

# Changes and Challenges in Weather and Weather Forecasting for Baffin Island 1972 to 2010



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Prairie and Arctic Storm Prediction Centre  
Environment Canada

for Storm Studies in the Arctic Workshop, June 2010, Winnipeg





***An exercise given by University of Manitoba Professor John Hanesiak to Edward Hudson***

- Outline challenges of weather forecasting for Baffin Island 1972 verses challenges 2010
- Give any changes or irregularities in weather patterns seen during this period.
- Outline a few significant historical weather events.

## Challenge: Issuing perfect forecasts

<b>Iqaluit</b>	<b>Verification of rain, snow, freezing rain, wind and blizzard warnings</b>					
<b>September 2008 – December 2009</b>	<b>RAIN</b>	<b>SNOW</b>	<b>FZRA</b>	<b>WIND</b>	<b>BLZD</b>	<b>TOTAL</b>
<b>TOTAL</b>	0	5	1	8	2	<b>16</b>
<b>TOTAL VERIFIED</b>	0	3	1	8	2	<b>14</b>
<b>% VERIFIED</b>	0	60%	100%	100%	100%	<b>88%</b>
<b>NUMBER OF EVENTS</b>	0	2	1	3	0	<b>6</b>
<b>HIT</b>	0	0	1	2	0	<b>3</b>
<b>NEAR HIT</b>	0	0	0	0	0	<b>0</b>
<b>FALSE ALARM</b>	0	1	0	5	2	<b>8</b>
<b>MISS</b>	0	2	0	1	0	<b>3</b>
<b>NOT VERIFIED</b>	0	2	0	0	0	<b>2</b>

*Courtesy Andrew Giles*

Higher than desired FALSE ALARMS.

Slightly lower than desired PROBABILITY OF DETECTION

*Andrew Lancaster, Aviation Forecaster, Edmonton*

## **Pangnirtung:**

From aviation point of view the specific forecasting details for YXP are still a work in progress as TAF has only recently come online and YXP is only a partial program TAF which creates its own unique challenge in developing a good personal knowledge base for the site

*As with most Arctic sites, main challenges for YXP involve terrain induced local effects; this is both a challenge to human forecasters and numerical models*

YXP has odd limits (2500-3, 2800-3) which leaves little room for error in terms of keeping TAF above landing/alternate conditions

*The standard Arctic limitation of sparse surface data and relative lack of detailed satellite data applies*

*Overall, from an aviation point of view, the weather at YXP is "good" (above alternate conditions) quite often. The synoptic situations that tend to generate below alternate/landing conditions are usually readily recognized.*

## **Iqaluit:**

Overall understanding of Iqaluit climatology and geography is good; however precise timing of events such as wind shifts, precipitation onset, etc is still limited by sparse data

*As with YXP, local geography plays a major role in determining weather events. Forecasters have a reliance on models which do not capture the local geographic subtleties*

Small changes in wind direction/speed and pressure tendencies can make a significant difference in reported conditions at YFB; with current model resolution and available data forecasting this level of detail is difficult.

*As with all remote sites understanding boundary layer conditions is a major challenge*

## **Changes over my time doing the Baffin forecasts:**

For Southern Baffin there's been a decrease in human observations... but there has been an increase in available satellite data and an increase in model data.

*It is also much easier to access/view a wide array of satellite photos and model data*

Monitoring software has been greatly improved allowing for much quicker responses to changing conditions

## *Christine Van Eaton, Aviation Forecaster, Edmonton*

### **Challenges**

The area/workload has gotten larger – i.e. we now support off-ice stuff, we have more TAFs, and we have a wider variety of products.

Our client's needs and activities have increased – the north is 'opening up'... we have sovereignty issues, more exploration for minerals, oil, etc., increased activity due to global warming concerns, and increased activity in general

<http://www.statcan.gc.ca/pub/16-002-x/2009001/tbl/transpo/tbl005-eng.htm> (when I was in Iqaluit September 2008, the tower operators told me they were easily on track for 22,000 for 2008 – Mary's River being a big contributor).

Our client is becoming more demanding – they want more accurate forecasts, one-on-one briefings, demand 'better value for their dollar' (sometimes these expectations are unrealistic in my eyes, but we try). The upside of this is we can learn as much from them as they can from us.

Clients in the north are 'better connected' with the outside world, and more aware and sensitive to weather. After watching the show Ice Pilots NWT on History channel, I've realized it's only a matter of time before we start getting calls/increased expectations from smaller operators (i.e. other than First Air or Canadian North).

While demand, expectations and workload has increased, it seems to me in the last 7 years the models haven't really improved. They still do not handle the boundary layer stuff well, and I despair that we'll ever be able to forecast fog and stratus (two big impacts on aviation) well. Some cool, useful products have come out of our HAL, but due to increased workload I find I can only digest and ponder so much information on-the-fly on shift.

The area is not well covered with observations, and a lot of the observations that are there (especially AUTO stations) can be suspect.

Opportunities to get north are rare. Christine self-funded a trip to Iqaluit.

## *Christine Van Eaton, Aviation Forecaster, Edmonton*

### **Changes/Irregularities**

I've noticed changes in the freeze/thaw timelines, leading to oddities in our expected patterns. Some of the typical patterns have seemed to be 'off' in the last few years. It's not something I can quantify; it's just more of a general observation/feeling I've gotten. For example, I struggled forecasting start/end times for blizzards this last winter, where I recall nailing these earlier in my short career. It just seemed the snowpack and winds weren't behaving as expected.

*We didn't really seem to get the cold, clear Arctic high type of days this past winter that we had previously. A sign of things to come?*

### **Significant Events**

Long lasting blizzards in Rankin / Baker et al winter 2008/2009. We had calls everyday from First Air and Canadian North desperate to get into these locations as the locals were running low on supplies

*18 Oct 2009 - Strong SW surface winds at Iqaluit. SW winds are not common and such strong SW winds are rare.*

*Mike MacDonald, Public and Marine Forecaster, Winnipeg*

**Changes or irregularities in weather patterns seen during the period 1972 to 2010** *“The biggest change has been the trend to warmer conditions up north over the past decade. The eastern Arctic is coming off it's warmest winter on record. I believe 4 of the 5 warmest winters on record have all occurred in the last decade. Warmer conditions lead to more forecast challenges, more stratus, stronger winds with the jet stream pulled north and more mixed precipitation (freezing rain/drizzle). Don't have the clear cold stretches that we had even 5 or 6 years ago.*

*Lynda Schuler, Public and Marine Forecaster, Edmonton*

## **Challenges**

East winds...and also precipitation with the east downslope winds.

Precipitation...with the model over doing amts especially in winter when a bit of mid level moisture advected over the area resulted in snowfall amts when in fact lots of times only mid and high level cloud was reported. Also because of the model resolution, upslope flow on the terrain to the east would result in SCRIBE forecasting precipitation because of the spill over.

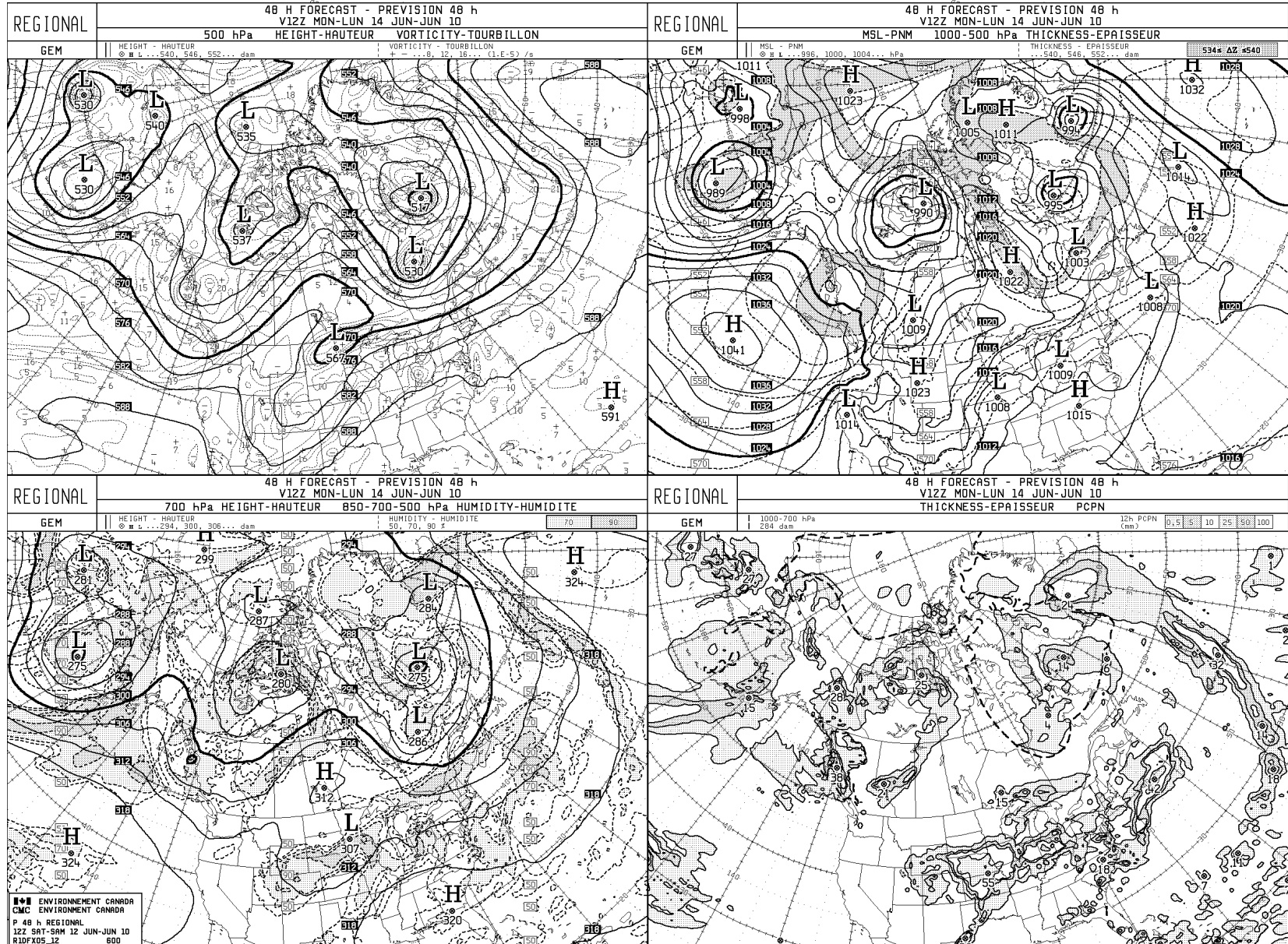
NW-SE winds not usually strong enough due to the channeling...UMOS may be getting better at this but when we did the forecasts, they were often 5-10 knots too light.

Boundary layer cloud can be a forecast problem as well as temperature if the winds are wrong.

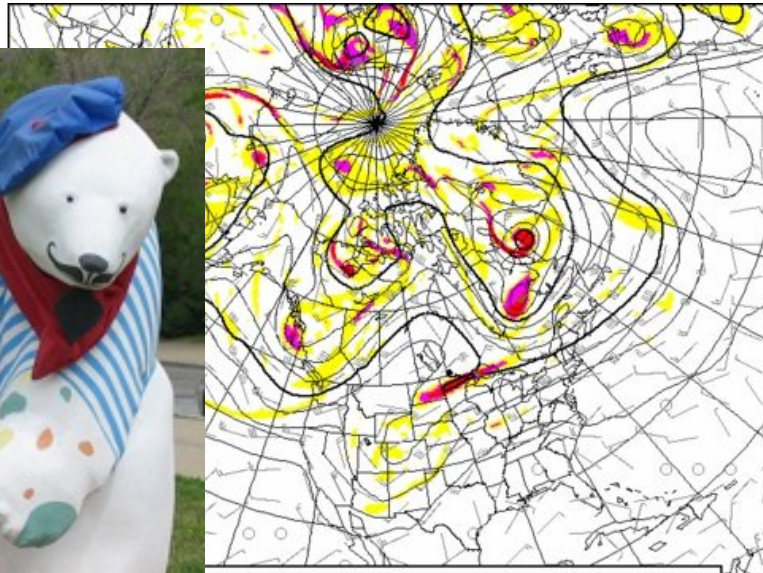
Winter verification stats likely were better for us as we struggled more in the shoulder seasons due to boundary layer conditions.



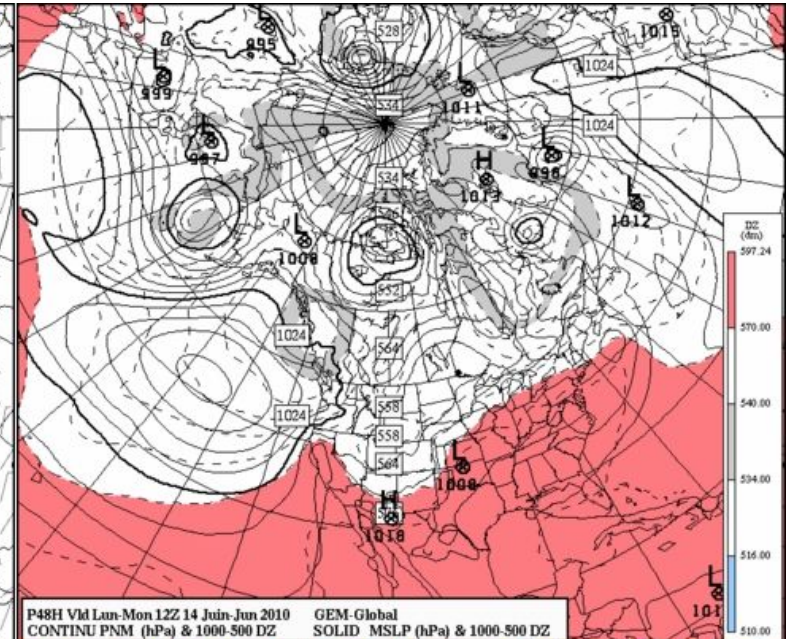
# 1972 – Black and white guidance



# 2010 – It's a colorful world !

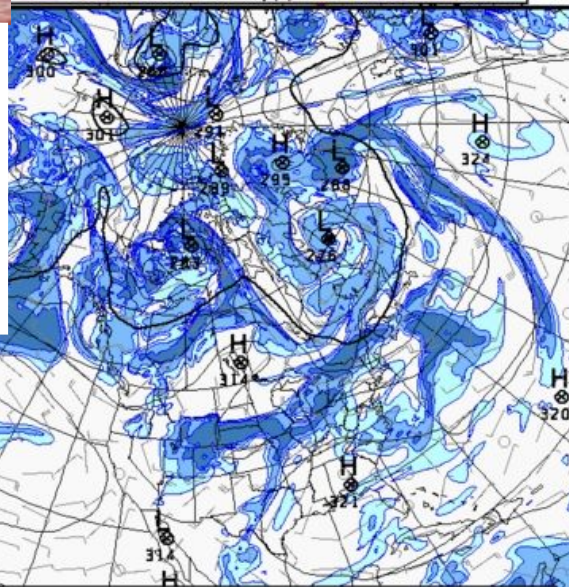


14 Juin-Jun 2010  
 hPa (dam)  
 24-32, 32-50, 10E-5  
 GEM-Global  
 Geopotential height at 500 hPa (dam)  
 Wind Barbs at 500 hPa (kts)  
 Abs Vorticity (s): 16-24, 24-32, 32-50, 10E-5

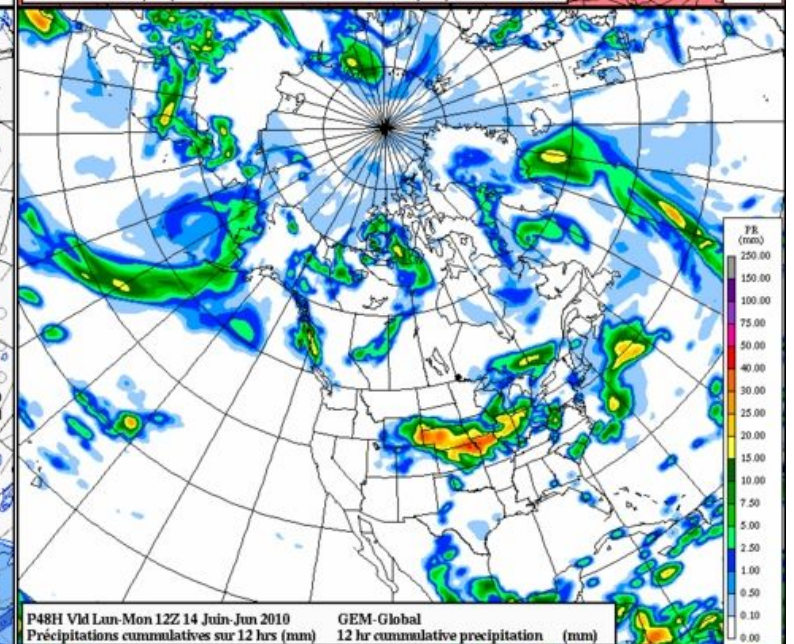


P48H Vid Lun-Mon 12Z 14 Juin-Jun 2010  
 CONTINU PNM (hPa) & 1000-500 DZ  
 GEM-Global  
 SOLID MSLP (hPa) & 1000-500 DZ

- Improved physics
- Improved topography
- Improved resolution
- Improved visualizations

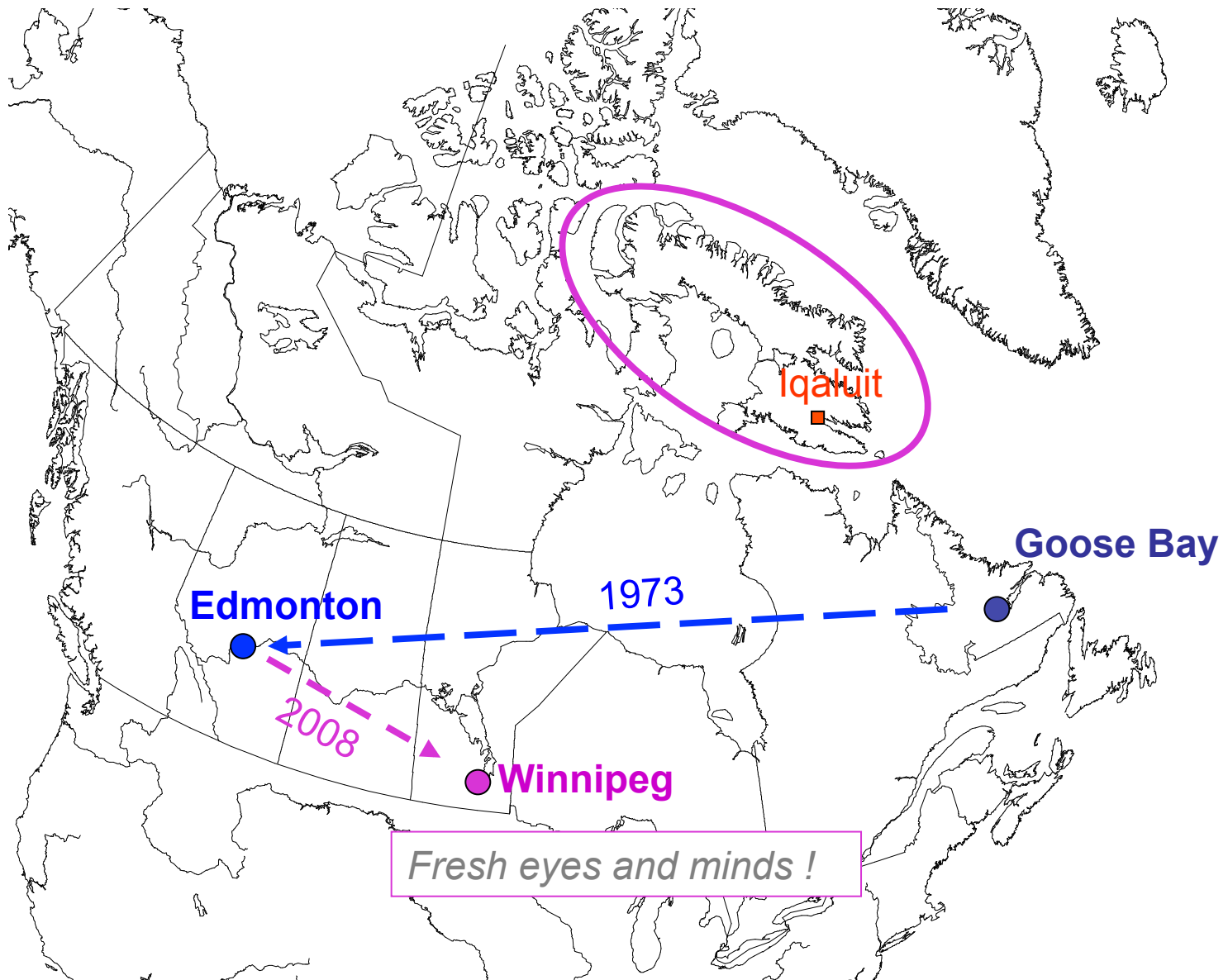


P48H Vid Lun-Mon 12Z 14 Juin-Jun 2010  
 Arrière plan: Humidité relative à 700 hPa (50,70,90%)  
 Hanteur géopotentielle à 700 hPa (dam)  
 GEM-Global  
 Background: Relative humidity at 700 hPa (50,70,90%)  
 Geopotential height at 700 hPa (dam)



P48H Vid Lun-Mon 12Z 14 Juin-Jun 2010  
 Précipitations cumulatives sur 12 hrs (mm)  
 GEM-Global  
 12 hr cumulative precipitation (mm)

## Forecast office handling Baffin Island public and marine weather evolved from 1972 to 2010



# Public and Marine Weather Forecasts done by forecasters in Winnipeg



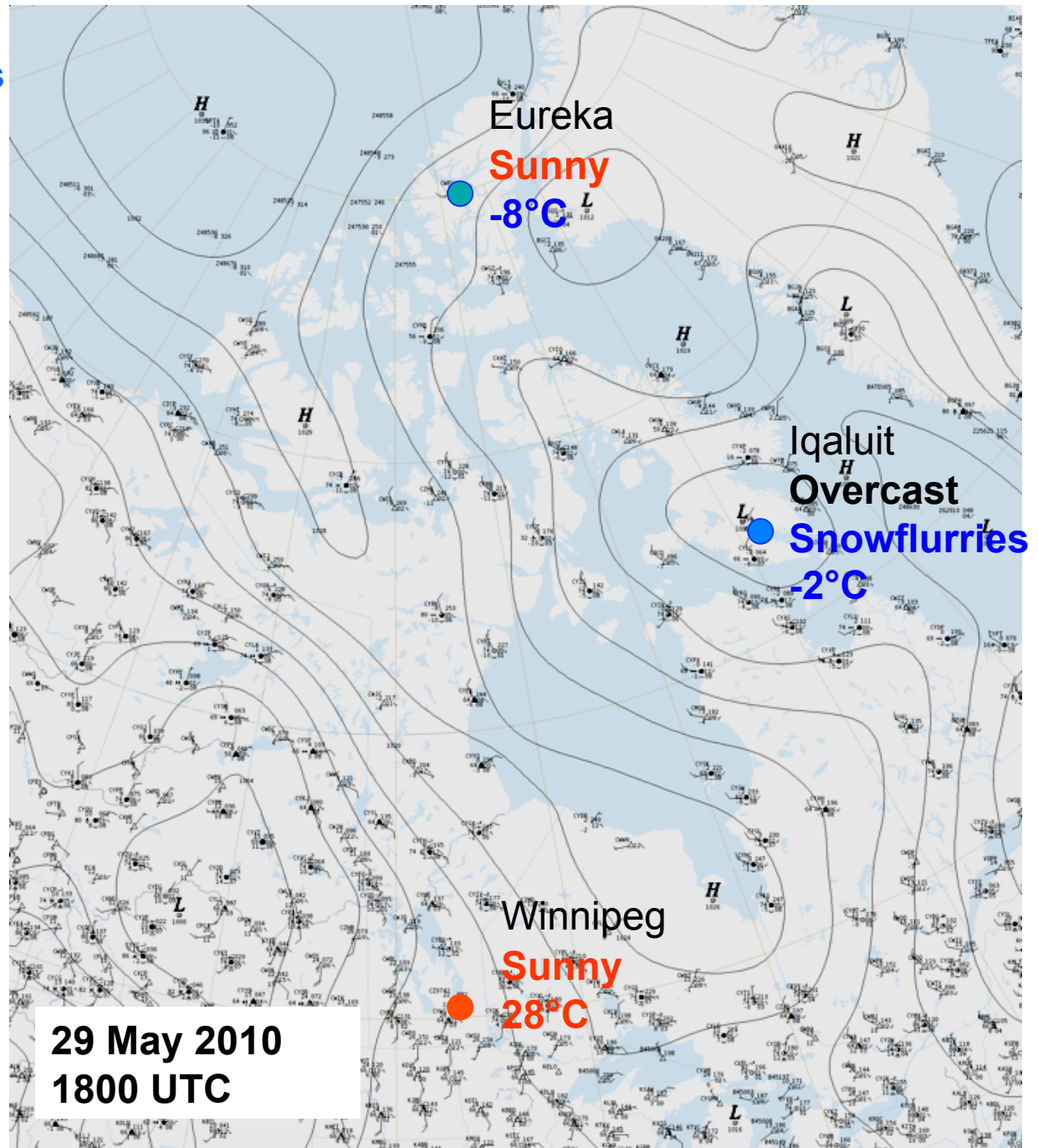


Iqaluit



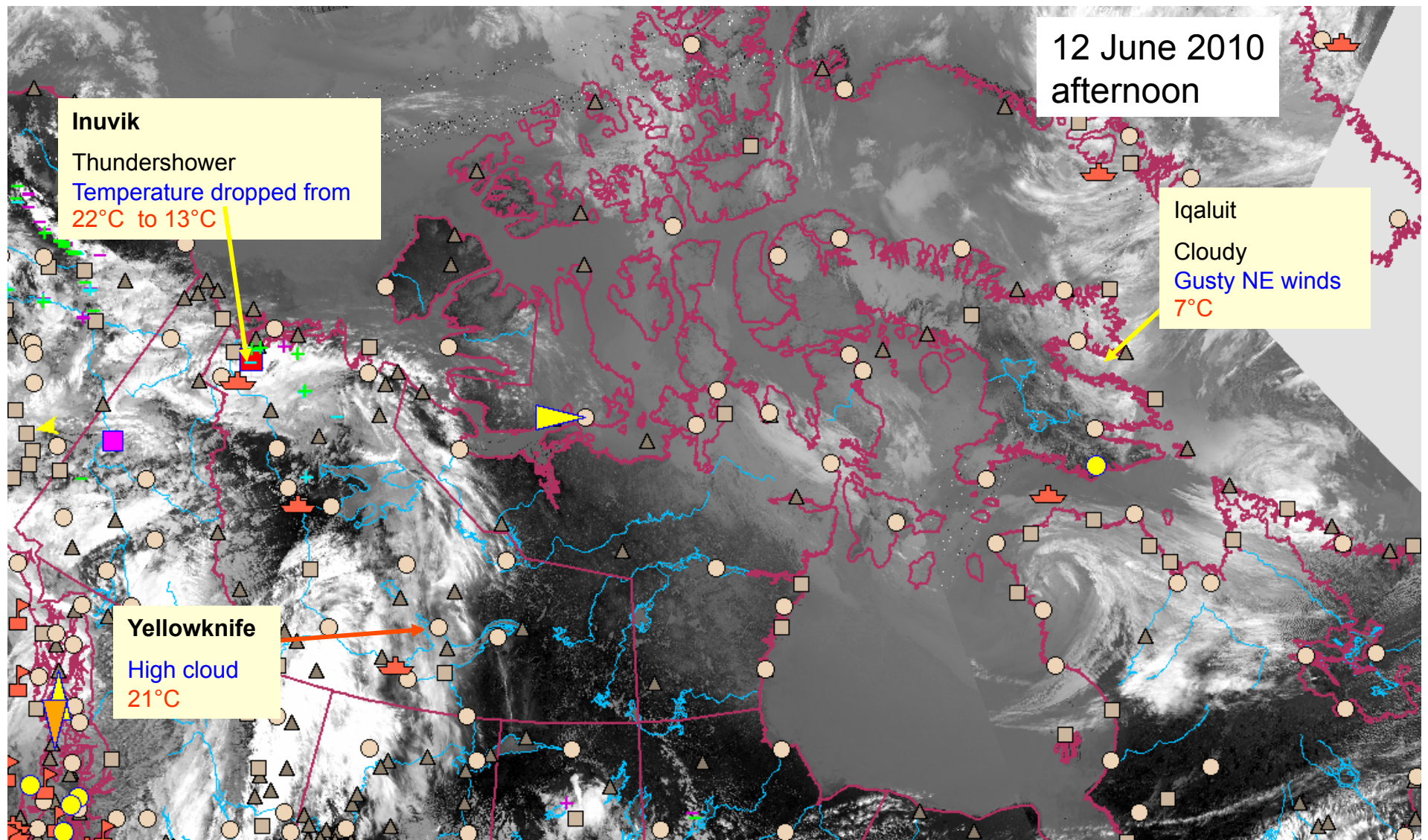
**Challenge** of forecasting across an area where in the spring and fall the high impact weather can range from thundershowers in the south to snow and blowing snow in the north.

*But it makes our job so unique and special*

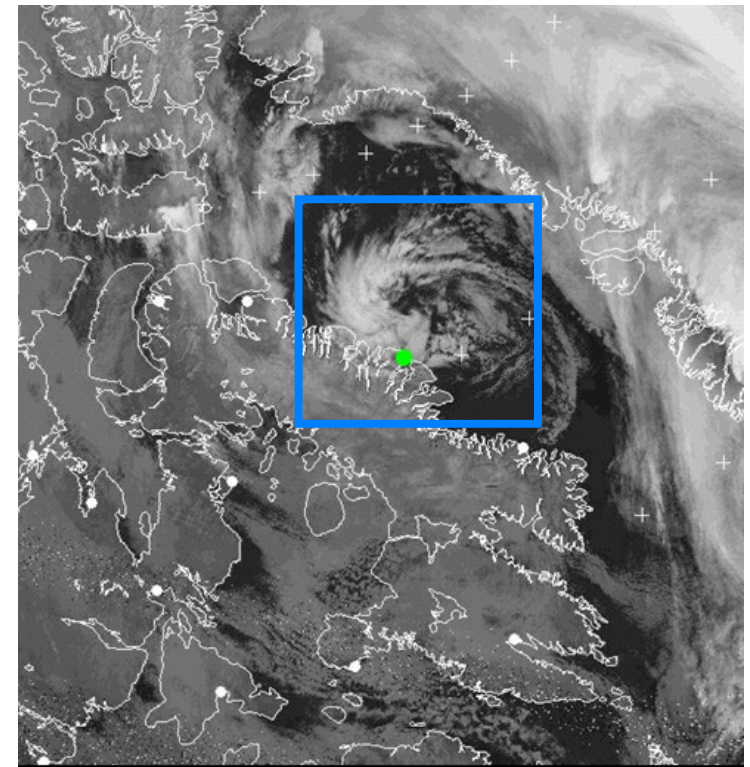
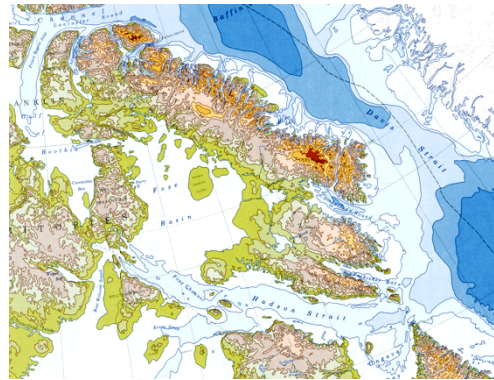


**Challenge** of forecasting across an area where the weather can range from thundershowers in the west - Inuvik - to a spring day in the east - Iqaluit

*But it makes our job so unique and special*

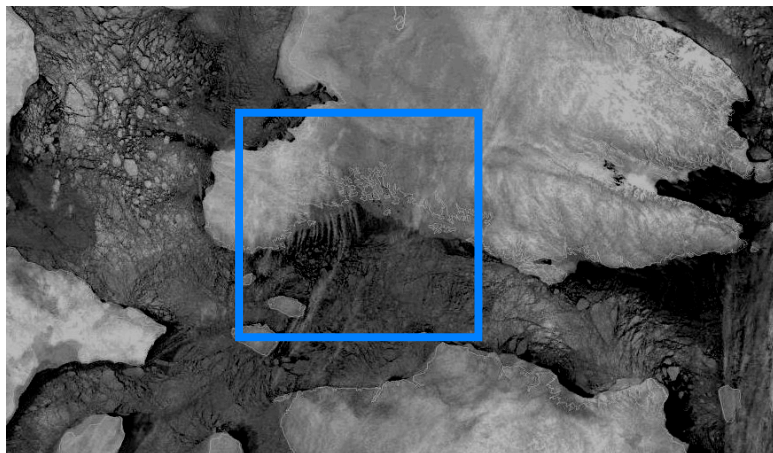


**Challenge** being surrounded by ice and/or water to the models to the forecasters



Interesting weather on many scales.

- windward versus lee side for snow events
- streamers off leads and breaks in the ice
- polar lows
- fog
- low cloud
- freezing drizzle

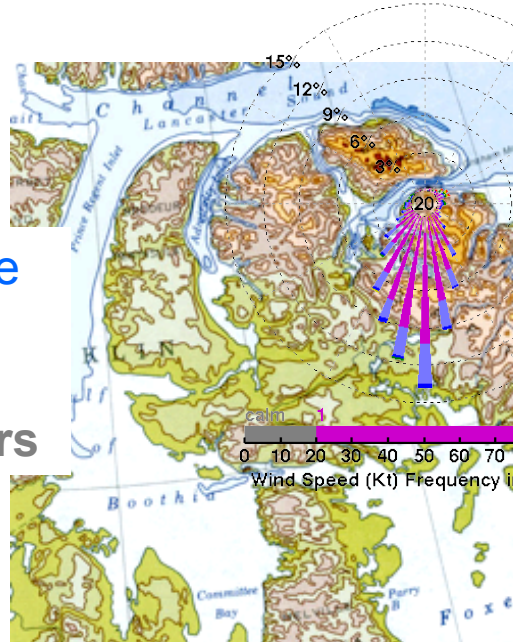


CYCY 200700Z 29011G16KT 9SM CLR SLP907  
**CYCY 200800Z 28019KT 5/8SM FEW024 FEW076 FEW088 SLP905**  
 CYCY 200900Z 27023G28KT 1/8SM CLR SLP903 50003  
 CYCY 201000Z 27021KT 2SM CLR SLP899  
 CYCY 201100Z 28028KT 3/8SM -SN VV003 SLP892  
 CYCY 201200Z 29035KT 1/8SM +BLSN VV000 BLSN8 SLP890 56011  
**CYCY 201300Z 28035G41KT 0SM +BLSN VV000 BLSN8 SLP894**  
**CYCY 201400Z 30033G39KT 0SM -SN OVC000 OVC093 SLP902**  
 CYCY 201500Z 30032KT 1/8SM FEW016 FEW024 SCT064 SLP913 53022  
 CYCY 201600Z 29027G32KT 1/2SM CLR  
 CYCY 201700Z 30027G33KT 1/2SM  
 CYCY 201800Z 30023KT 15SM DRSN FEW015 BKN040

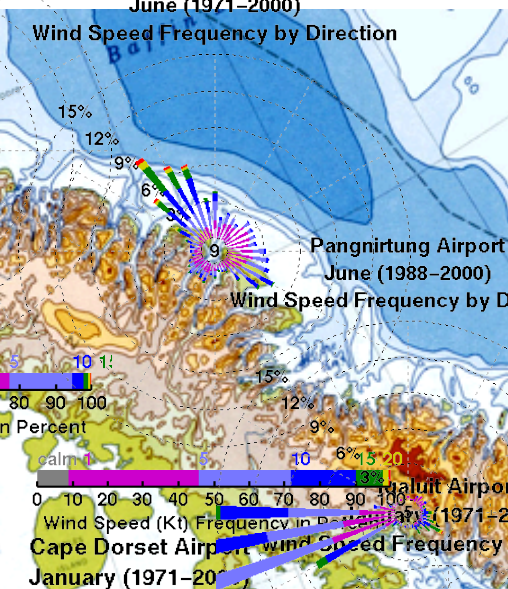


Terrain effects are a challenge to the models to the forecasters

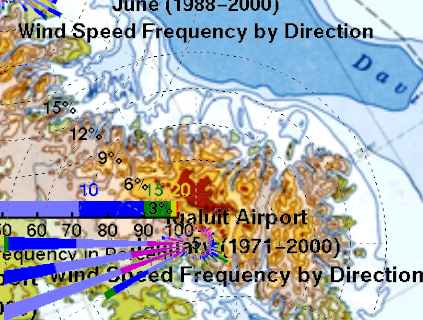
Pond Inlet Airport  
January (1975–2000)  
Wind Speed Frequency by Direction



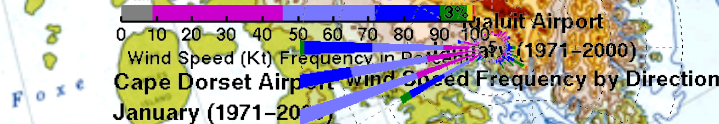
Clyde Airport  
June (1971–2000)  
Wind Speed Frequency by Direction



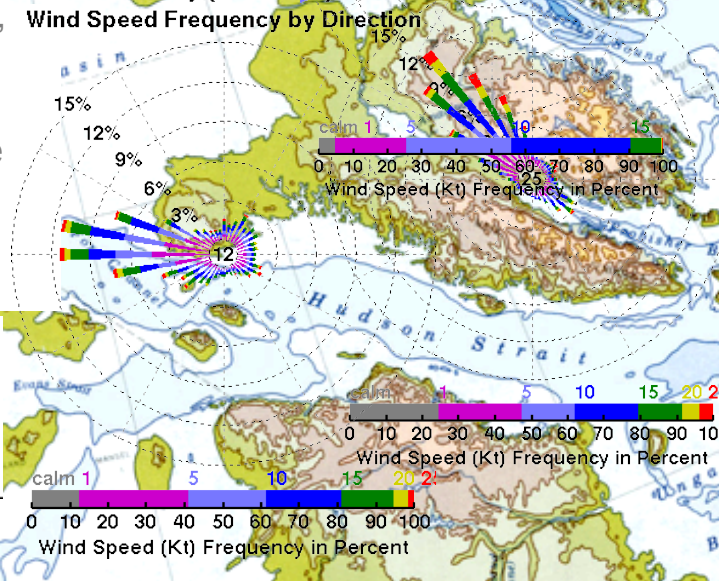
Pangnirtung Airport  
June (1988–2000)  
Wind Speed Frequency by Direction



Qaanaaq Airport  
June (1971–2000)  
Wind Speed Frequency by Direction

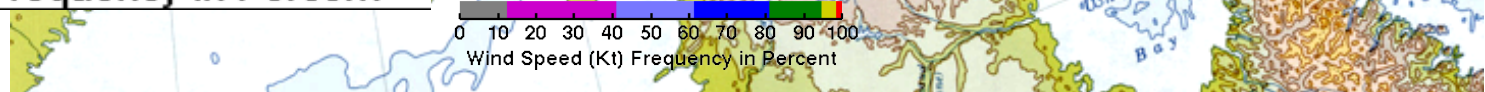
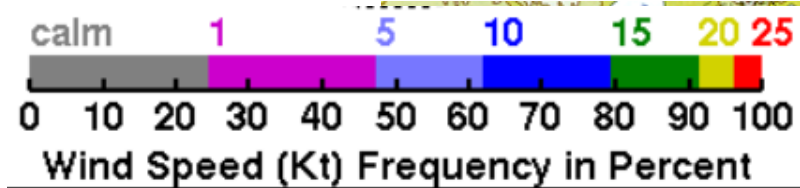


Cape Dorset Airport  
January (1971–2000)  
Wind Speed Frequency by Direction



Each Baffin community has unique “geography” It shows in the wind statistics.

The most interesting wind roses are those have wind directions that are seen infrequently BUT when they are seen they are with strong winds (red)

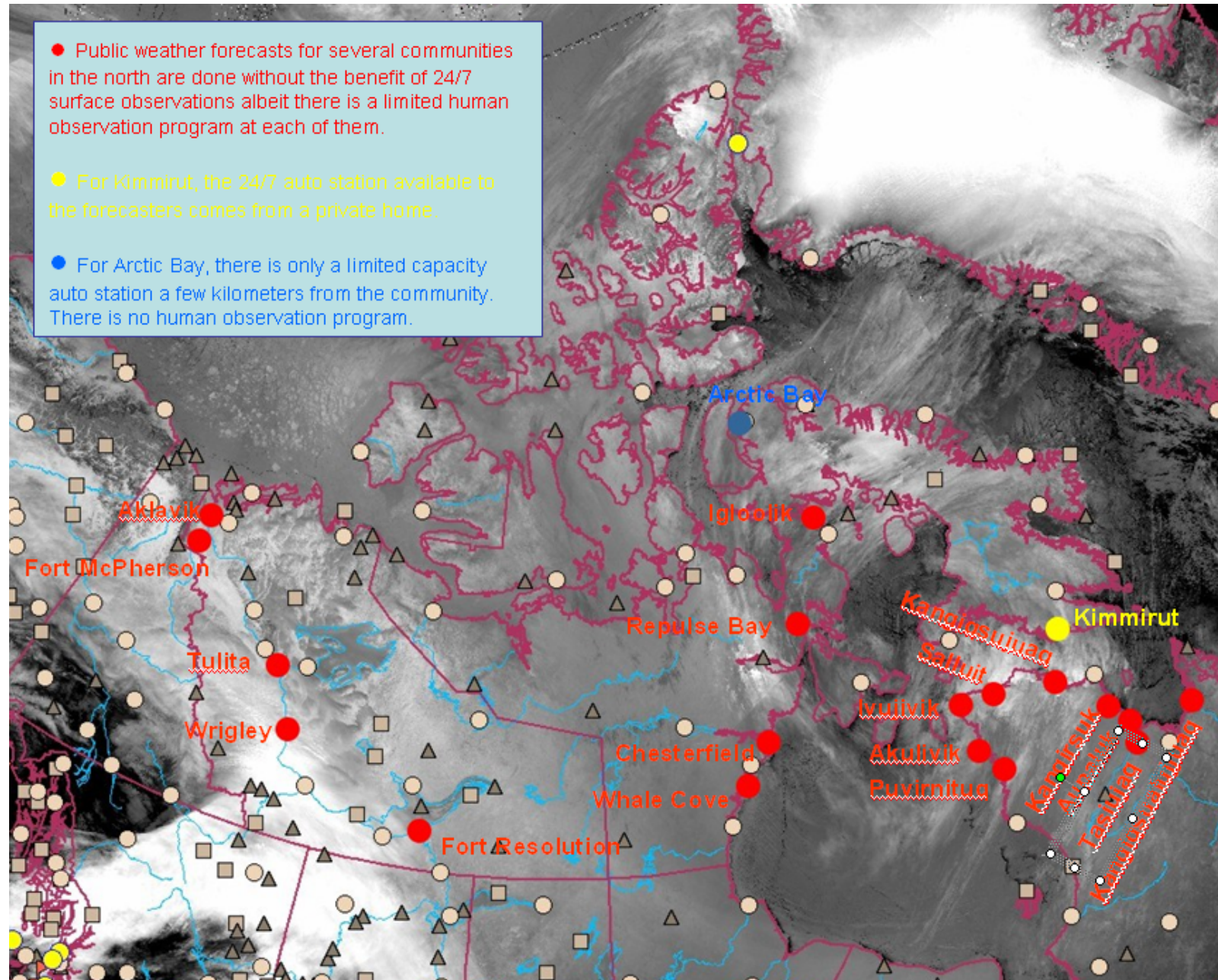


## Challenges of data for diagnosis, vetting of forecasts and knowledge

*With data comes understanding*

	1972	2010	201x
<b>Diagnosis: Data challenges</b>			
Surface observations		No 24/7 auto in Kimmirut Many communities surrounding Baffin Island without 24/7 observations	
Upper Air stations	Iqaluit, Hall Beach, Kuujjuaq	Iqaluit, Hall Beach, Kuujjuaq	Iqaluit Hall Beach, Kuujjuaq
Satellite	Not yet. Cloud done per textbook adjusted to fit surface observations.	Geostationary and Polar orbiting. Imagery, many channels, soundings, winds	Even better resolution, improved visualizations, molniya orbits
...Web Cams	No	CBC Iqaluit Citizen in Kimmirut	
...AMDAR aircraft soundings	No	Getting AMDAR north	Hopefully
...Lightning	No	There are systems that show lightning in the the north	Improved systems
Radar	No	No	Cloudsat?

## Challenge: Getting 24/7 auto stations for every community we forecast for and thereby upstream stations

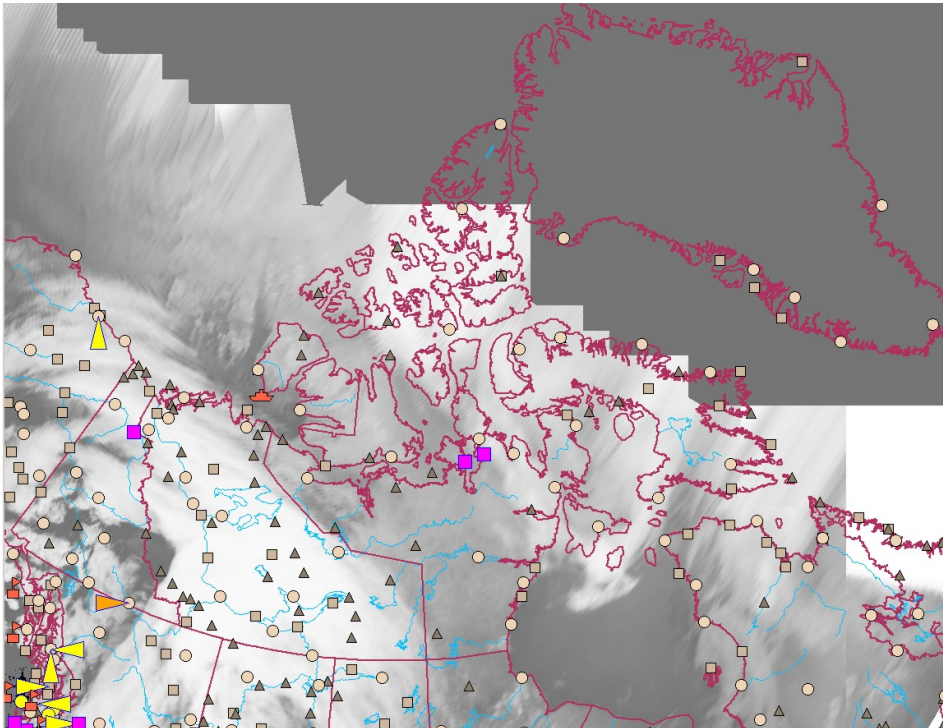


**Challenges:** Establishing ad hoc sounding program on Arctic Basin.  
Getting science sondes on the GTS in real time

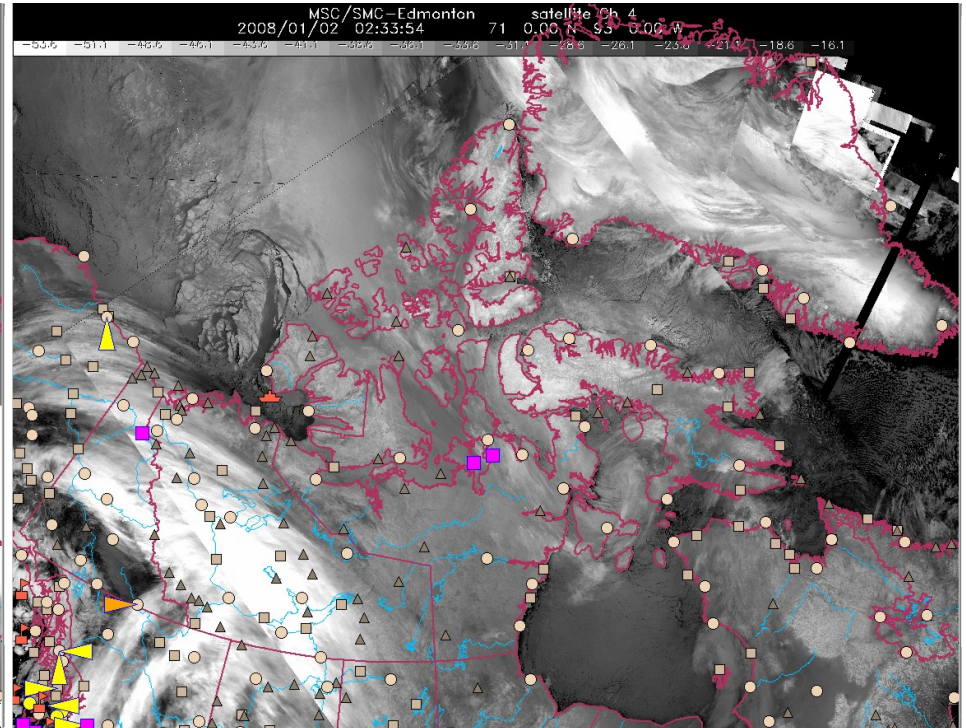


## Challenges with satellite imagery:

Satellite imagery came on-stream mid 70's and continues to improve



GOES imagery at its limit but..



Polar Orbiting imagery in its glory

Polar orbiting <http://www.oso.noaa.gov/history/first-launched.htm>

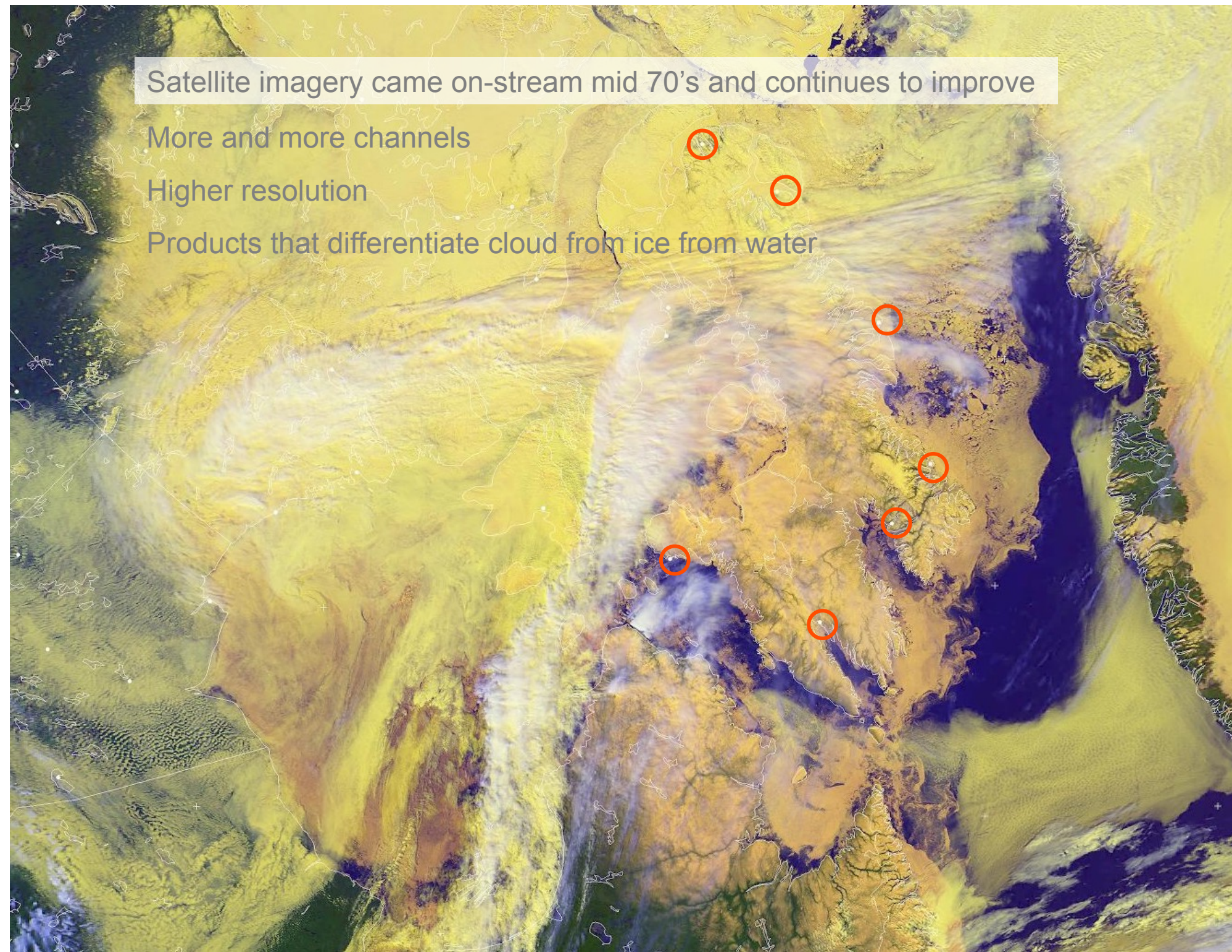
Geostationary [http://en.wikipedia.org/wiki/Geostationary\\_Operational\\_Environmental\\_Satellite](http://en.wikipedia.org/wiki/Geostationary_Operational_Environmental_Satellite)

Satellite imagery came on-stream mid 70's and continues to improve

More and more channels

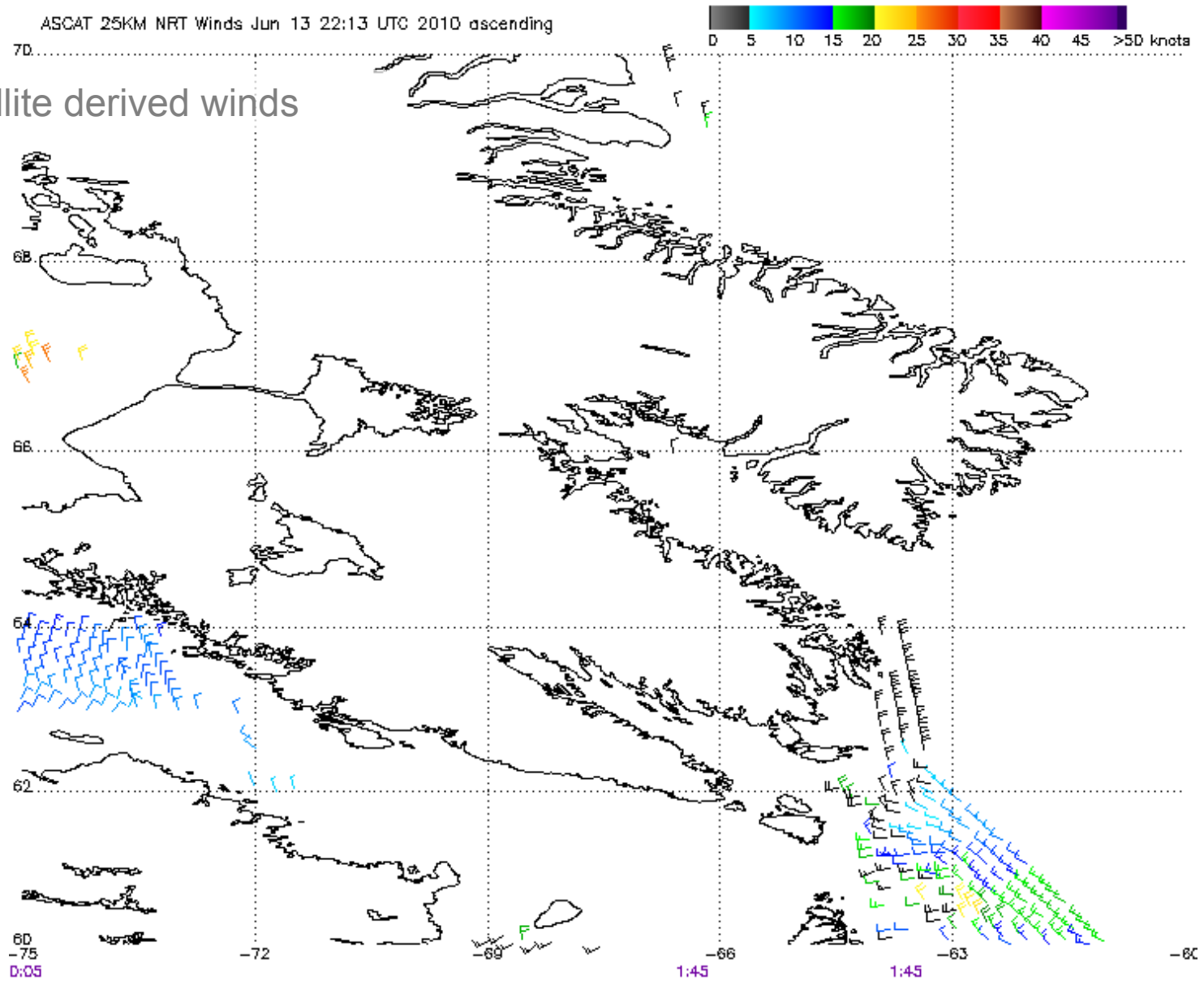
Higher resolution

Products that differentiate cloud from ice from water



# Satellite imagery came on-stream mid 70's and continues to improve

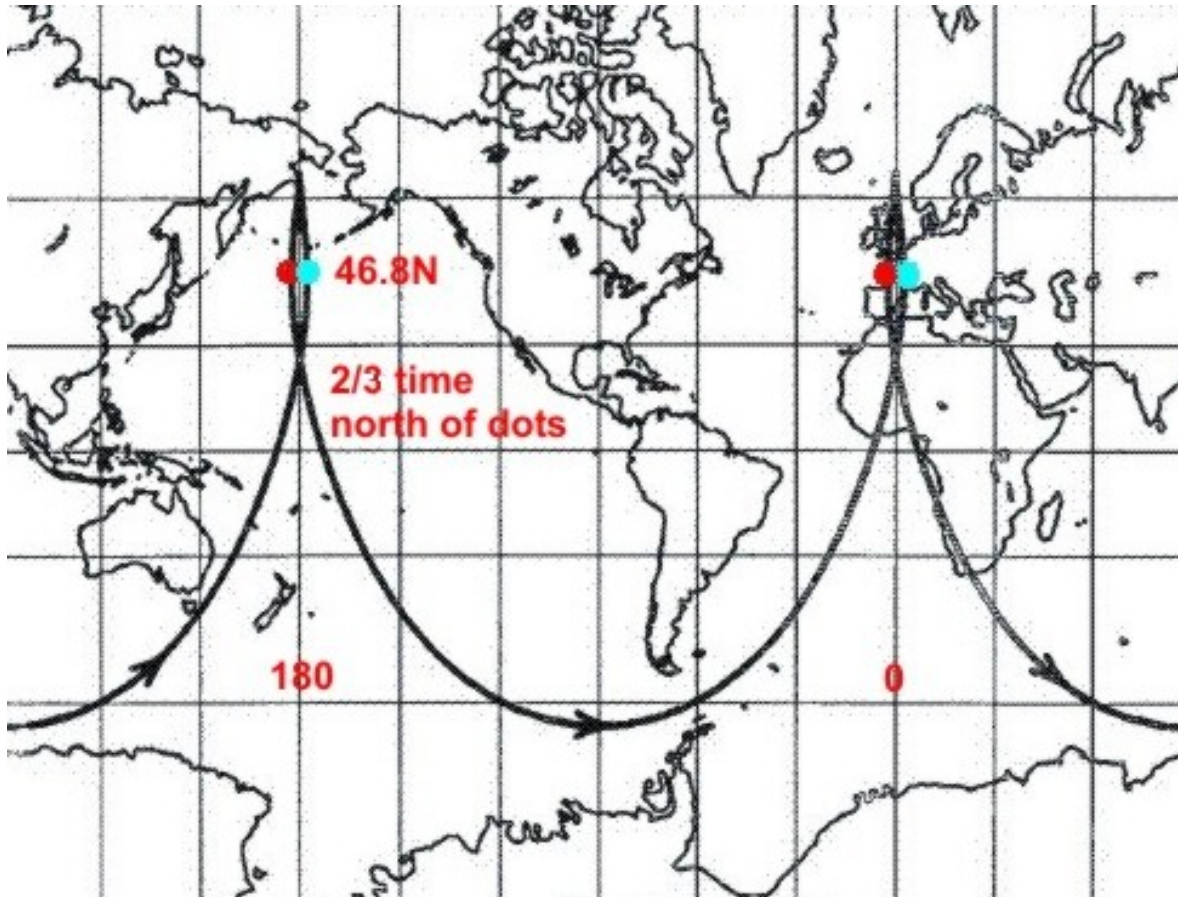
## Satellite derived winds



Note: 1) Times are GMT 2) Times along bottom correspond to measurement at 65N  
 3) Data buffer is 22 hrs from Jun 13 22:13 UTC 2010 4) Black circles indicate possible contamination  
 NOAA/NESDIS/Office of Research and Applications

## In our future?

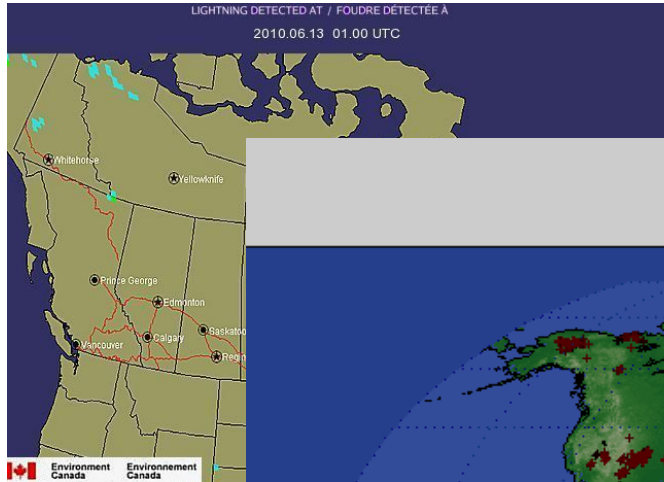
**Molniya orbit** - highly eccentric orbit used by Soviet Molniya satellites functions like a high latitude geostationary orbit - to give GOES like imagery for polar regions



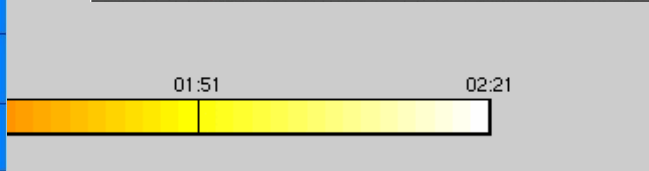
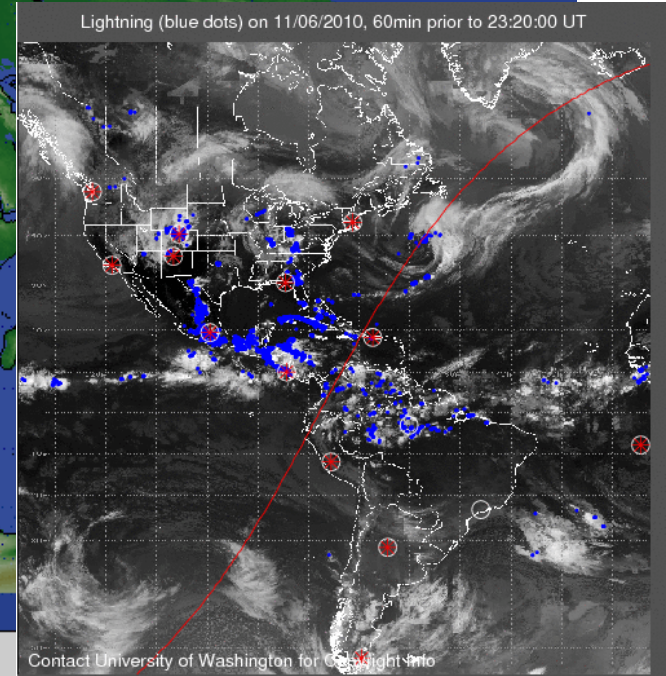
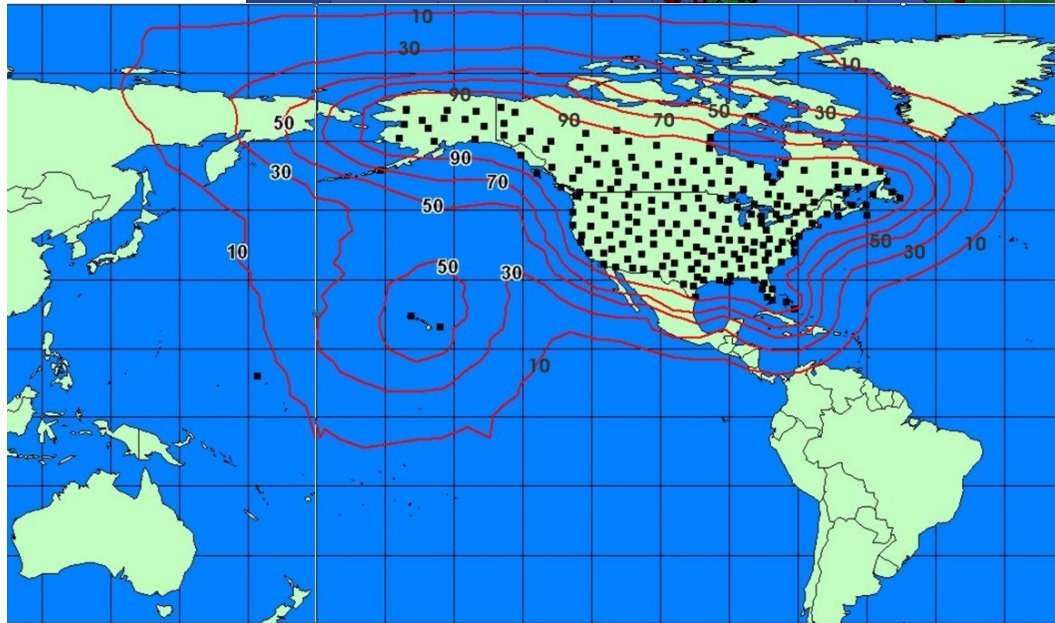
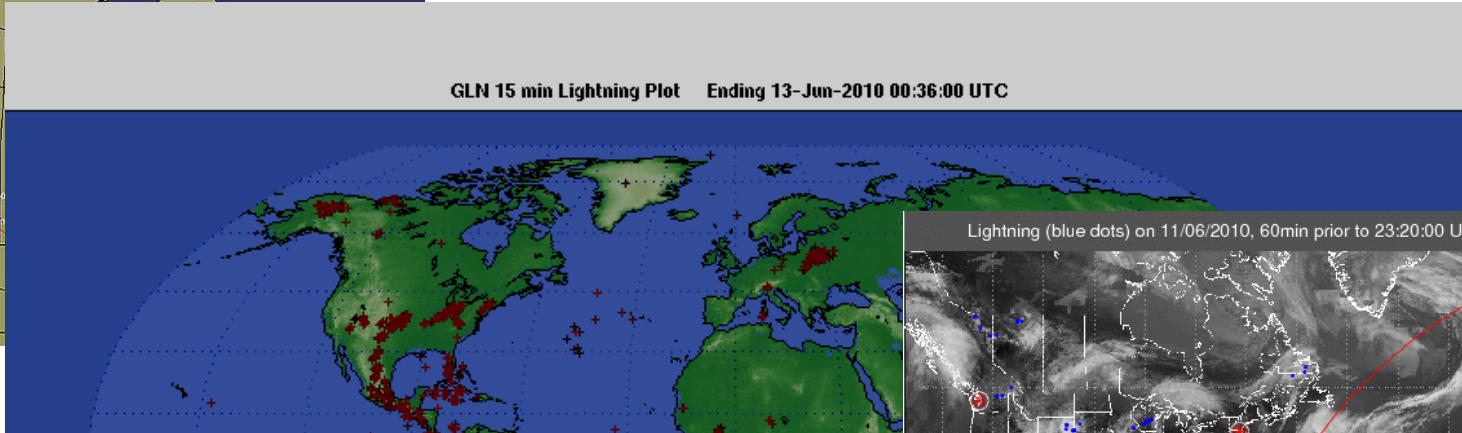


Challenge: Detecting lightning in the north

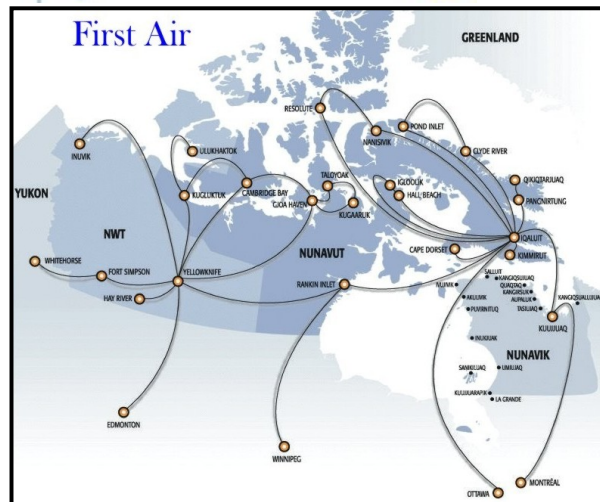
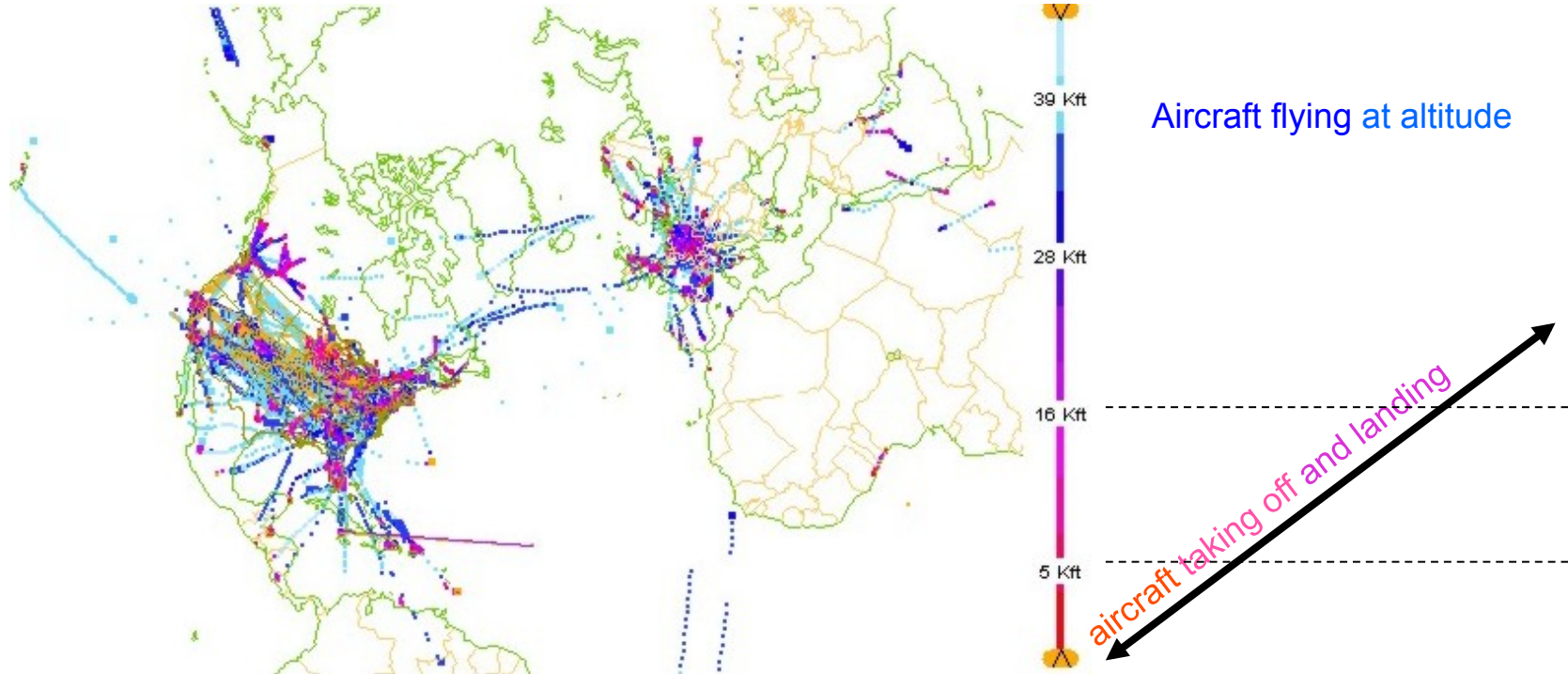
Challenge: Getting those who can detect lightning in the north to show the north



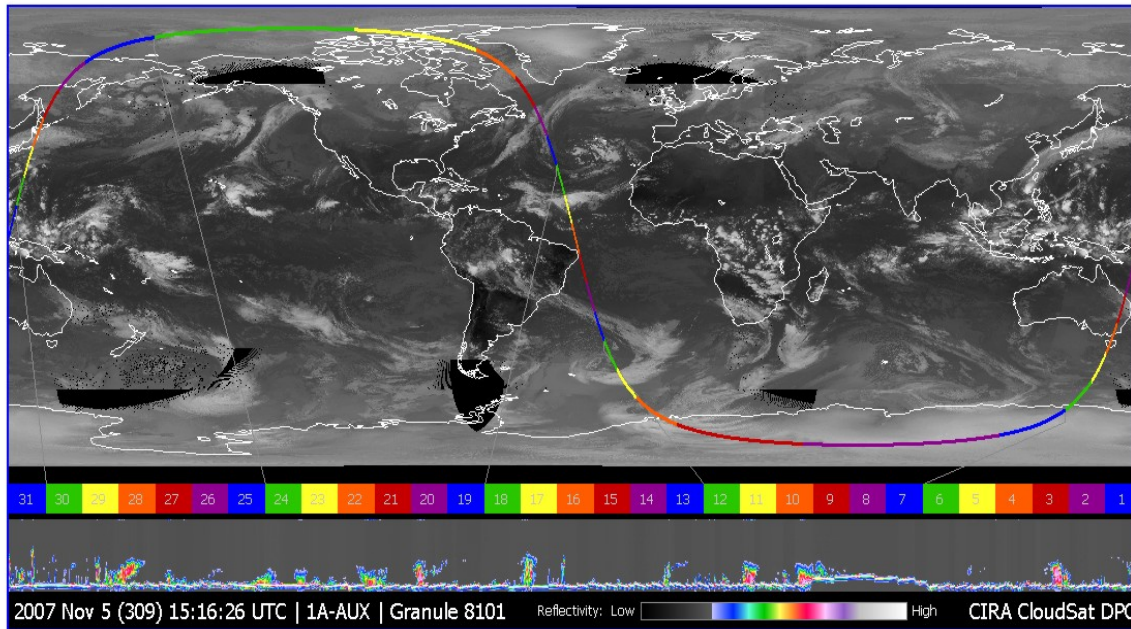
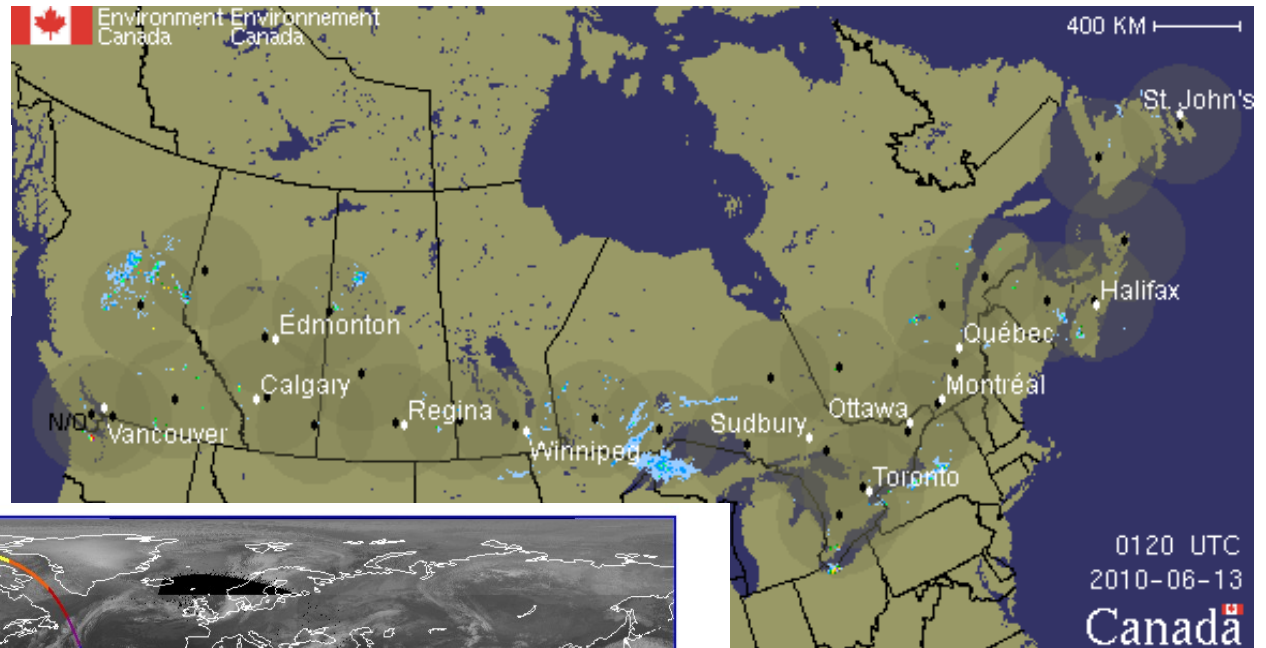
University of Washington - <http://webflash.ess.washington.edu/>  
Low res [http://www.uspln.com/images/gln\\_animated.gif](http://www.uspln.com/images/gln_animated.gif)



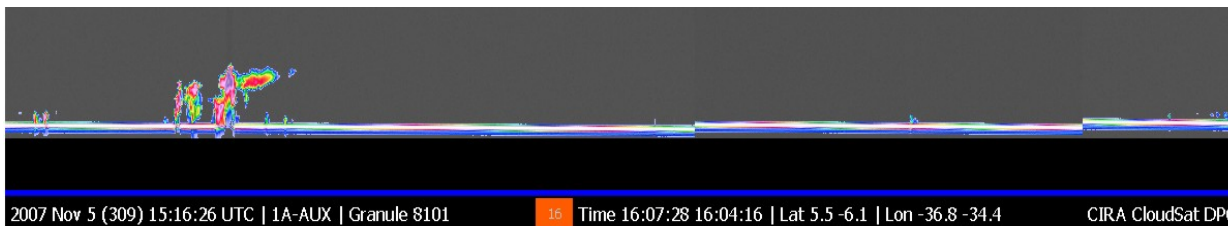
# Challenge – Getting AMDAR – aircraft sounding systems - the northern Canada fleets. ??? System for smaller aircraft



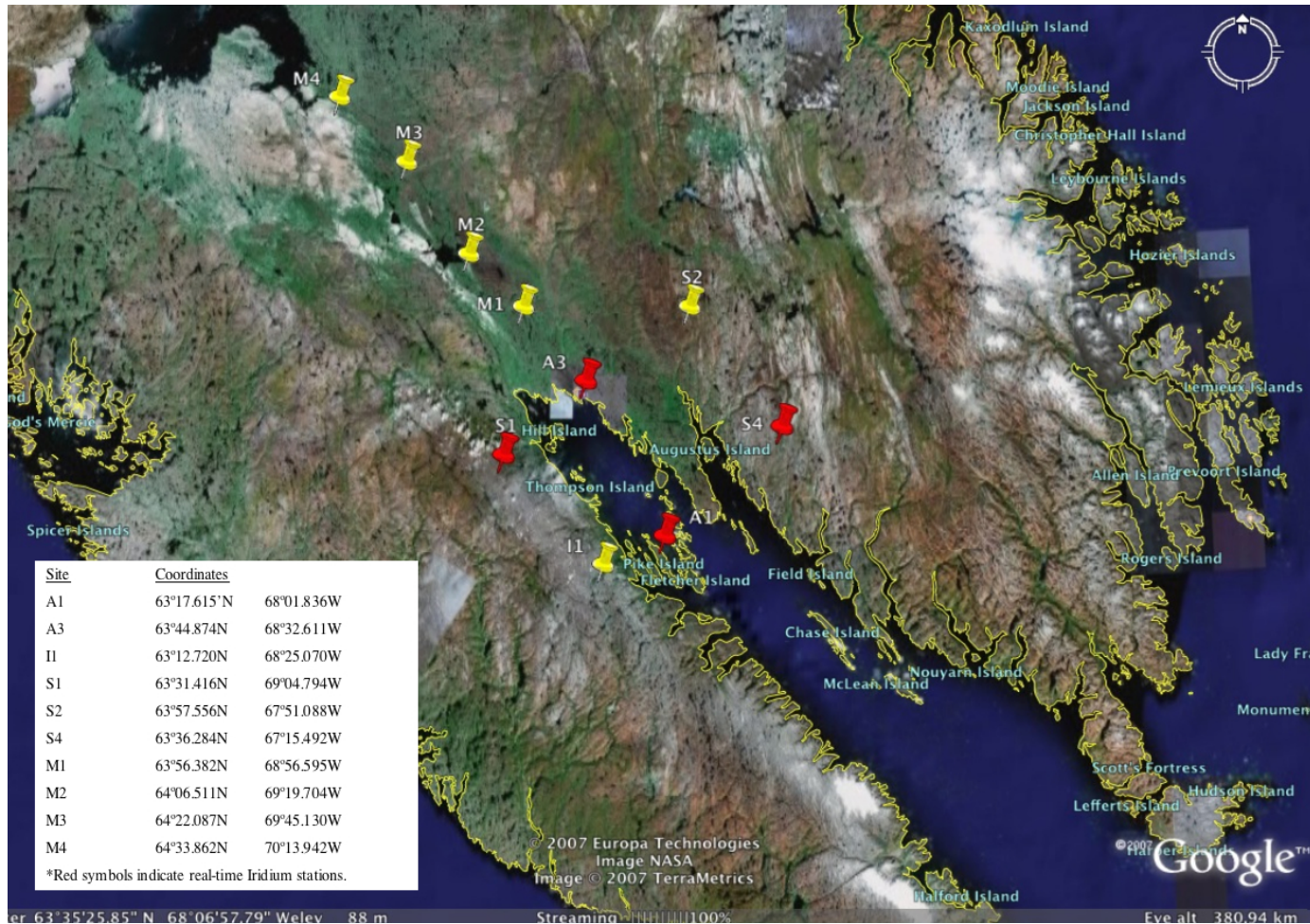
Radar: If surface systems are out, perhaps a satellite system



CloudSat [//www.nasa.gov/mission\\_pages/cloudsat/main/index.html](http://www.nasa.gov/mission_pages/cloudsat/main/index.html) <http://cloudsat.atmos.colostate.edu/>



**Challenge** – Making some surface observations from science projects available to the forecasters in real-time



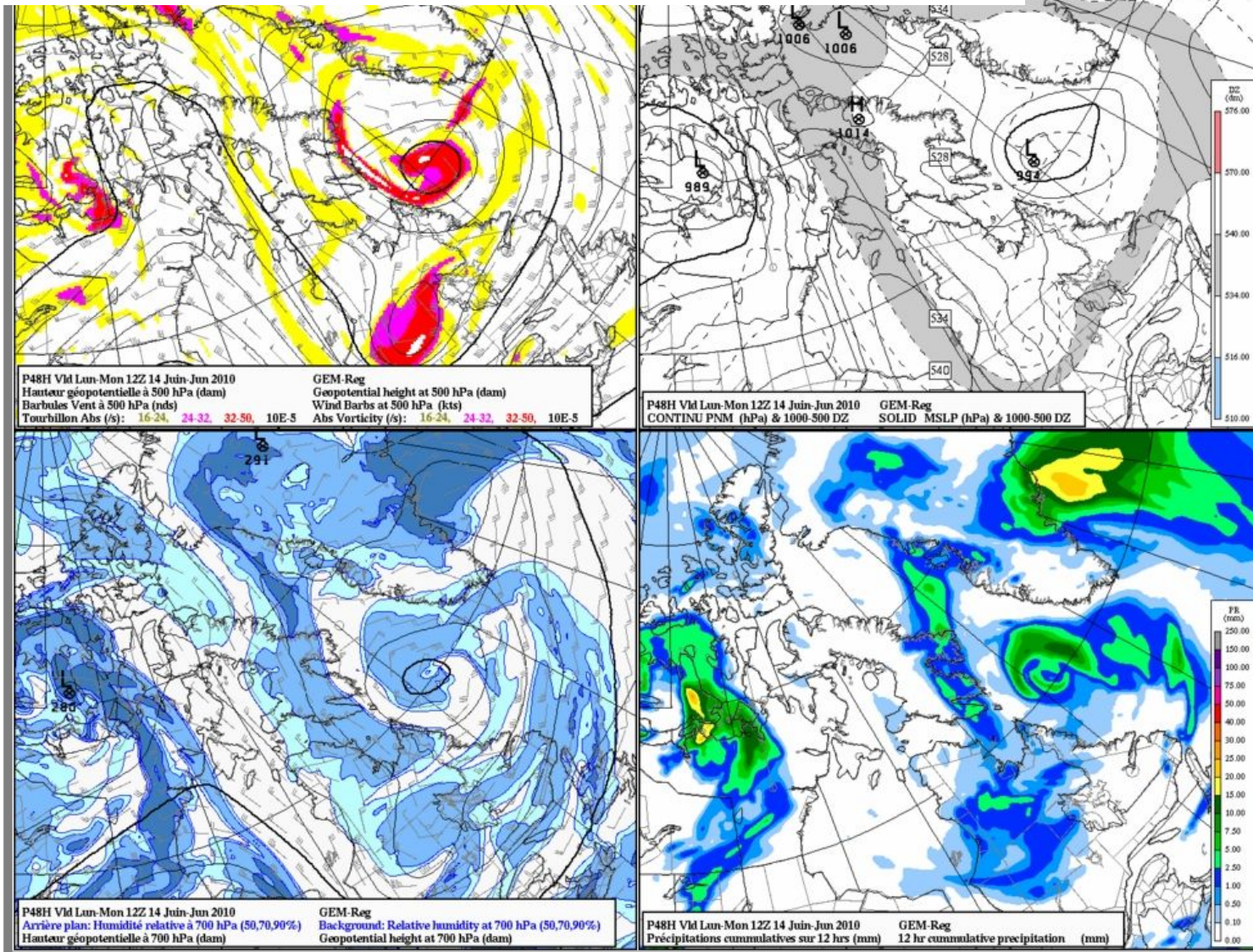
**Challenge** – Leaving a few surface sites from the science project as a legacy for a few years.

<b>Challenges of weather forecasting for Baffin Island</b>			
	<b>1972</b>	<b>2010</b>	<b>201x</b>
<b>Modelling</b>			
Resolution	100 km?	Local Area Model 2.5 km Regional 15 km Global 35 km	Even better resolution
.. Handling terrain	?	<i>Improvements in the high resolution models have afforded us to "see" typical strong topographically induced wind regimes such as the northeasterlies at Iqaluit</i>	Good?
Visualizations	Basics available on paper	Numerous Integrated Softcopy	Everyone

Boundary level cloud remains a challenge to the forecasters and to the models

Product 1	Run 1	Domain 1	Category 1	Images 1	Hours 1	Product 2
-GEM-Regional	2010061212	ARCTIC_EAST	4PAN	CLASSIC_12h	Fcst	GEM-Regional
						RUN2_

Challenge: To interpret – and use - the charts correctly



**Product 2**

GEM-Regional  
RUN2\_

**ExpertComp**  
Reload Product1

**Animation**

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 - + STOP

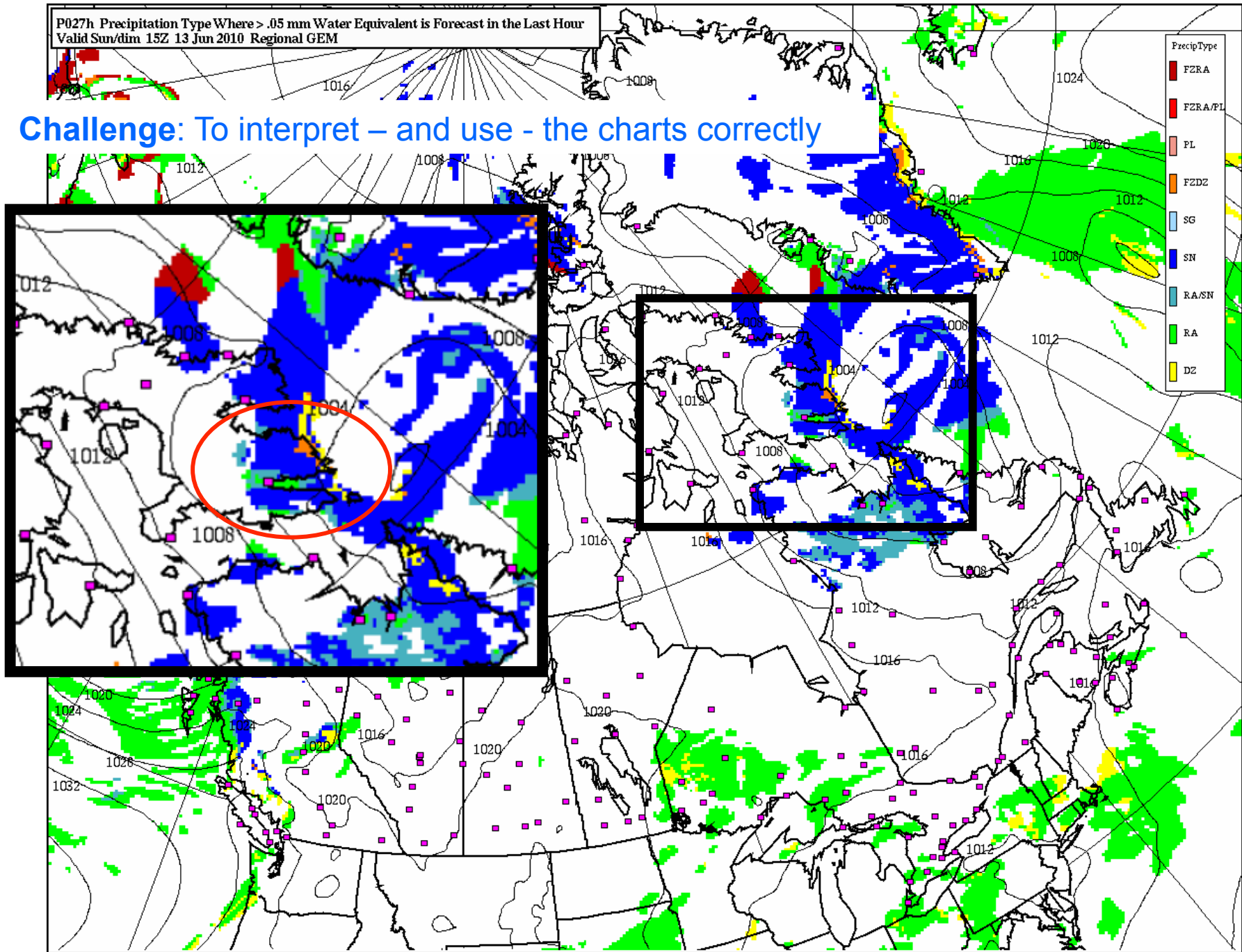
**Reset Speed**

**Image Number**  
005/005

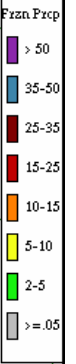
**Help**  
 Our Products  
 Vizaweb  
 Français  
 @ mail  
 What's New?

P027h Precipitation Type Where > .05 mm Water Equivalent is Forecast in the Last Hour  
Valid Sun/dim 15Z 13 Jun 2010 Regional GEM

Challenge: To interpret – and use - the charts correctly

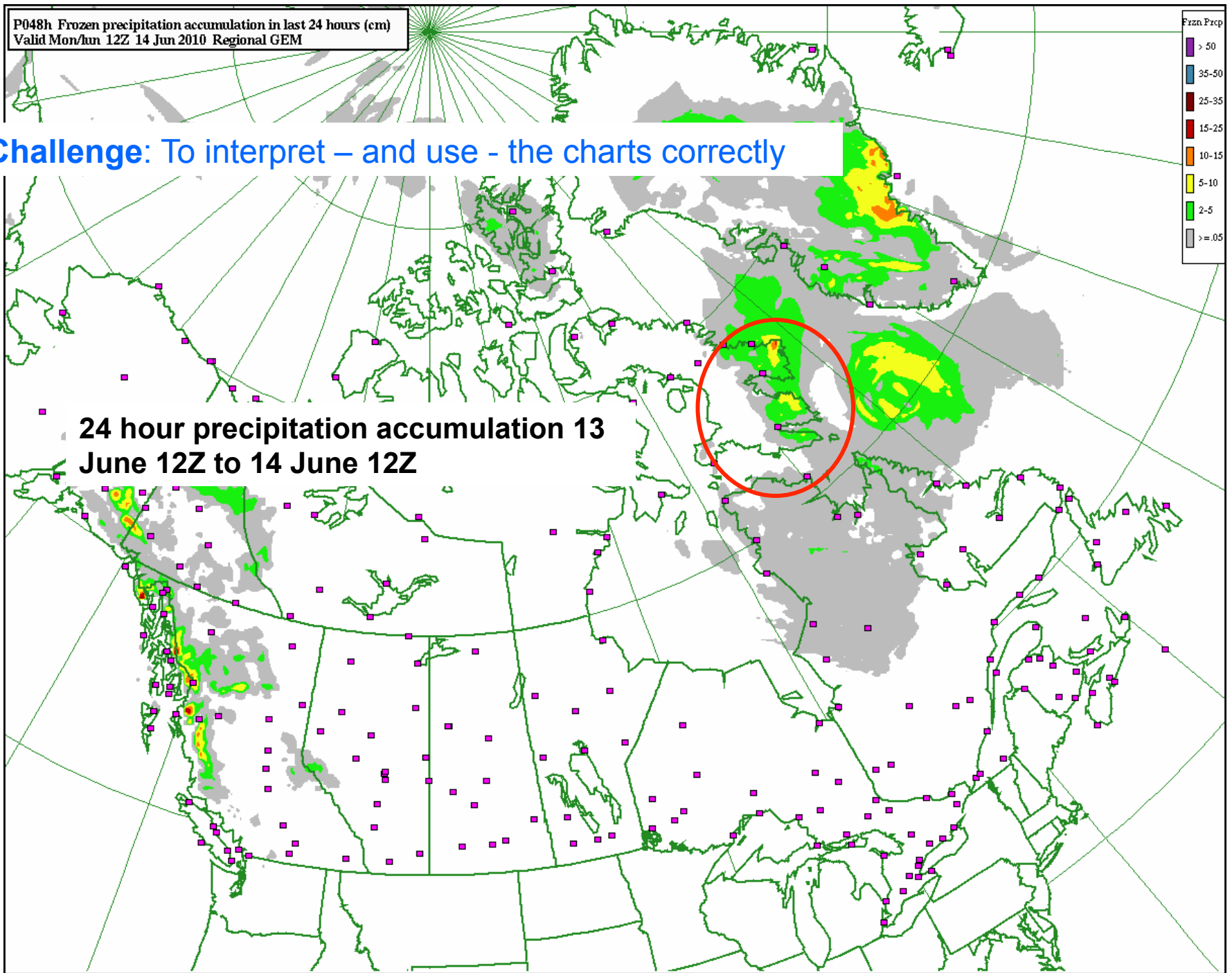


P048h Frozen precipitation accumulation in last 24 hours (cm)  
Valid Mon/hun 12Z 14 Jun 2010 Regional GEM



Challenge: To interpret – and use - the charts correctly

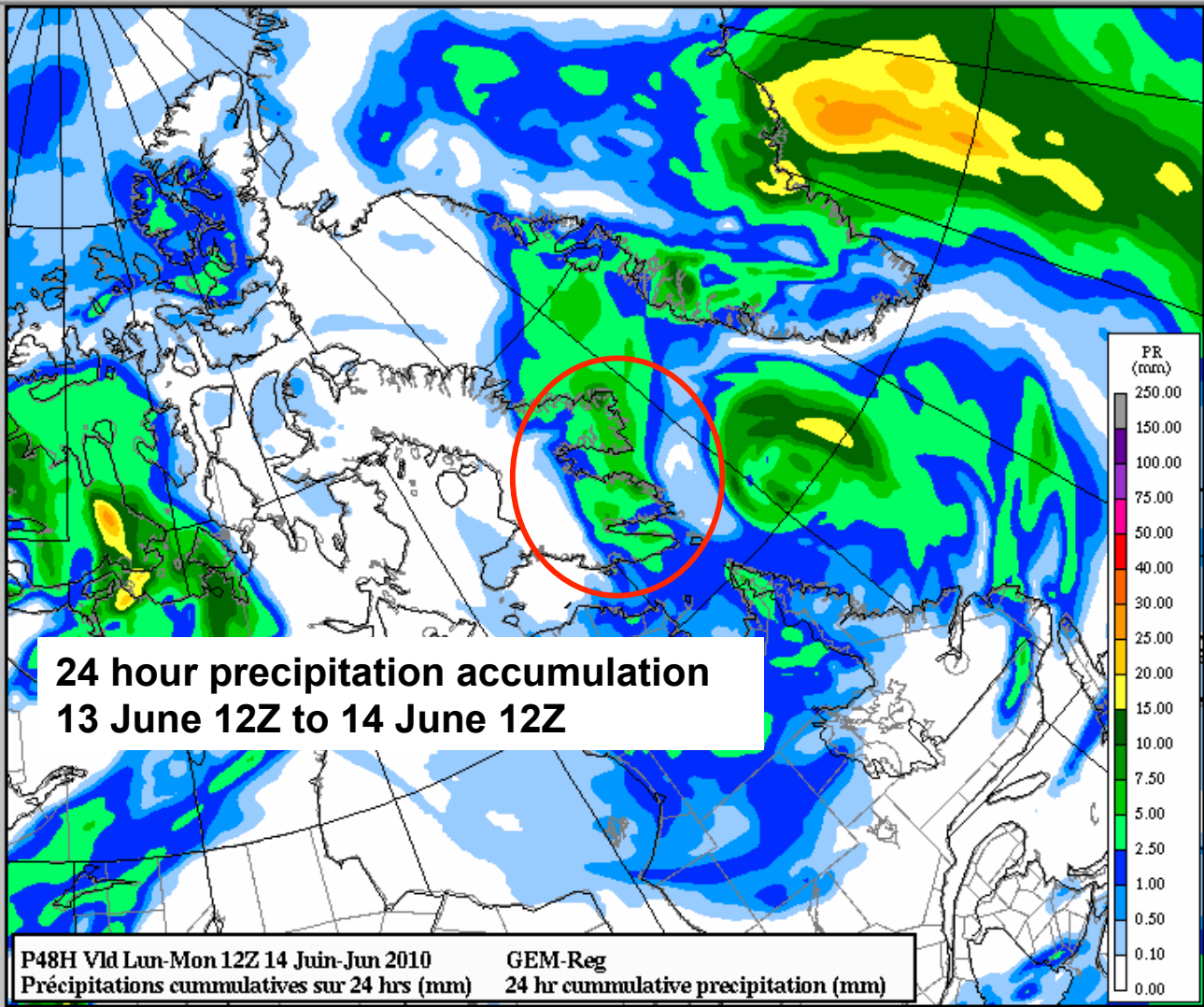
24 hour precipitation accumulation 13  
June 12Z to 14 June 12Z





Product 1	Run 1	Domain 1	Category 1	Images 1	Hours 1
-GEM-Regional	2010061212	ARCTIC_EAST	QPF_	Total_24h	Fcst

Product 2
GEM-Regional
RUN2



**ExpertComp**  
**Reload Product1**

**Animation**

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- + STOP

**Reset Speed**

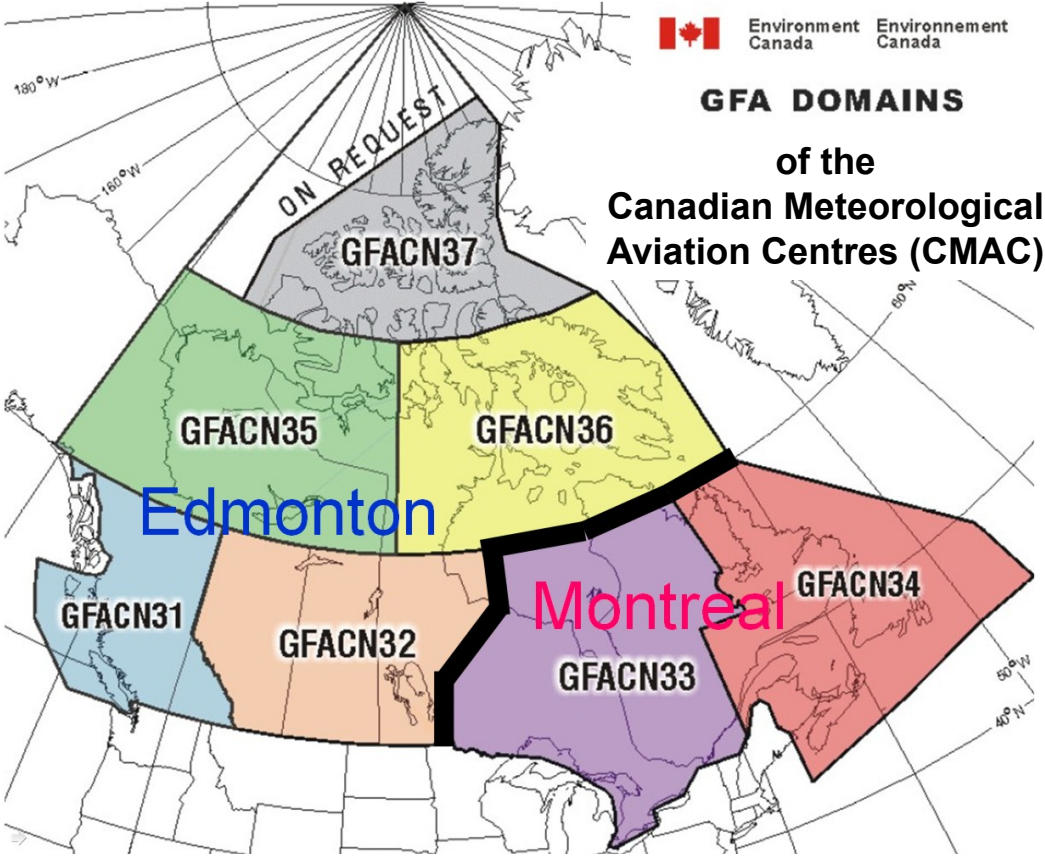
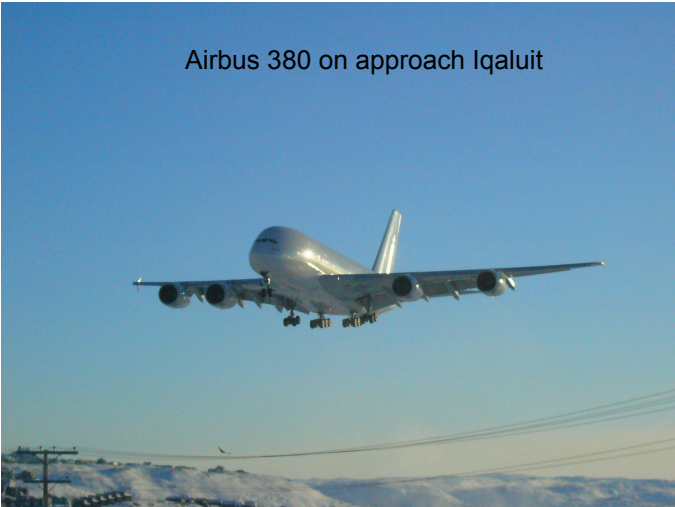
**Image Number**

003/003

- Help**
- Our Products**
- Vizaweb**
- Français**
- @ mail**
- What's New?**



# Aviation Forecasts done by forecasters in Edmonton

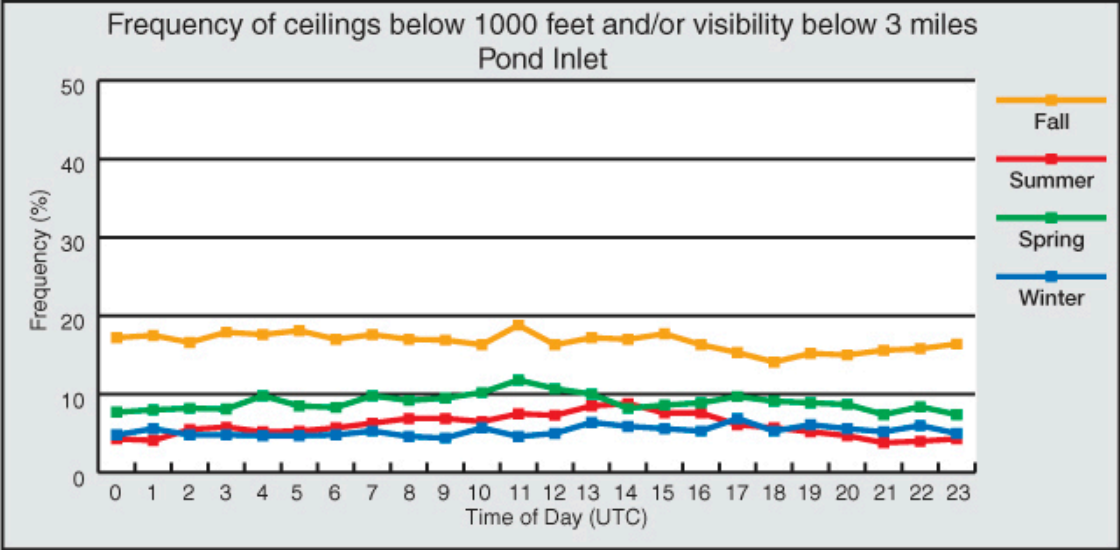


**Challenges:** Forecast the ceilings and visibility, clouds and weather, icing, and turbulence for the Baffin aviation sites / over Baffin Island

**Pond Inlet**

Poorest flying weather at Pond Inlet occurs during **fall**

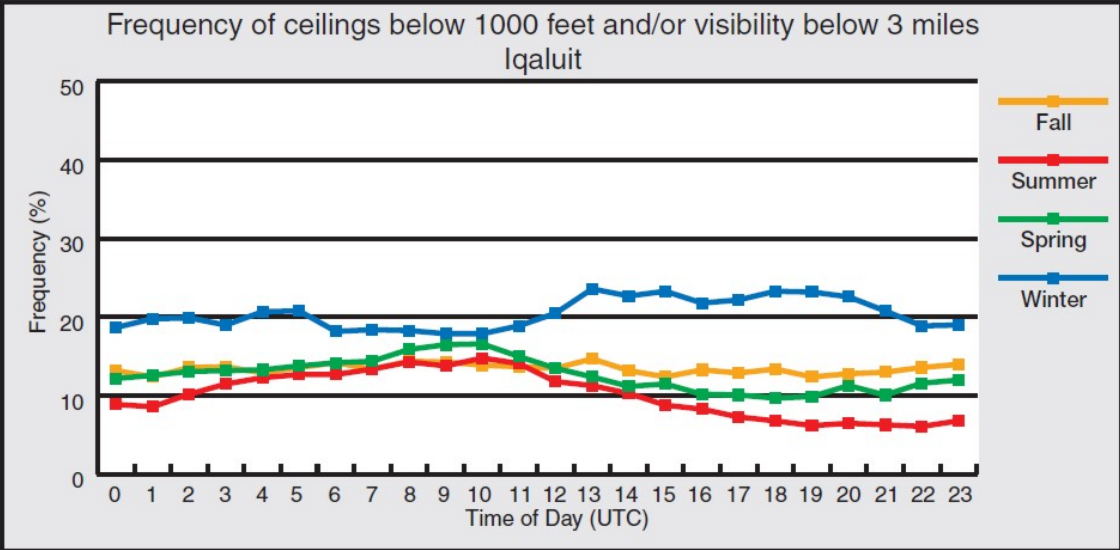
Forecasting challenge: catch the low cloud and/or precipitation events



**Iqaluit**

Poorest flying weather at Iqaluit occurs during **winter**

Forecasting challenge: forecast the low cloud and/or snow and blowing snow events



1972

<b>Challenges of weather forecasting for Baffin Island</b>			
	1972	2010	201x
<b>Forecasts</b>			
Time period	2 days	5 days	?? days
Focus		High impact weather, first 24 hours,	High impact weather, ? Days
<b>Production</b>			
	Labour intensive. Vulnerable to spelling and grammar mistakes	Scribe - Model displayed graphically with the forecaster having the ability to modify	Scribe's replacement
Warning thresholds: Wind Blowing Snow Blizzard		Changed a few days ago	

# Challenge – Forecasting blizzard events at Baffin communities

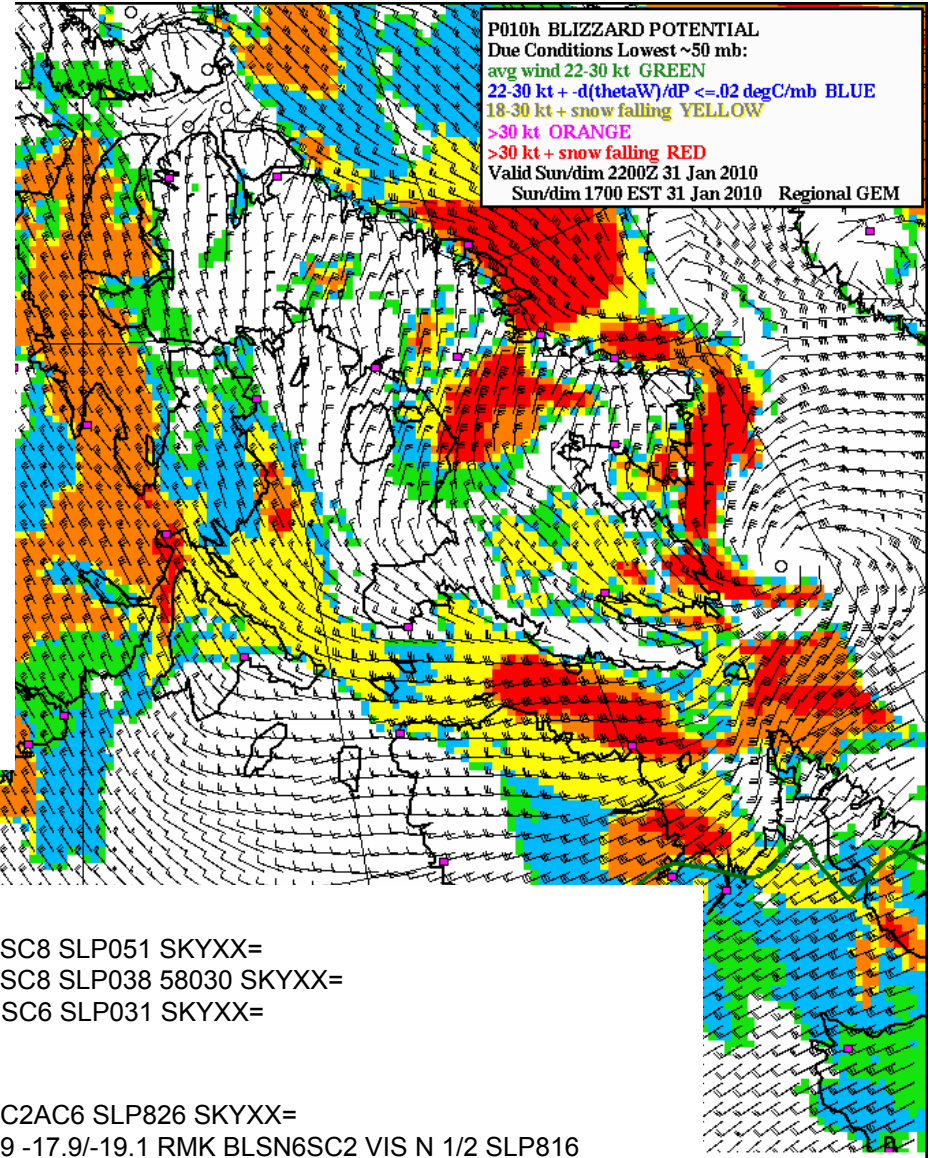
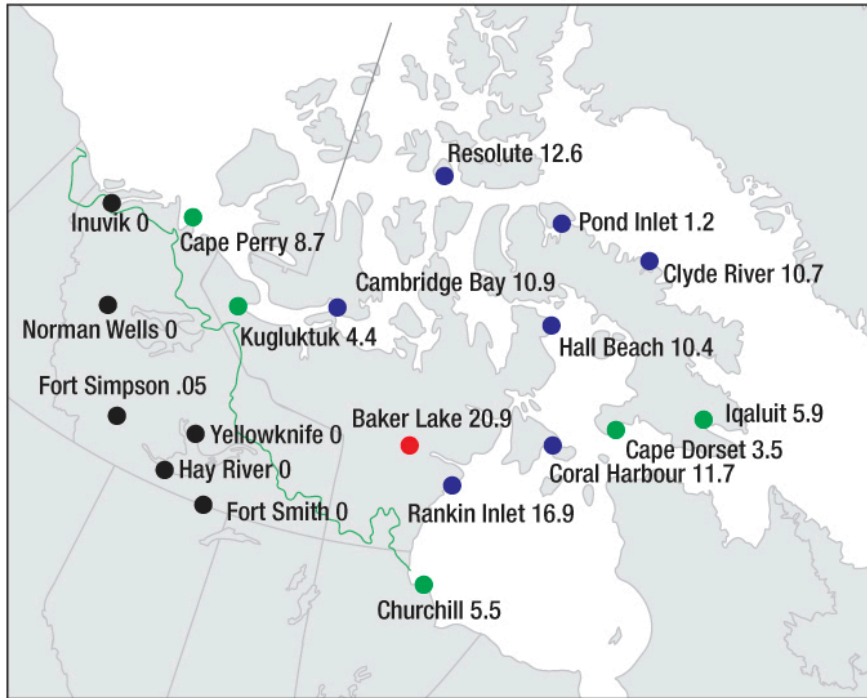


Fig. 3-15 - Average number of blizzard events per year for selected communities in Northwest Territories and Nunavut plus Churchill, Manitoba 1980 to 1999 data except 1982 to 1999 Rankin Inlet and 1985 to 1999 Clyde River and Cape Dorset

## Clyde

CYCY 311700Z 32024G29KT 1/2SM -SN BLSN OVC038 -20.3/-24.0 RMK SC8 SLP051 SKYXX=  
 CYCY 311800Z 31025G30KT 1/2SM -SN BLSN OVC017 -20.2/-23.8 RMK SC8 SLP038 58030 SKYXX=  
 CYCY 311900Z 31027KT 1/2SM -SN BLSN OVC015 -19.8/-23.3 RMK SN2SC6 SLP031 SKYXX=

## Iqaluit

CYFB 311600Z 32025KT 5SM BLSN FEW025 OVC085 -17.1/-18.5 RMK SC2AC6 SLP826 SKYXX=  
 CYFB 311700Z 33031KT 1 1/2SM R35/1200V2200FT/D -SN BLSN OVC029 -17.9/-19.1 RMK BLSN6SC2 VIS N 1/2 SLP816  
 SKYXX=  
 CYFB 311800Z 32029KT 1/2SM R35/1600FT/N -SN BLSN VV015 -17.3/-18.6 A2897 RMK BLSN8 SLP813 56020 SKYXX=

## Challenge – building up an inventory of examples to help us recognize “events” to facilitate analogue techniques

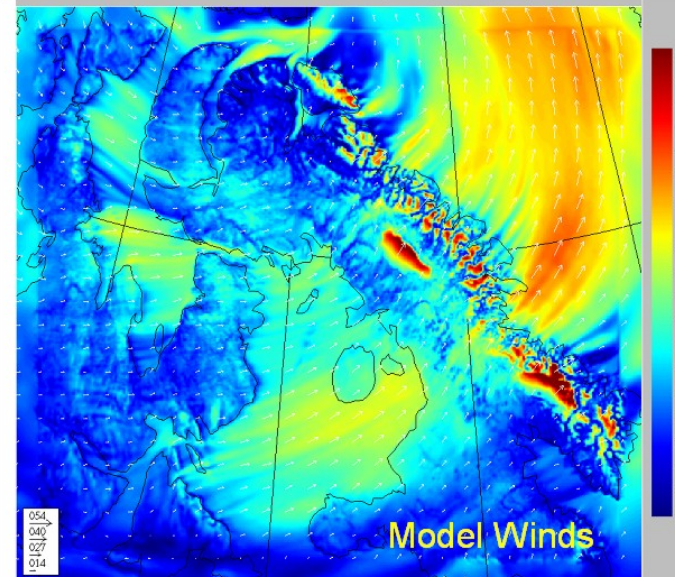
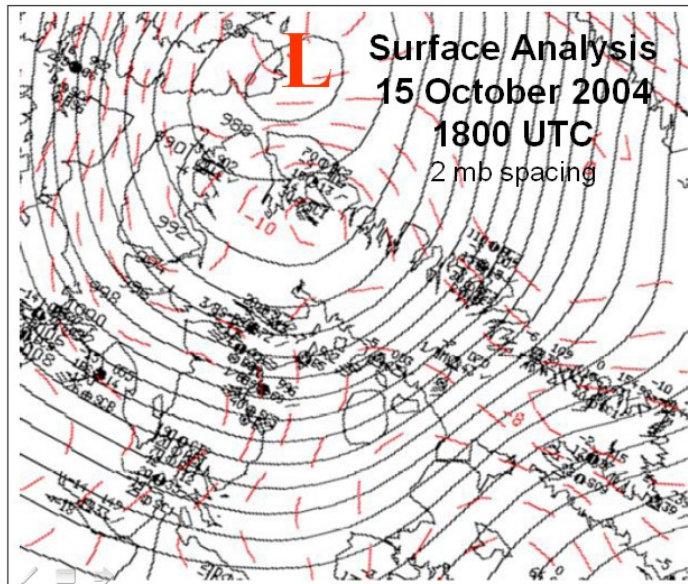
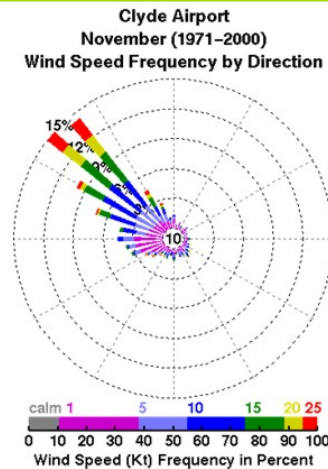
### Clyde River – Southwesterly Winds

Not common !

Can occur with two different set-ups.

Shown is the less-common strong synoptic southwesterly flow over a large region – a big blow + potential downslope flows

Not a lot of history on wind-strengths for this pattern, but can be strong. E.G. 15 October 2004, winds peaked at 25G35, but were quite variable



**Challenge** – building up an inventory of examples to help us recognize “events” to facilitate analogue techniques

*Phillips, Climates of Canada, 1990* cites this example

Iqaluit, 8 February 1979

-40°C 100 km/h winds, snow.

Residents indoor for 10 days.

**Challenge** – building up an inventory of examples to help us recognize “events” to facilitate analogue techniques

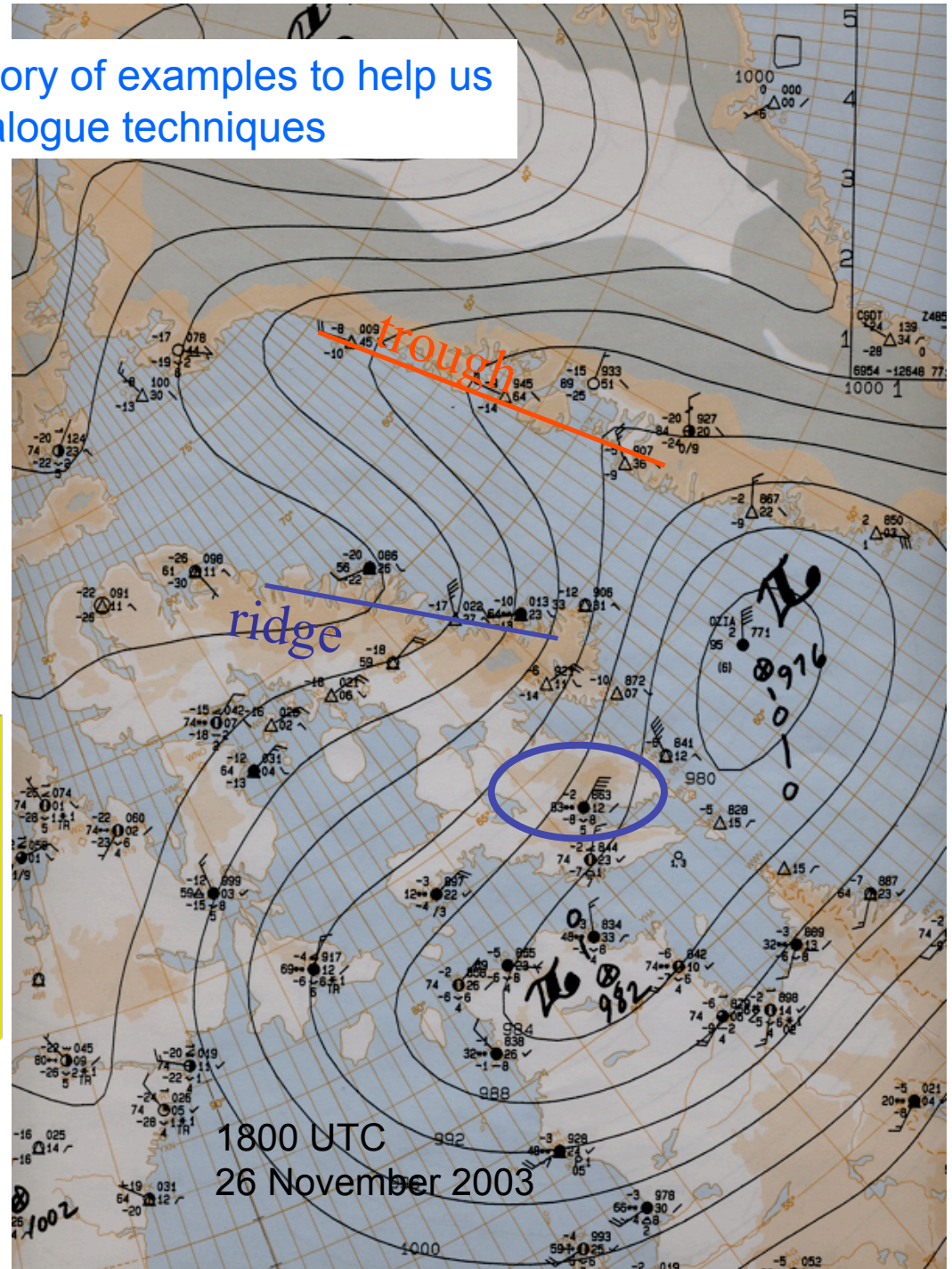
## Iqaluit

This weather pattern **usually** gives a wind event (very strong northeasterly winds) at Iqaluit.

Falling snow is required along with the strong winds to make a blizzard.

In this case, Iqaluit experienced winds from the east-northeast of 70 gusting 90 km/h

***BUT no blizzard or restriction in visibility.***



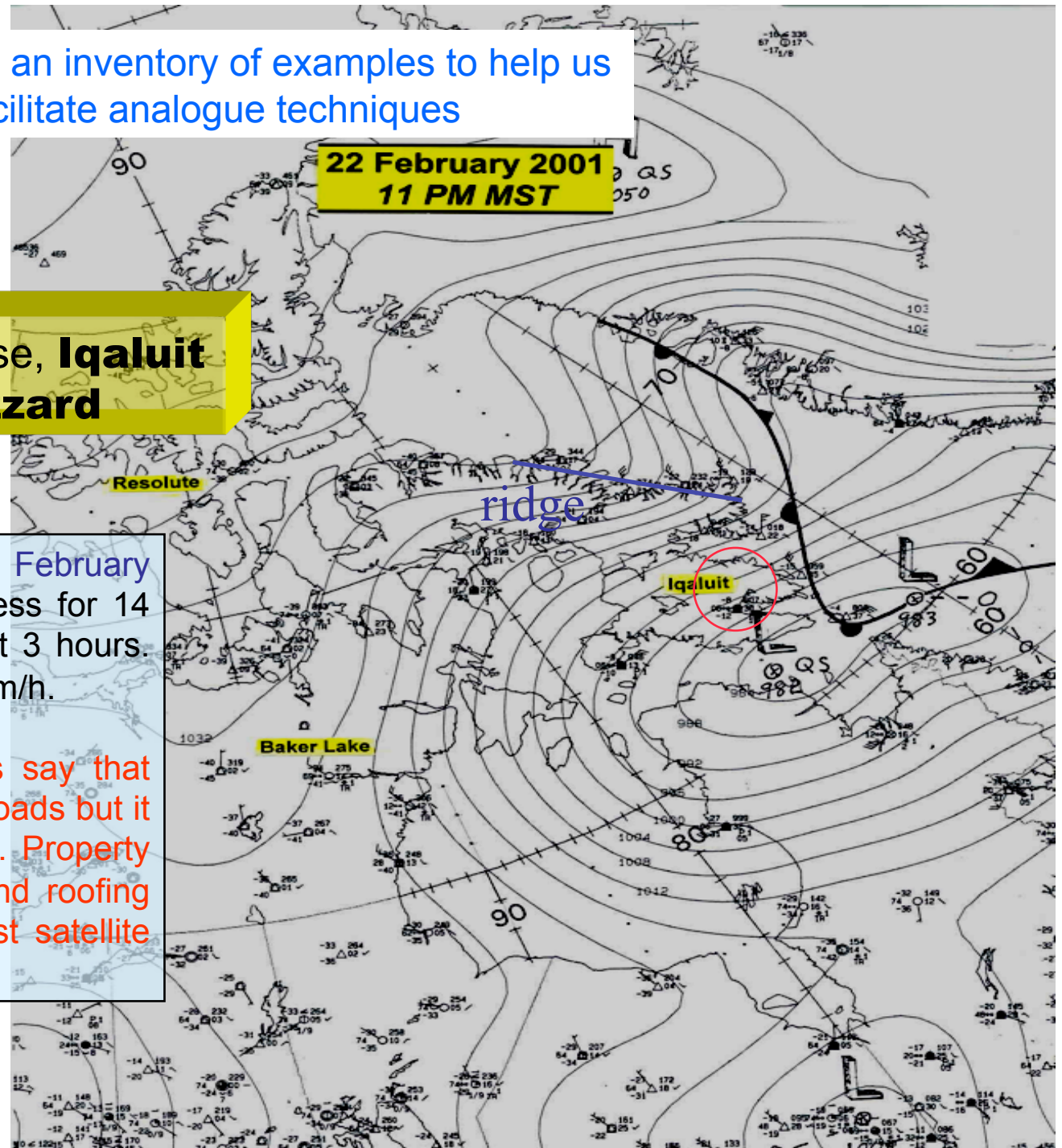


**Challenge** – building up an inventory of examples to help us recognize “events” to facilitate analogue techniques

HOWEVER, in this case, **Iqaluit** experienced a blizzard

**Iqaluit Blizzard**, 22-23 February 2001  
Visibility ½ mile or less for 14 hours and zero for at least 3 hours.  
Maximum wind 100G122 km/h.

Schools closed. Residents say that they have seen worse for roads but it took a while to open town. Property damage included siding and roofing blown off houses and most satellite dishes in town



A recent significant ice event

**Severe ice breakage:  
Qikiqtarjuaq, Nunavut**

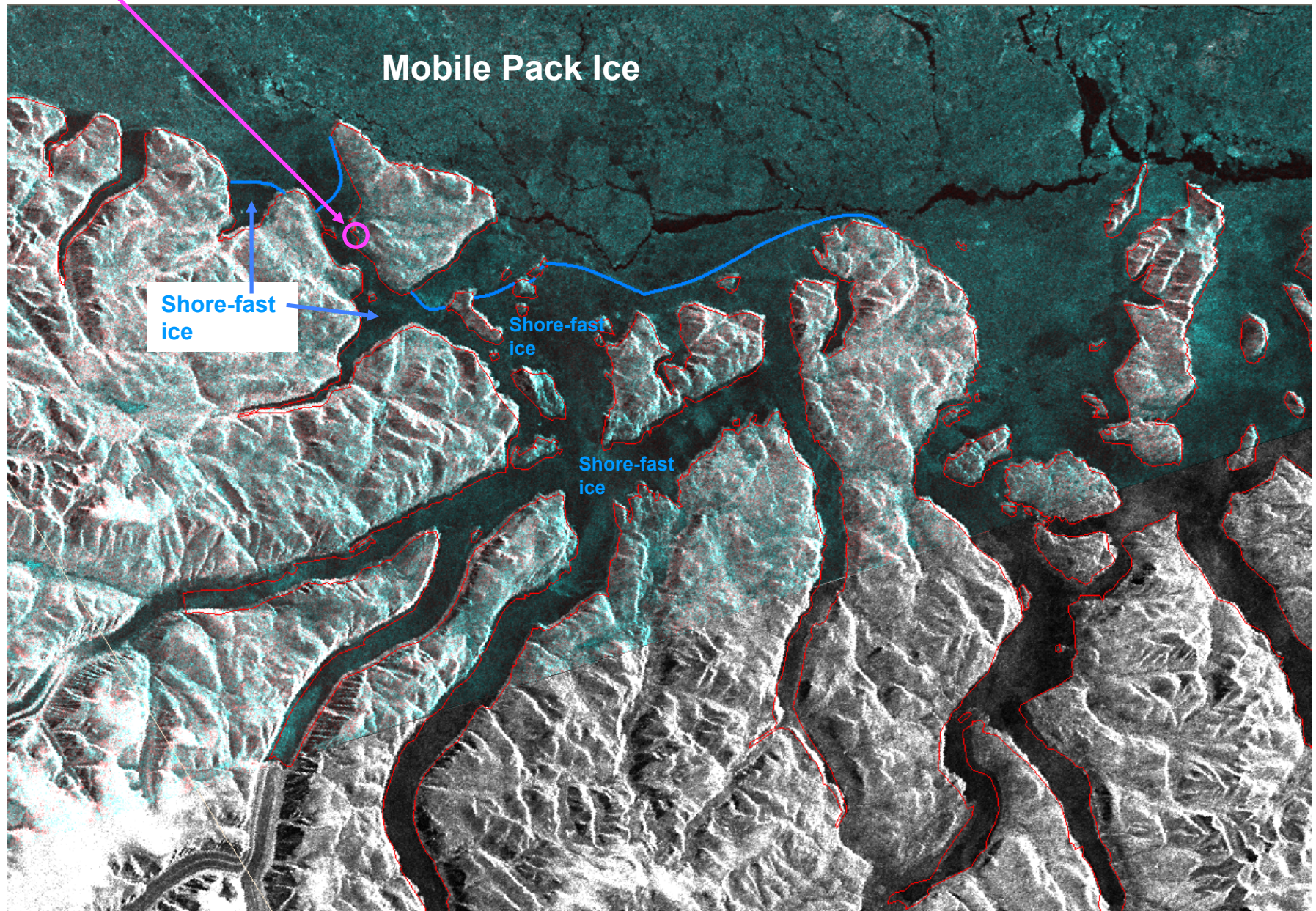
(2 a.m. Dec. 31, 2009)

*Slides courtesy Trudy Wohlleben, Canadian Ice Service*



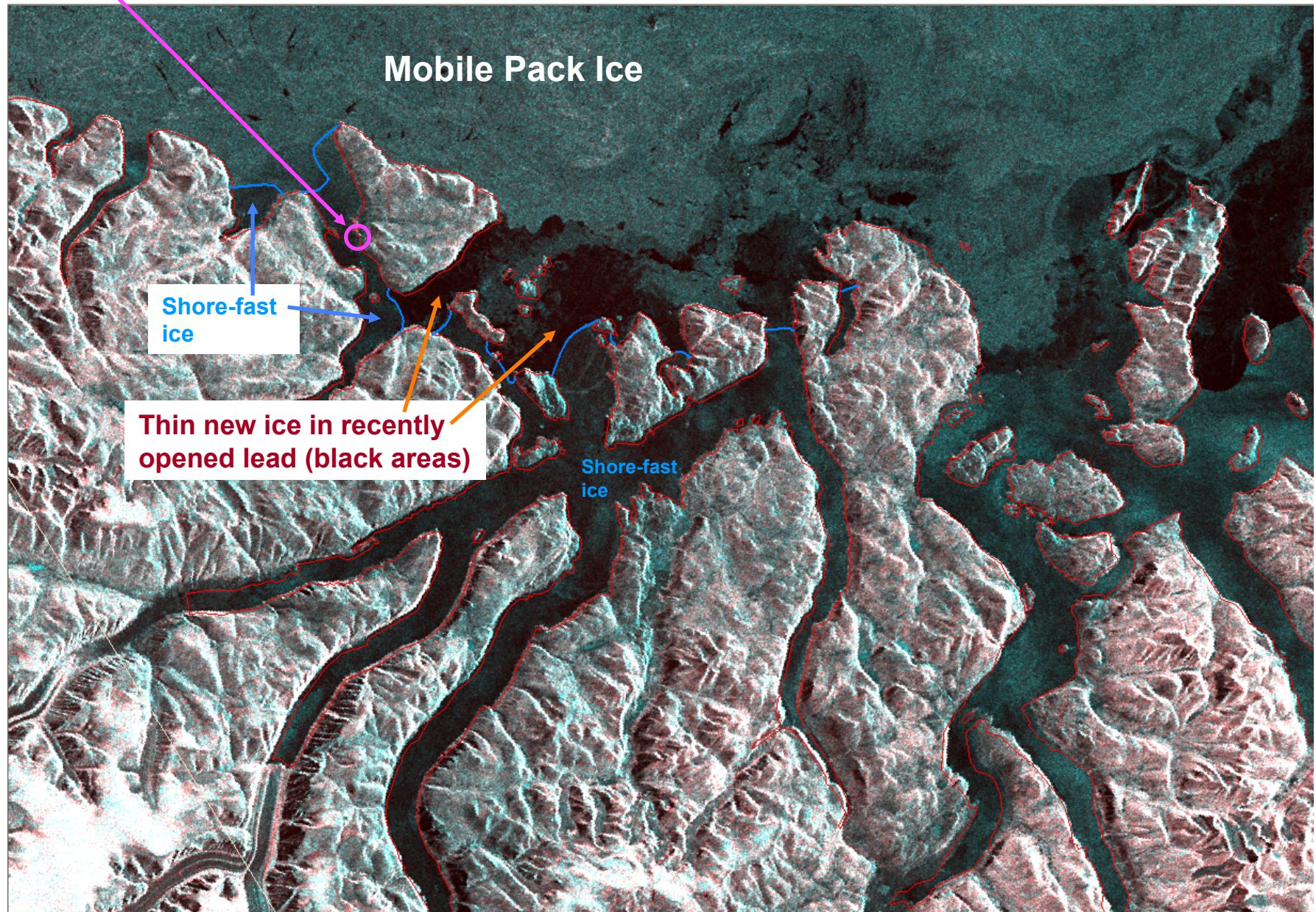
Qikiqtarjuaq

Radarsat2 image: 27 Dec 2009, 1058 UTC



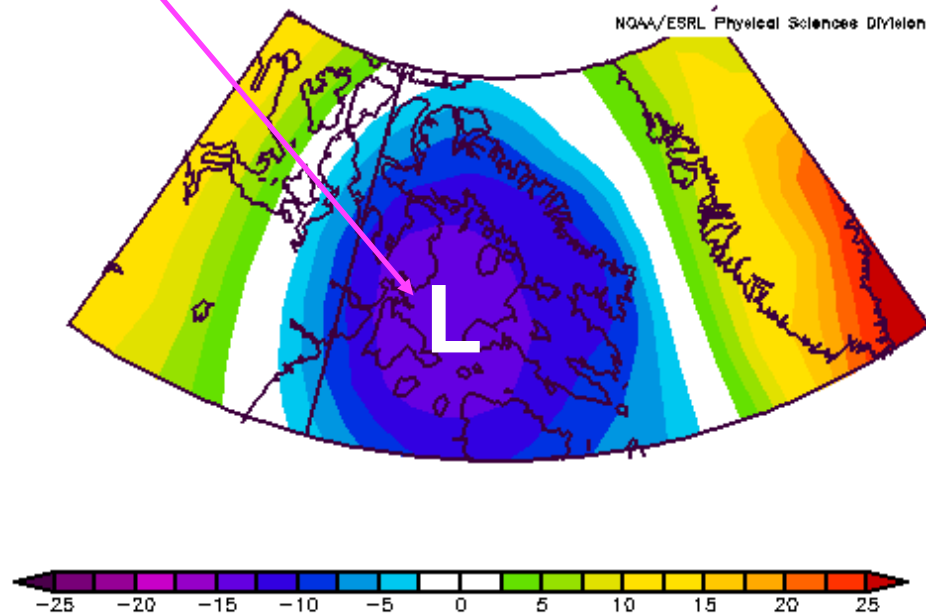
Qikiqtarjuaq

Radarsat2 image: 03 Jan 2010, 1055 UTC



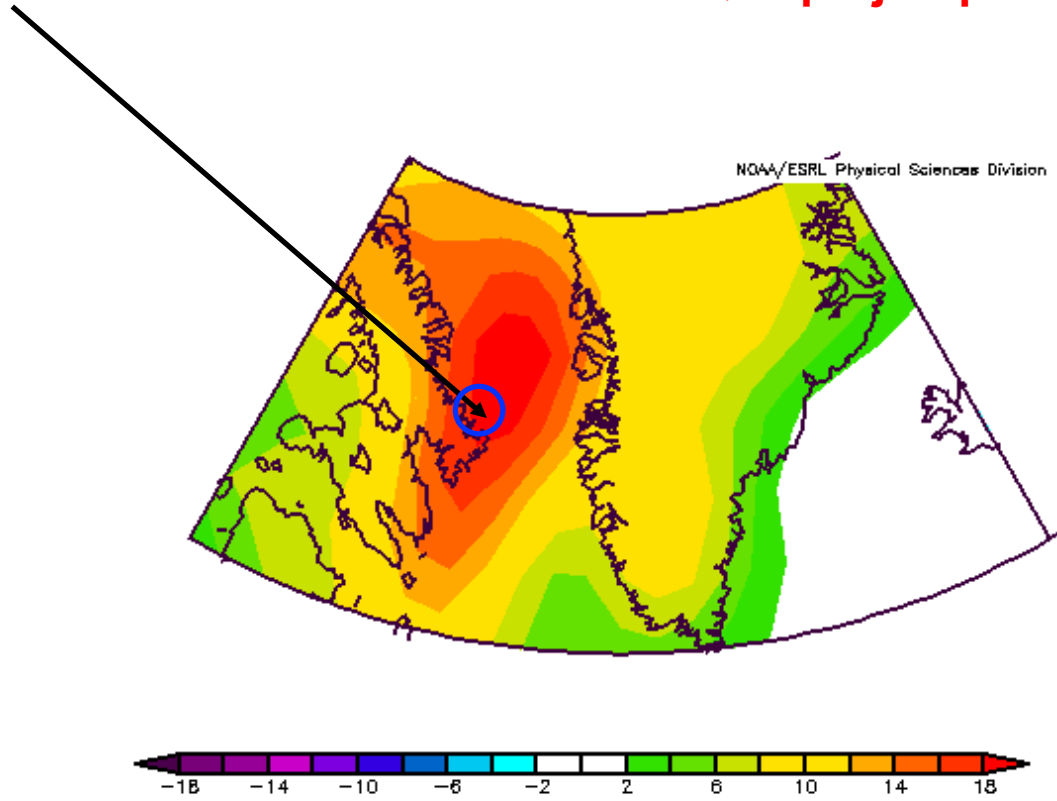
Surface pressure anomaly: 27 Dec 2009 – 01 Jan 2010

**Lower than normal Pressure in Foxxe Basin, indicating abnormal storm systems in the area**



Surface temperature anomaly: 27 Dec 2009 – 02 Jan 2010

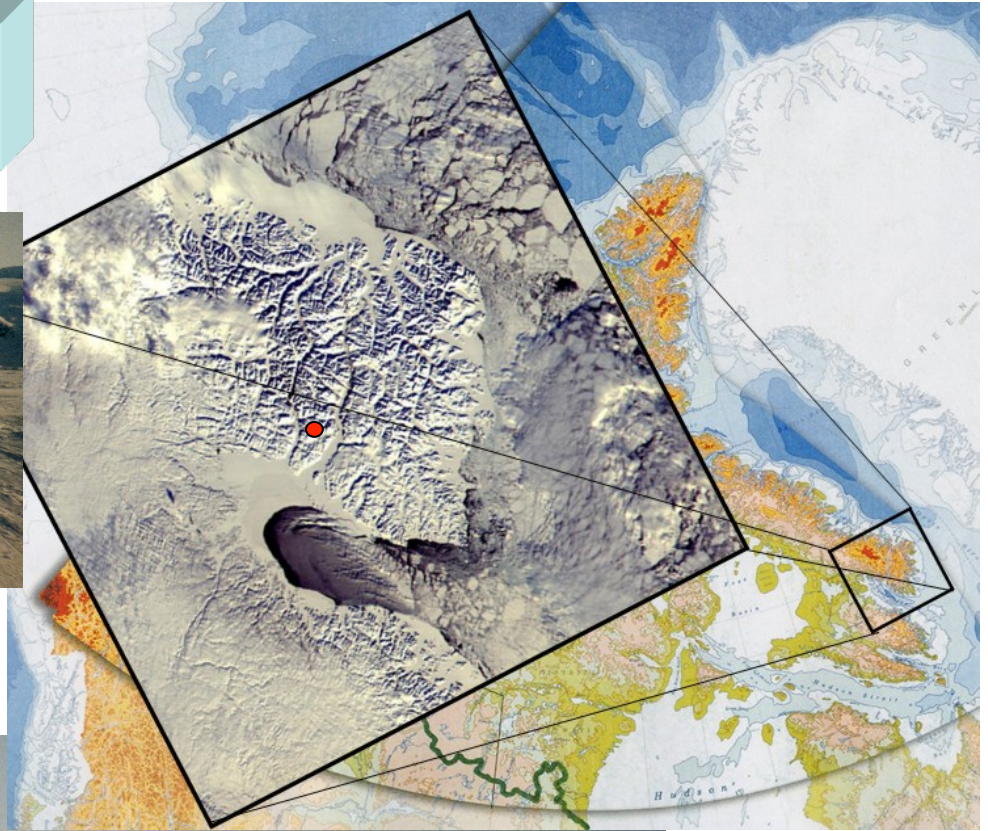
**16-18°C warmer than normal in the area of Qikiqtarjuaq**



## Pangnirtung fishery



Heading out from Pangnirtung to the through-the-ice winter fishery on Cumberland Sound





**Challenge:** Forecasts for floe edge growth, breakup, pulling away ?

Wind and temperature forecasts key elements

Print Product

There is a floe edge product

Polar View  
Earth Observation for Polar Monitoring

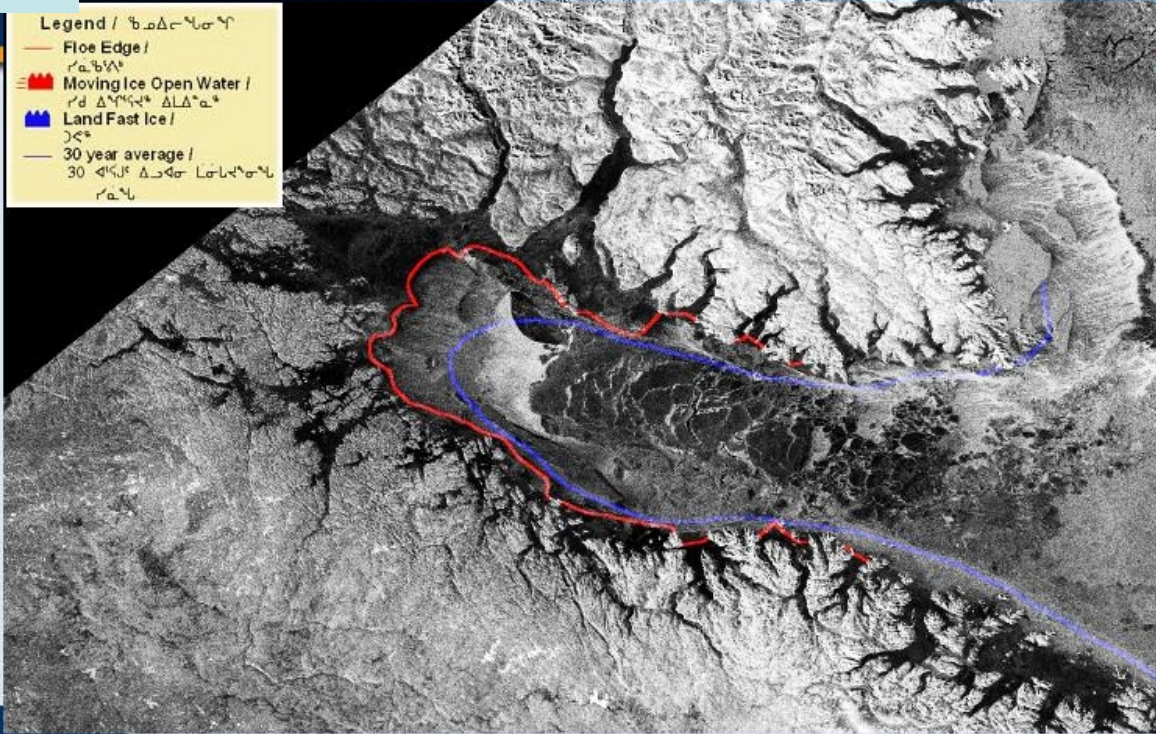
CUMBERLAND SOUND February 28, 2010



POLAR VIEW	#	Product	Image Date mm/dd/yy	Regional Overview	Nunataq	Iqalulik	Kikirton	Umanajuag
Products Pangnirtung	1	Floe Edge - Pangnirtung	2/28/2010 9:52:56 PM					
CapeDorset Pangnirtung	2	Floe Edge - Pangnirtung	2/28/2010 9:52:56 PM					
Igloolik Lancaster HighArctic JonesSound Amundsen Akulivik	3	Floe Edge - Pangnirtung	2/27/2010 10:22:13 PM					
SAR Imagery	4	Floe Edge - Pangnirtung	2/27/2010 10:22:13 PM					
MODIS (Colour Composite)	5	Floe Edge - Pangnirtung	2/13/2010 10:59:16 AM					
True Colour	6	Floe Edge - Pangnirtung	2/1/2010 9:40:16 PM					
MODIS (Highlights Clouds / Water / Ice)	7	Floe Edge - Pangnirtung	1/31/2010 10:09:39 PM					
MODIS	8	Floe Edge - Pangnirtung	1/31/2010 10:39:01 AM					
MODIS (Sea Surface Temperature)	9	Floe Edge - Pangnirtung	1/21/2010 10:01:32 PM					

Legend / ንግግሮብ

- Floe Edge / ገጽገጽ
- Moving Ice Open Water / ገጽ ልሳን ልሳን ልሳን
- Land Fast Ice / ገጽ
- 30 year average / 30 ዓመት ልምድ ገጽ



supported by:  
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Canadian Ice Services /  
Environment Canada

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*Time to* →



*Yellowknife*

*J. Phillips*

# Every year is a polar year in the Arctic



Ice bergs, Nares Strait  
early morning 2 August 2003