Environment Canada Environnement Canada

Canadă

Canadian Activities

David Hudak, and Paul Joe

Cloud Physics and Severe Weather Research Section

PMM Science Team Meeting, November 7-10, 2011, Denver, CO

Environment Canada Environnement Canada

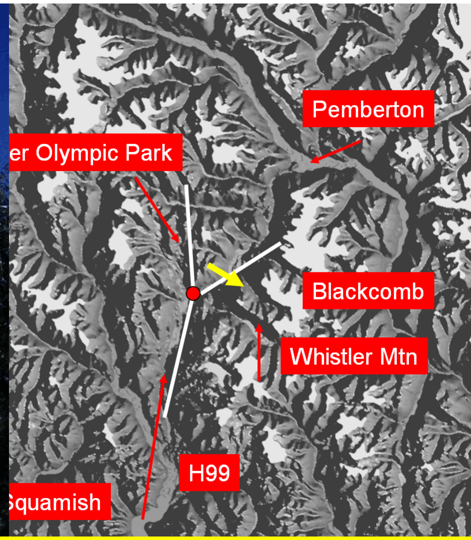
Canada

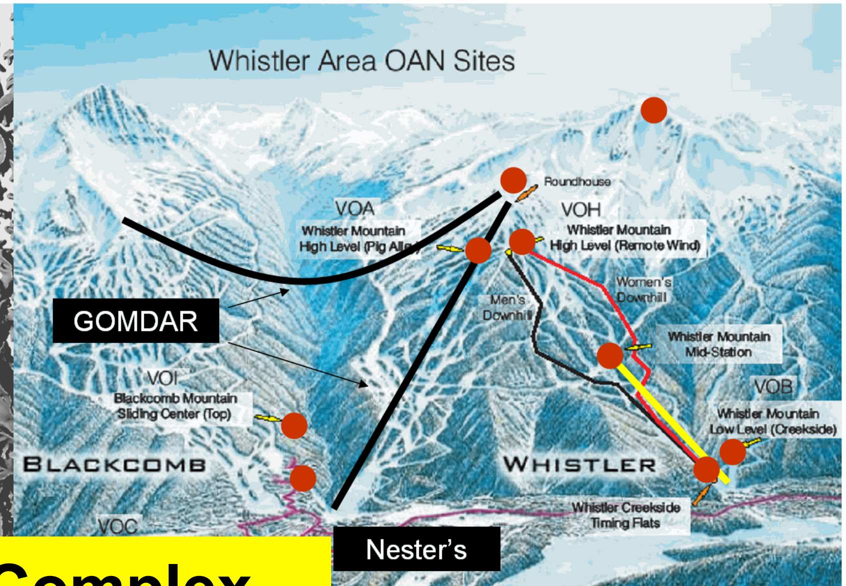
Science and Nowcasting Olympic Weather for Vancouver 2010 (SNOW-V10)

A World Weather Research Program Project

Paul Joe and George Isaac

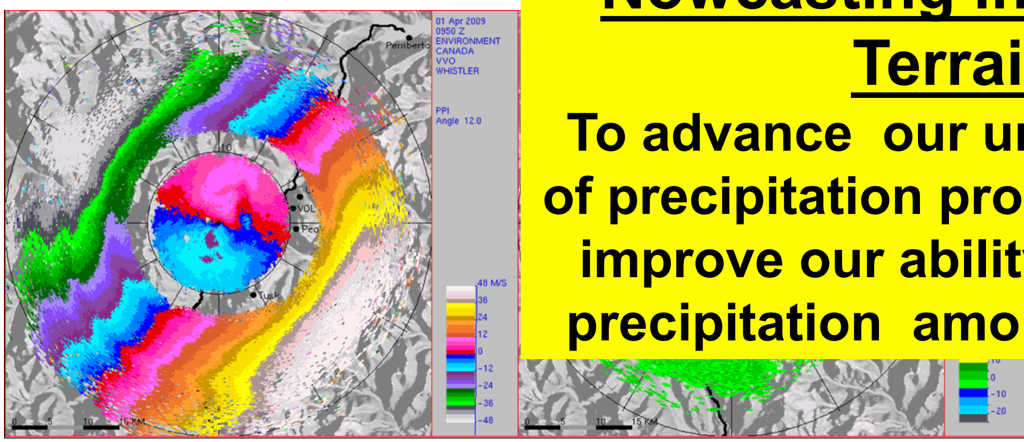
PMM Science Team Meeting, November 7-10, 2011, Denver, CO



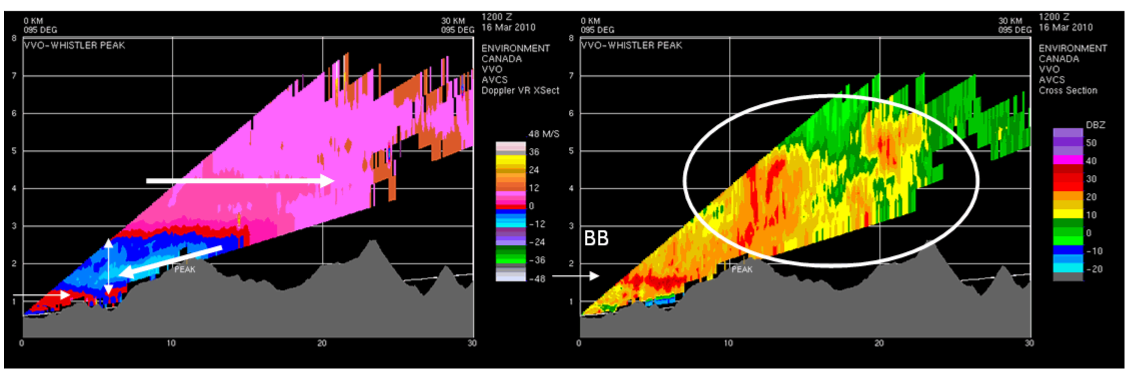


Nowcasting in Complex Terrain

To advance our understanding of precipitation processes and to improve our ability to forecast precipitation amount and type



...evalent feature and often ...ultiple layers as there is a ...ponent to the weather ...tain crest) and a local ... the weather.



Air flows can obviously be very complicated in complex terrain. There is flow separation between the orographic winds and the synoptic winds, as well as, terrain induced flows

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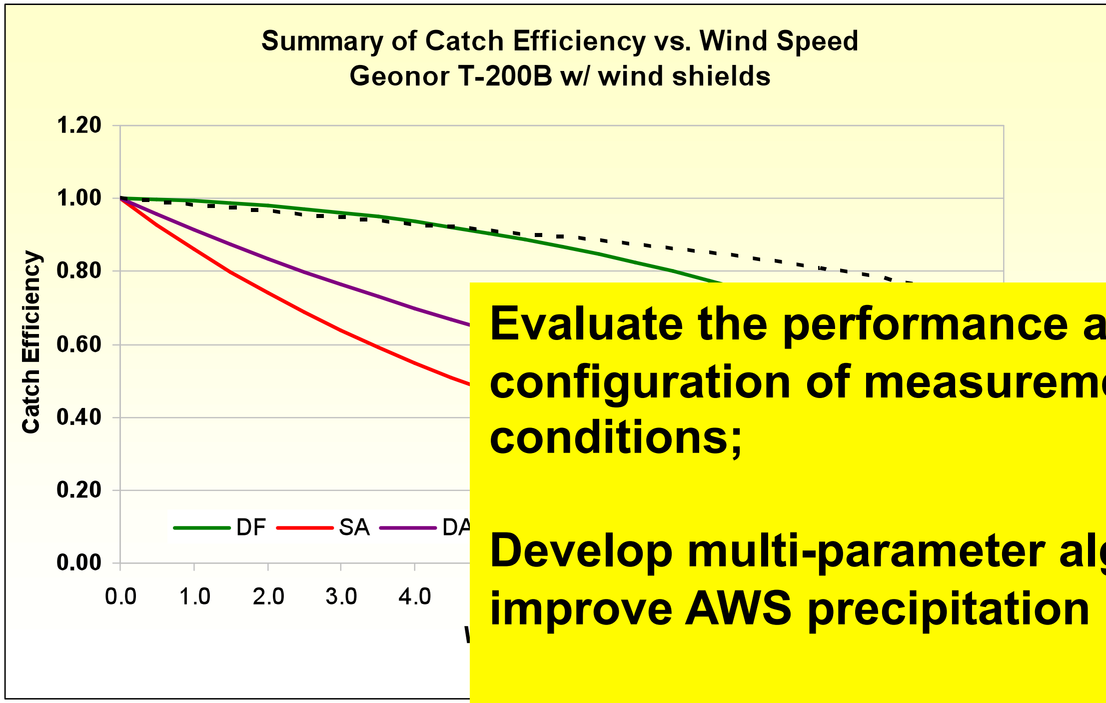
Solid Precipitation Inter-Comparison Experiment (SPICE)

A WMO Commission for Instruments and Methods of Observation (CIMO) Priority

Rodica Nitu and Paul Joe

PMM Science Team Meeting, November 7-10, 2011, Denver, CO

An instrument intercomparison for solid precipitation measurements at AWS

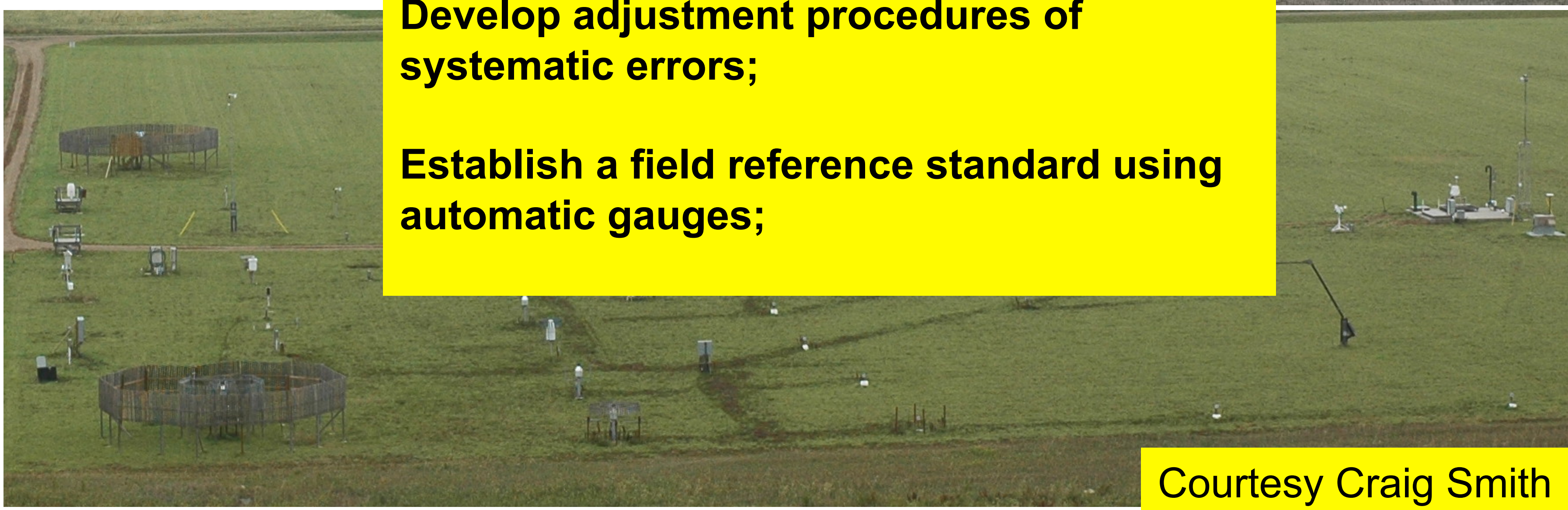


Evaluate the performance and configuration of measurements in field conditions;

Develop multi-parameter algorithms to improve AWS precipitation data ;

Develop adjustment procedures of systematic errors;

Establish a field reference standard using automatic gauges;



Courtesy Craig Smith

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The GPM Cold Season Precipitation Experiment

NASA PIs

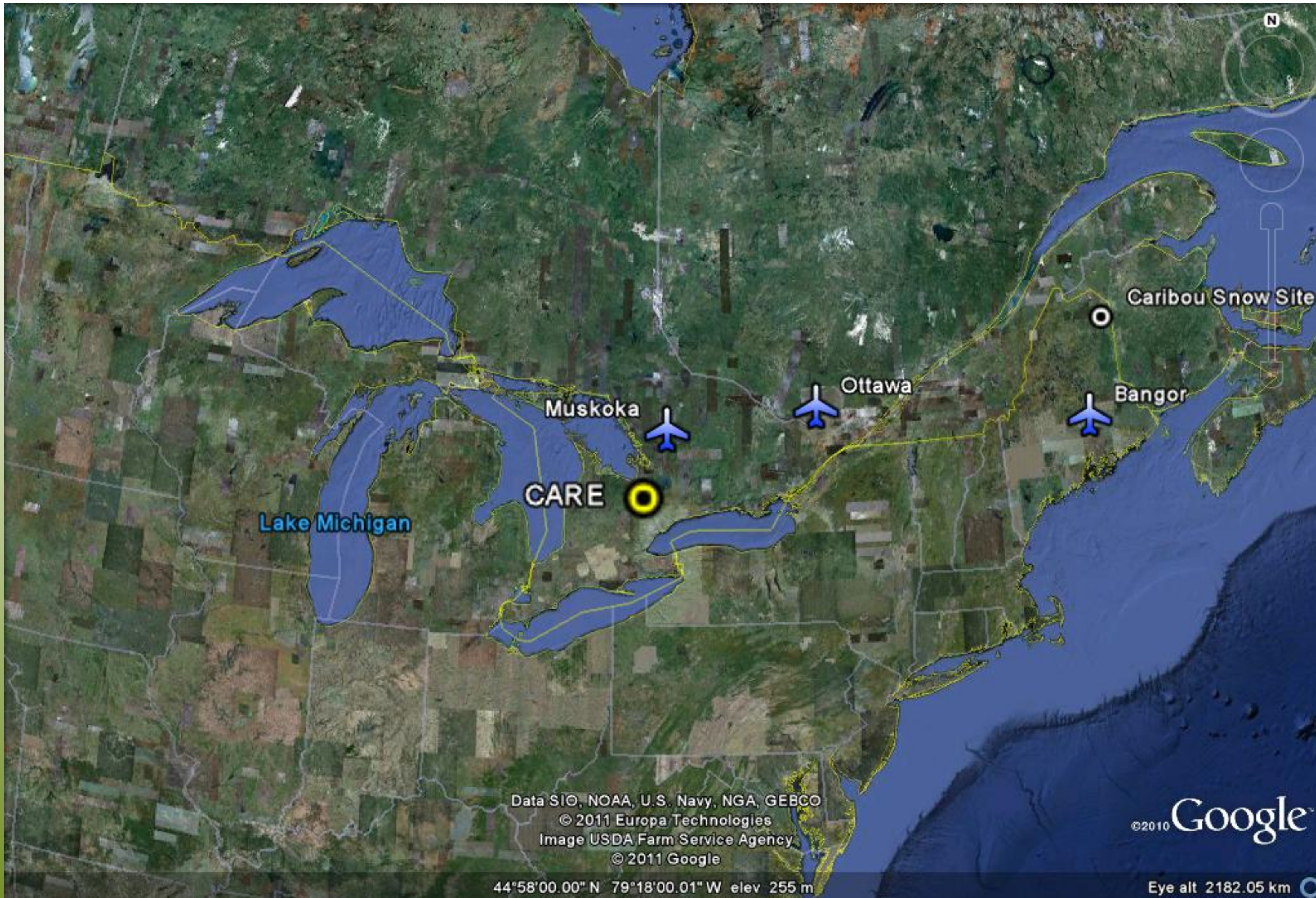
Walt Petersen
Matt Schwaller
Gail Skofronik-Jackson

Environment Canada PIs

David Hudak
Paul Joe
Chris Derkson

Canadian Space Agency Agence spatiale canadienne

CSA ASC


Caribou Snow Site
Ottawa
Bangor
Muskoka
CARE
Lake Michigan
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Europa Technologies
Image USDA Farm Service Agency
© 2011 Google
©2010 Google
44°58'00.00" N 79°18'00.01" W elev 255 m
Eye alt 2182.05 km

DC-8 inflight

NASA/Dryden DC-8 (NASA 817)

DC-8 Instrumentation	
CoSMIR (Passive) H+V polarizations	
Frequencies	50, 89, 165.5, 183.3+/-1, 183.3+/-3, 183.3+/-7 GHz
Resolution at 20 km range	1.4 km footprint at nadir
APR-2 (Active)	
Frequency (inner/outer beam)	13.4, 35.6 GHz (HH, HV)
Transmit peak power	200 W (Ku), 100 W (Ka)
3 dB beam width	3.8° Ku, 4.8° Ka
MDS (dBZ_e, 6 dB pulse width of 60 m., 10km range)	+5.0 / +5.0 dBZ_e
Range gate	30 m
Beam swath	+/-25°

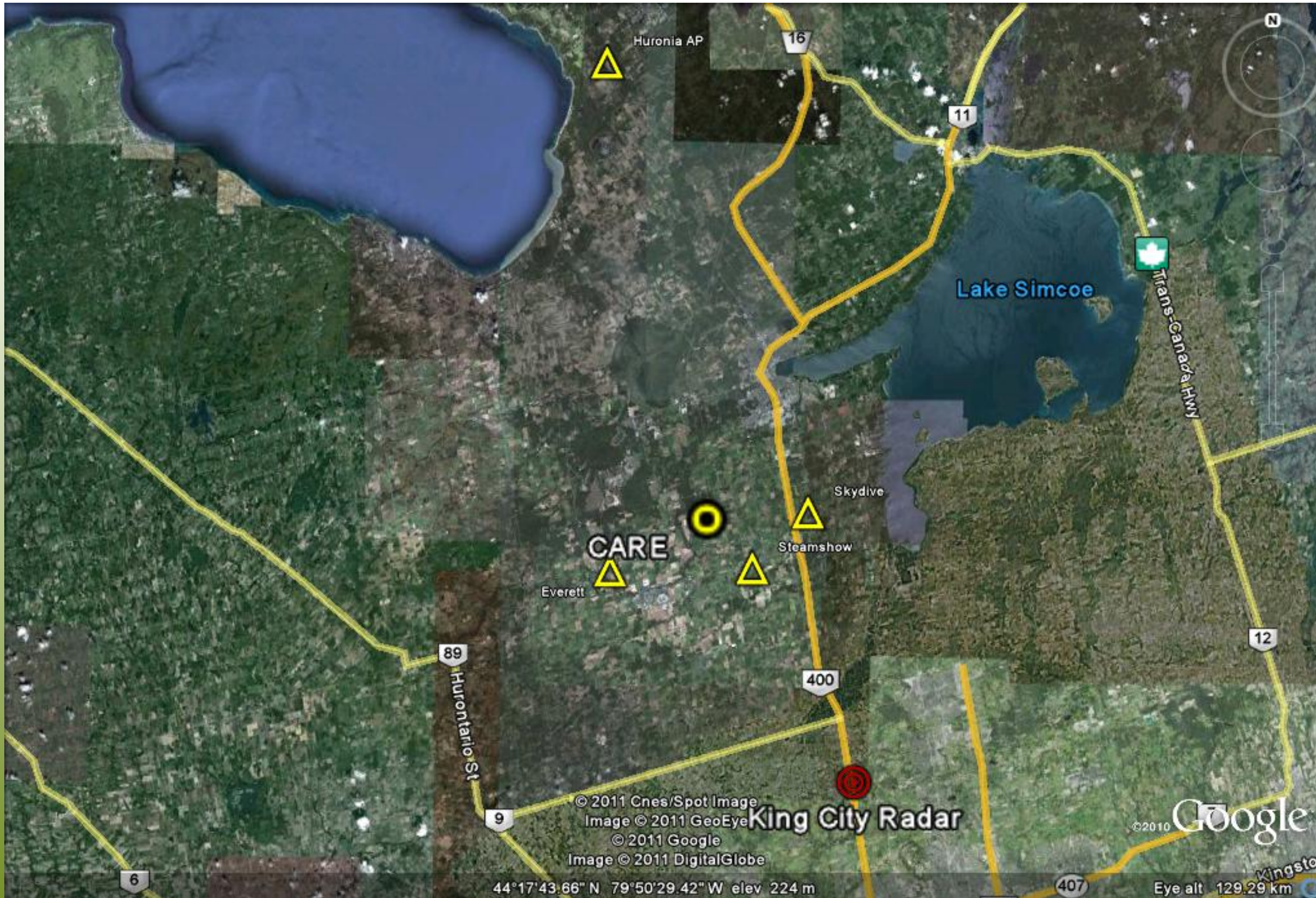
University of North Dakota Citation (Cloud 1)

Probe	Range	Notes
CDP	2 – 50 μm	30 bins
2DC	30 – 960 μm	30 μm resolution
CIP	25 – 1550 μm	25 μm resolution
HVPS-3	150 μm – 19.2 mm	150 μm resolution
Nevzorov	0.003 – 2.0 gm^{-3}	Total water, liquid water content.
King LWC	0 – 5 gm^{-3}	Liquid water content
CPI	2.3 – 2300 μm	Particle images, fuselage mount
Rosemount Icing Rate Meter	Detection of Supercooled Liquid Water	
Temperature	-65°C to +50°C	Rosemount total temperature
Dew Point	-60°C - + 40°C	Chilled mirror
Water Vapor	125 – 30,000 ppmv	Maycomm Laser hygrometer
Pressure	0-1034 mb	Pressure
3-D Winds		Gust probe, Applanix inertial system
CN Counter	10 nm cut	Alcohol condensing
GPS Position		Applanix
Orientation (pitch, roll, yaw)	Orientation (pitch, roll, yaw)	Applanix inertial system

National Research Council Convair-580 (Research 9)

Instrument	Source	Measurements
PMS 2D-C (25 um)	EC	Cloud drops spectra and shape
PMS 2D-P	NASA	Precipitation spectra and shape
FSSP – SN002	EC	Cloud drops
FSSP – 100	NASA	Cloud drops 3-45 um
OAP-2DG-P (150 um)	NASA	Precipitation spectra and shape
CCP	DMT	LWC, Cloud Particle spectra and shape
CPSD – Cloud Particle Spectrometer with Depolarization	DMT	Particle diameter, depolarization, scattering rat – inference of particle composition and shape
BCP – Backscatter Cloud Probe	DMT	Size Distribution – 5 – 75 um – LWC, # Conce MVD, effective diameter
CVI	NASA	Total Water Content
King	EC	Liquid Water Content
Nevzorov	SkyPhysTech	Total Water Content
Rosemount Icing Detector	NRC	Icing Indicator
Atmospheric state parameters	NRC	Temperature, Dew Point, Pressure and 3D-win
Aircraft state parameters	NRC	GPS&INS systems
NAWX Radar	**NRC**	**Cloud structure and dynamics**

Courtesy Mengistu Wolde


Huronia AP
16
11
Lake Simcoe
Trans-Canada Hwy
Skydive
Steamshow
CARE
Everett
89
Hurontario St
400
12
9
© 2011 Cnes/Spot Image
Image © 2011 GeoEye
King City Radar
© 2011 Google
Image © 2011 DigitalGlobe
©2010 Google
6
407
Kingston
44°17'43.66" N 79°50'29.42" W elev 224 m
Eye alt 129.29 km

Precipitation Sensor Suite

(CARE + 4 secondary sites)

POSS

10m met tower (P,T,RH,,10 & 2 m wind)

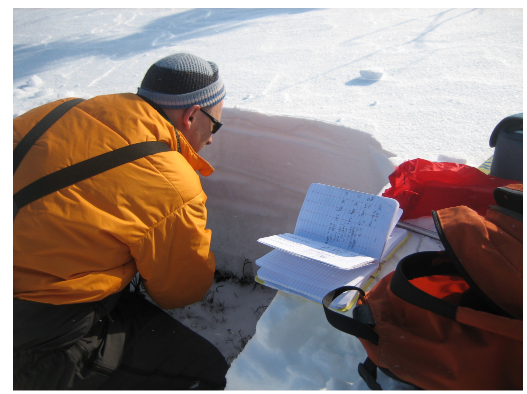
Parsivel optical disdrometer

2D video disdrometer

Hot Plate Precip system

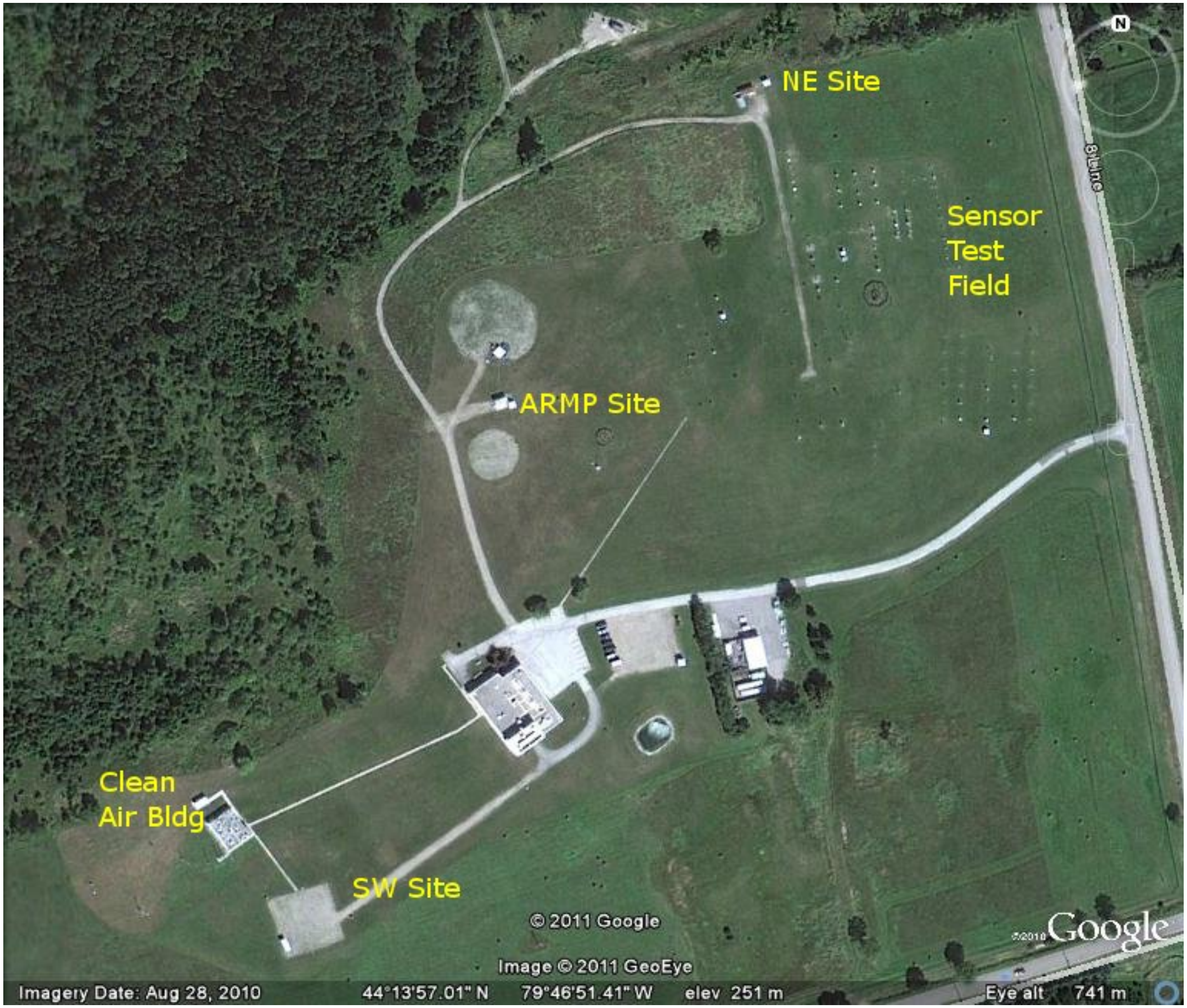
Micro Rain Radar

Pluvio gauge



Snow surveys

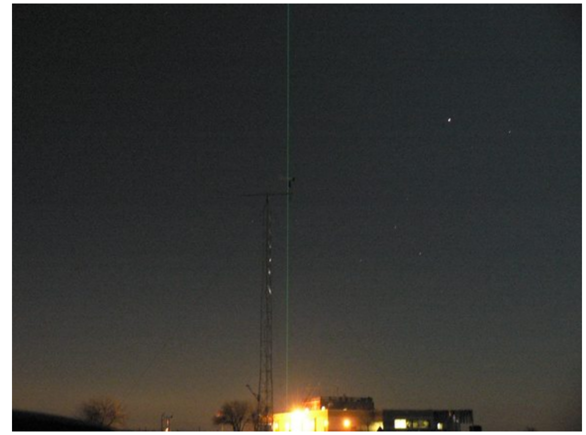
EC Centre for Atmospheric Research Experiments (CARE)



Active Remote Sensors (CARE)

W-band VPR
(McGill U.)

X-band VPR
(McGill U.)



Dual 1064/532 nm
polarized lidar

NASA Ka- & Ku-band fully polarimetric, scanning Doppler radar (D3R)

- **-10 dBZ @ 15 km**
- **150 m range resolution to 30 km**

Passive Remote Sensors (CARE)

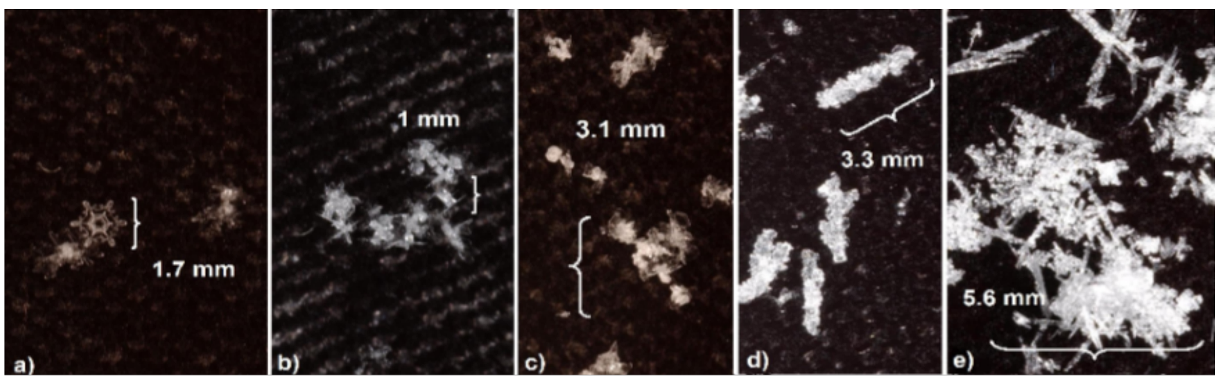
TP3000 profiling radiometer
22 to 30 GHz and 51 to 59 GHz

Dual Polarization Radiometer (DPR)
90 and 150 GHz
(U. Cologne)

ADvanced MIcrowave RAdiometer for Rain Identification (ADMIRARI)
Dual polarization
10.65 21.0 36.5 GHz
(U. Bonn)

In-Situ Measurements (CARE)

NASA Particle Video Imager



Particle Hi Res Photography
(U. Manitoba)

Profiling at CARE

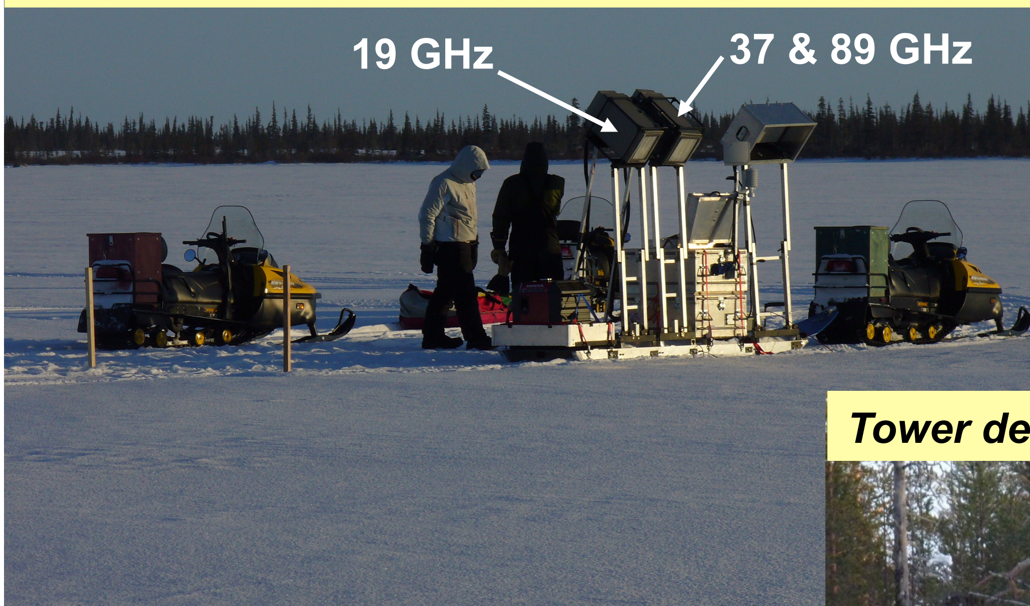
Upper air sonde system

915MHz wind profiler

VHF Wind Profiler (50 MHz) O – Q Net

Ground-Based Radiometer Measurements of Snow Covered Ground (CARE)

Sled-based deployment, Churchill Manitoba, 2010

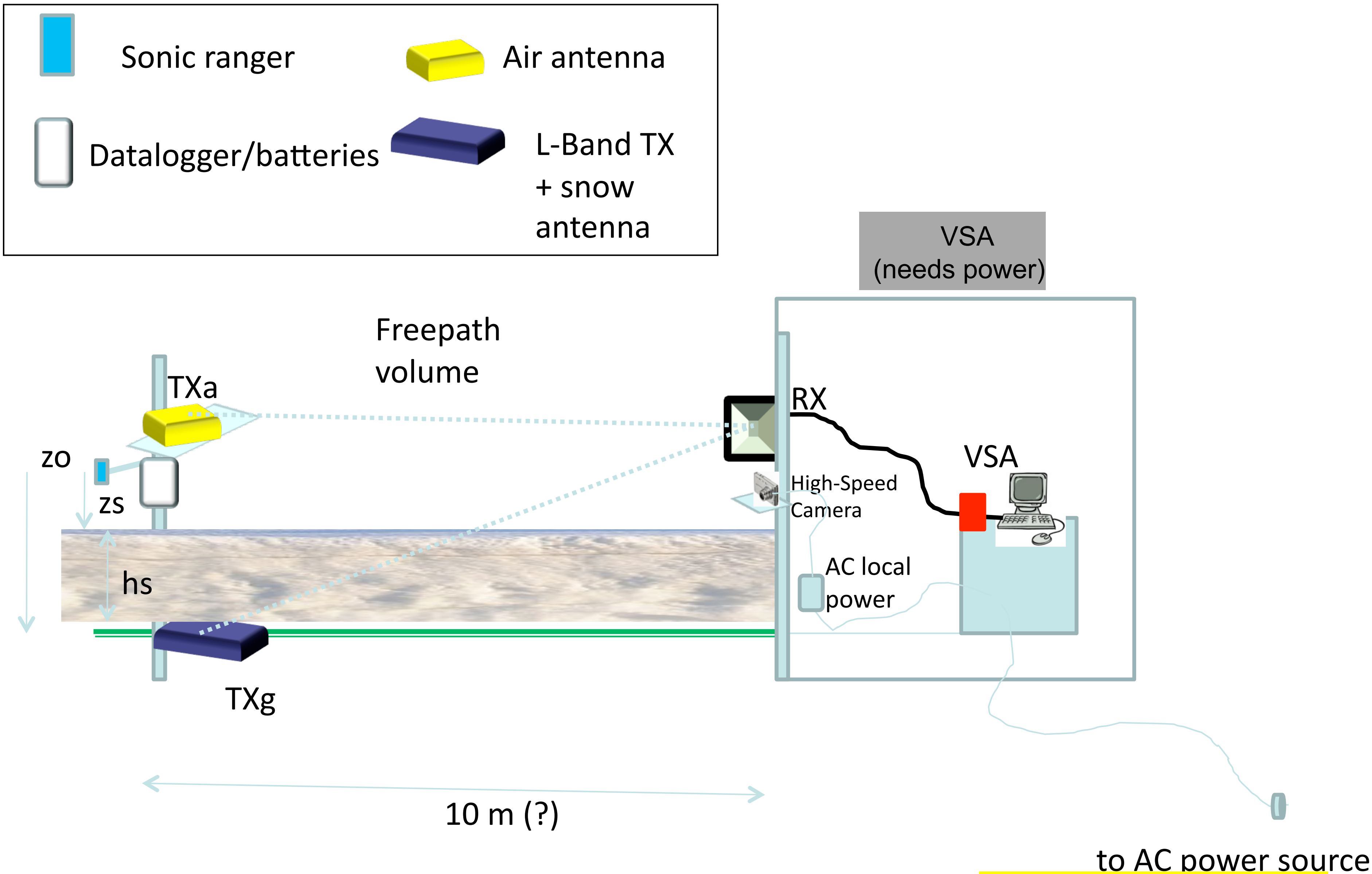


19, 37, and 89 GHz (dual-pol) radiometers will be deployed on a tower for continuous measurements of the surface during the snow cover season.

Tower deployment, Sodankyla Finland, 2011

These instruments have been deployed on numerous previous campaigns.

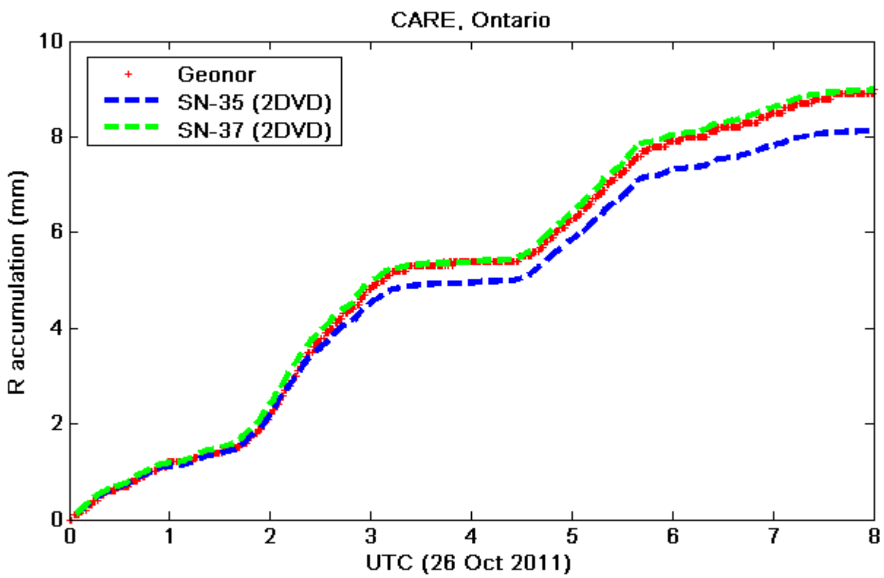
L-band Cluster within CARE (Duke U.)

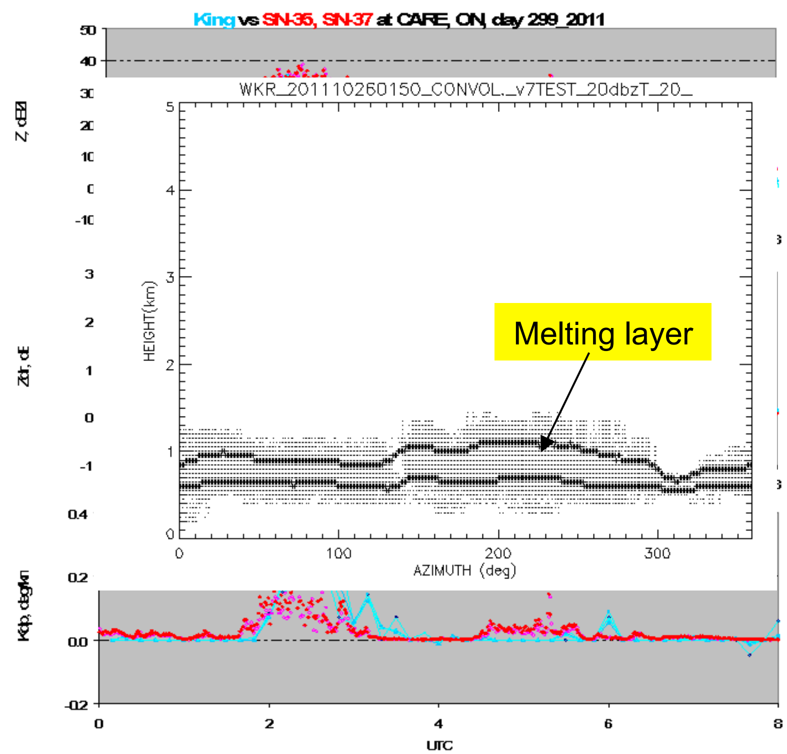


Courtesy Ana Barros

Courtesy Matt Wingo & Steve Brady

2DVD Tests at CARE – October 26, 2011





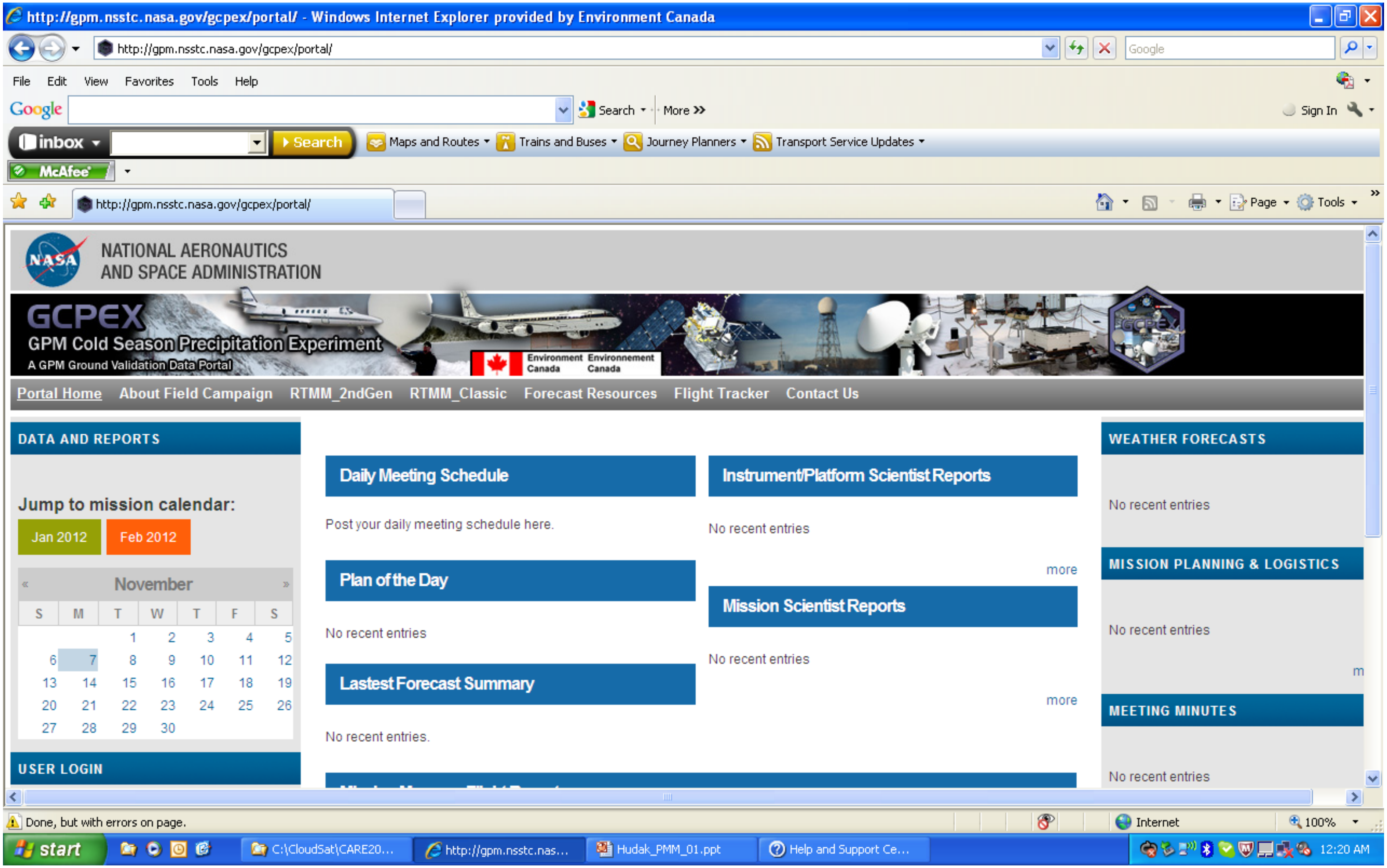
Rain Accumulation
2DVD vs Geonor gauge

Radar Parameters
2DVD vs King radar

Courtesy Merhala Thurai

Schedule

- CARE precipitation suite with fencing finished week of November 14, 2011
- 4 secondary sites operational by December 9, 2011
- Enhanced setup at CARE
  - Ground staring radiometers (when snow on ground) + TP3000
  - L-band system by December 23, 2011
  - Arrival of ADMIRARI, D3R, McGill W and X-band radars by January 9
- First forecasting day January 15, 2011
- IOP from January 17, 2012 to February 29, 2012



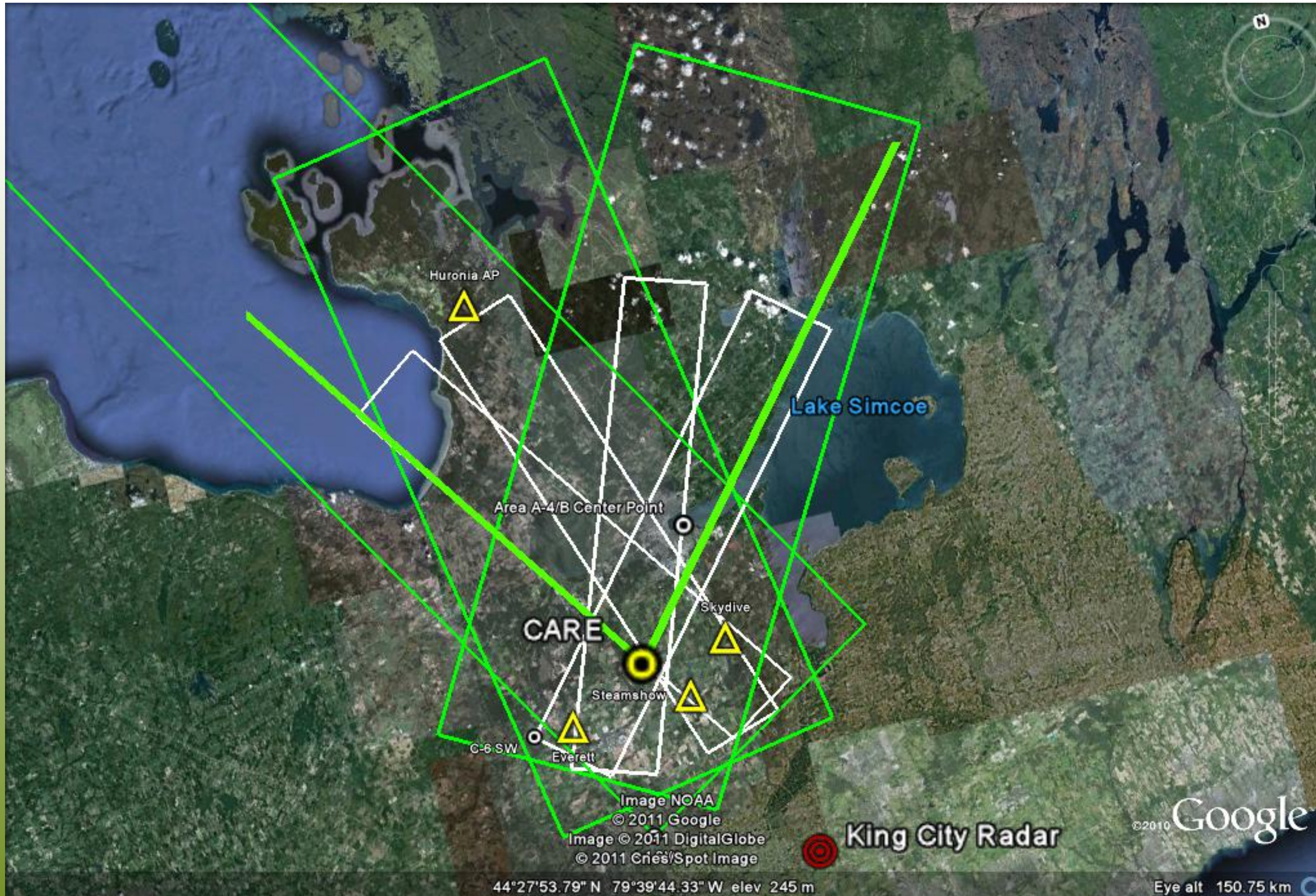
http://gpm.nsstc.nasa.gov/gcpex/portal

Overview

- To address shortcomings in GPM snowfall retrieval algorithm by collecting microphysical properties, associated remote sensing observations, and coordinated model simulations of precipitating snow
- To characterize the ability of multi-frequency active and passive microwave sensors to detect and estimate falling snow.
  - What are the minimum snow rates that can be detected?
  - Does detectability and estimation accuracy/approach vary by meteorological regime ?
  - How well can these sensors discriminate falling snow from rain or clear air?
  - Can we develop and/or constrain parameterizations between the physical properties of falling snow and their radiative properties in a statistical sense?
  - What is the impact of variability in these microphysical assumptions and/or parameterizations?
  - What are the detection/estimation impacts of ancillary data?
  - Can we improve cloud resolving model (CRM) simulations of falling snow events?.

EC-CSA Objectives

- To enhance precipitation type/rate algorithms based on measurements from a dual polarization C-band radar
- To conduct feasibility studies towards the development of a high sensitivity, high vertical resolution dual frequency Doppler radar (Ka and W-bands) capable of characterizing snowfall and light precipitation, particularly at high latitudes
- To determine how snowfall information can feed into microwave emission models for snow-on-ground (snow water equivalent) retrievals.


Huronia AP
Lake Simcoe
Area A-4/B Center Point
Skydive
CARE
Steamshow
C-6 SW
Everett
Image NOAA
© 2011 Google
Image © 2011 DigitalGlobe
© 2011 Cnes/Spot Image
King City Radar
©2010 Google
44°27'53.79" N 79°39'44.33" W elev 245 m
Eye alt 150.75 km