Science and Nowcasting Olympic Weather for Vancouver 2010 (SNOW-V10)
A new World Weather Research Program Project

by

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World Weather Research Programme (WWRP) of WMO

- WWRP advances society's ability to cope with high impact weather through research focused on improving the accuracy, lead time and utilization of weather prediction.
- The Nowcasting Working Group of WWRP advances the science of nowcasting, including meteorological processes and predictability; to promote and aid the implementation, to develop and implement RDPs and FDPs to advance the underlying science as well as to develop, compare, validate and exchange various nowcasting techniques, and to involve the operational evaluation outcomes.

Past/Current/Future Nowcasting WWRP Projects

- Sydney 2000 FDP (Emphasis Nowcasting Summer Convection)
- Beijing 2008 FDP and RDP (Emphasis Nowcasting Summer Convection)
- Vancouver 2010 (SNOW-V10 FDP/RDP) (Emphasis Nowcasting Winter Weather in Complex Terrain)

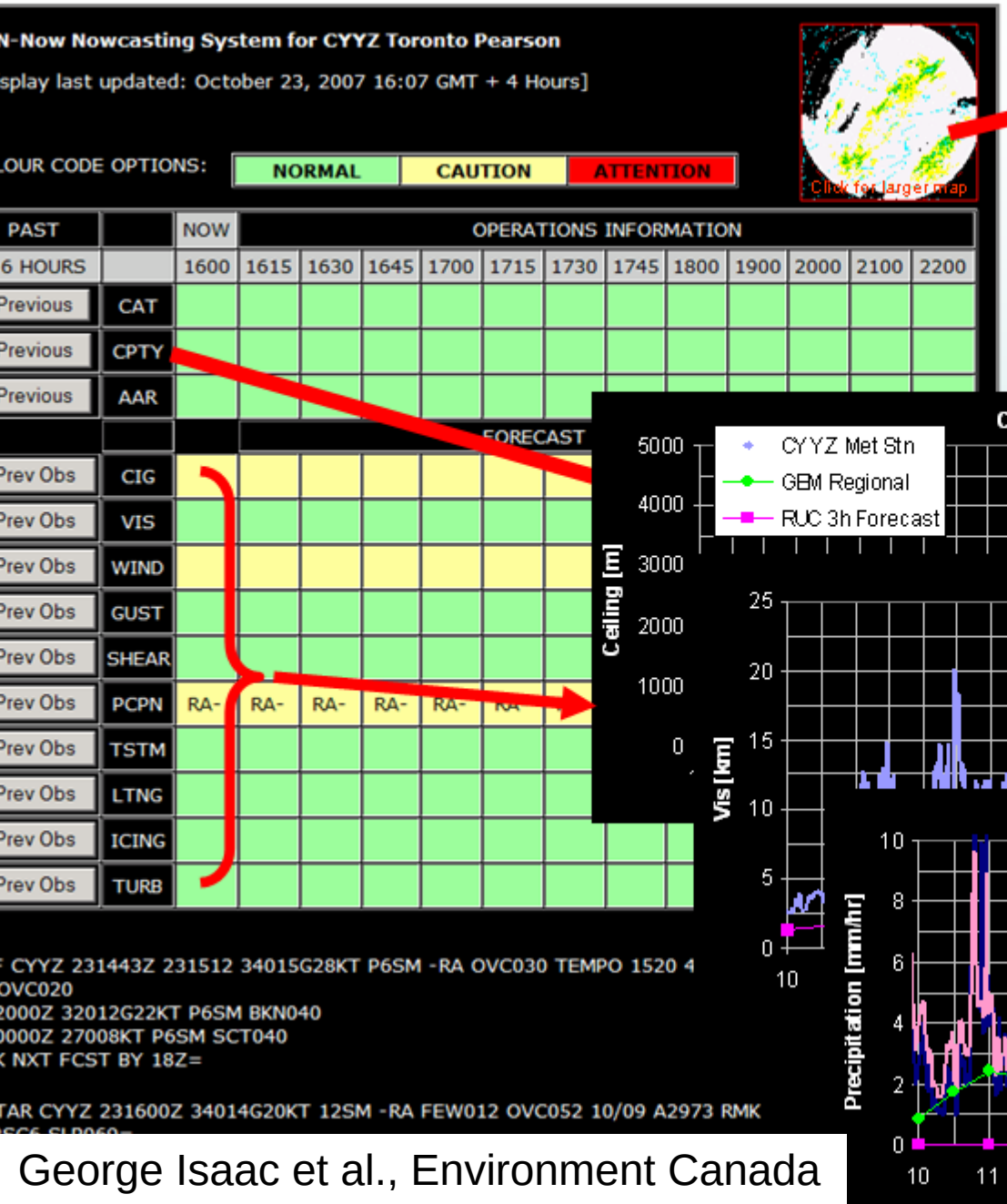
Main Goals of SNOW-V10 Related to Nowcasting in Complex Terrain (Developed at March 08 Workshop)

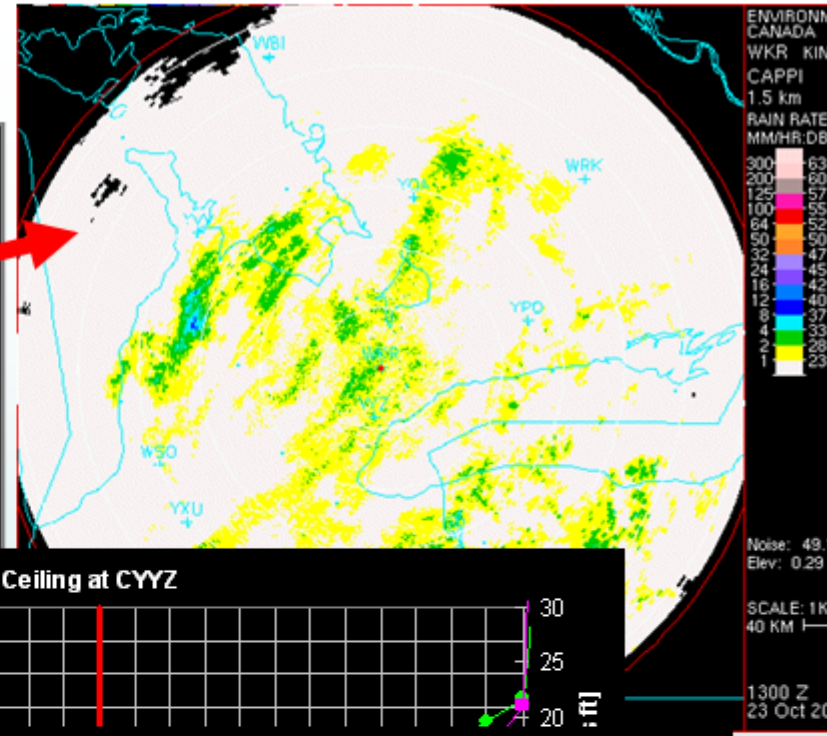
- **To improve our understanding and ability to forecast/nowcast low cloud, and visibility;**
- **To improve our understanding and ability to forecast precipitation amount and type;**
- **To improve forecasts of wind speed, gusts and direction;**
- **To develop better forecast system production system(s).**
- **Assess and evaluate value to end users;**
- **To increase the capacity of WMO member state**s (Training component).

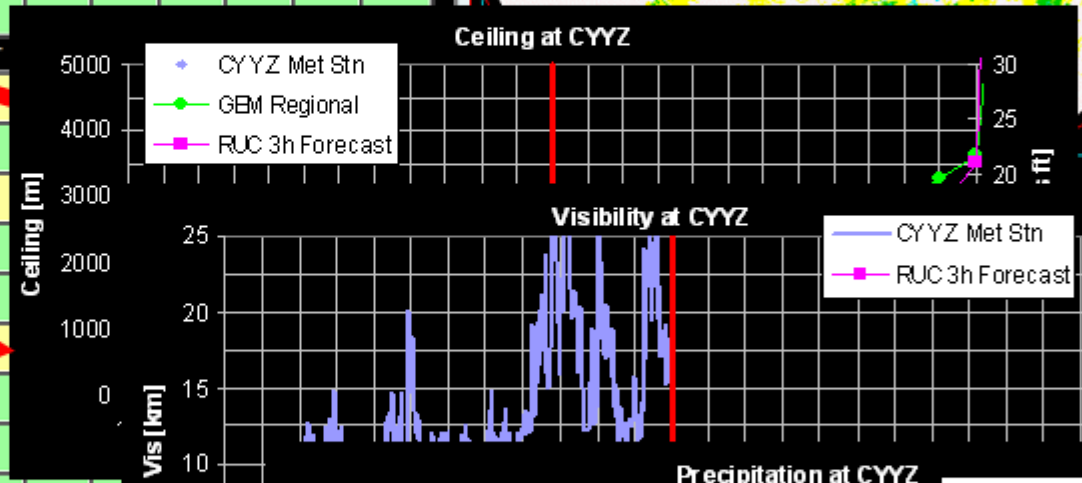
Roundhouse During High Winds, Precipitation

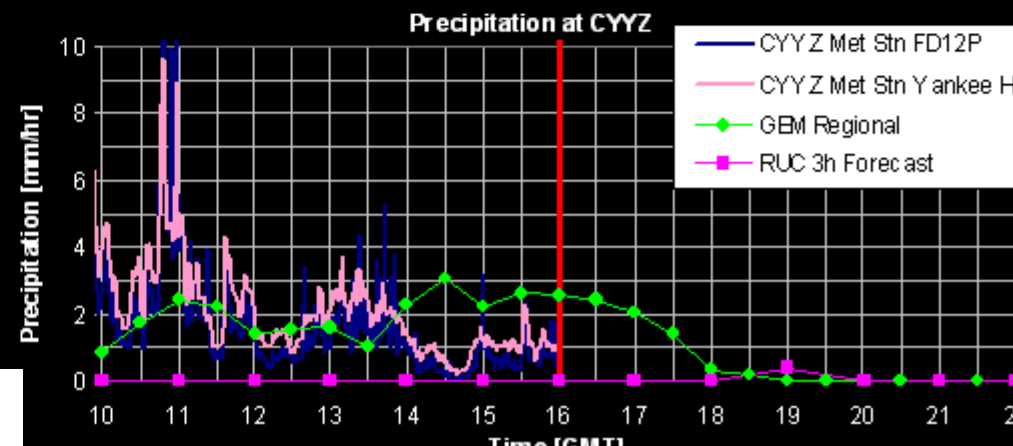
Whistler Peak

Prototype Display for CAN-Now



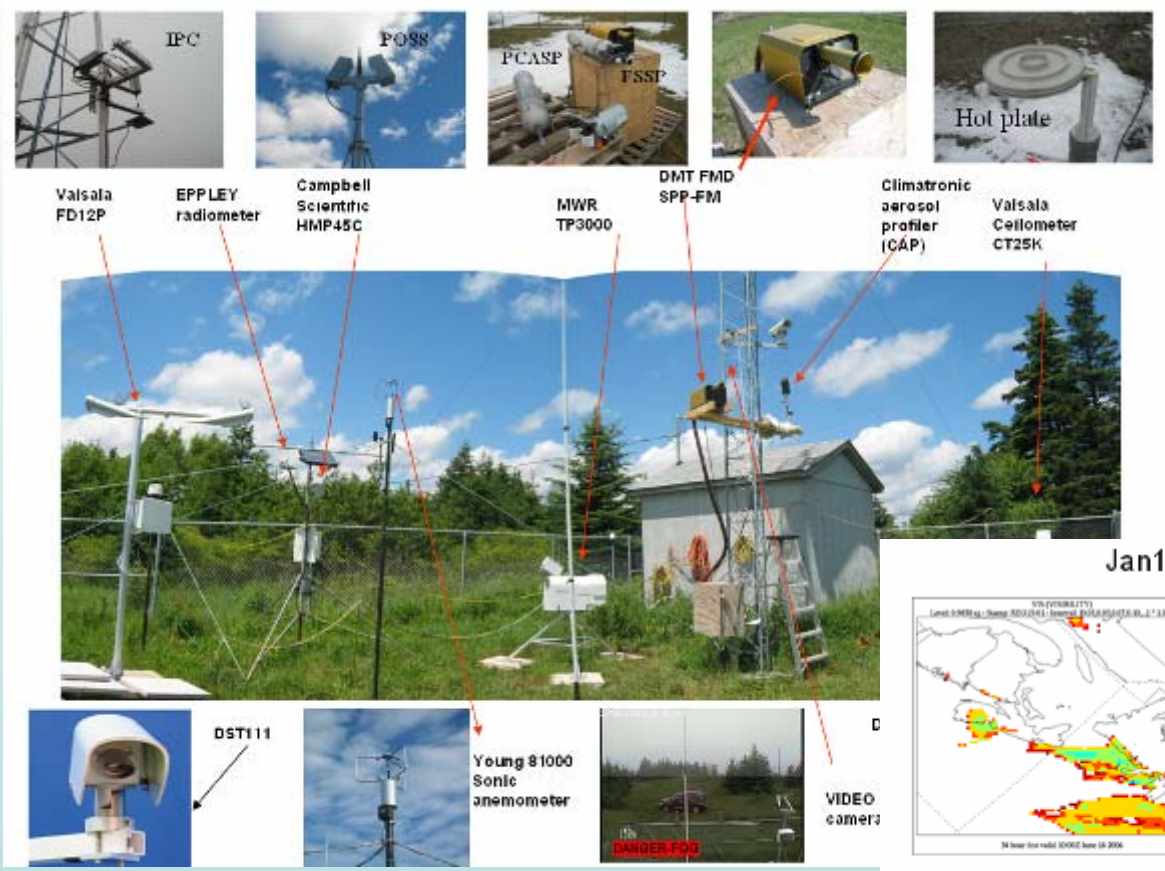


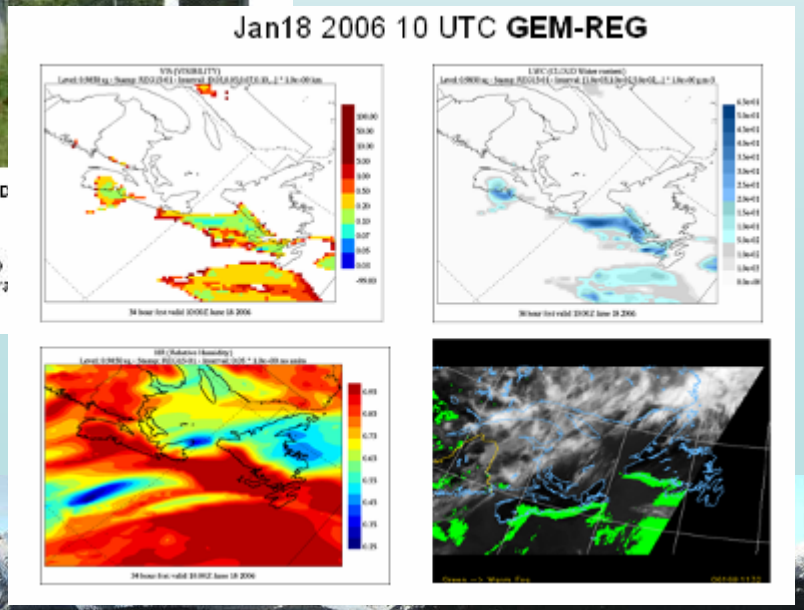


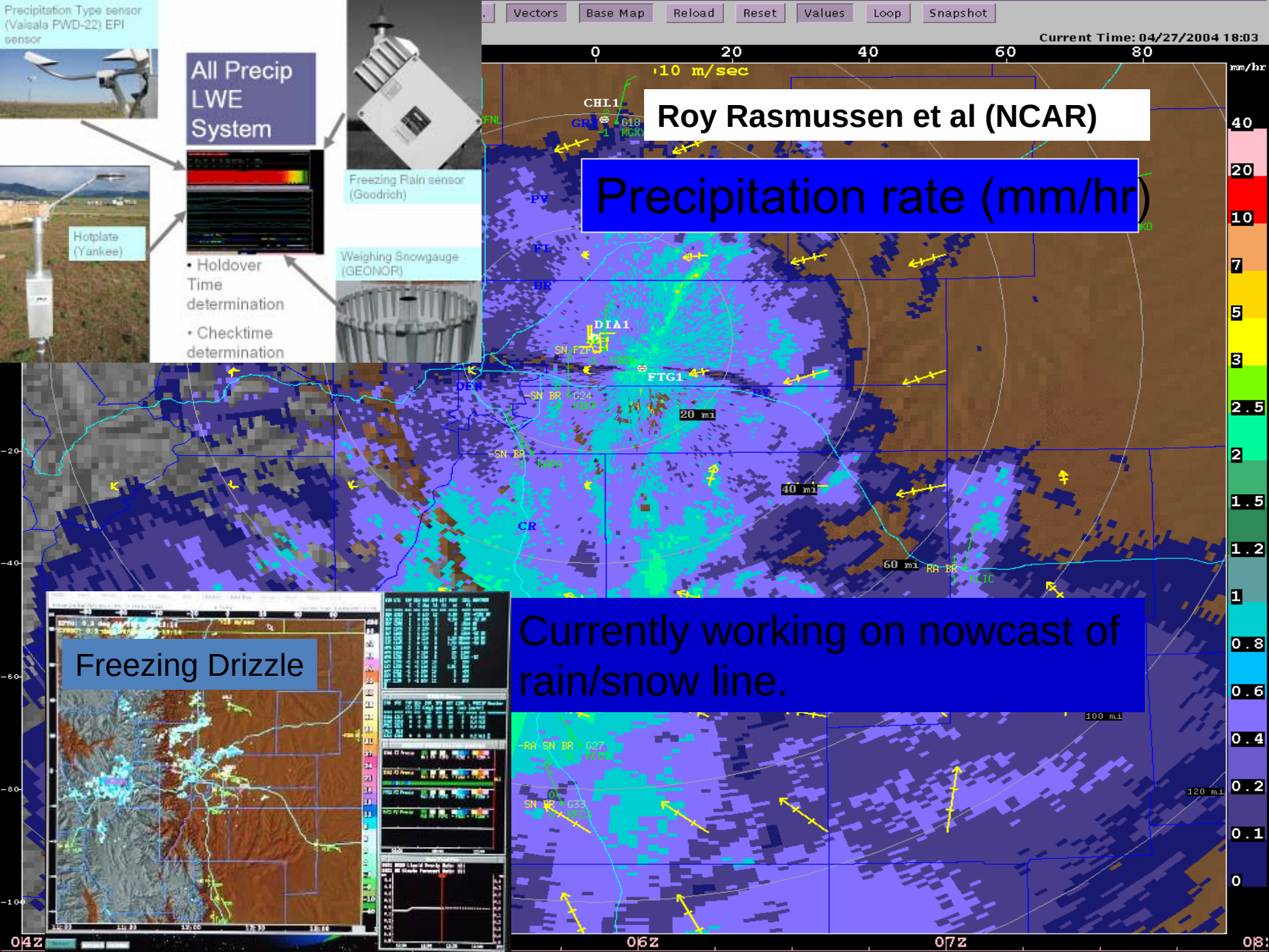


George Isaac et al., Environment Canada

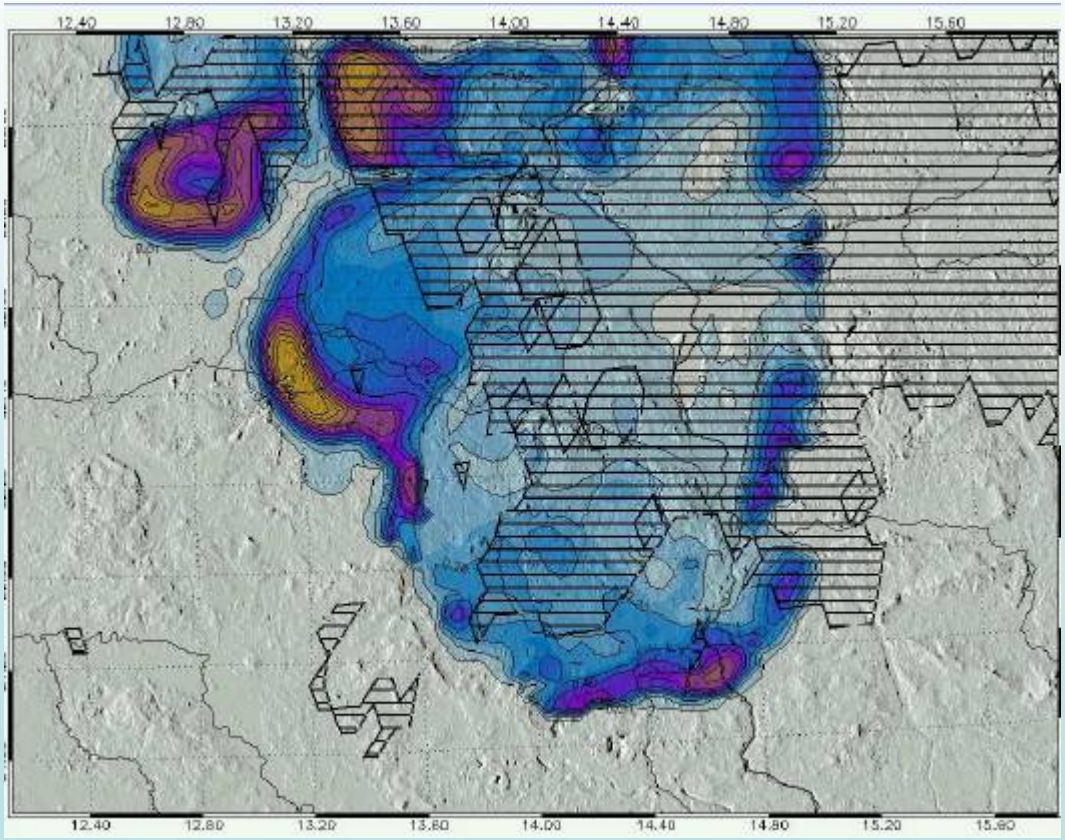
Fog Research Gultepe (EC)






Precipitation Type sensor (Vaisala PWD-22) EPI sensor
All Precip LWE System
Freezing Rain sensor (Goodrich)
Hotplate (Yankee)
Weighing Snowgauge (GEONOR)
• Holdover Time determination
• Checktime determination
Vectors
Base Map
Reload
Reset
Values
Loop
Snapshot
Current Time: 04/27/2004 18:03
10 m/sec
mm/hr
40
20
10
7
5
3
2.5
2
1.5
1.2
1
0.8
0.6
0.4
0.2
0.1
0
Roy Rasmussen et al (NCAR)
Precipitation rate (mm/hr)
Freezing Drizzle
Currently working on nowcast of rain/snow line.
04z
06z
07z

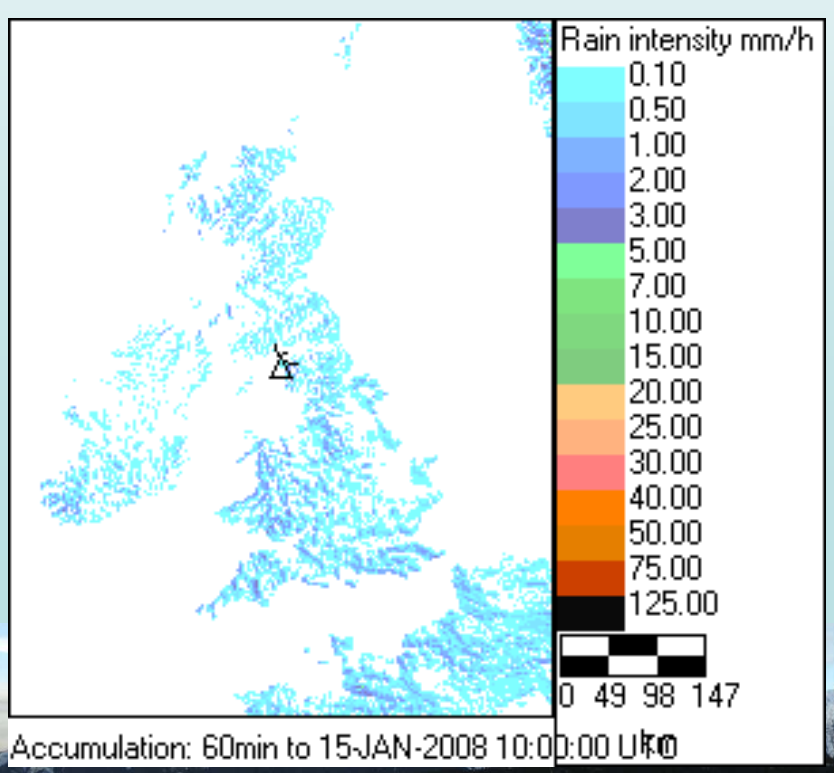
Andreas Bott (UBonn)
PA FOG – COST 722

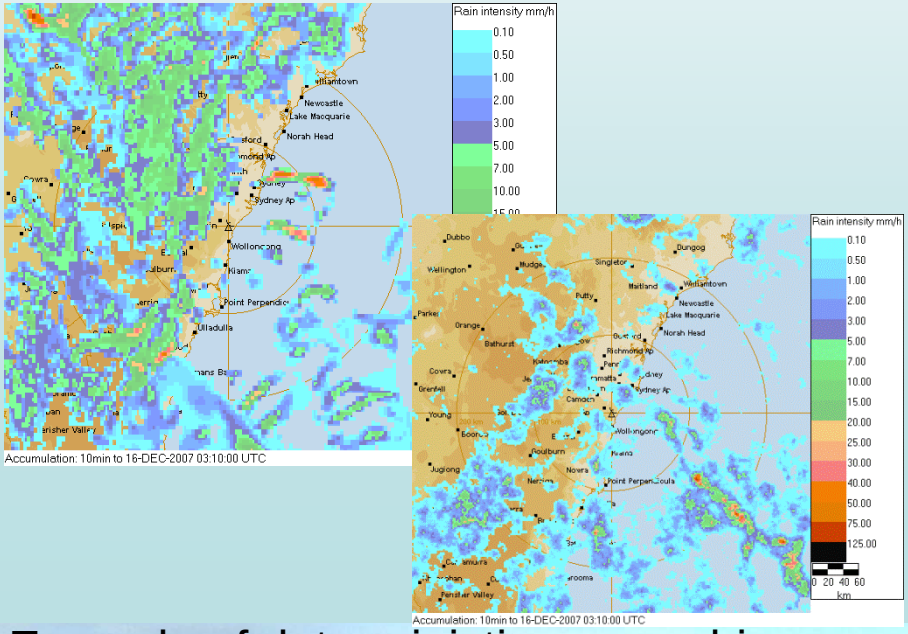


Orography and STEPS

Alan Seed et al.
Australia

- Met Office use model output and high-resolution DEM to calculate the orographic rainfall component
- This is a deterministic component in STEPS at the Met Office which is added back into the forecasts
- Need to condition the stochastic component of the forecast to take into account the likely increased probability of rain occurrence or rain intensity due to orographic effects





Example of deterministic orographic rainfall component from the Met Office

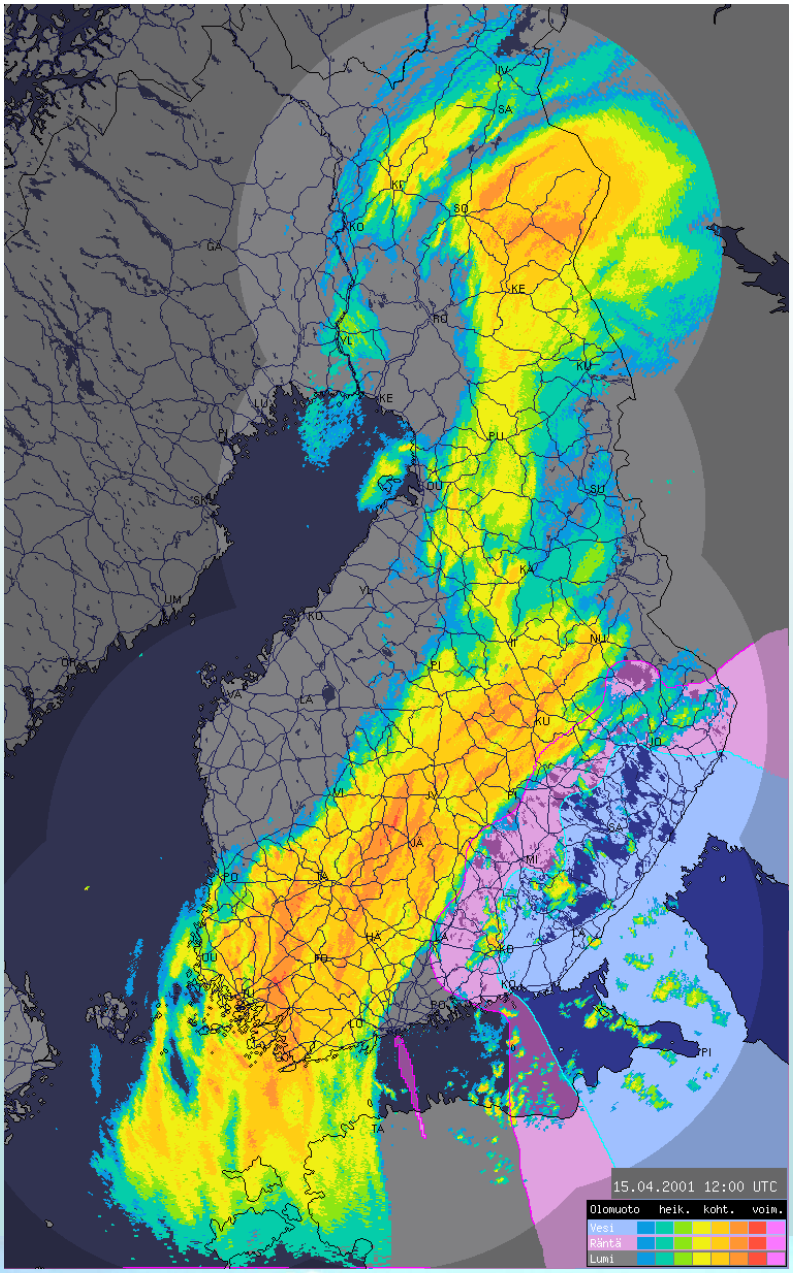
Koistinen (FMI)

Precipitation type analysis at ground

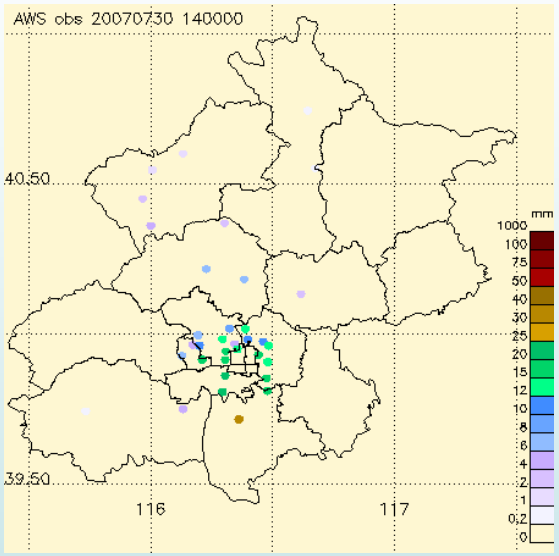
- Hydrometeor phase (rain, sleet, snow) based on Kriging-analysis of SYNOP data (T,RH). Resolution 5 min & 1 km (extrapolation).
- Time-space variable R(Z) & $S(Z_e)$ relations.

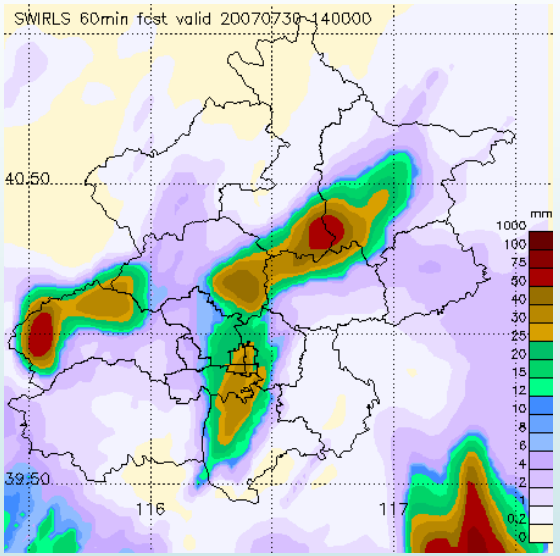
Operational since 1999:

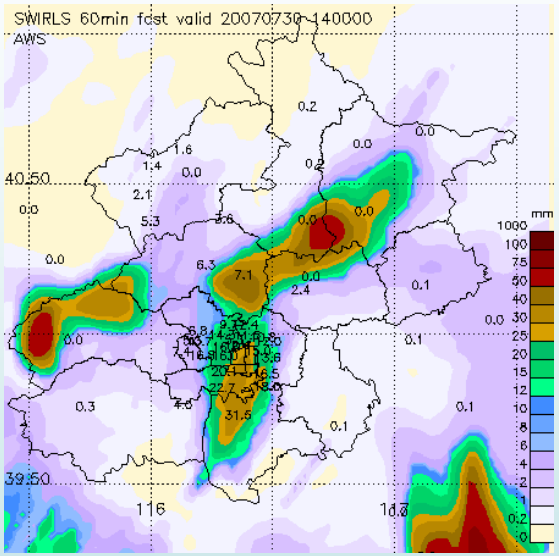
Grey background: snow
Blue background: rain
Pink background: mixed

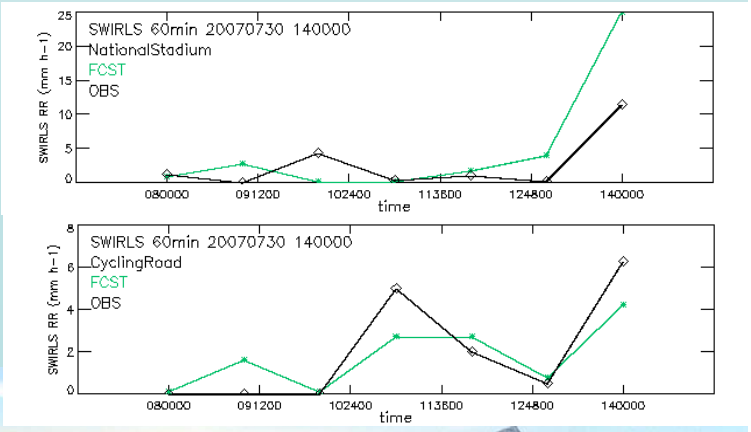


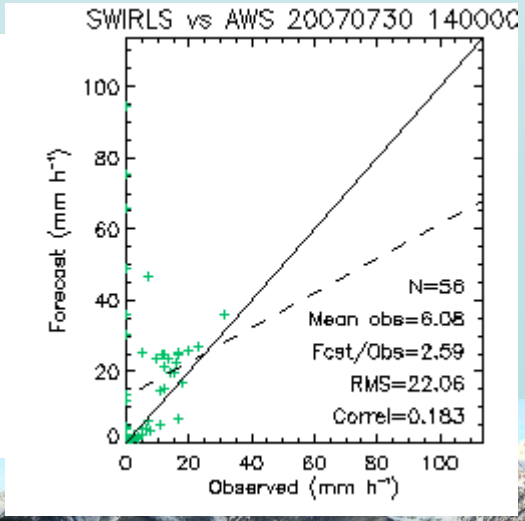
Sample ***graphical*** verification Beth Ebert (CAWCR)

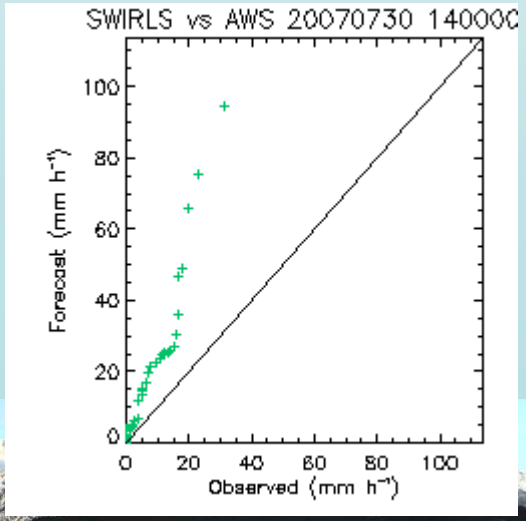












Post-Workshop Interest

- MAP D-Phase
  - High resolution 4D-VAR
- Donghai Wang (CMA)
  - Winter Nowcasting with Grapes
  - Microphysics
- Monika Pfeiffer
  - Winter nowcasting (Munich Airport)
  - NinJo
- Vaisala
  - Sponsor PDF (50-50)

End User Requirements

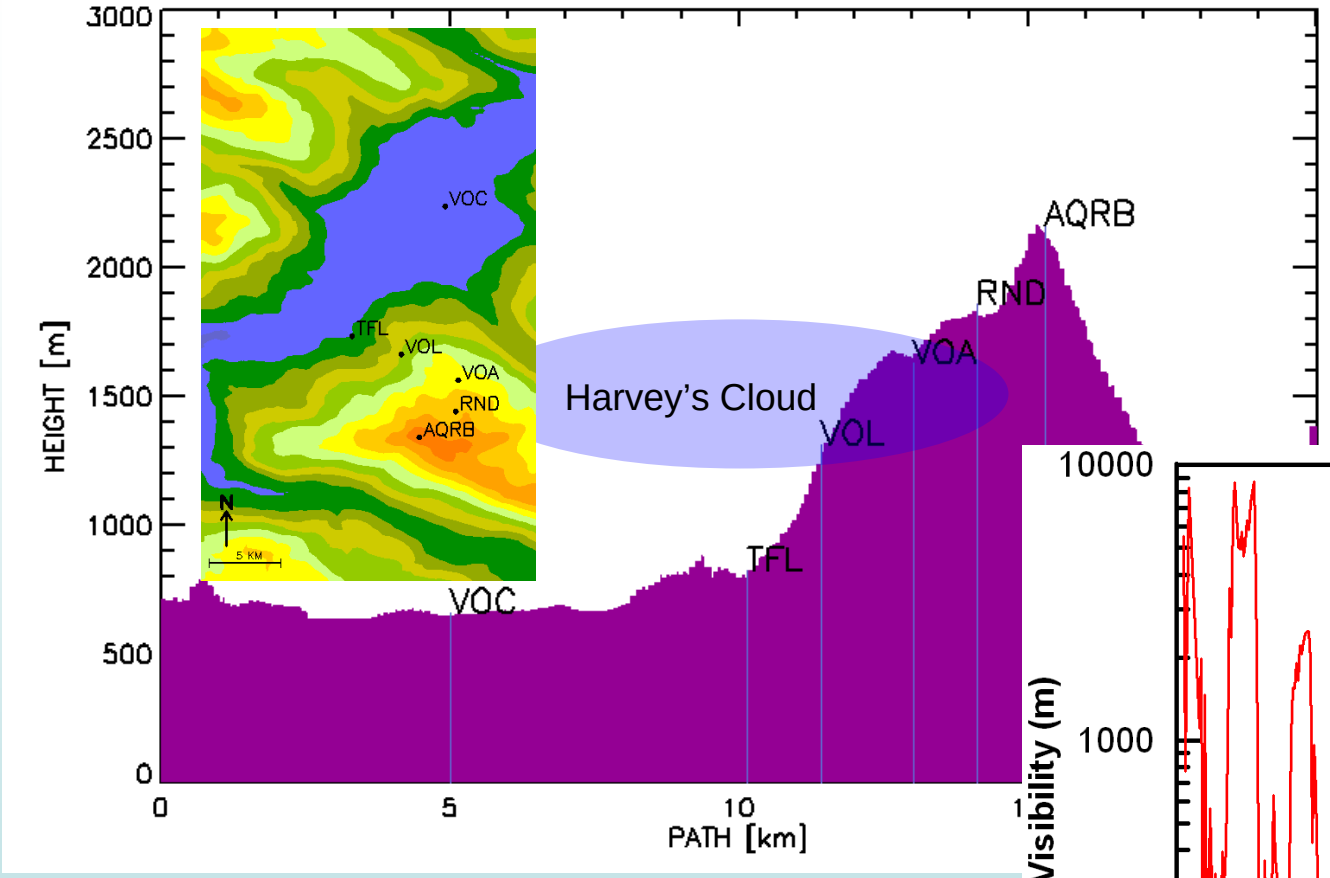
Threshold Matrix for Downhill, Slalom and Giant Slalom (from Chis Doyle)					
	New Snow (24 hours)	Wind	Visibility	Rain	Wind Chill
Critical Decision point	> 30 cm	Constant above 17 m/s or gusts > 17 m/s	< 20 m on the entire course>	15mm in 6 hours or less	> -20
Significant decision point	> 15 cm and < 30 cm	Constant 11 m/s to 17 m/s <	20 m on portions of the course	Mixed precipitation	
Factor to consider	> 5 cm > 2 cm within 6h of an event	Gusts above 14 m/s but < 17 m/s>	>20m but <50m on whole or part of the course		

SNOW V10 Venue Forecast:
Whistler Creekside Downhill/Slolam/Giant Slolam
Roundhouse/Mid Station/Valley

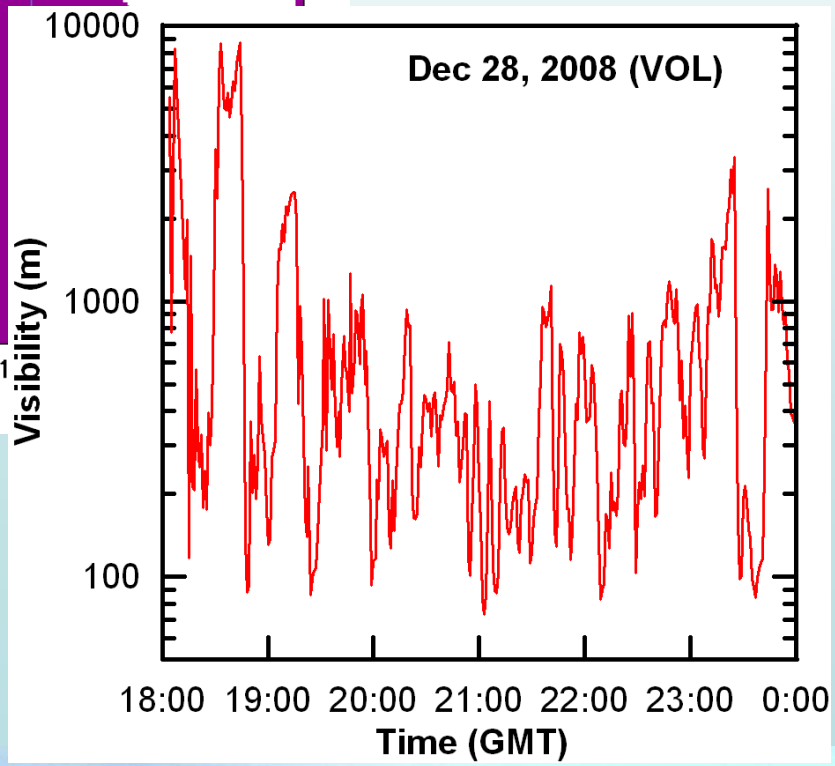
	METEOROLOGICAL CONDITIONS : VALID AT 2010-02-13 16:00 GMT																	
	PAST						NOW	NOWCAST										
	-6h	-5h	-4h	-3h	-2h	-1h		+15	+30	+45	+1h	+15	+30	+45	+2h	+3h	+4h	+5h	+6h
GMT TIME	10	11	12	13	14	15	16				17				18	19	20	21	22
WIND [m/s]	10	10	12												15	20	22	15	15
GUSTS [m/s]	0	0	5												10	15	15	10	10
VIS [m]	100+	100+	100+												100+	100+	100+	100+	100+
SNOW [cm]	0	0	0												0	0	0	0	0
RAIN [mm]	0	0	0												0	0	0	0	0
T [C]	-18	-18	-16												-16	-16	-16	-16	-16
WIND CHILL [C]	-20	-20	-20												-20	-25	-25	-20	-20

Click on box would give reason for alert and indication of confidence (from forecaster or verification scores) in forecast. All boxes would likely contain a range of values or most likely value.

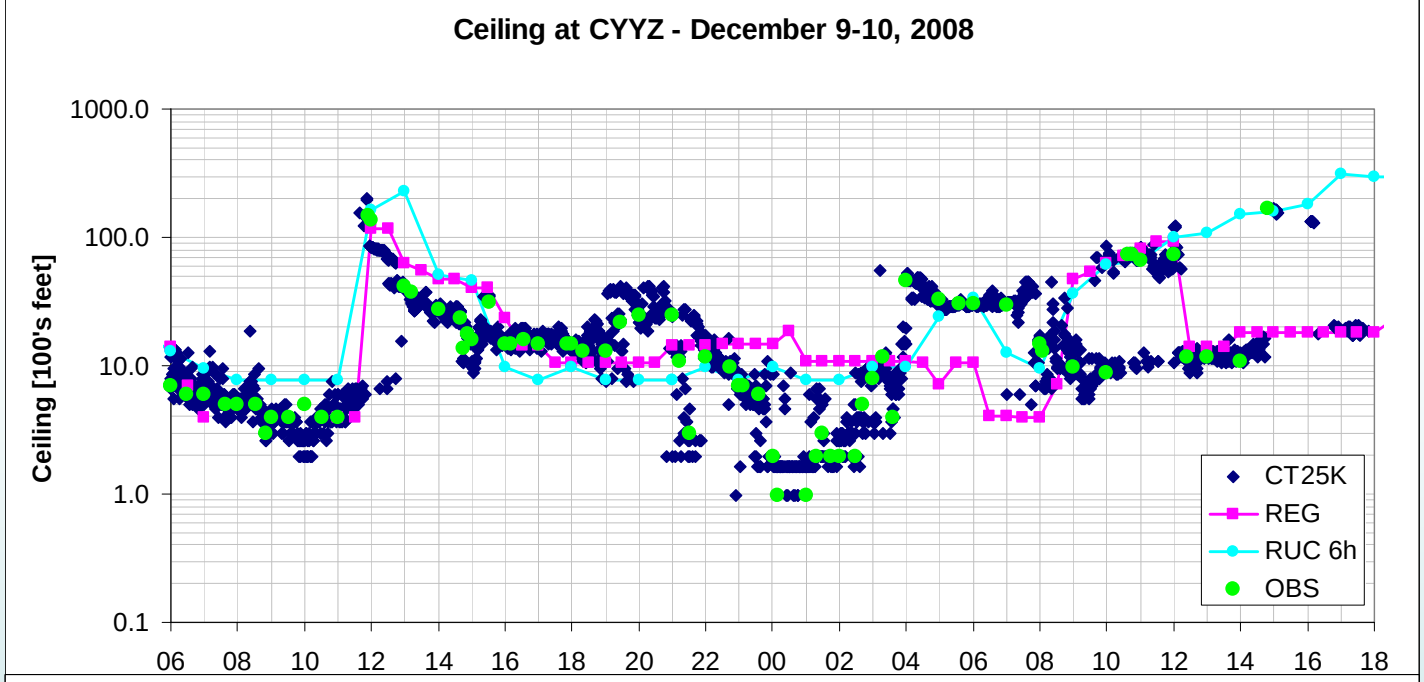
Prototype Product for Venue Managers Under Discussion

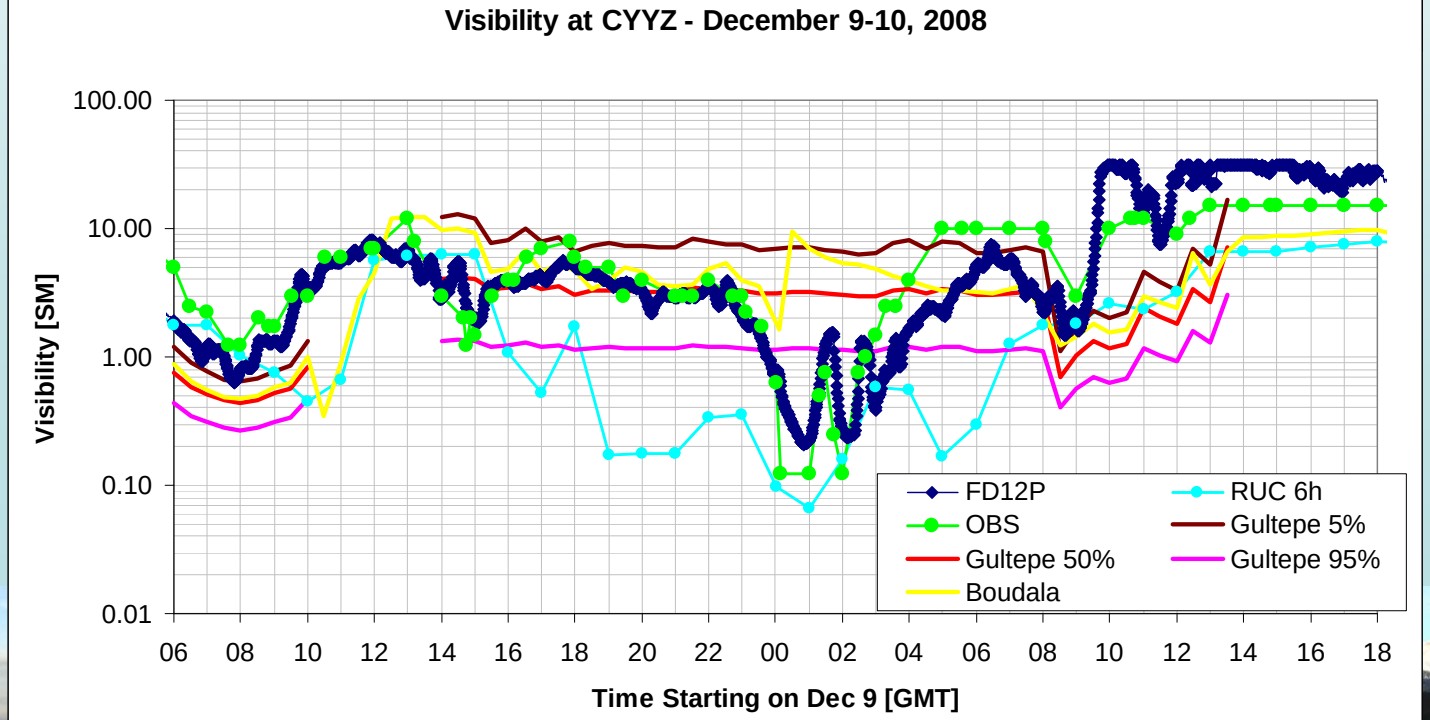


Need for Measurements at High Time Resolution



Rapidly Varying Visibility (on scale of min) at Mid Station in Falling Snow





Models are not always right and forecaster needs Nowcasting tools to assist him/her during those occasions.

Verification of CAN-Now Forecasts (Bailey et al., 2008)

Mean Absolute Errors for Temperature (Winter) °C						
Forecast lead time: hours	1 hour	2 hours	3 hours	4 hours	5 hours	6 hours
raw model (GEM 15km)	2.33	2.33	2.33	2.33	2.33	2.33
error persistence	0.70	1.71	1.51	1.85	2.11	2.31
error trend	0.82	1.57	2.35	3.17	4.00	4.81
least squares error	0.65	1.08	1.41	1.66	1.84	1.97
observation persistence	0.48	0.81	1.12	1.41	1.67	1.90

Observation persistence gives the best forecast for temperature at all times.
2nd best forecast in blue

Mean Absolute Errors for Relative Humidity (Winter)						
Forecast lead time: hours	1 hour	2 hours	3 hours	4 hours	5 ours	6 ours
raw model (GEM 15km)	11.88	11.88	11.88	11.88	11.88	11.88
error persistence	3.24	4.80	5.94	6.85	7.50	7.94
error trend	4.45	8.06	11.61	15.23	18.74	21.99
least squares error	3.19	4.71	5.75	6.55	7.07	7.43
observation persistence	2.60	3.99	5.21	6.70	7.14	7.85

Observation persistence is best to 3 hours, least squares error best to 6 hours

Governance

- SNOW V10 Chair
  - George Isaac
- Science Steering Committee
  - A representative from each system
  - WWRP representative
  - Sub-committee chairs
  - Vaisala
  - University rep
- EC Committee
  - V10 Science Steering Committee
  - Cober **, Brunet, Wallace, Charron, Jean, Joe, Isaac, Snyder, Doyle, Mailhot, Watson

Sub-Committees

Responsible for delivering science objectives

- Visibility – Mathias Mueller/Ismail Gultepe
- Precipitation – Jarmo Koistinen/Roy Rasmussen
- Wind – Jocelyn Mailhot
- Nowcasting Systems – George Isaac/Roy R/Martin Charron
- Evaluation and Value – Barb Brown/Chris Doyle
- Training/Capacity Building – Paul Joe/Brad Snyder
- Logistics/Infrastructure - Doyle
- Observing Systems – Paul Joe/Bill Scott/Frederick
- Modeling Systems – Martin Charron/Andreas Bott
- DQ WG etc – as needed

Summary

- The Vancouver 2010 Olympic and Paralympic Winter Games provides a unique opportunity for international collaboration on the science of winter nowcasting in complex terrain.
- A team of scientists has agreed to participate in the project and the WWRP has endorsed SNOW-V10 as a project. It will be a blended FDP and RDP project.
- A science plan has been drafted.
- Prototype products will be produced during winter of 2009 and further refined for 2010.