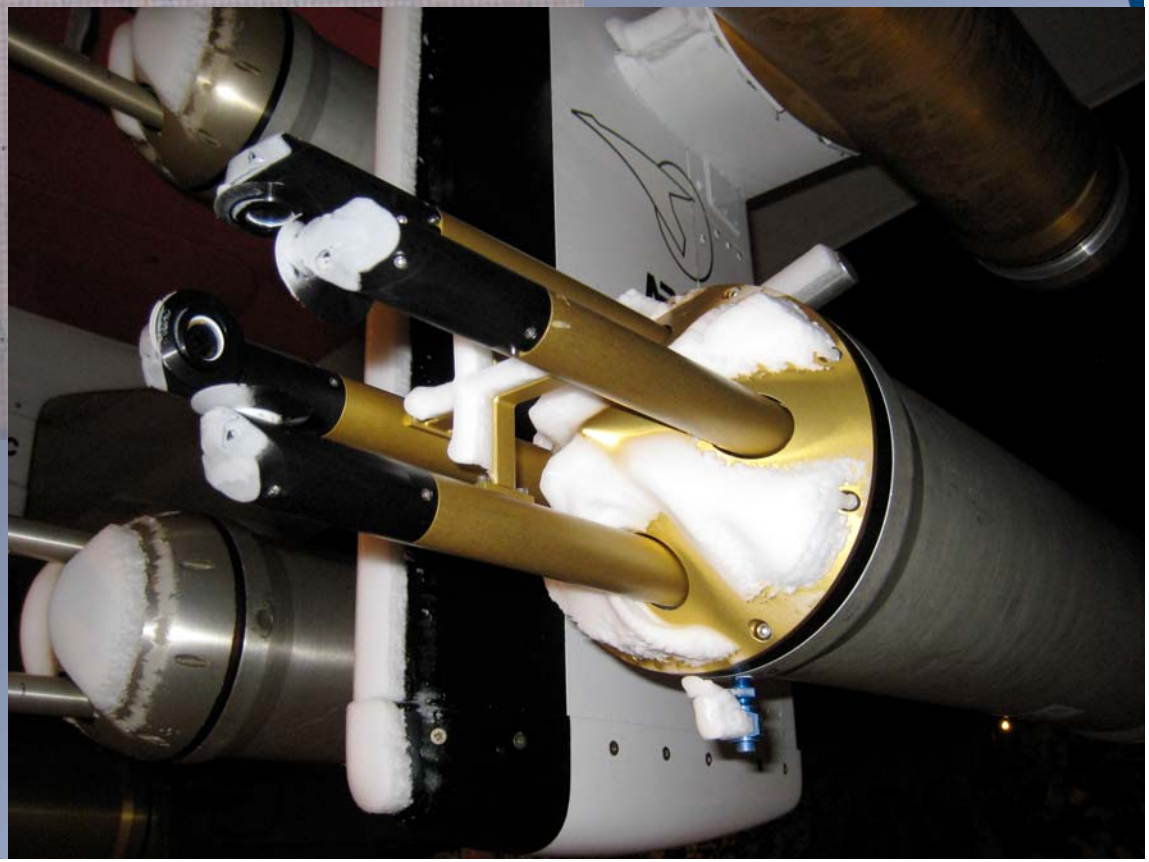
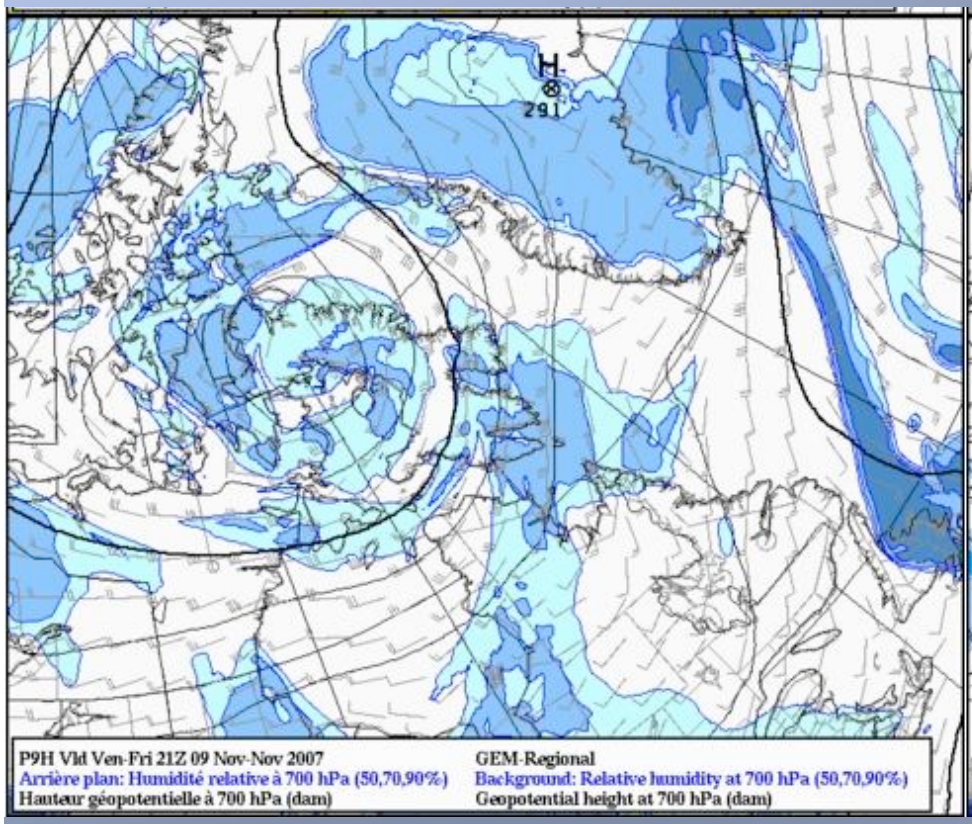
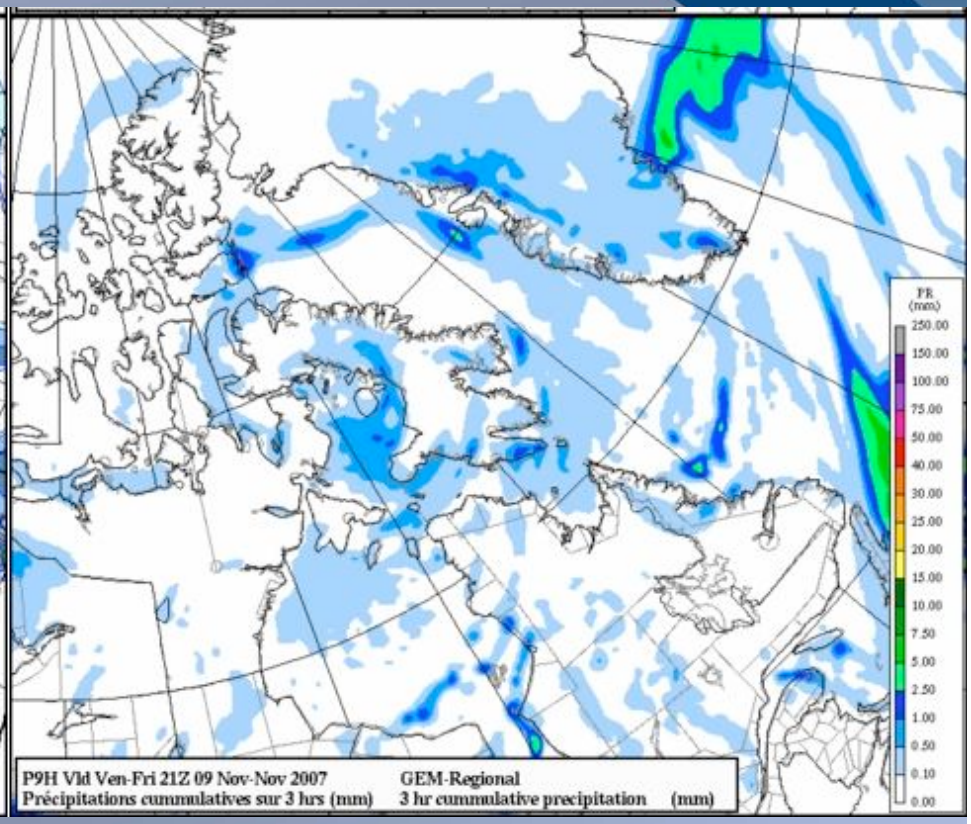


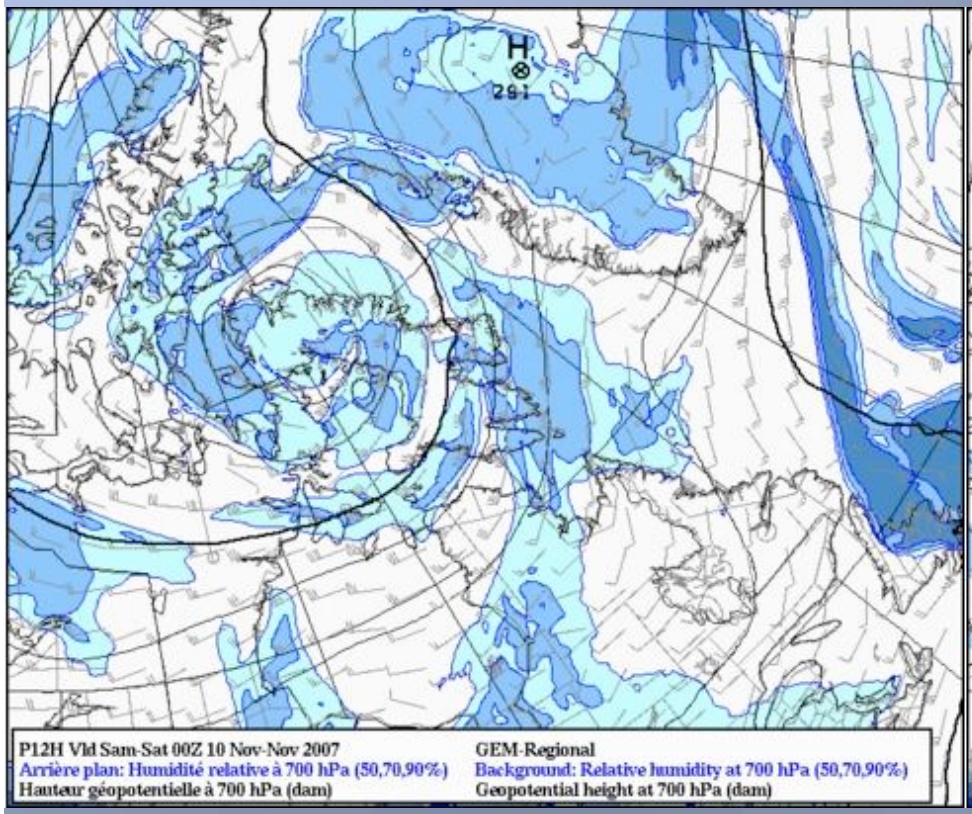
Theme 3 (Modeling & Prediction)

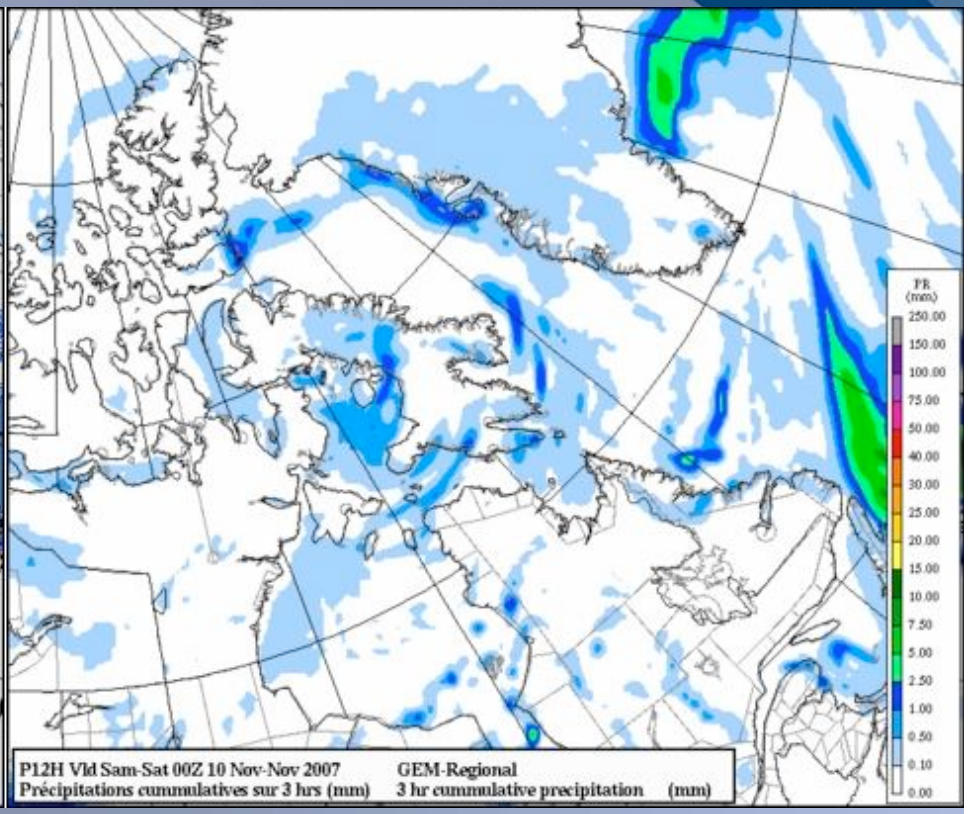




How well do models do in this environment?
Use models to better understand processes/feedbacks
No detailed study in Iqaluit area

Theme 3 (Modeling & Prediction)





How well do models do in this environment?
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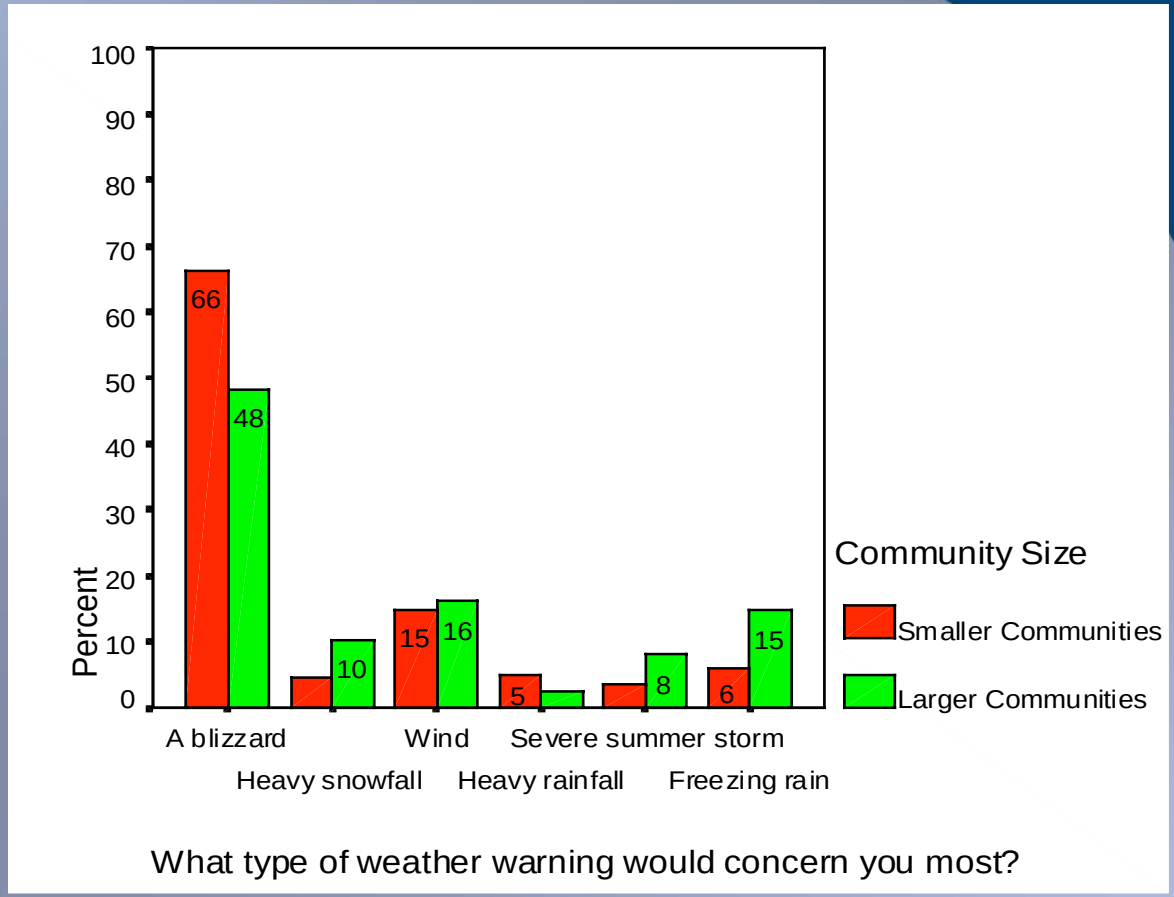
Prediction Issues

- Winds & Topographic influences
- Interaction of synoptic-scale systems with local topography (e.g. timing of fronts)
- Upslope precipitation (common on Baffin Island)
- Modification of weather systems by sea ice and MIZ
- Weather elements

Theme 4 (Communities & Users)

- Iqaluit most concerned about blizzards & strong winds
- Heavy snow & freezing precip as well
- Sea ice in Fall & Spring



Theme 4 (Communities & Users)

- OBJECTIVES:

- Integrate traditional knowledge and scientific observations to document and understand changes and hazards (working with James Ford - IPY project
- Conduct an assessment clarifying peoples' perspectives of storms, the hazards and associated impacts, in the context of the analysis of storm systems (STAR-SHIP project with Yvonne Bilon-Wallace / Bob Kochtubajda ; northern agency interactions with Gordon McBean)
- Examine human impressions of severe storms as they are studied by STAR (James, Yvonne/Bob, Gordon)
- Communicate research results to relevant government agencies and impacted sectors of society

- Seminars & workshops with communities
- Web site & STAR publications

Theme 4

- STAR - Storm Hazards Impact Project

- 1-800-440-4434 and leave a voice message
- Fax: 780 495-3529
- email: nunavut.weather@ec.gc.ca
  nunavut.meteo@ec.gc.ca
- Online: www.starnetwork.ca

Long-Term Goals

- To better understand and predict weather and weather-related extremes in the Arctic; and
- To better assess whether the intensity and frequency of such extremes will change in the future with climate

Collaboration & Users

- Direct
  - ArcticNet
  - IPY (2007-08)
  - NAC, NRI
  - EC (many divisions of MSC)
  - NRC

- MSC (prediction and warnings)
- DND
- CIS for ice impacts from storms
- NavCanada
- Town of Iqaluit & Pangnirtung
- All northern communities will benefit

What will STAR achieve?

- First field expedition in this region
- Unique dataset
- Multi-dimensional (link meteorology, topography, sea ice, fiords, communities)
- Improve prediction capabilities
- Provide tangible results for users
- Only CloudSat validation in the Arctic

Timing

- **2007**

Sept 19-26	installation of equipment at Iqaluit and surrounding region
Oct 10–Dec 5	Autumn field experiment

- **2008**

Feb 1-28	Blowing snow field experiment
Spring	Annual workshop
Spring/Summer	Iqaluit visit

- **2009**

Spring/Summer	Iqaluit visit
Summer	Annual workshop

- **2010**

Summer	Iqaluit visit
Autumn	Project completion and final international workshop Special issue for STAR research in a selected peer-reviewed journal

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