Environment and Climate Change Canada | Environnement et Changement climatique Canada

Canada

Understanding and monitoring Arctic weather using Iqaluit Supersite meteorological observations

Gabrielle Gascon[1], Zen Mariani[2], Armin Dehghan[2], Paul Joe[2], William Burrows[2], and Stella Melo[2]

[1]Meteorological Service of Canada Prediction and Services, Environment and Climate Change Canada, Government of Canada

[2]Severe Weather and Cloud Physics Research Section, Environment and Climate Change Canada, Government of Canada

Connaught Summer Institute in Arctic Science

July 21, 2016

Iqaluit


Arctic Ocean
Ellesmere Island
Alert
Kalaallit Nunaat
(Grønland)
(Denmark)
Iceland
North Magnetic Pole
Arctic Circle
Alaska
(USA)
Beaufort Sea
Banks I.
Resolute
Baffin Bay
Arctic Circle
Inuvik
Victoria Island
Baffin Island
Dawson
Yukon Territory
Gjoa Haven
Whitehorse
Iqaluit
Northwest Territories
Nunavut
Labrador Sea
Yellowknife
Baker Lake
Atlantic Ocean
Fort Nelson
CANADA
Nain
Newfoundland
British Columbia
Kuujjuaq
Fort McMurray
Churchill
Hudson Bay
Churchill Falls
Prince George
Alberta
Saskatchewan
Manitoba
St John's
Pacific Ocean
Edmonton
Sept-Îles
Vancouver
Calgary
Saskatoon
Sandy Lake
Quebec
Prince Edward Island
Charlottetown
Victoria
Kamloops
Regina
Winnipeg
Thunder Bay
Ontario
New Brunswick
Québec
Nova Scotia
Halifax
Fredericton
Montréal
United States of America
Ottawa
Toronto
LEGEND
National capital
Provincial or Territorial capital
Other populated places
Scale
300 0 300 600 900
km km

Background

- Growing interest in the Canadian Arctic
  - Potential for significant increase in shipping routes through the Canadian Arctic
  - First large cruise ship to sail the northwest passage this August
- Weather is a safety issue for the Arctic
  - Blowing snow, blizzard, fog, extreme cold
  - Challenging flying conditions
  - Mechanisms associated with Arctic weather still not well understood
- Weather data in the Arctic is limited

Background

→ There is a need to increase reliability of weather forecasts

→ The Iqaluit Supersite will:

- Increase available, real-time, weather observation
- Increase available data to evaluate numerical models
- Test the ability of meteorological instruments to operate in cold weather

Iqaluit Supersite

Iqaluit Supersite

Doppler Lidar

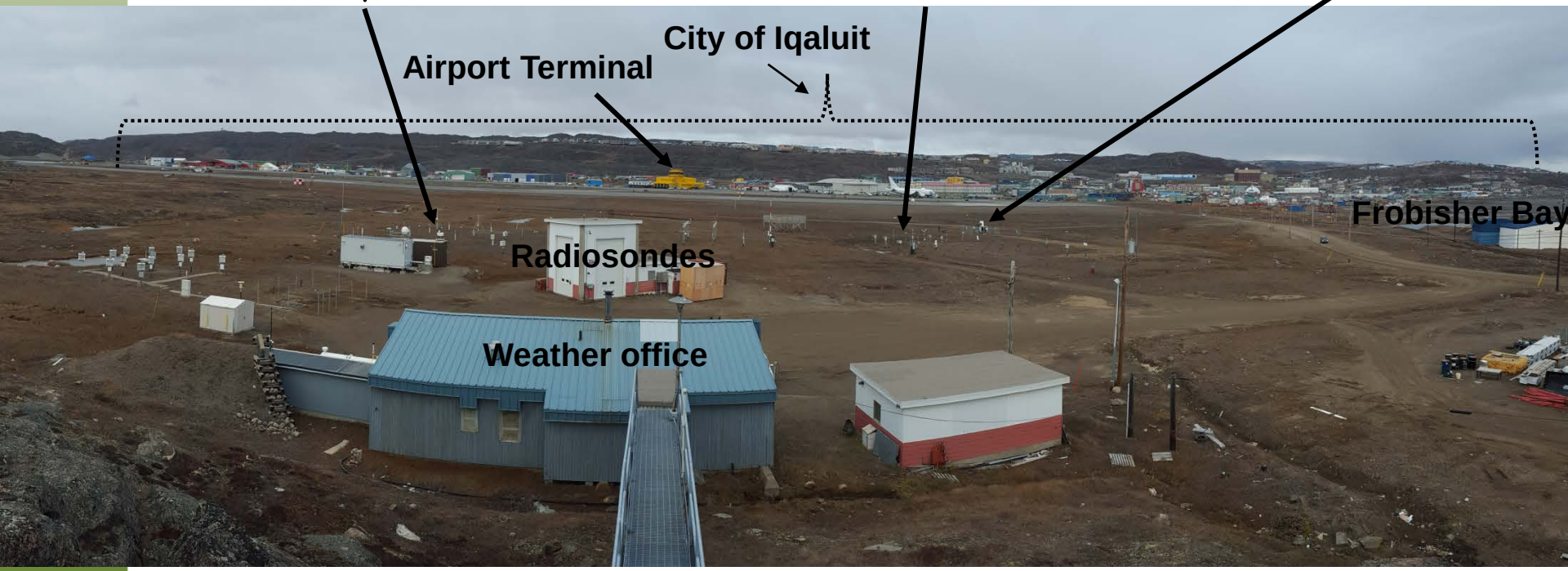
Precipitation Imaging Package

Ceilometer

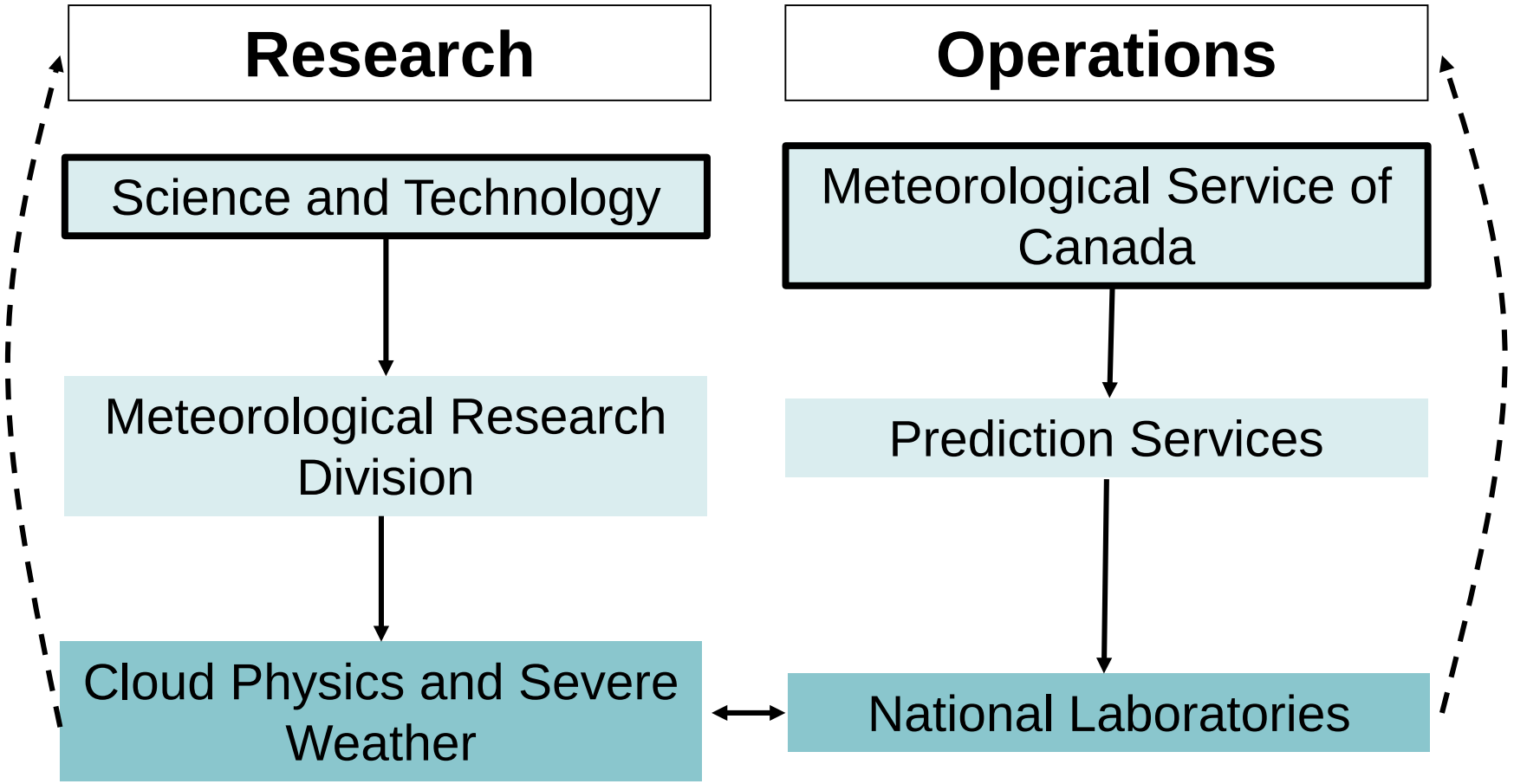
Radiometer

Present weather detection

Ka-Band radar



Where does this project fit within ECCC's mandate?



Iqaluit weather observations is support of operation and research programs

- **Operation**
- Research
- Research ↔ Operation

ecpass.ca

INTEGRATED PRODUCTS
(Multiple Instrument's Observations)

Surface Conditions	Upper Air	Altitudes of Interest	Comparisons	Additional Products	Satellite Imagery
Surface Visibility	Convection	Met. Parameters at Mixing Layer Height	Radiometer vs. Radiosonde	Flat Light	MODIS 250 m
Blowing Snow	Ice Creation	Met. Parameters at Cloud Base Height	HRDPS Tephigram (Latest)	VDRAS 3D Winds	IR time-composite
Surface Winds	Cloud Cover				Cloud-top Height
	Precipitation Type				

SURFACE METEOROLOGICAL OBSERVATIONS
(Click HERE for more information)

P, T, RH, Winds	Surface Visibility (PWD52)	Scintillometer	PIP Camera	Camera (latest)
Latest METAR/TAF	Luminance, Temp, Visibility	Turbulence	Daily Summary	Ka Band Radar
Surface Obs.	Precip Type (simplified)	Scintillation Index	eDensity Daily Summary *Experimental product: not for redistribution	Runway View (E)
	Precip Type (detailed synop)	Sensible Heat Flux		Lidar Cam
				NW Camera
				Sky Camera

VERTICAL PROFILES
(CLOUDS, T, P, RH)

Ceilometer	Radiometer	Radiosonde
Cloud Base Amount (past 24 hrs)	Profiles up to 1 km (past 24 hrs)	Radiosonde Soundings
Raw Backscatter (past 24 hrs)	Profiles up to 10 km (past 24 hrs)	
Backscatter Gradient (past 24 hrs)	Temp and DewPoint (past 24 hrs)	
Backscatter Profile (Latest)		

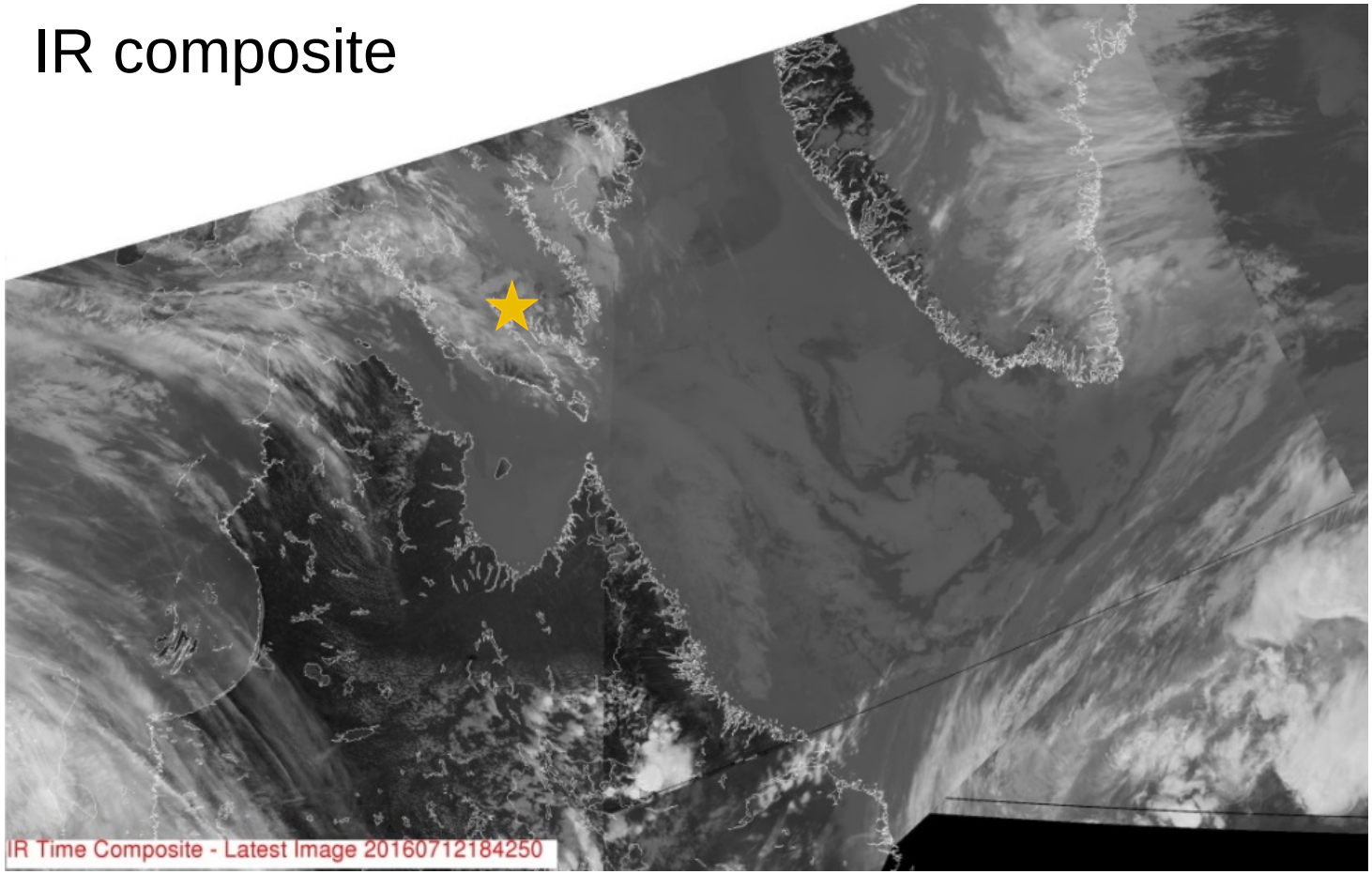
LIDAR WIND (VR) AND AEROSOL (BETA) PRODUCTS
(Click HERE for more information)

DEPOL. RATIO	PPI (Latest)	DBS WIND PROFILE	VERTICAL STARE	RHI VR
Water vs. Ice Profile	BETA	INSTANT (latest)	BETA HOURLY	North-South Scan
	VR	DAILY	VR HOURLY	AZ=135 (Frobisher Bay)
	BSCAN-BETA		BETA (Past 6 hrs)	

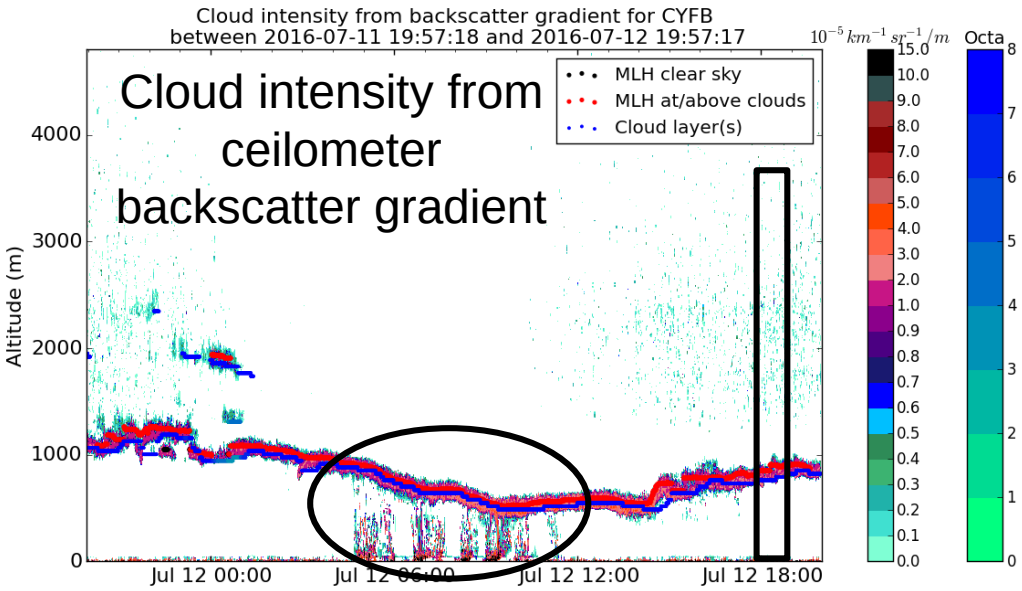
Example: July 11-12, 2016

Example: July 11-12, 2016

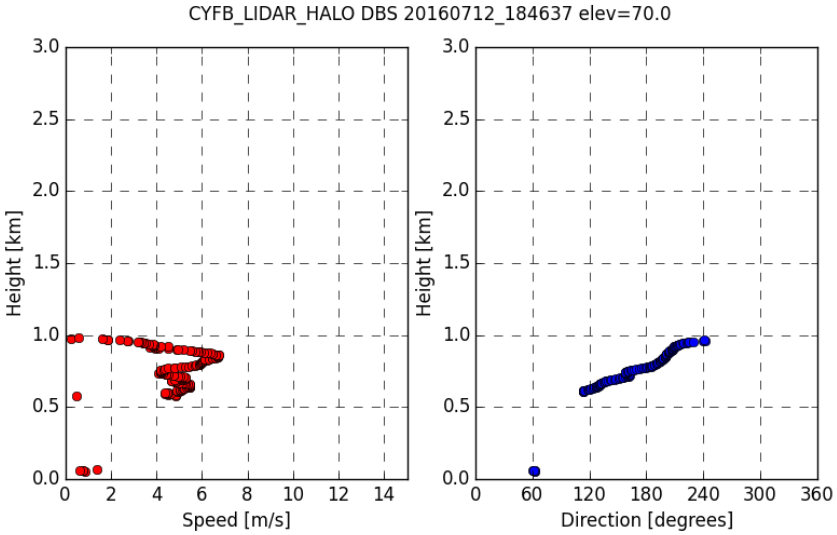
IR composite

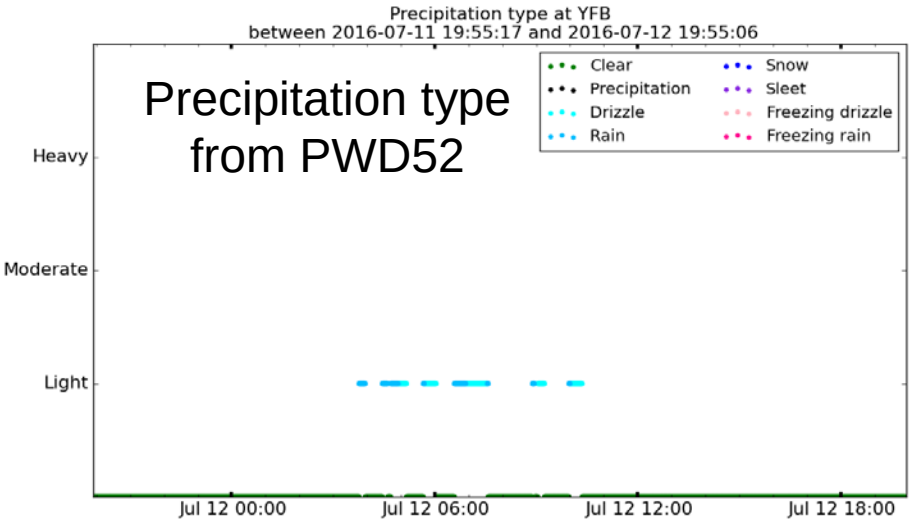


Example: July 11-12, 2016

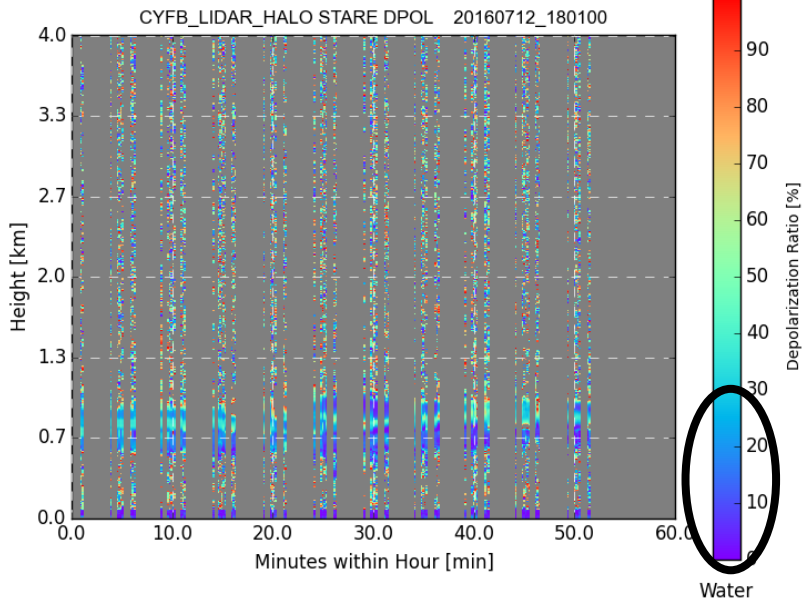


Wind profile at 1846 UTC from lidar





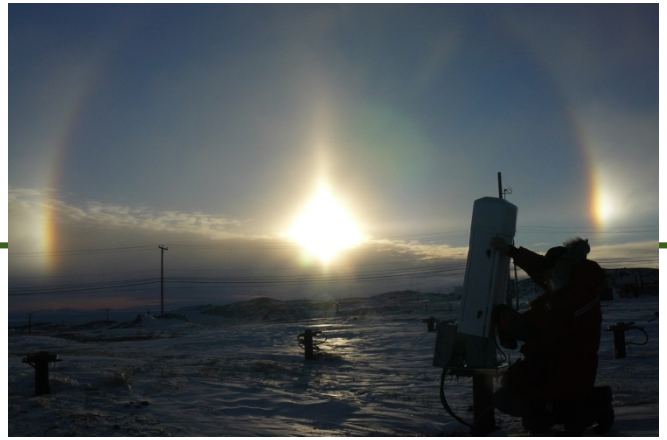
Depolarization ratio from Lidar



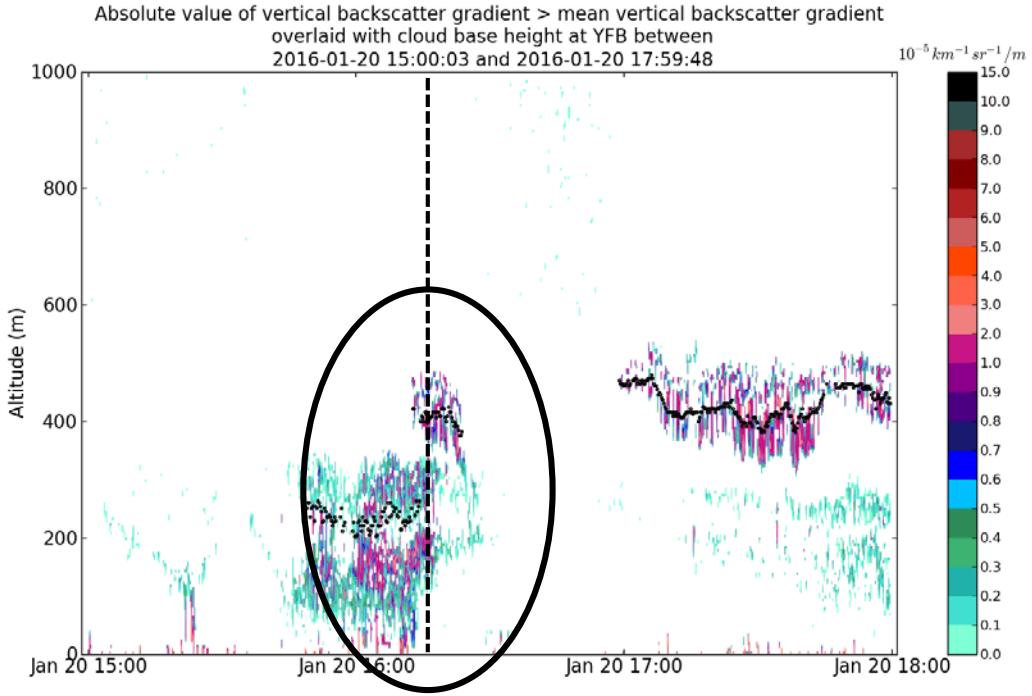
Iqaluit weather observations is support of operation and research programs

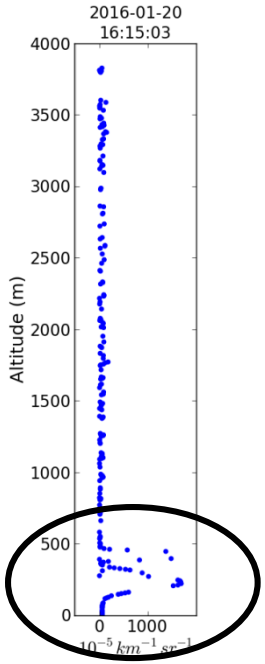
- Operation
- **Research**
- Research ↔ Operation

Diamond dust
January 20, 2016

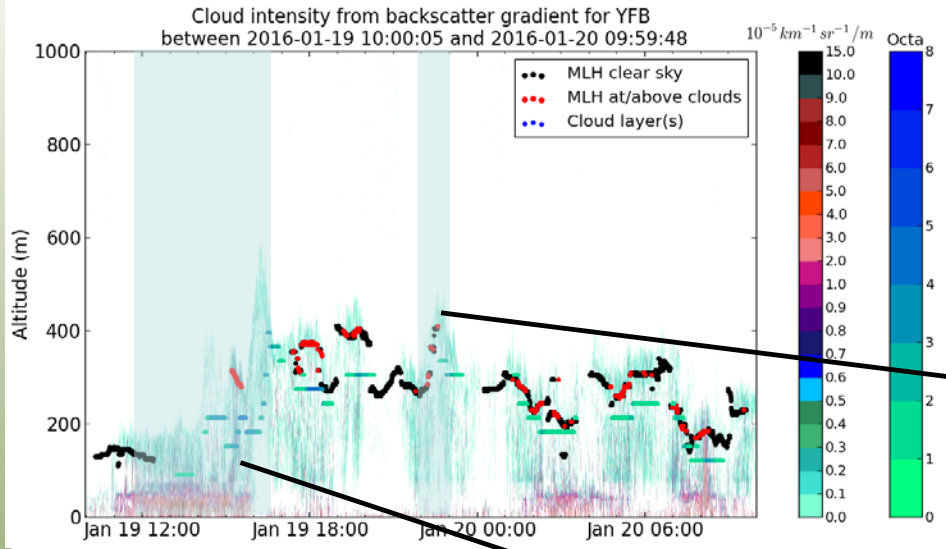


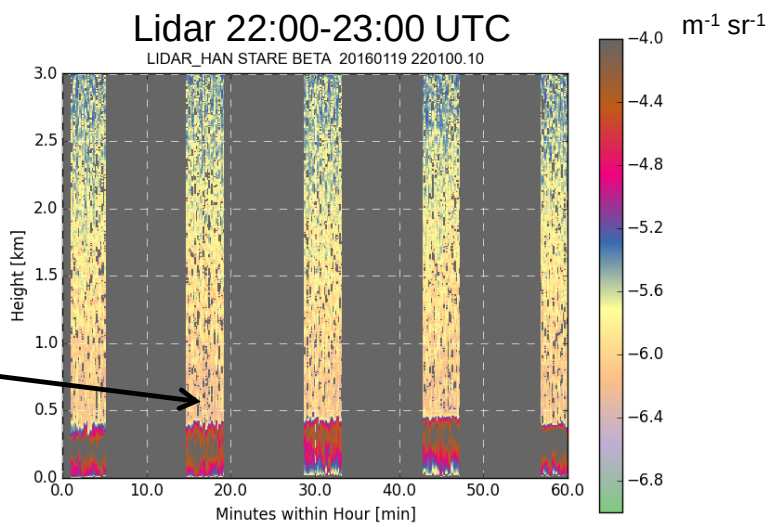
Event
January 20, 11:02 am local (16:02 UTC)
Ice crystals created atmospheric optical features



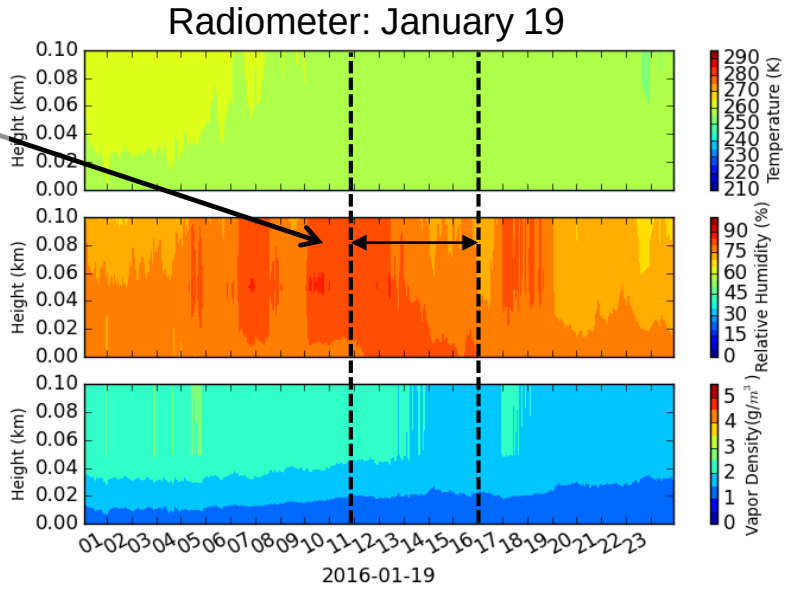


Blowing snow January 19-20, 2016

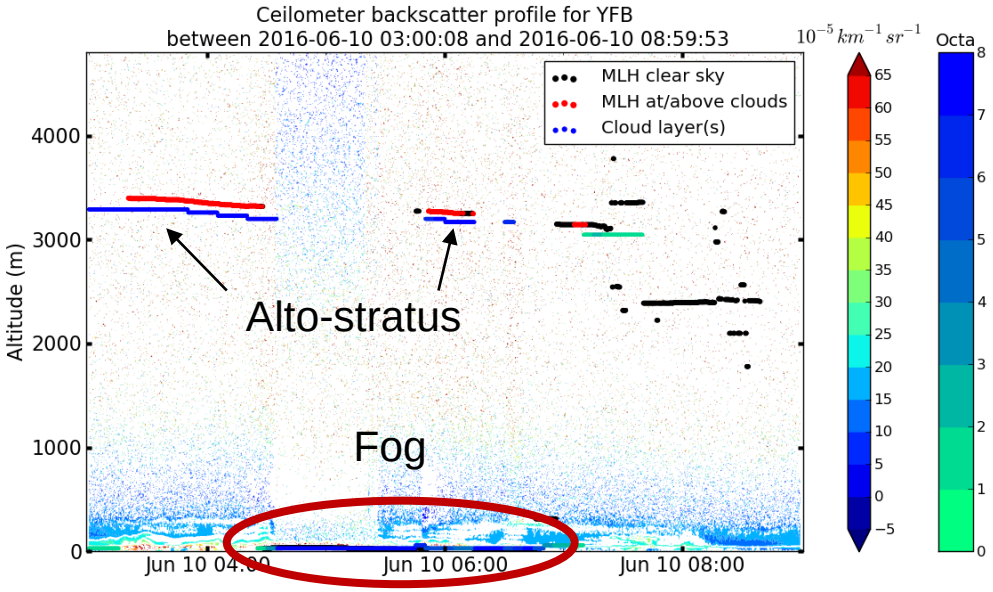


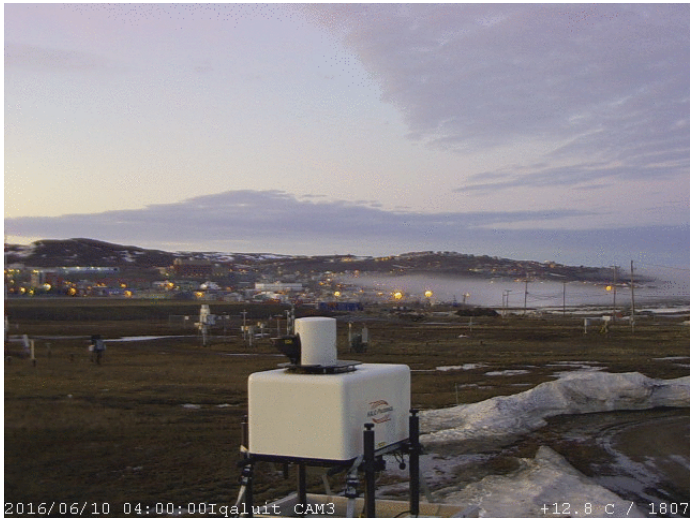


- Good agreement between the different instruments:
  - At 22-23 UTC Lidar sees vertical extent of blowing snow up to 450 m, and ceilometer sees blowing snow thickness up to 425 m
  - Radiometer captures increase in relative humidity extending to the surface during blowing snow

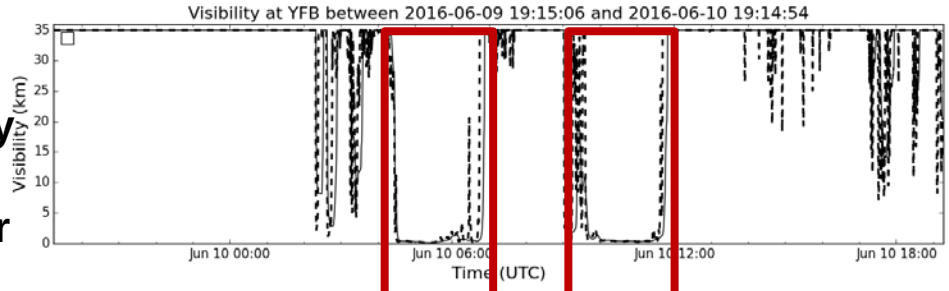


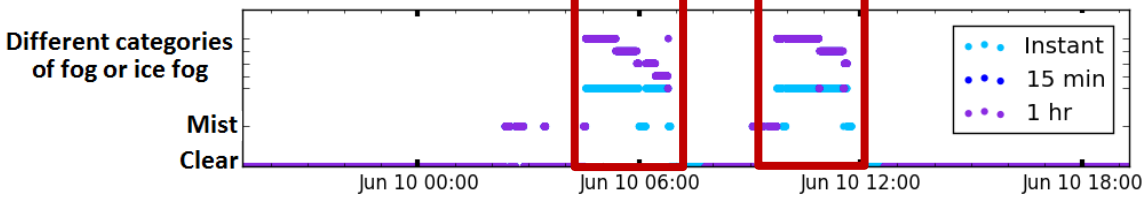
Fog
June 10, 2016



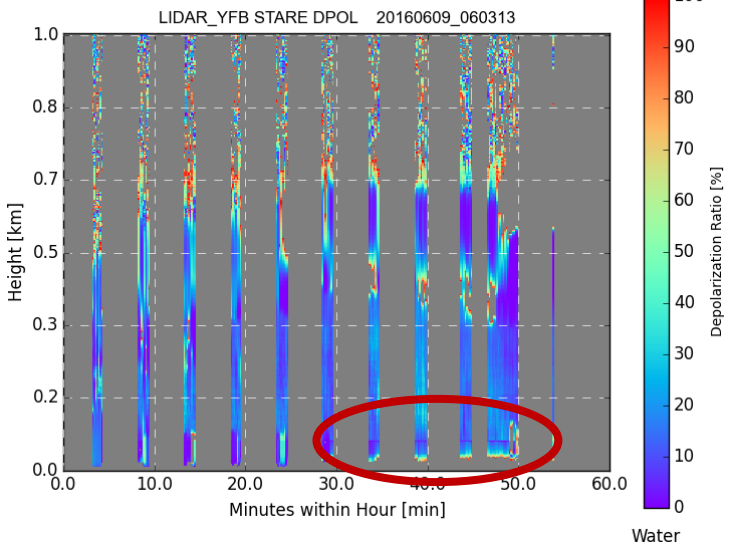


PWD52 Visibility and Weather





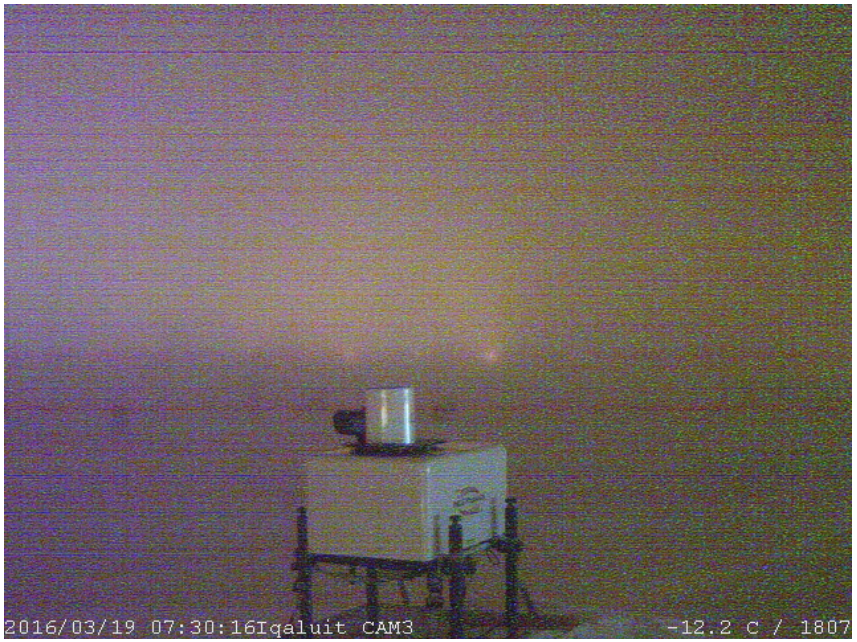
LIDAR, 0600-0700 UTC



Case study: March 19-20 2016 Weather conditions

Ka-Band radar

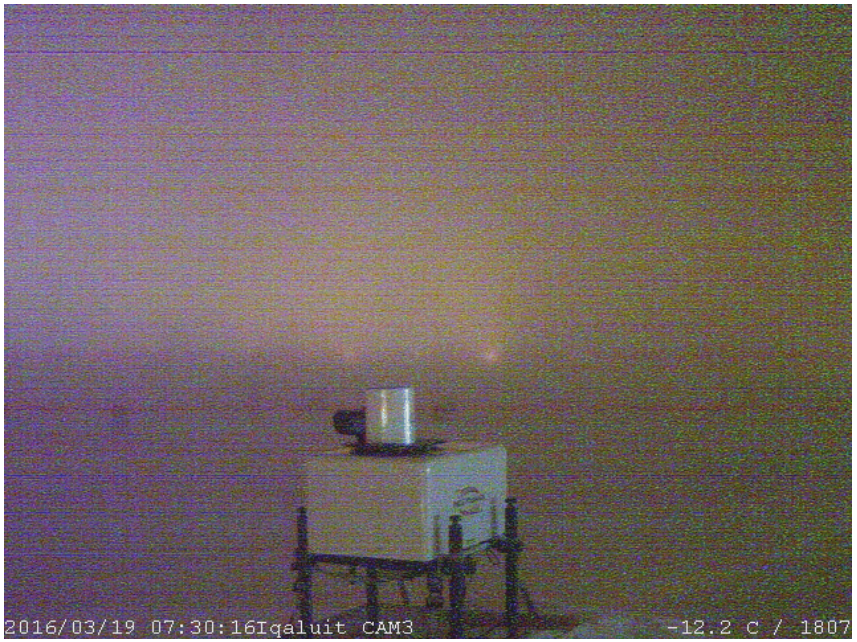
Dopppler Lidar (HALO)



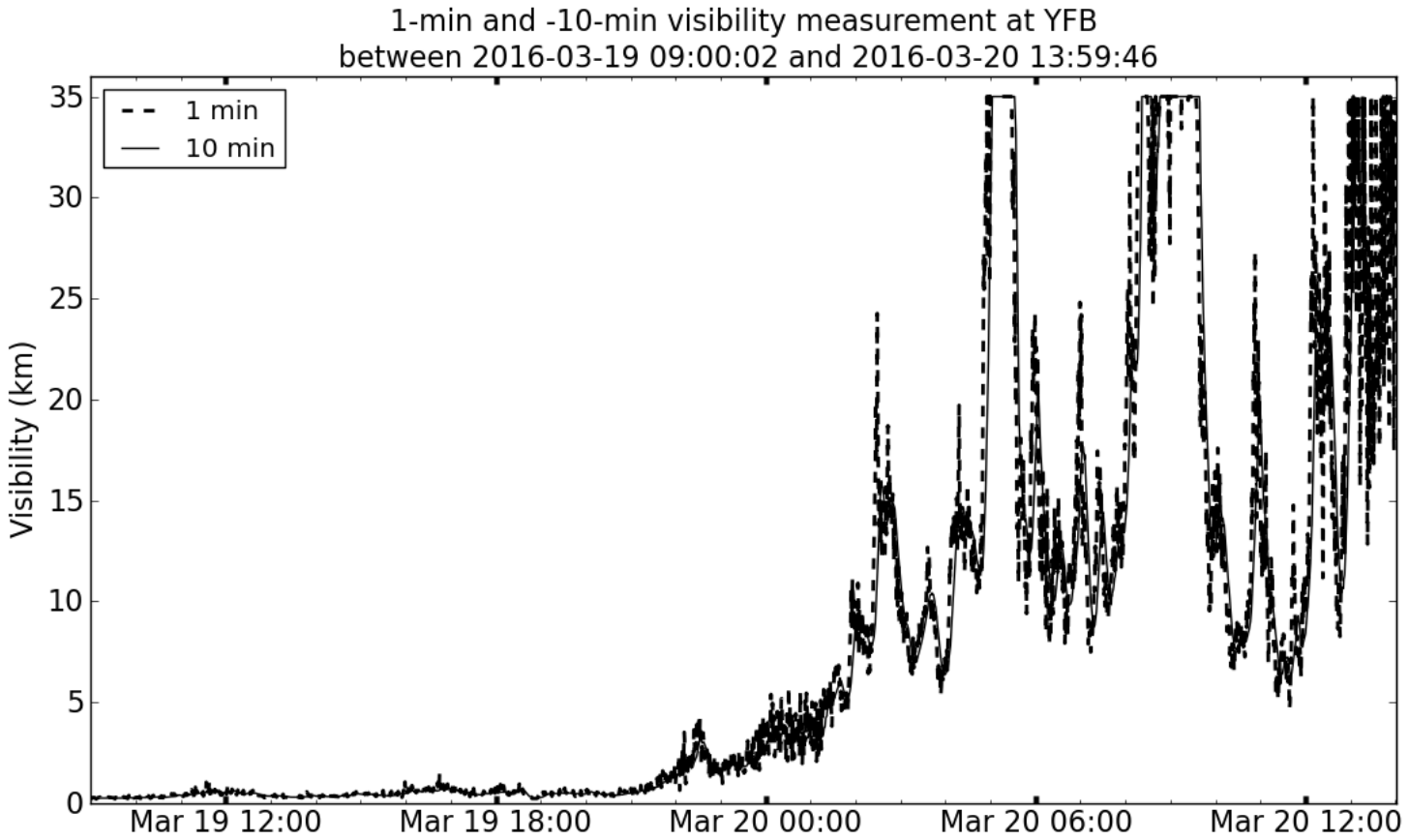
Case study: March 19-20 2016 Weather conditions

Ka-Band radar

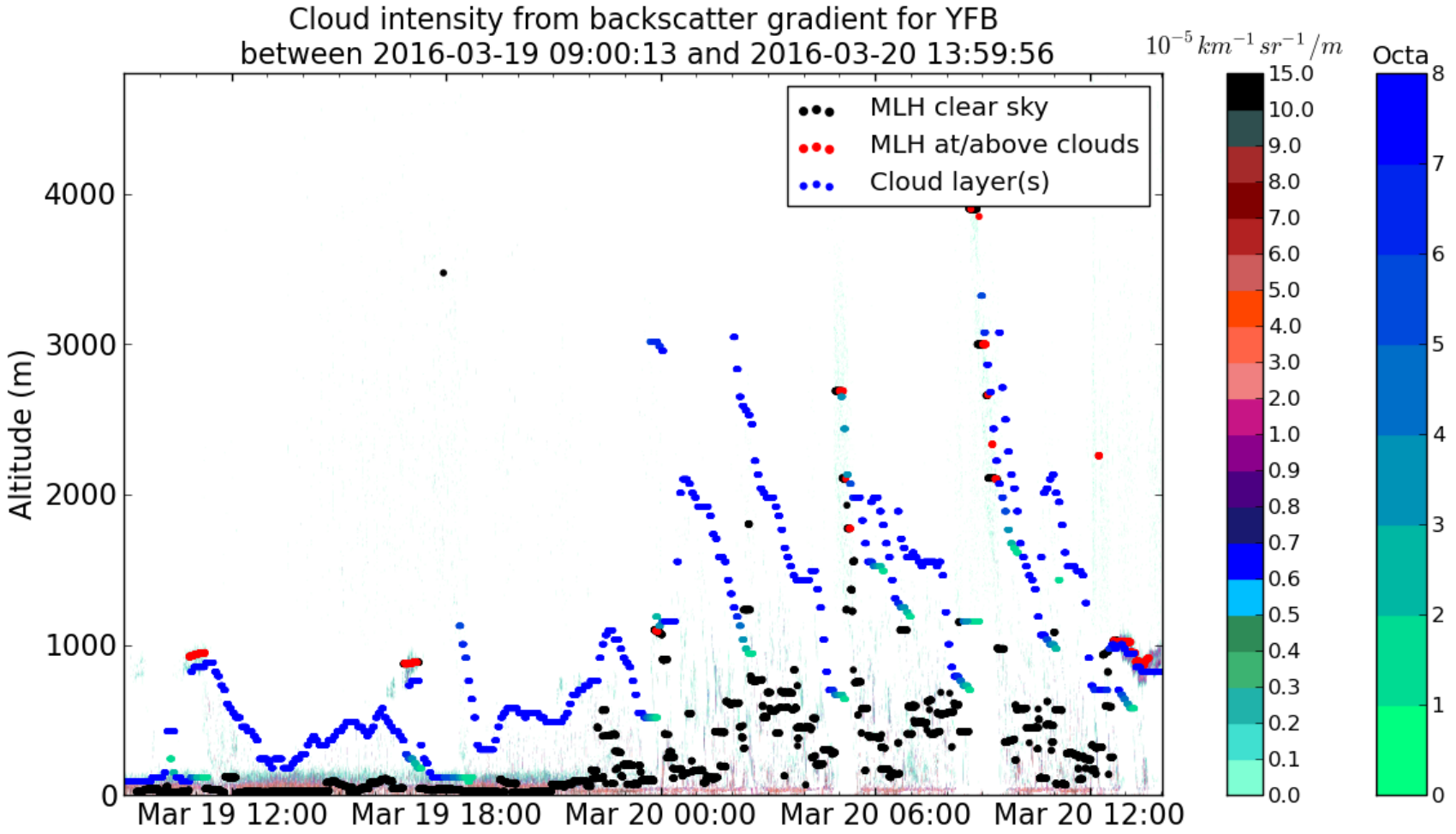
Dopppler Lidar (HALO)



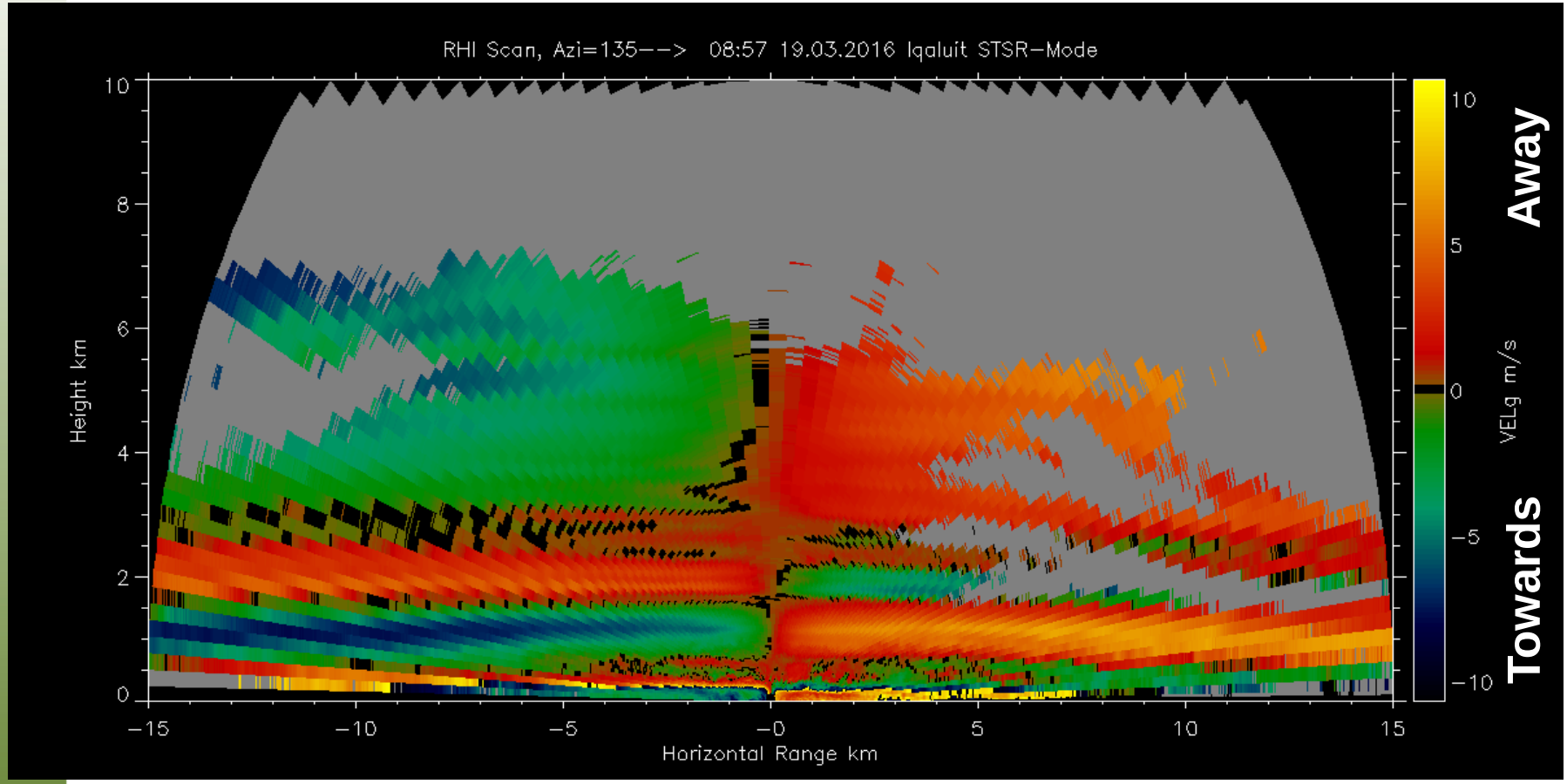
Case study: March 19-20 2016
Horizontal visibility



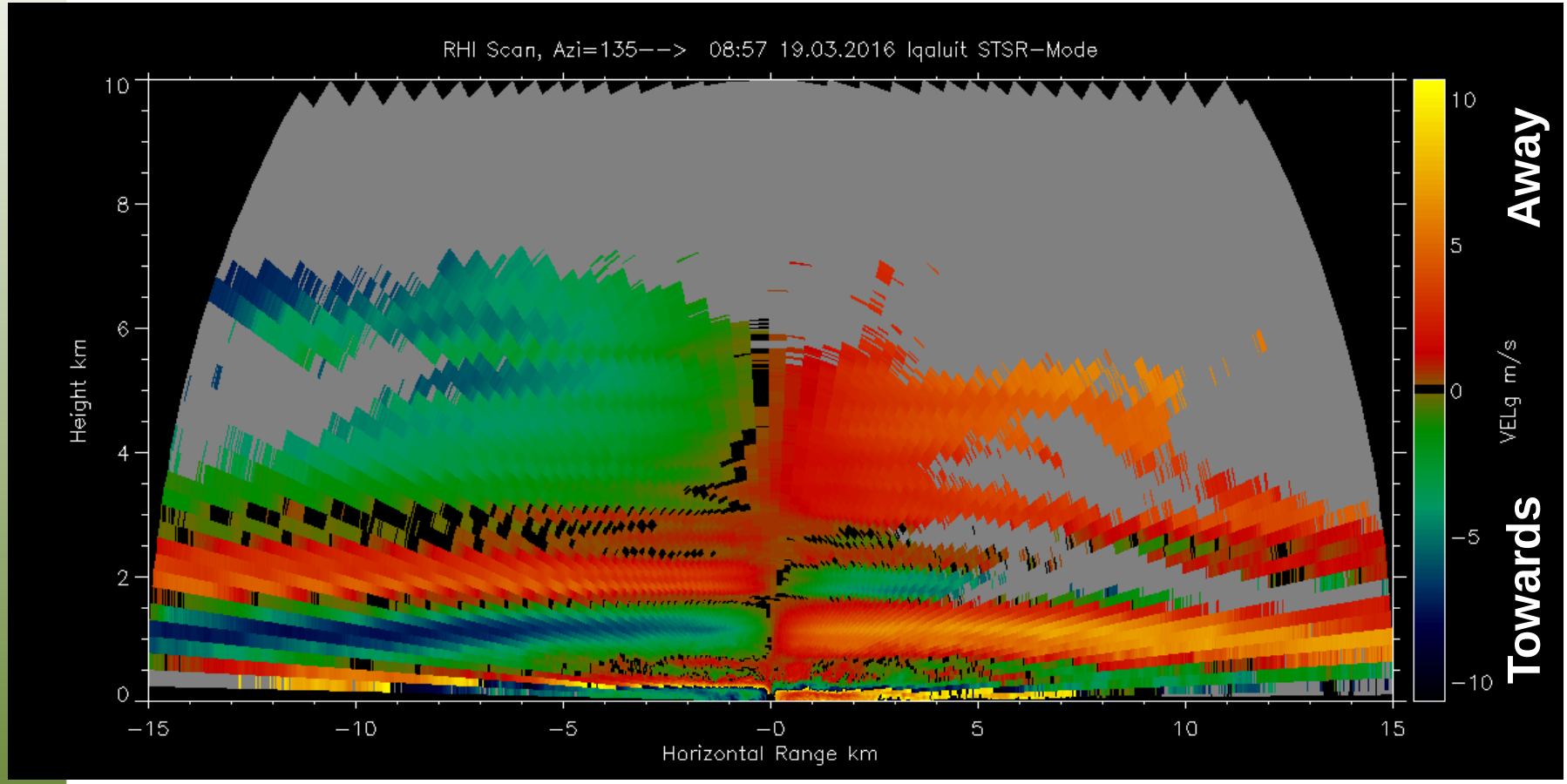
Case study: March 19-20 2016
Cloud parameters and mixing layer height

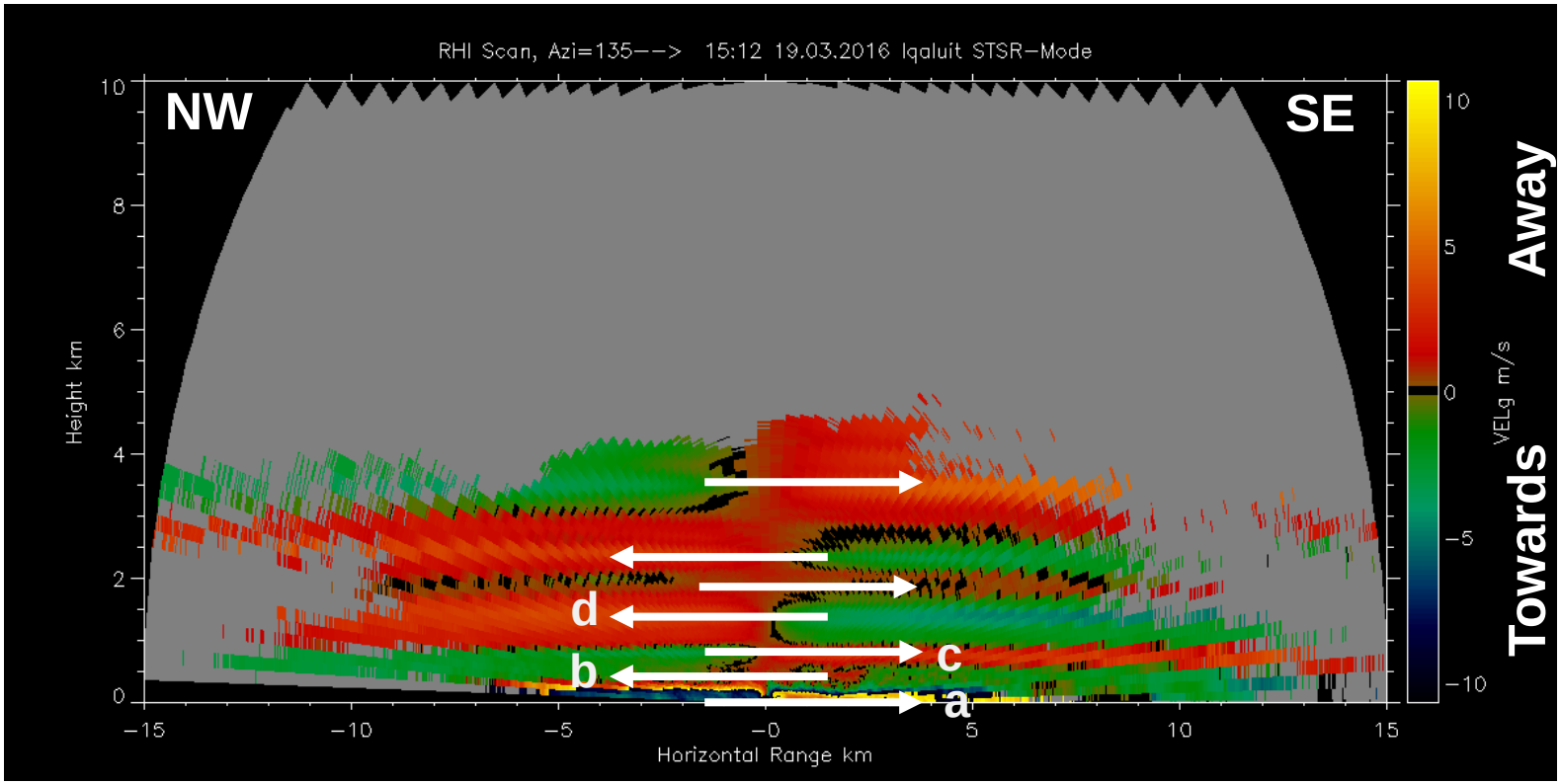


Case study: March 19-20 2016
Wind reversal

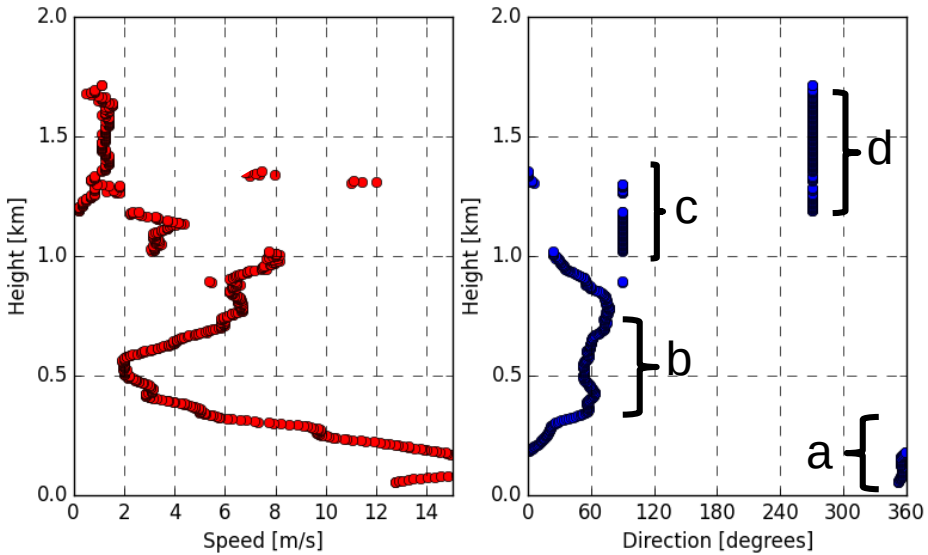


Case study: March 19-20 2016
Wind reversal

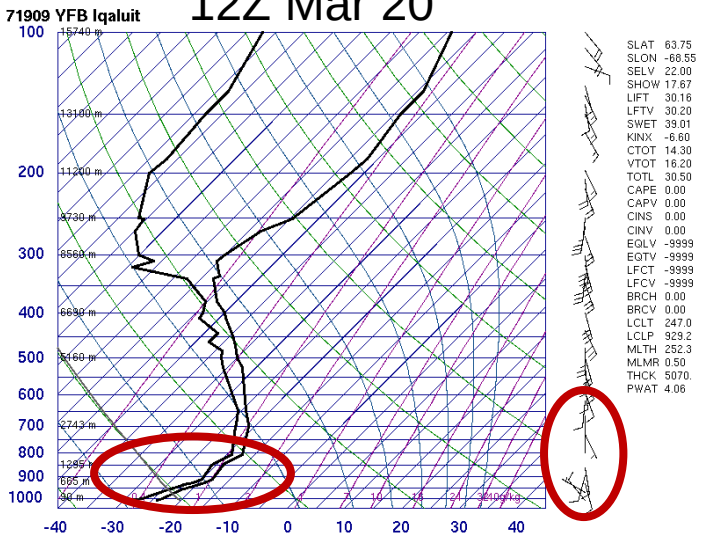




Lidar wind profile 1521 UTC Mar 19



12Z Mar 20



Iqaluit weather observations is support of operation and research programs

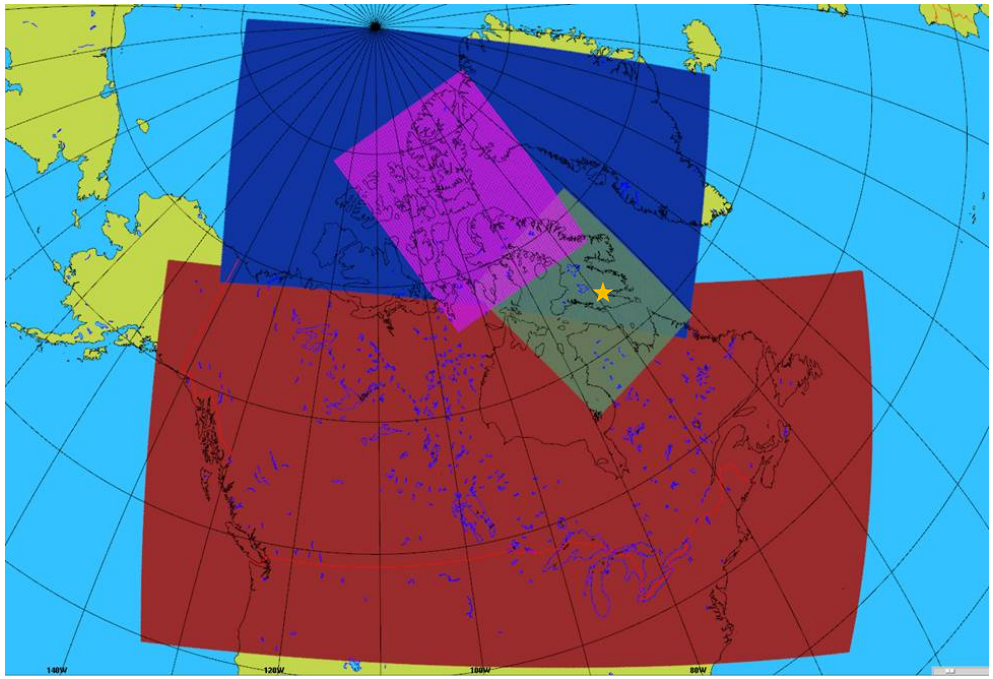
- Operation
- Research
- **Research ↔ Operation**

Evaluation of numerical models using Iqaluit observations

HRDPS: High Resolution Deterministic Prediction System

To become the new short-term forecast guidance system

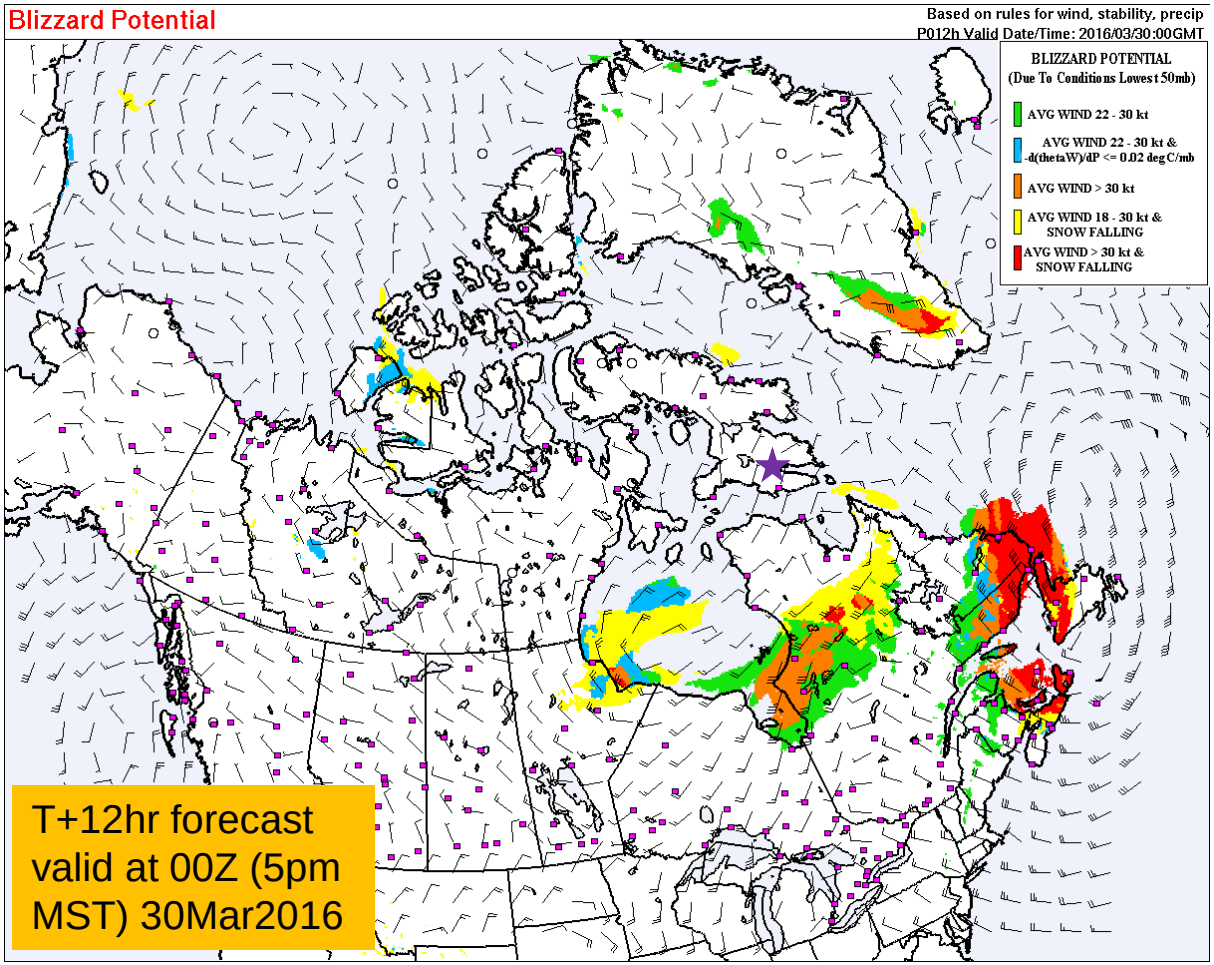
Brown-red: Current pan-Canadian domain
Green/pink: Small Arctic domain
Blue: New Arctic domain



Current work:
Mixing layer height (MLH)

How well does the HRDPS represent MLH at Iqaluit?

Development of an experimental blizzard potential product



- Based on wind speed, falling snow and atmospheric stability in the atmospheric layer just above the ground
- Red areas (e.g. over Labrador) represent regions very likely to experience blizzard conditions (winds > 30kt (~56kph) and falling snow)

Concluding remarks

- Iqaluit supersite provides detailed near real-time meteorological observations on ecpass.ca
- These meteorological observation support operational forecasting, process studies, and model development.
- Ongoing work includes case study analysis, development of integrated weather products, and numerical model evaluation using ground-based observations.