A Canadian Perspective on GPM

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Environment Canada

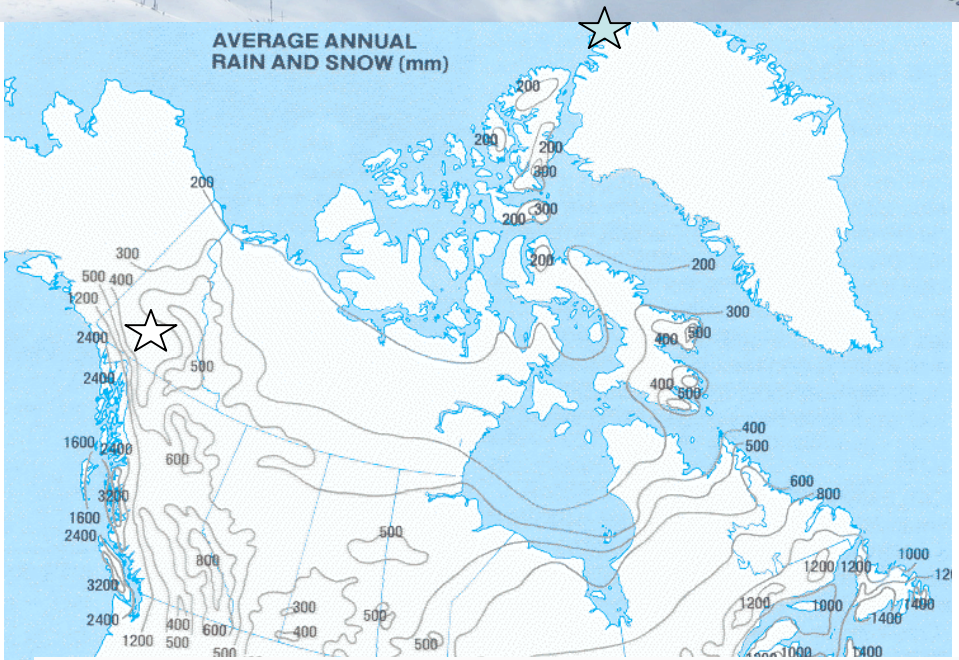
Canada

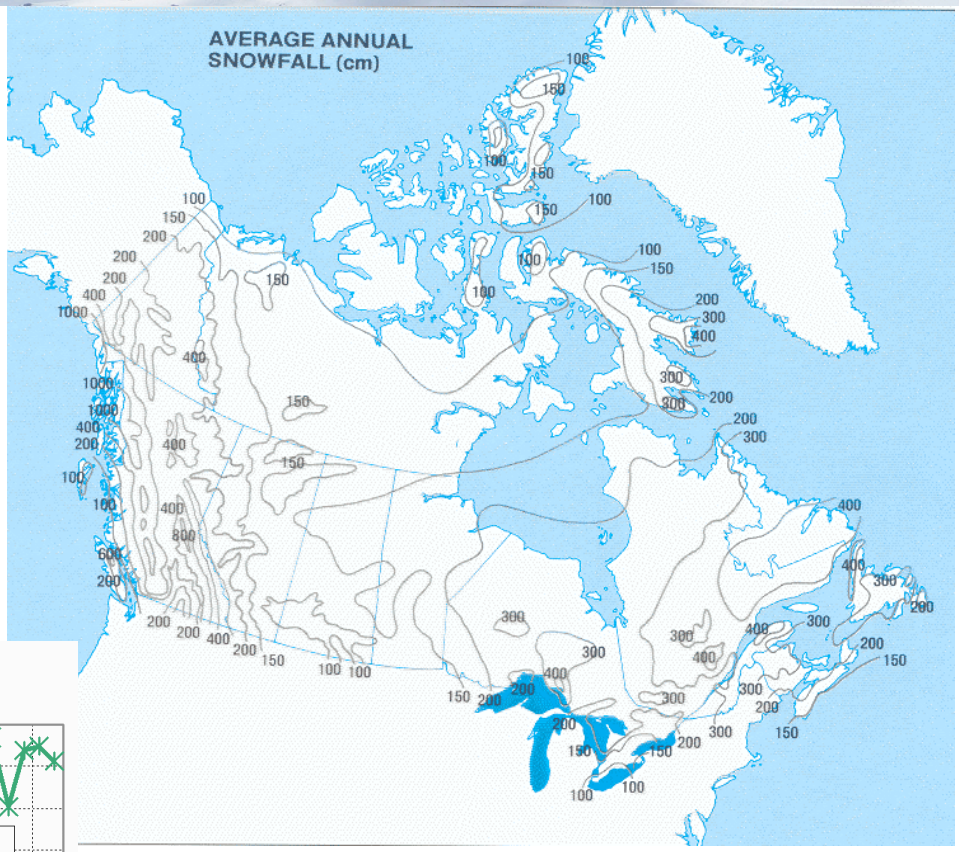
Outline

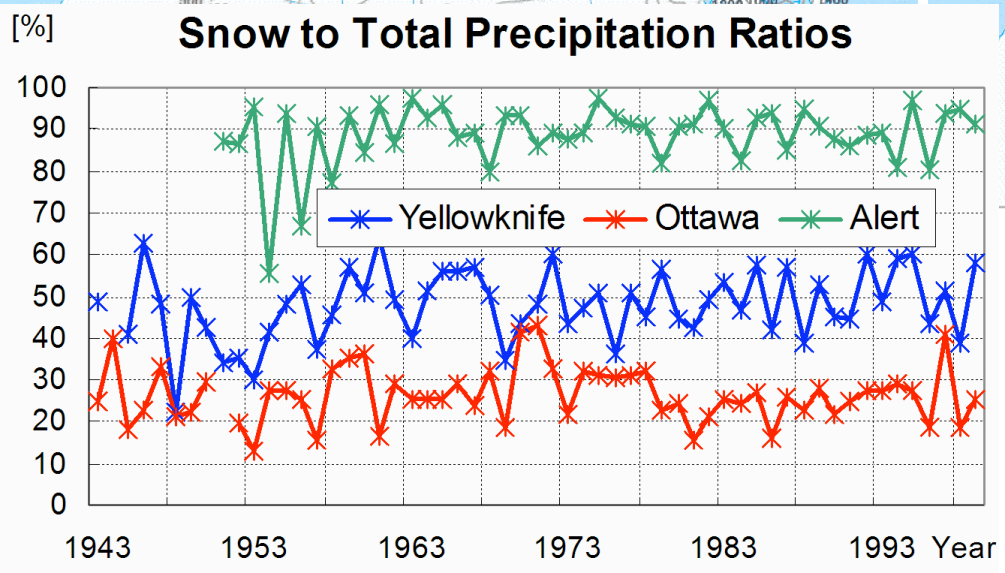
- Introduction/Motivation
- Scientific Interest
- Requirements
- Canadian Cloudsat/CALIPSO Validation Project (C3VP)

- **Aluiqqaniq** : Snowdrift on a steep hill, overhanging on top.
  Aniuk : Snow for drinking water.
  Aniuvak : Snow remaining in holes.
  Aput : Snow on the ground (close to the generic Snow)
  Aqilluqqaaq : Fresh and soggy snow
  Auviq : snow brick, to build igloo
  Ijaruvak : Melted snow, turned in ice crystals.
  Isiriartaq : Falling snow, yellow or red.
  Kanangniut : Snowdrift made by North-East wind.
  Katakartanaq : Crusty snow, broken by steps.
  Kavisilaq : snow hardened by rain or frost
  Kinirtaq : wet and compact snow.
  Masak : wet snow, saturated.
  Matsaaq : snow in water
  Maujaq : deep and soft snow, where it's difficult to walk.
  Mingullaut : thin powder snow, enters by cracks and covers objects.
- **Mituk** : small snow layer on the water of a fishing hole.
  Munnguqtuq : compressed snow which began to soften in spring.
  Natiruviaqtuq: snow blasts on the ground.
  Niggiut : snowdrift with South-east wind
  Niummak : hard waving snow staying on ice fields
  Pingangnuit : snowdrift made by south-west wind
  Piqsiq : snow lift by wind. Blizzard.
  Pukak : dry snow crystals, like sugar powder
  Qannialaaq : light falling snow
  Qanniq : falling snow
  Quiasuqaq : re-frozen snow surface, making crust.
  Qiqiqralijarnatuq: snow when walked on.
  Uangniut : snowdrift made by north-west wind.
  Uluarnaq : round snowdrift
  Uqaluraq : taper snowdrift

Snow vs Rain


AVERAGE ANNUAL
RAIN AND SNOW (mm)

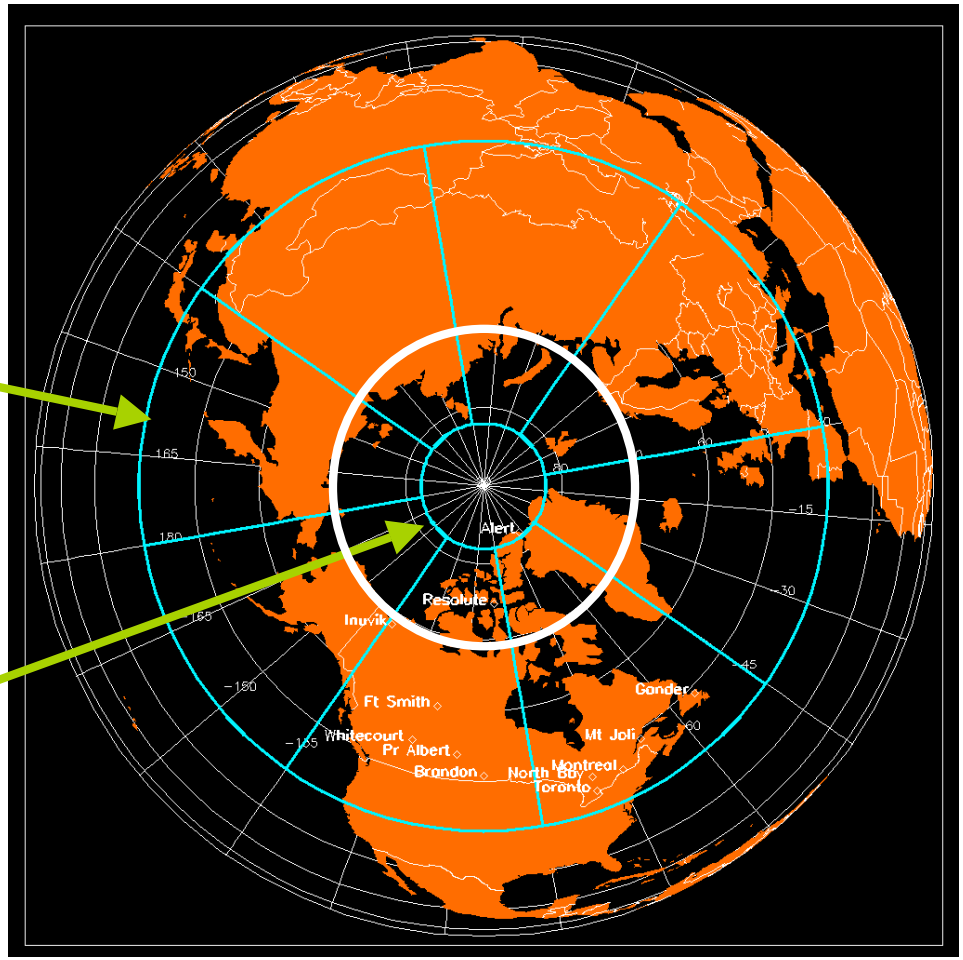

AVERAGE ANNUAL
SNOWFALL (cm)


Snow to Total Precipitation Ratios
[%]
100
90
80
70
60
50
40
30
20
10
0
Yellowknife
Ottawa
Alert
1943
1953
1963
1973
1983
1993
Year

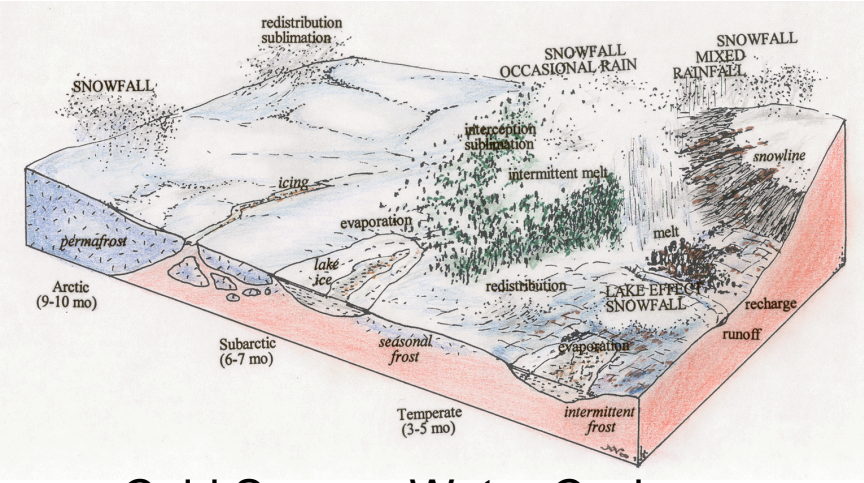
EGPM Coverage

TRMM Limit

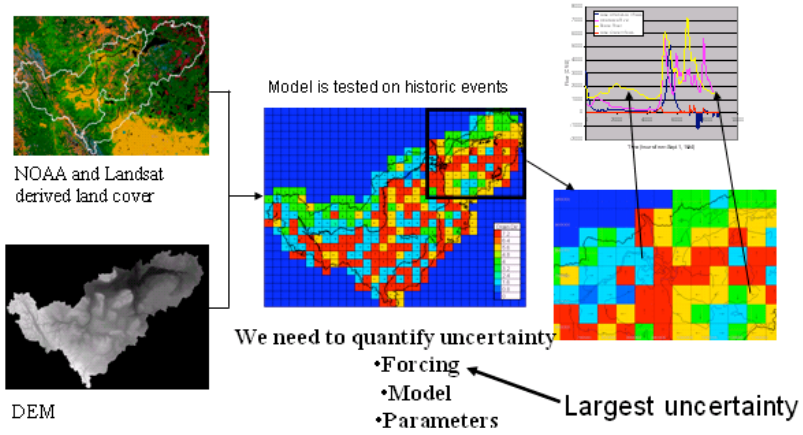
EGPM Limit
(83°N)



Science Team Interests

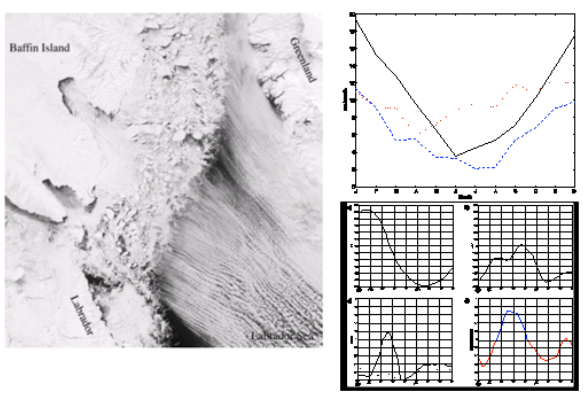


Cold Season Water Cycle



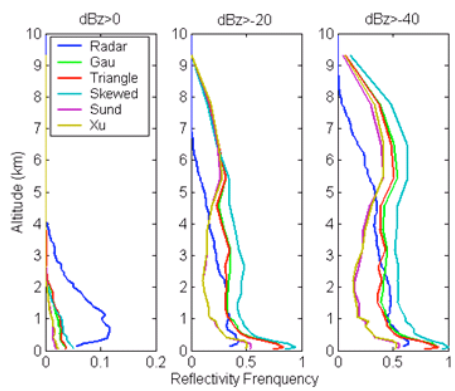
Al Pietroniro NWRI
Nick Kouwen U of Waterloo

Hydrological Modeling



Kent Moore U of Toronto

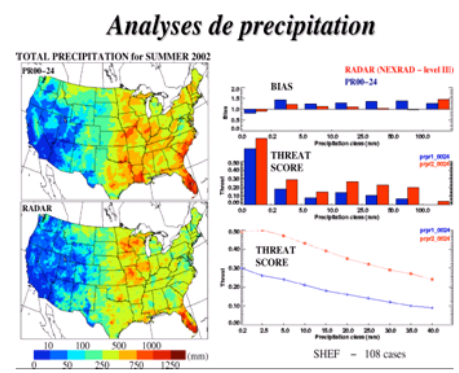
Ocean Circulation



Ulrike Lohmann Dalhousie University/MOC2

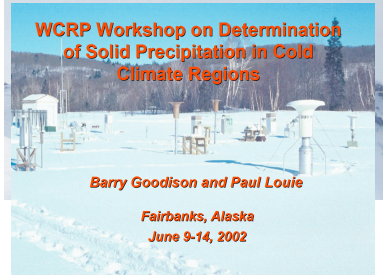
GCM Parameterization

- Accurate QPF still a challenge
- Latent heat release important for system intensification – hurricanes, MCC, explosive cyclogenesis
- Observations in rainy/cloudy areas not assimilated
- Interested in global data sets to improve various aspects of the global water cycle



Luc Fillion, Jean-Francois Mahfouf, Paul Vaillancourt, Andre Tremblay MSC

NWP & Data Assimilation



WCRP Perspective

Recommendations

- provide enthusiastic support to GPM by developing regional baseline data streams for algorithm development;
- develop a strategy for exploiting new technologies in the development of algorithms and models for third and fourth generation precipitation climatologies;
- use daily precipitation as a building block for precipitation climatologies

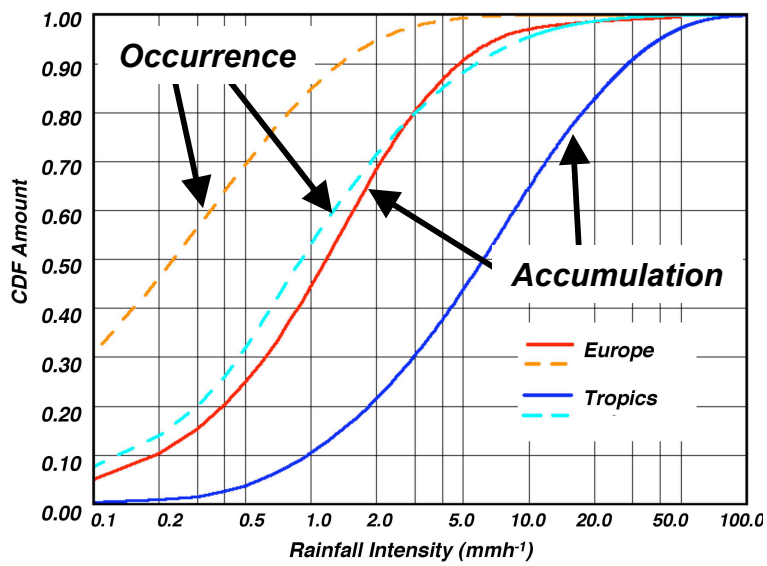
GAPS & Common Issues

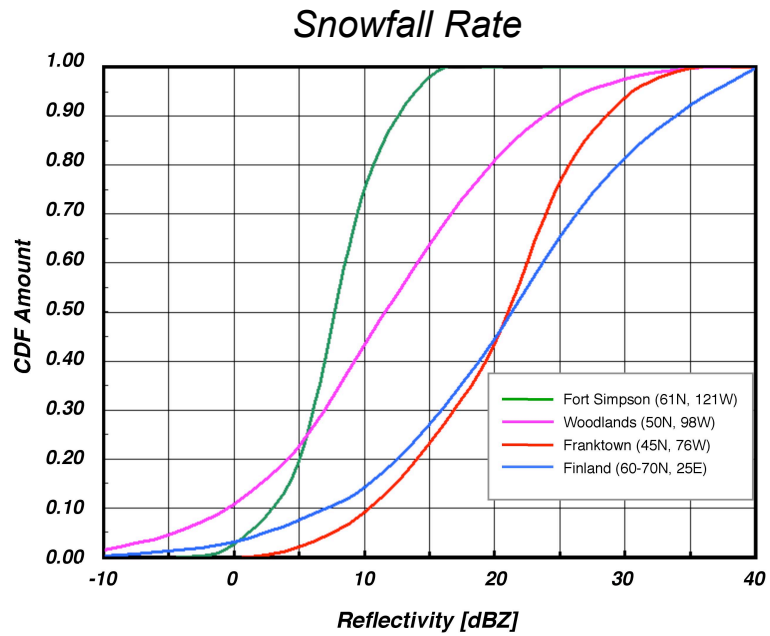
- precipitation measurement in mountainous regions;
- measurement of low intensity solid precipitation events;
- measurement /estimation of precipitation in Antarctica;
- solid precipitation over sea ice and ice covered Arctic Ocean;

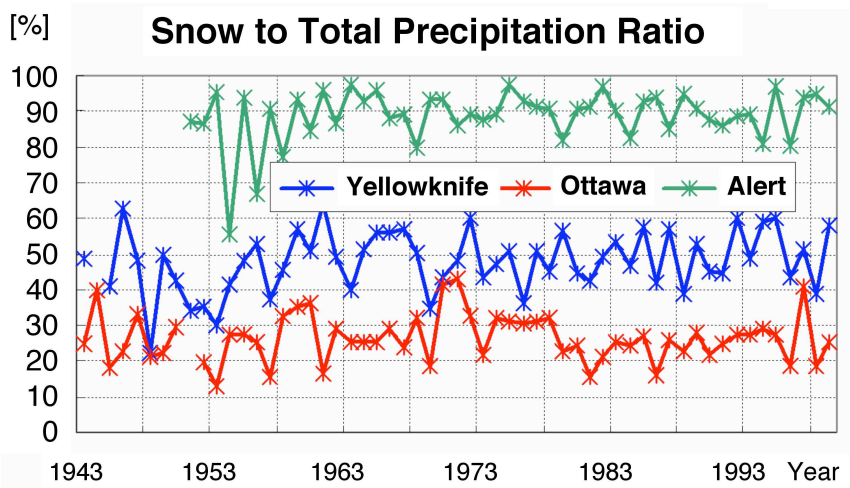
Barry Goodsion MSC

Need to merge snowfall measurement technologies to get the whole story!
IPWG
WMO Radar QPE Algorithm Intercomparison Workshops (TBD)

Precipitation Intensities and Snow Ratio





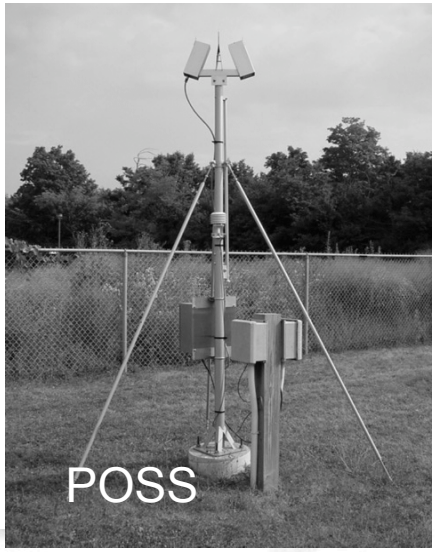


At higher latitudes:

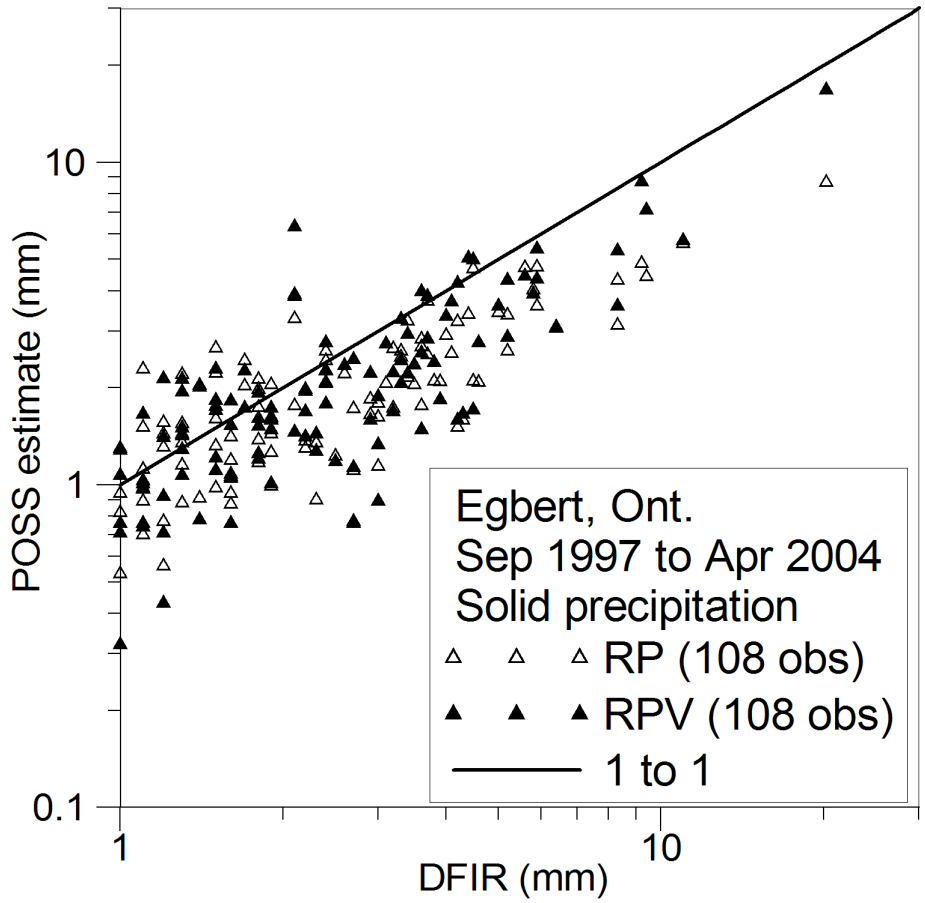
- **larger fraction of precipitation is 'light'**
- **percentage of solid precipitation high**

POSS – DFIR

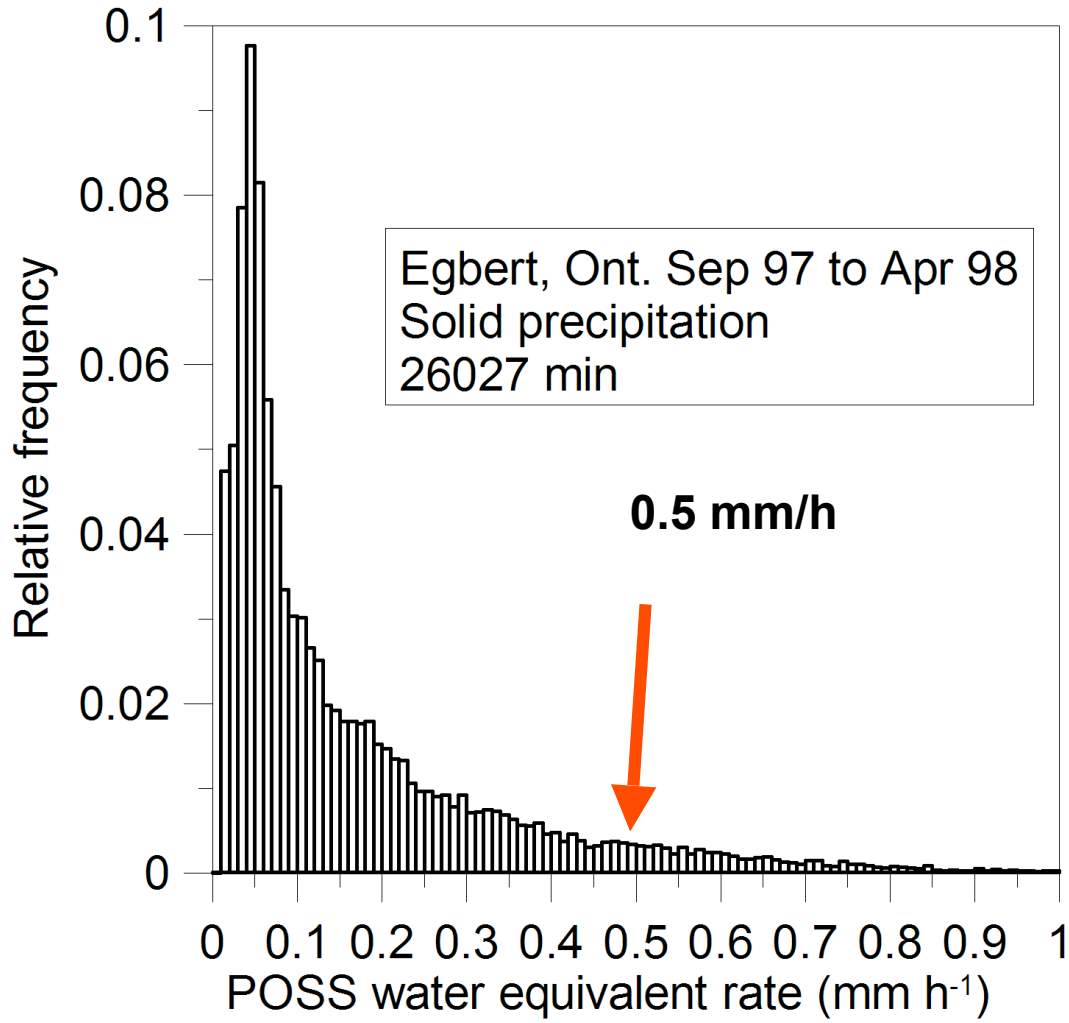
1 minute snowfall rate measurements



X Band
CW
Bistatic
Radar

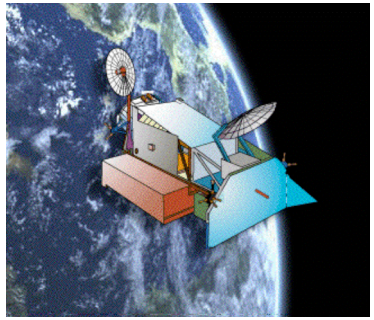


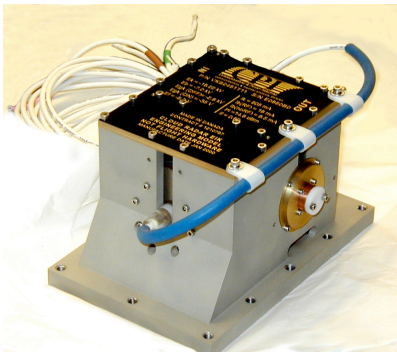
Snowfall Rate Distributions



Support for EGPM Radar

- High sensitivity (5 dBZ or less)
- High vertical resolution required (~200 m)
- Use Cloudsat heritage for pulsed high sensitive radar





Canadian Cloudsat/CALIPSO Validation Project

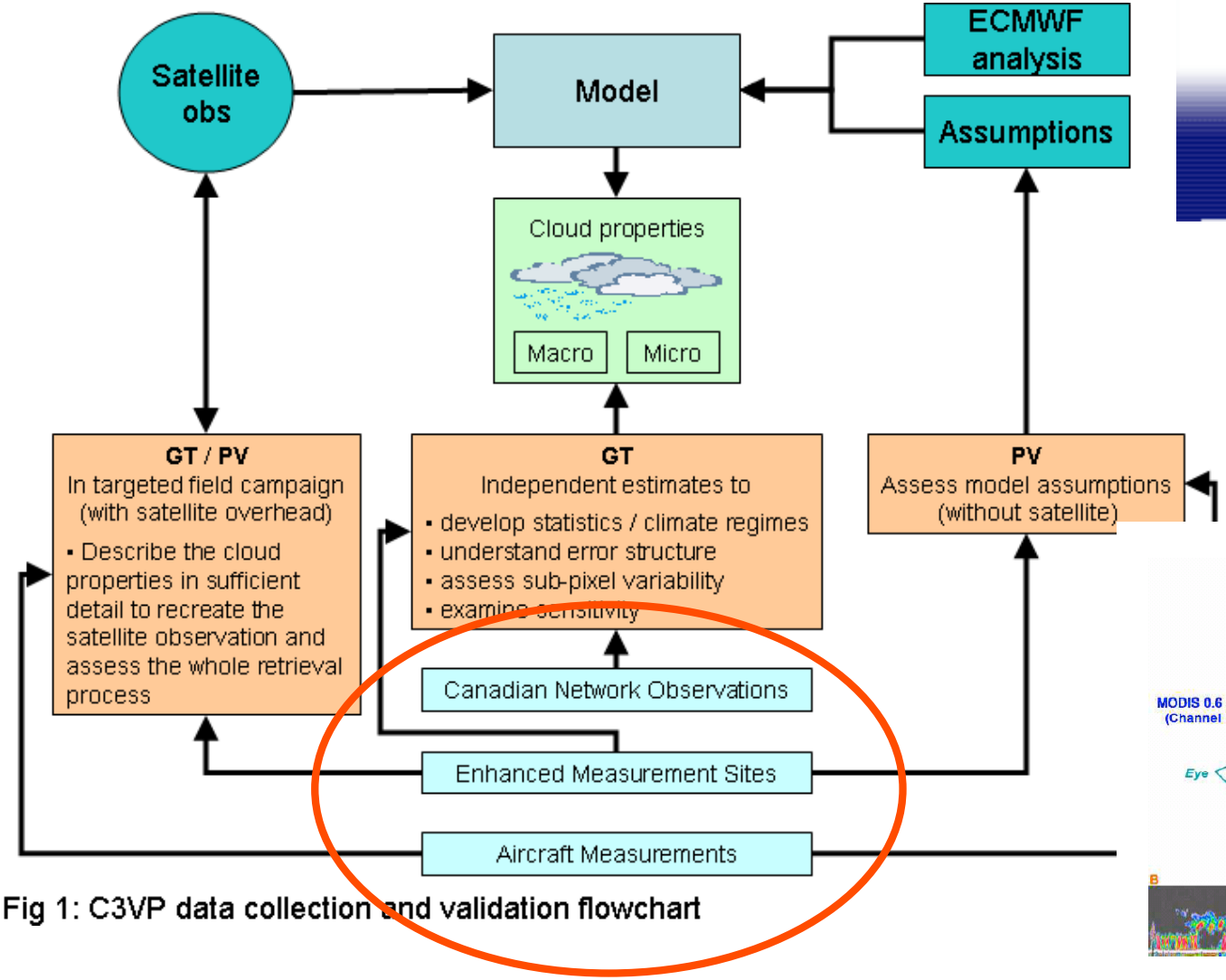
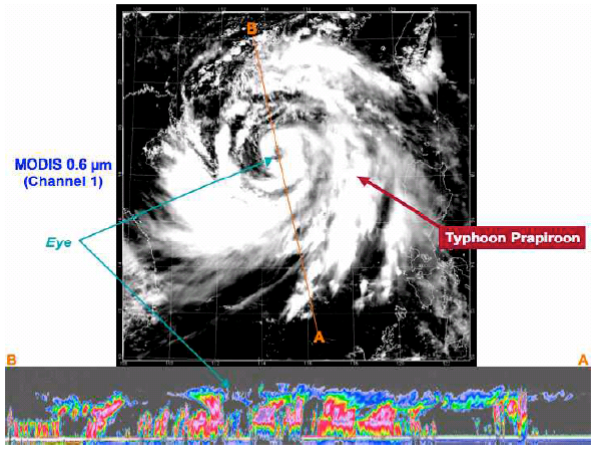


Fig 1: C3VP data collection and validation flowchart

Cloud and *Precipitation* Retrieval !

Typhoon Prapiroon - Aug 2, 2006



C3VP Ground Instruments

C3VP@CARE ground start date: 2006-Oct-04

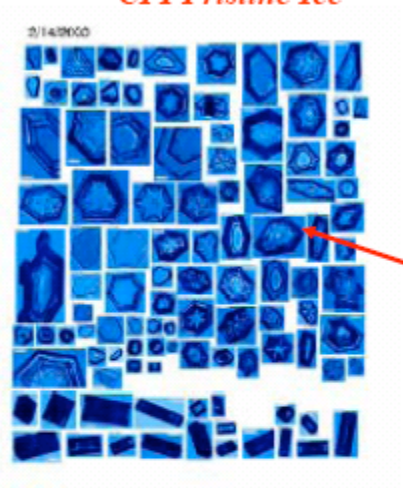
Affliation	Sensor / system	Measurement	2006 OCT pre-IOP	2006 NOV - DEC IOP 1 & 2
NASA/JPL	W-band Polarimetric radar	Cloud phase, particle type, precip rate		Oct-23 arrival
UMass	Adv Multi-Freq Radar (W, Ka, Ku-band)	Cloud phase, particle type, precip rate		
EC	Ceilometer	Geometric cloud profile	OK	
McGill	X-band VertiX Doppler radar	Cloud detection, particle type	OK	
McGill	Video Disdrometer	Precip fall velocity and shape, DSD	OK	
CSU	2D video disdrometer	Precip fall velocity and shape, DSD		
NASA/GSFC	Parsivel optical disdrometer	Precip rate, precip type, DSD		mid-Nov arrival
EC	POSS	Precip rate, precip type, DSD	OK	
EC	HotPlate	Precip rate	OK	
EC	Geonor precipitation gauge	Precip rate	OK	
EC	Visibility meter	Visibility, present weather indicator	OK	
EC	10m met tower	P, T, RH, wind	OK	
EC	TP/WVP-3000 profiling radiometer	LWP	OK	
NASA/GRC	89 & 150 GHz profiling radiometer	LWP w/ sensitivity to ice particles	early-Oct arrival	
EC	915MHz wind profiler w/ RASS	Wind profile, turbulence, temp profile	OK	
EC	Vaisala radiosonde system	P, T, RH, wind profiles	OK	
EC	Broadband radiometers	Pyranometer & pyrgeometer	OK	
PennState	Dual-radiometer package	Cloud optical depth		late-Oct arrival
McGill	Ground particle photography	Particle imaging & sample collection		arrival

C3VP Airborne Instrument

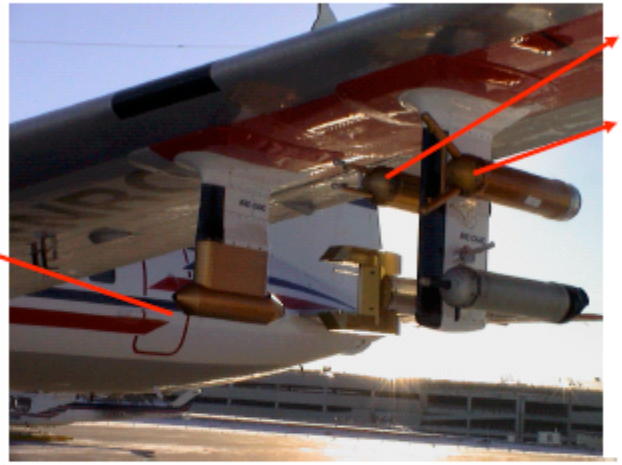
CONVAIR-580 CLOUD MICROPHYSICS (page 3)

CPI data courtesy of A. Korolev

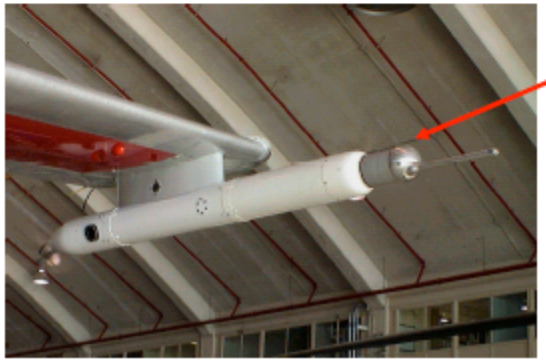
CPI Pristine Ice



Under-wing particle probes



Standard PMS 2D Imagery



Wing-tip Canisters

- DRI cloudscope/Tprobe combo
- ProSensing microwave radiometer
- possibly PCASP-100X

Plus Ka, X/W Band Radar, Lidar, Visible and IR Radiometers, TAMDAR, etc

Summary

- Snowfall a “motherhood” issue for Canada
- Excellent Canadian Science community support
  - Need to combine different technologies to get the whole snowfall story
- Need to measure snow and light precipitation
  - Research to measure snowfall at minute time scales
  - Continue to suport EGPM / Radar
  - Under GEO program
- Active C3VP snowfall algorithm and validation
  - Extend to GPM