SURFACE OBSERVATIONS DURING ISDAC: Light precipitation and ice fog occurrence

I. Gultepe

Contributions from
Connor Flynn, PNL
Pat Minnis, NASA Langley

Cloud Physics and Severe Weather Research Section,
EC, Toronto, Ontario M3H5T4, **ismail.gultepe@ec.gc.ca**

Objectives

- **Understand Physics of Ice Fog, snow precip/Extinction (visibility)**
- **Study snow PR/light snow precipitation amount**
- **Develop parameterizations for model applications**
- **Integrate surface and aircraft observations for model/remote sensing retrievals**

Why surface observations are important?

- **Observations can be used**

- **to verify model outputs.**
- **to validate remote sensing retrievals.**
- **to develop parameterizations for model physics and remote sensing retrievals.**

Outcome depends on

"accuracy of measurements".

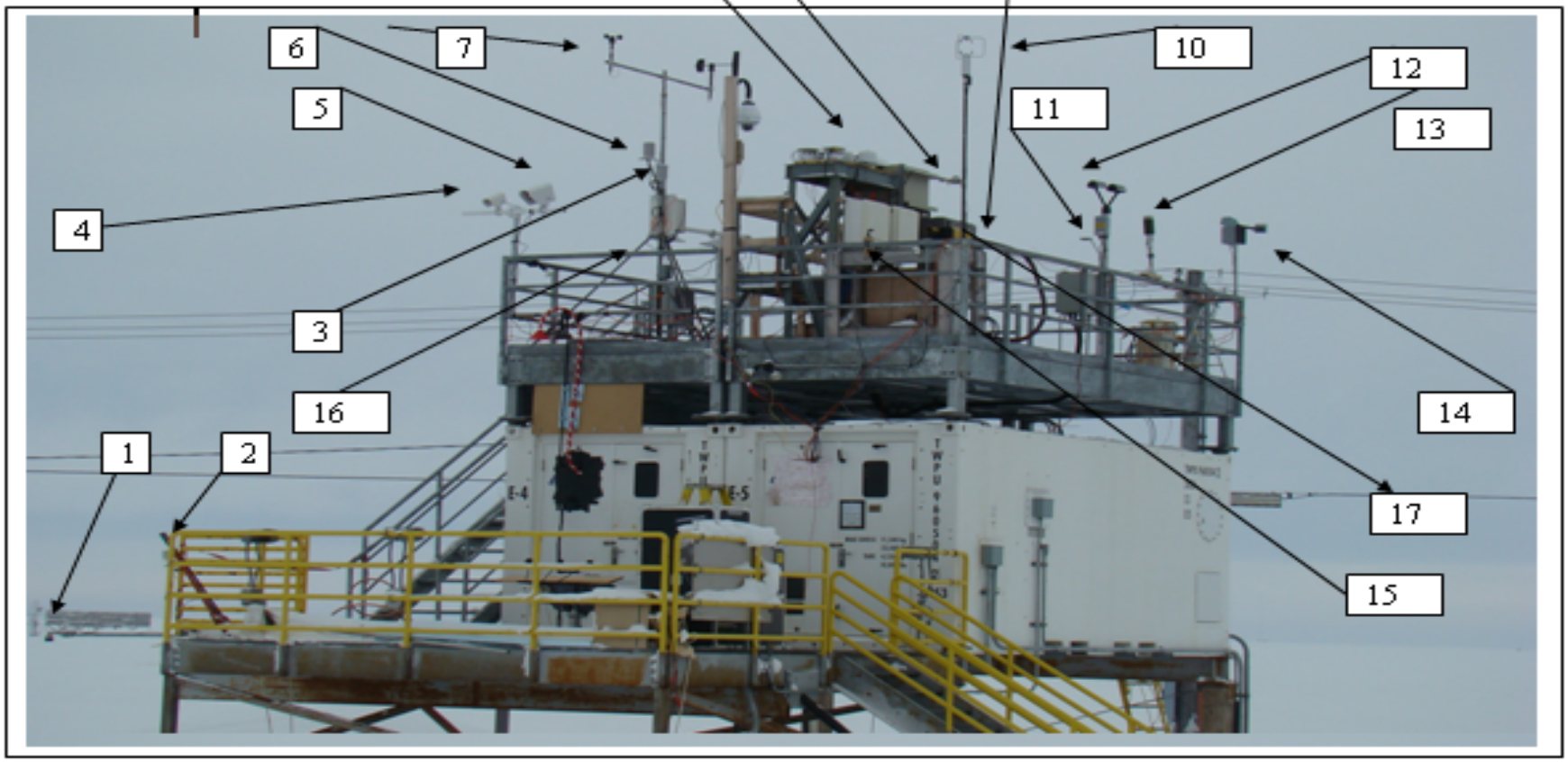
Surface Instruments

- CAP aerosol spectrometer (0.1-10 micron)
- DMT FMD (2-50 micron)
- DMT GCIP (7.5-1000 micron)??
- YU IPC (>30-50 micron)

- Vis sensors
- Precip sensors
- Present Weather Sensors
- Broadband radiometers
- Rosemount Icing Detector ??
- Young ultrasonic anemometer
- Surface conditions sensors

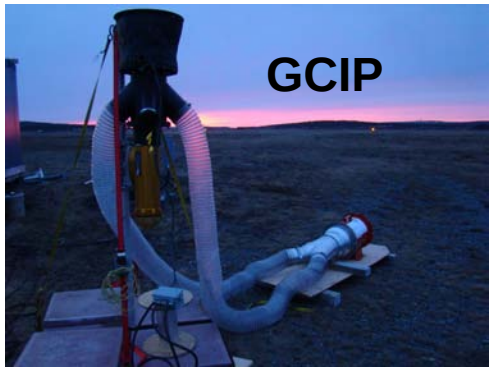
Environment Canada
Cloud Physics and Severe Weather
Research Section, Toronto

BARROW NSA SITE
I.GULTEPE
Ismail.gultepe@ec.gc.ca



1. Snow depth sensor
2. Temperature sensor
3. RH1 and T
4. Vaisala surface temperature
5. Vaisala water phase sensor
6. RH2 and T
7. Wind speed and direction
8. SW and IR fluxes
9. SPN1; cloud cover, direct and diffuse radiative fluxes
10. Turbulence measurements
11. Hot plate (TPS) precip sensor
12. Distrometer (precip rate/extinction)
13. CAP aerosol measurements
14. Sentry Vis sensor
15. DMIST Vis sensor/camera
16. Ice particle counter (IPC)
17. FMD droplet spectra
18. VRG101 precip instrument
19. FD12P precip and Vis sensor

SOME FRAM-S INSTRUMENTS



ISDAC-FRAM-B ICE FOG PROJECT DAILY SUMMARY

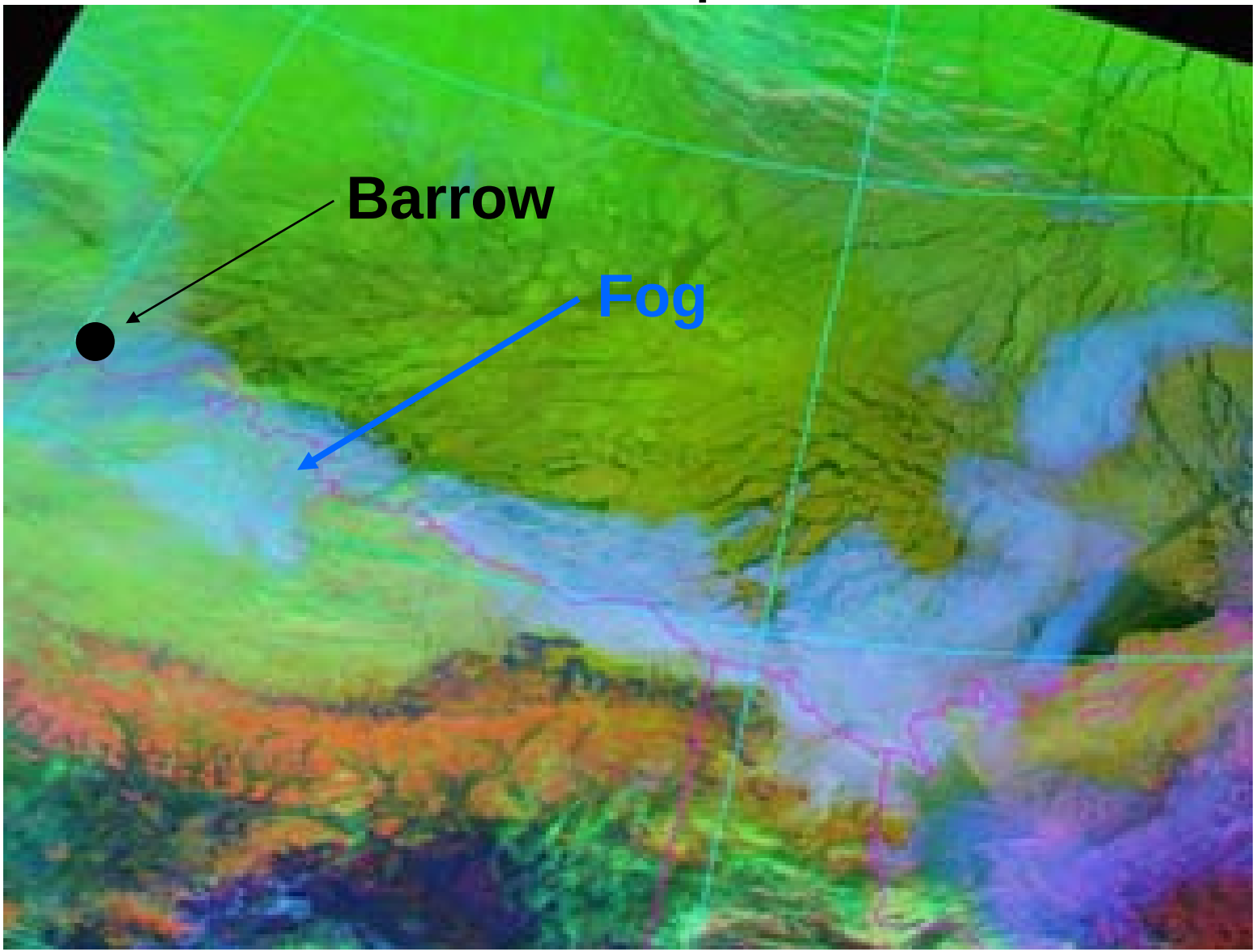
(I. GULTEPE- April 30 2008-ismail.gultepe@ec.gc.ca)

Ice fog and blowing snow cases are shown with yellow and light blue colors, respectively. Other cases usually had light snow/small ice crystals. There was only 2 cases for heavy snow conditions. The Convair's summary is prepared using the information available from the NRC flight summary table (Mengistu Wolde). The red colored days indicate the golden days for aircraft. Green checkmarks represent Convair flight days. The last column is for the flights during which Convair took off from Barrow and landed in Barrow before going to Fairbanks. The symbols as LS, IF, HS, BS, CW, and DD represent the light snow, ice fog, heavy snow, blowing snow, clear-weather and diamond dust conditions, respectively.

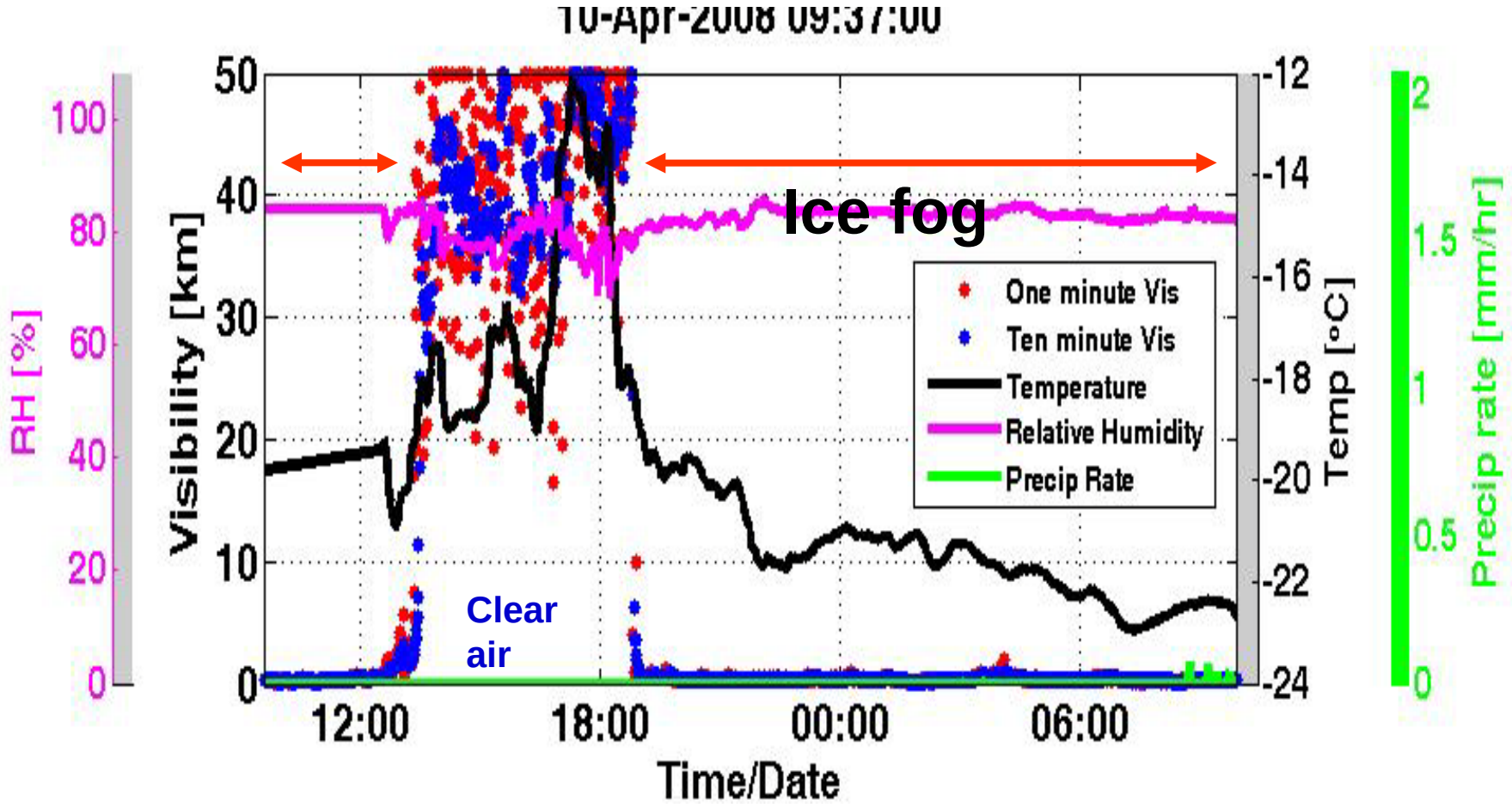
Day	Microphysics at surface	Convair over NSA site	Barrow to Barrow flights
April 1	LS+IF	√ (yes)	x (no)
April 2	HS	x	x
April 3	LS	x	x
April 4	IF	√	x
April 5	HS	√	x
April 6	IF	x	x
April 7	LS	x	x
April 8	LS	√(CL)	√
April 9	IF	x	x
April 10	IF	x	x
April 11	IF	x	x
April 12	IF+LS	x	x
April 13	LS+IF	√	x
April 14	LS	√	x
April 15	LS	x	x
April 16	LS	x	x
April 17	CW	x	x
April18	LS	√	√
April19	LS	√(PL)	x
April 20	LS	x	x
April 21	LS	x	x
April 22	BS	x	x
April 23	BS	x	x
April 24	BS	√	√
April 25	CW	√	x
April 26	LS	√(CL)	√
April 27	LS+IF	x	x
April 28	**LS**	√	x
April 29	DD	x	x
April 30	LS	x	x

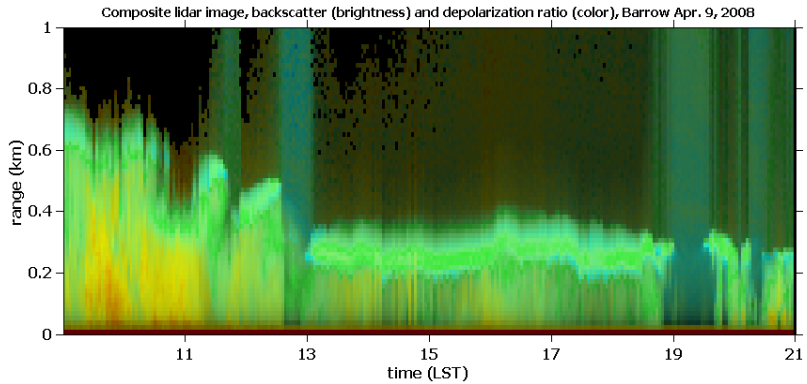
- **ICE FOG (IF)**
- **BLOWING SNOW(BS)**
- **DIAMOND DUST(DD)**
- **HEAVY PRECIP (HS)**
- **LIGHT PRECIP(LS)**
- **CLEAR WEATHER (CW)**

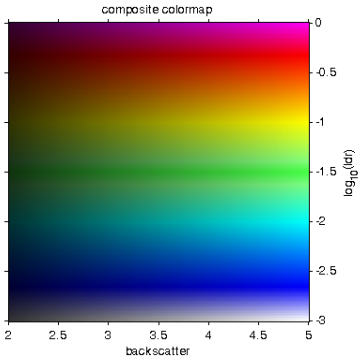
NOAA AVHRR April 10 2008

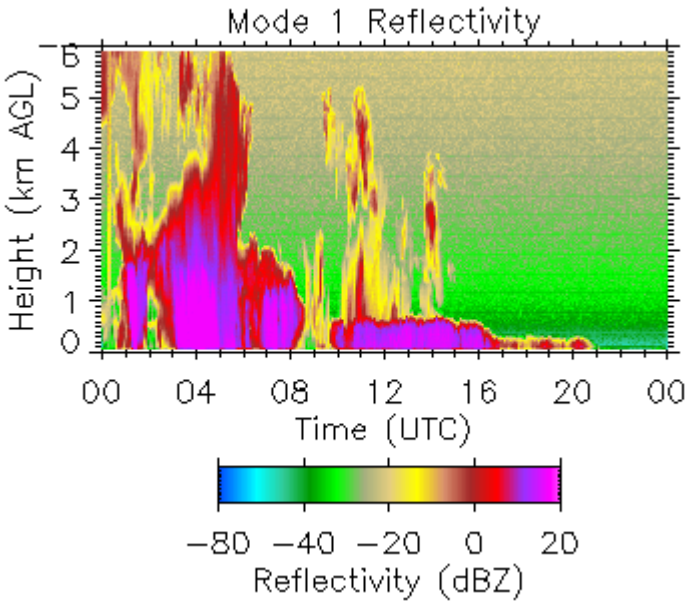


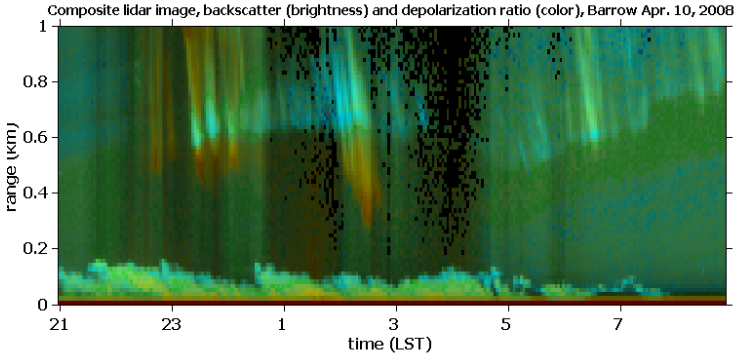
April 10 2008-ice fog

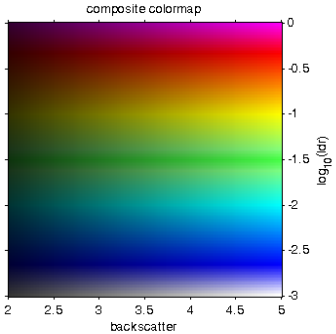



Composite lidar image, backscatter (brightness) and depolarization ratio (color), Barrow Apr. 9, 2008
range (km)
time (LST)


composite colormap
backscatter
log10(ldr)


Mode 1 Reflectivity
Height (km AGL)
Time (UTC)
Reflectivity (dBZ)


Composite lidar image, backscatter (brightness) and depolarization ratio (color), Barrow Apr. 10, 2008
range (km)
time (LST)


composite colormap
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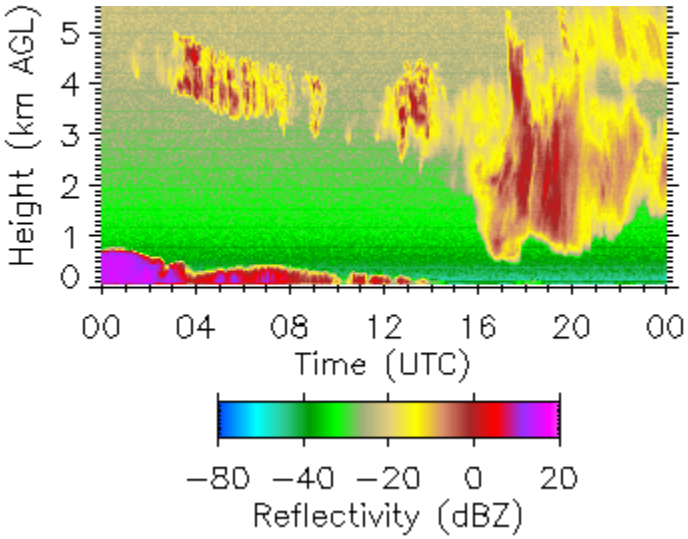
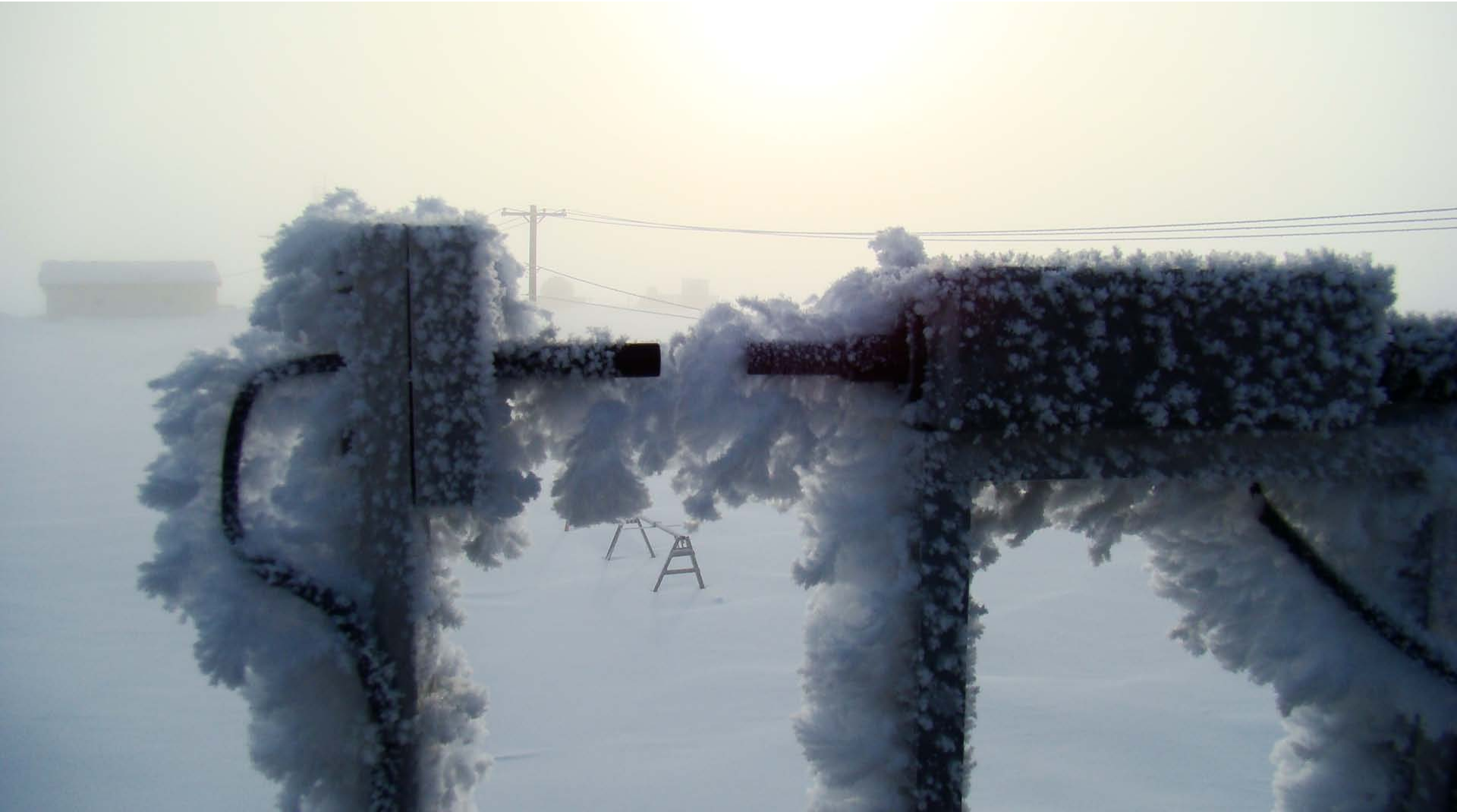
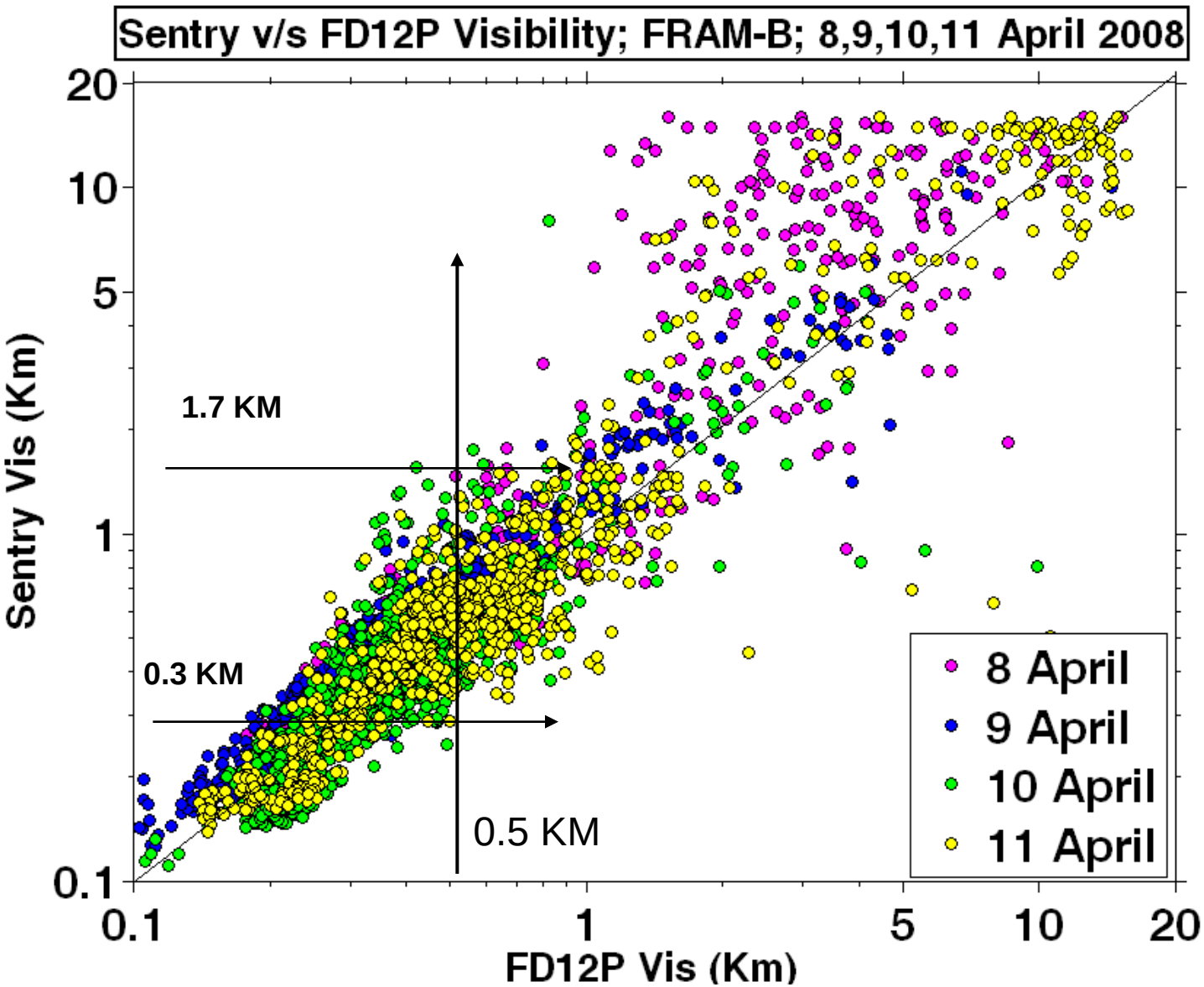

Height (km AGL)
Time (UTC)
Reflectivity (dBZ)

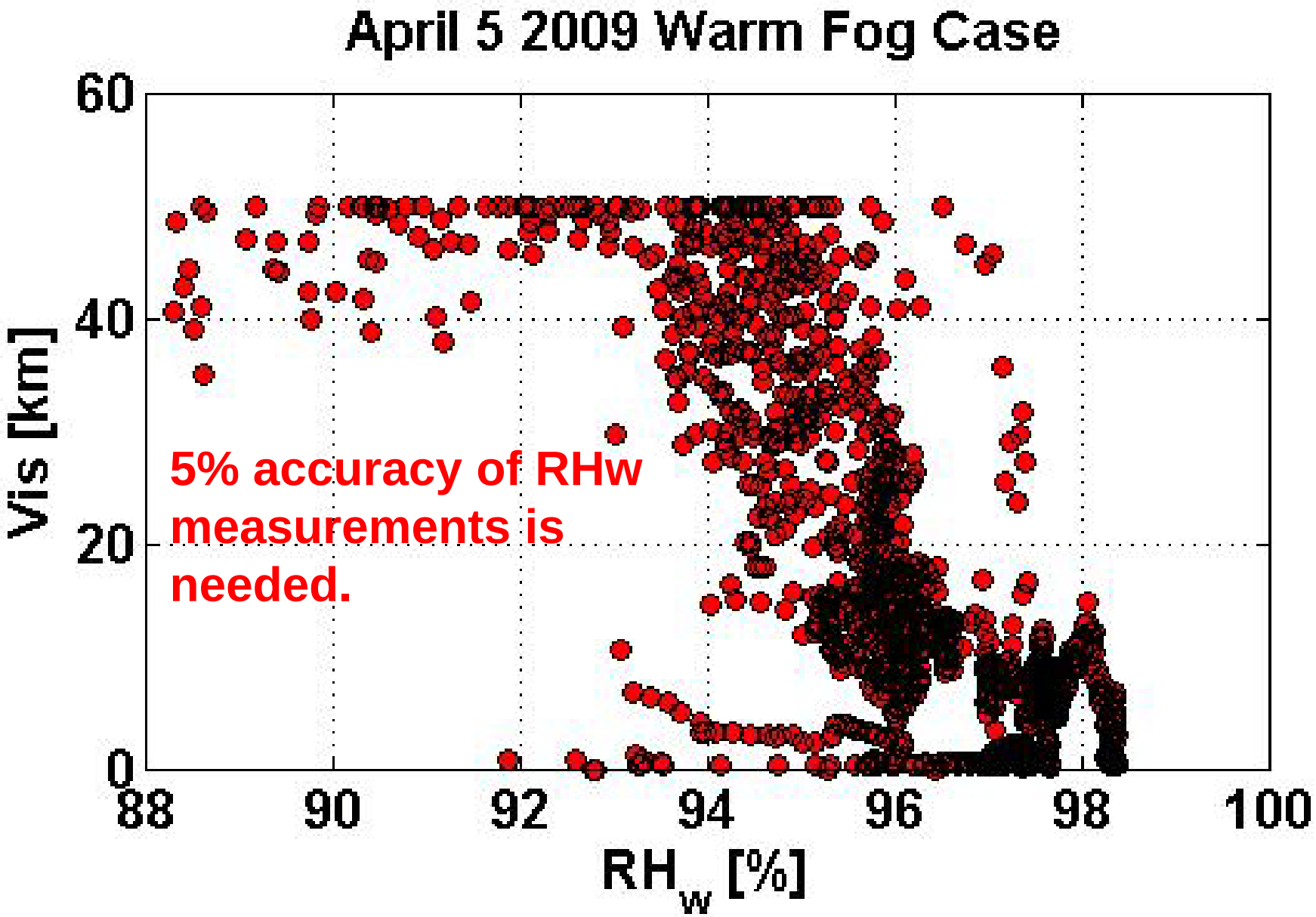
Ice fog/frost during FRAM-B



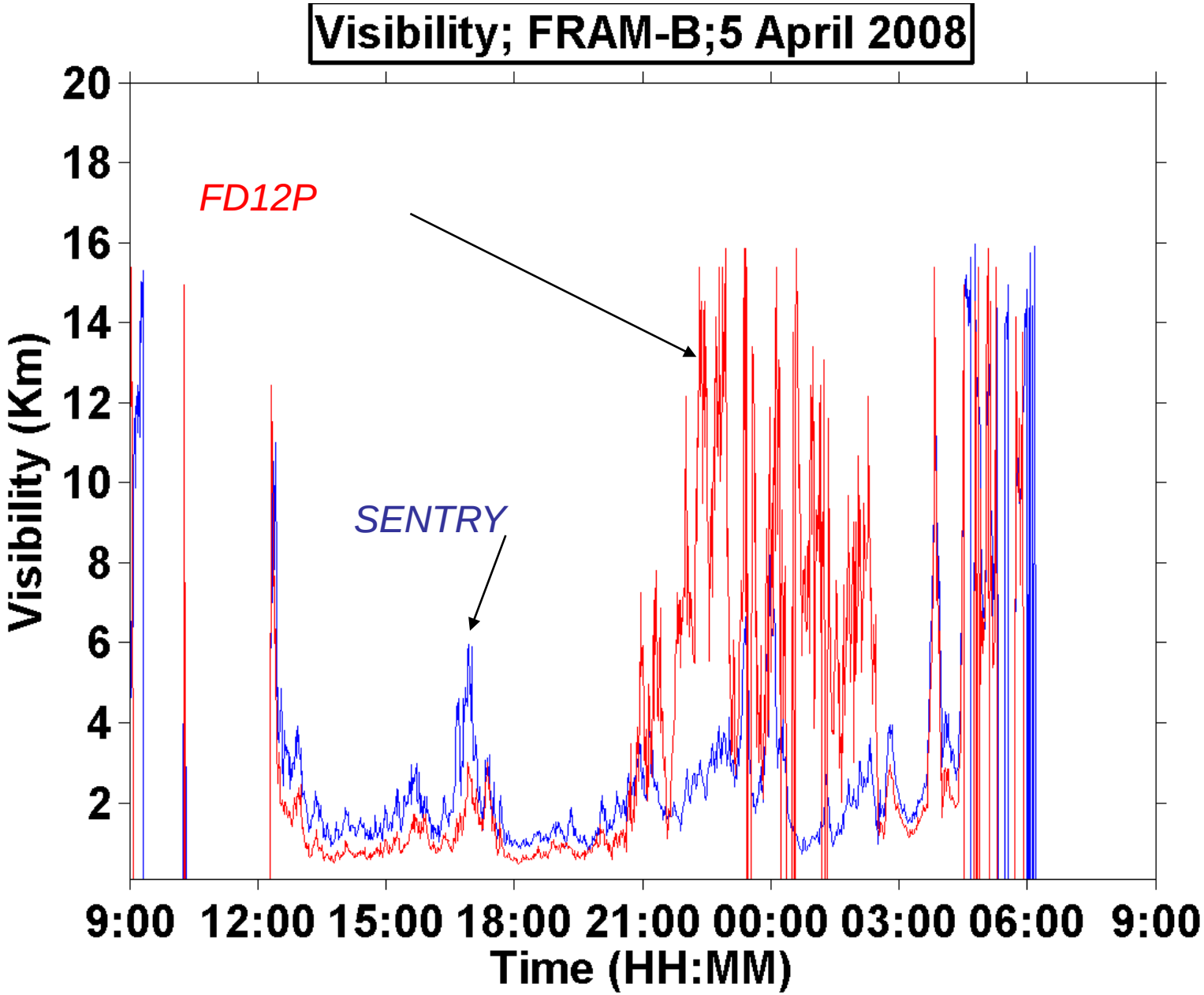
VIS COMPARISONS



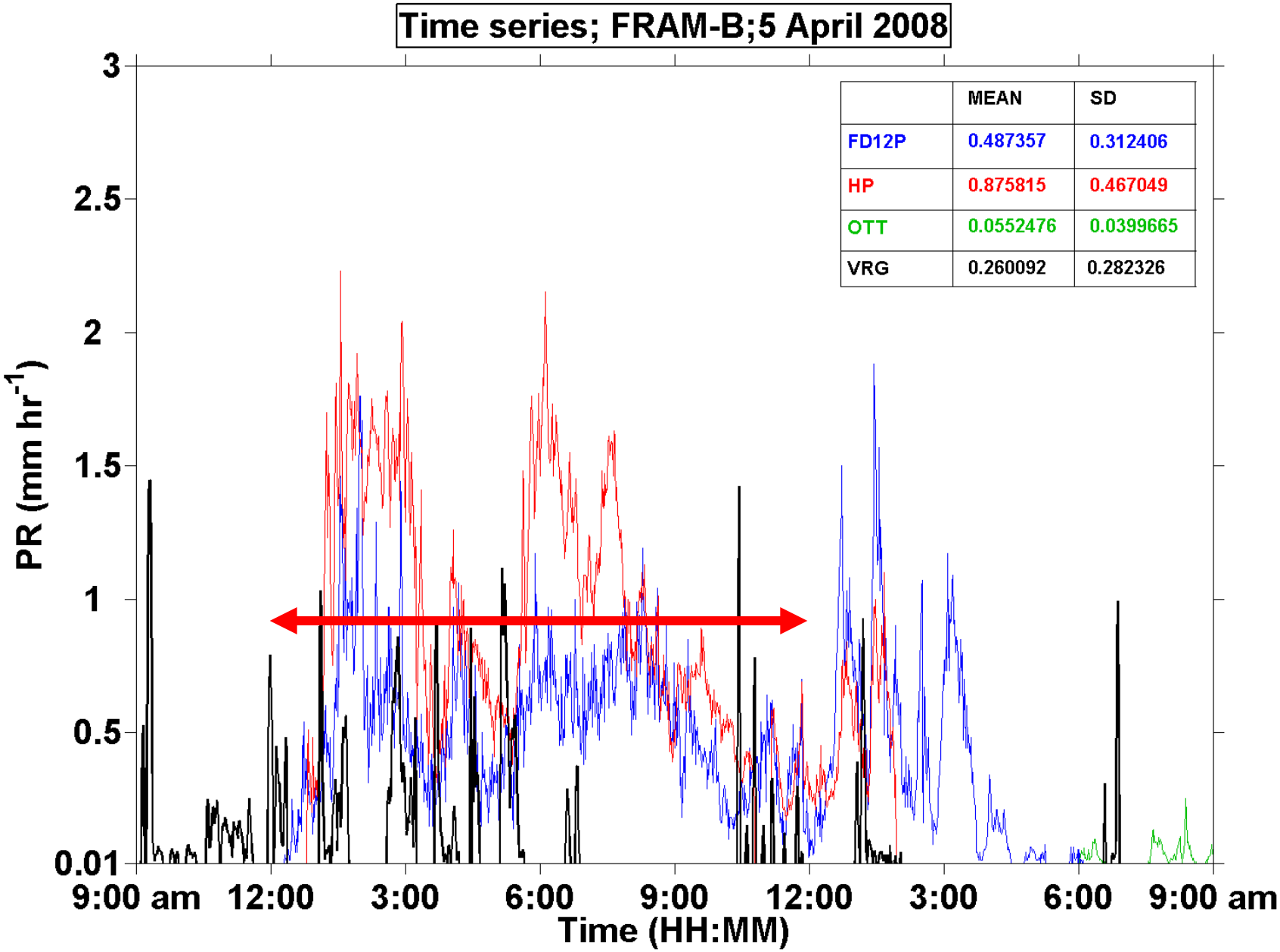
Vis versus RHw



Comparisons of Vis for snow conditions

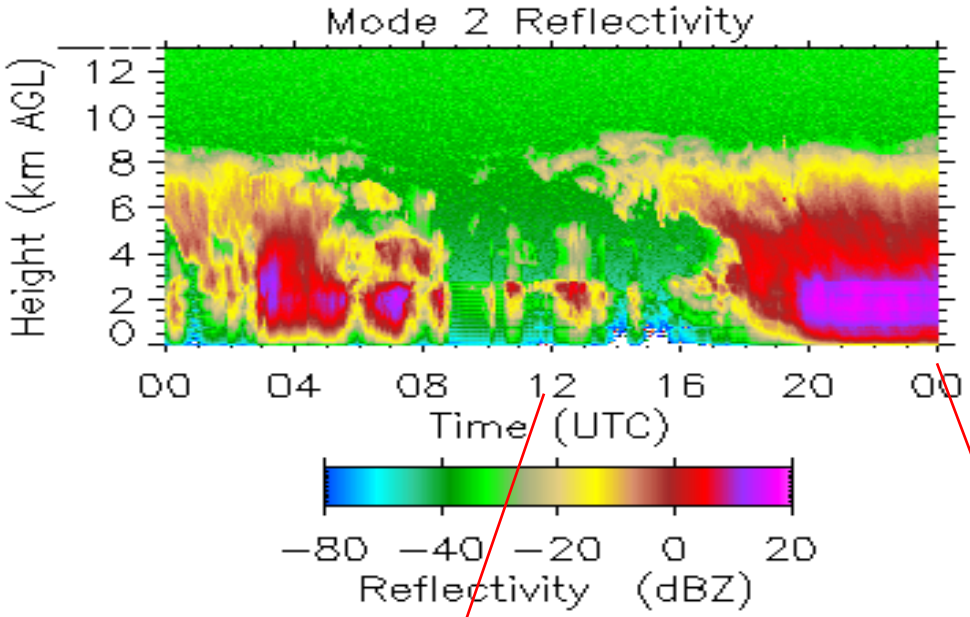


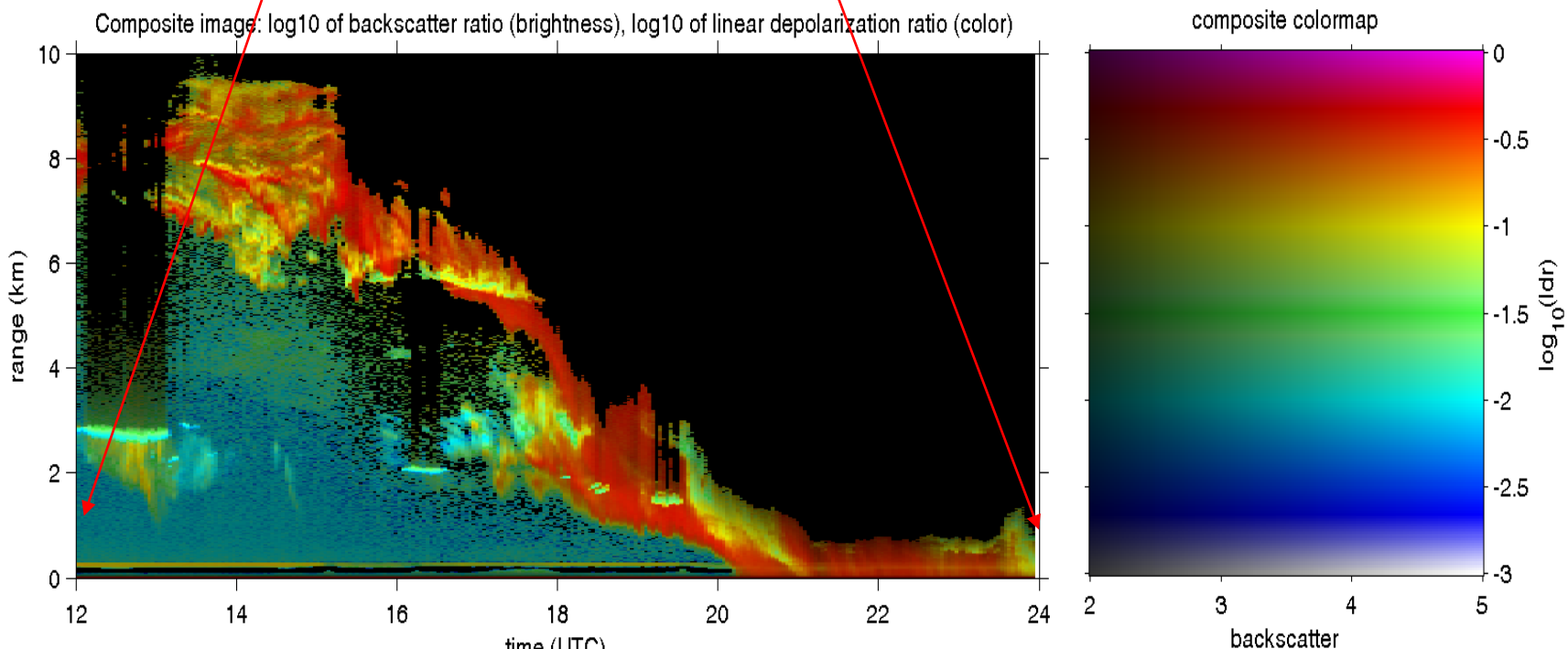
Comparisons of snow PR



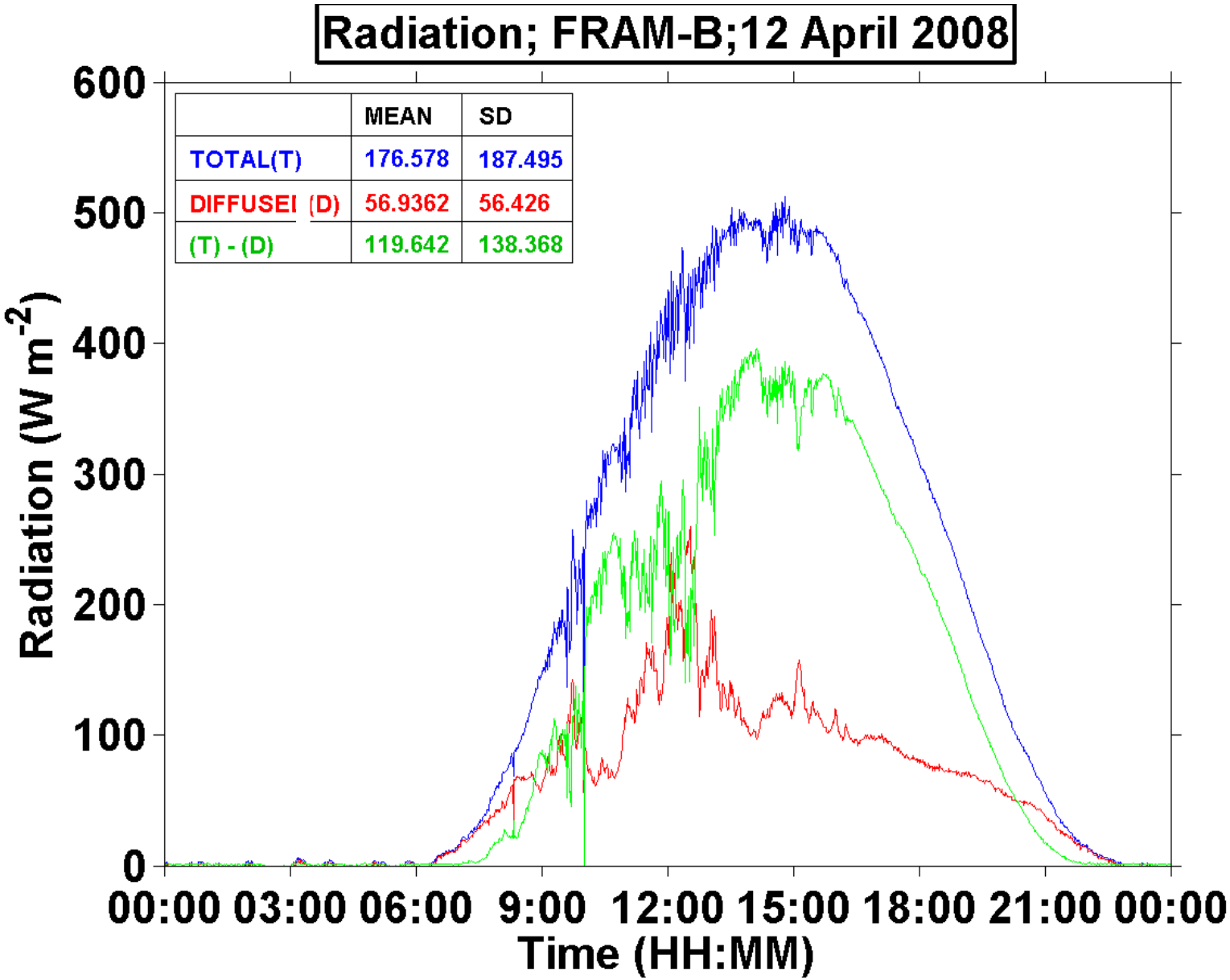
	MEAN	SD
FD12P	0.487357	0.312406
HP	0.875815	0.467049
OTT	0.0552476	0.0399665
VRG	0.260092	0.282326

April 5
snow precip case

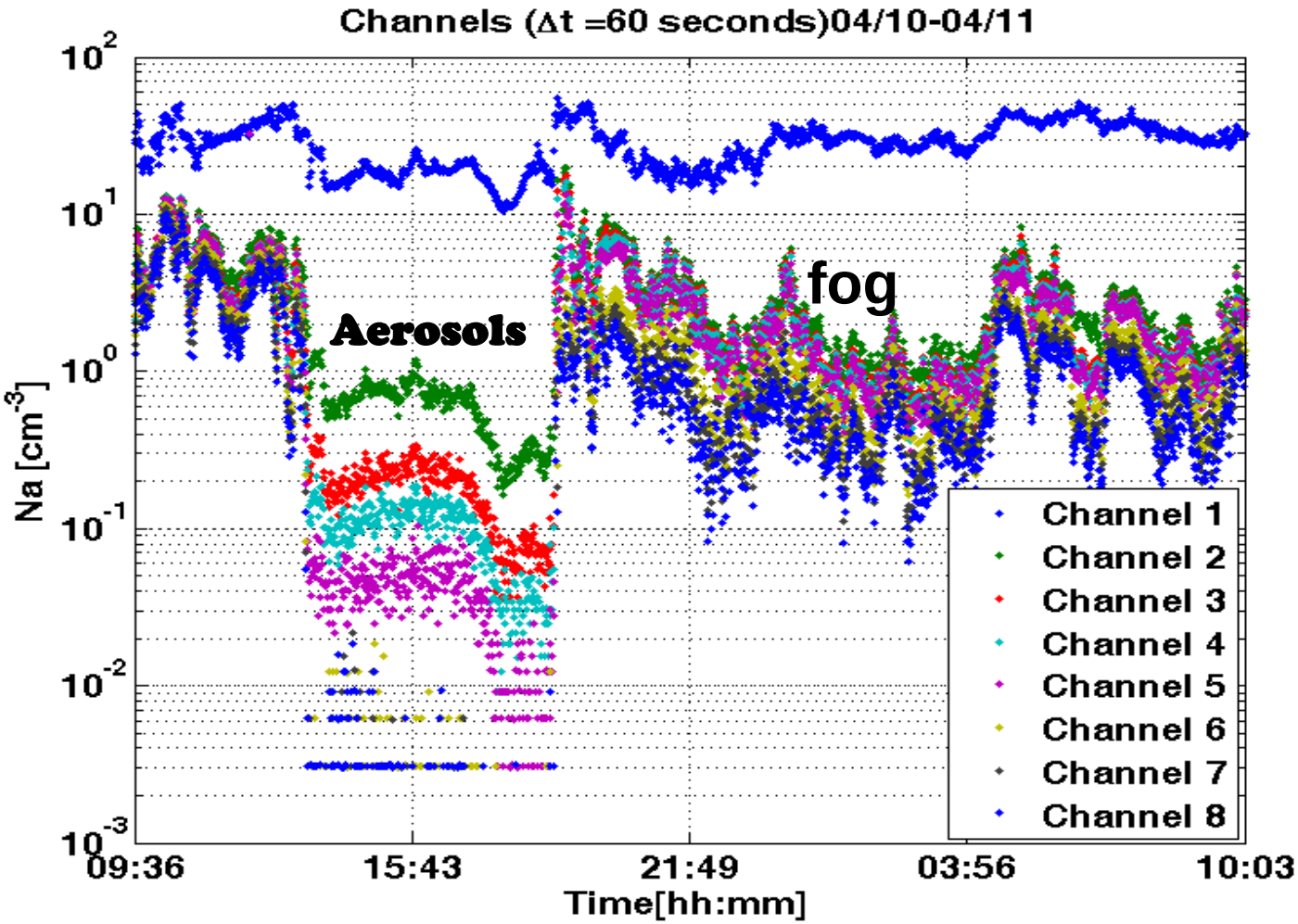




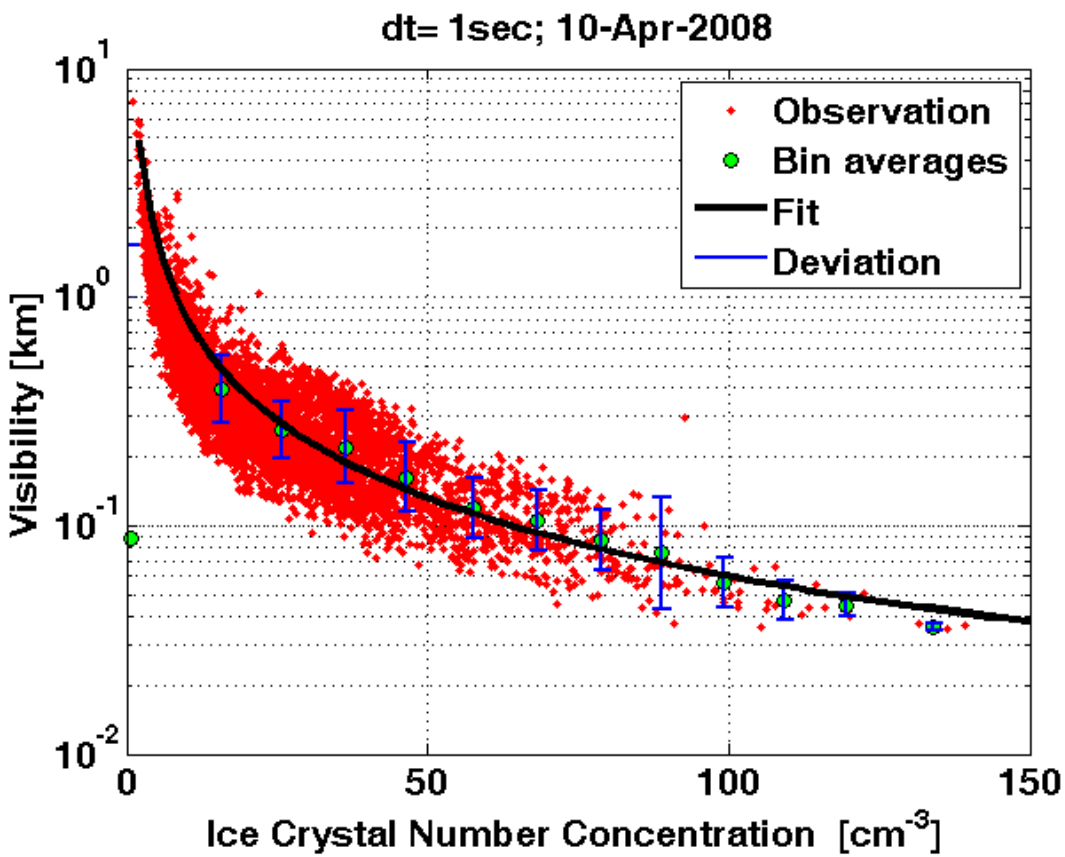
Ice fog/light snow effects on SW radiative fluxes

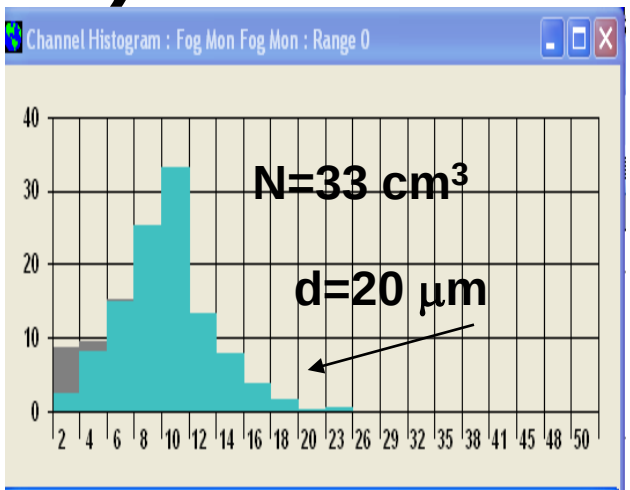


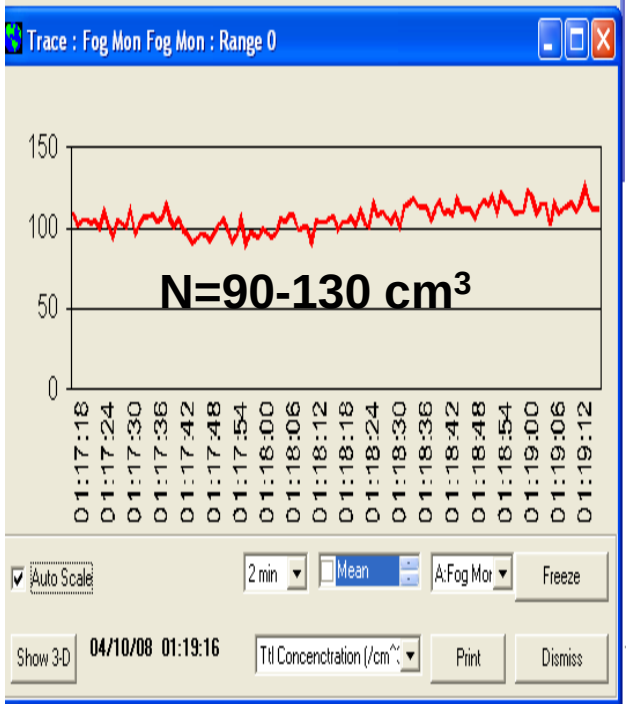
CAP Particle sensor (aerosol and/or small droplets <10 micron)



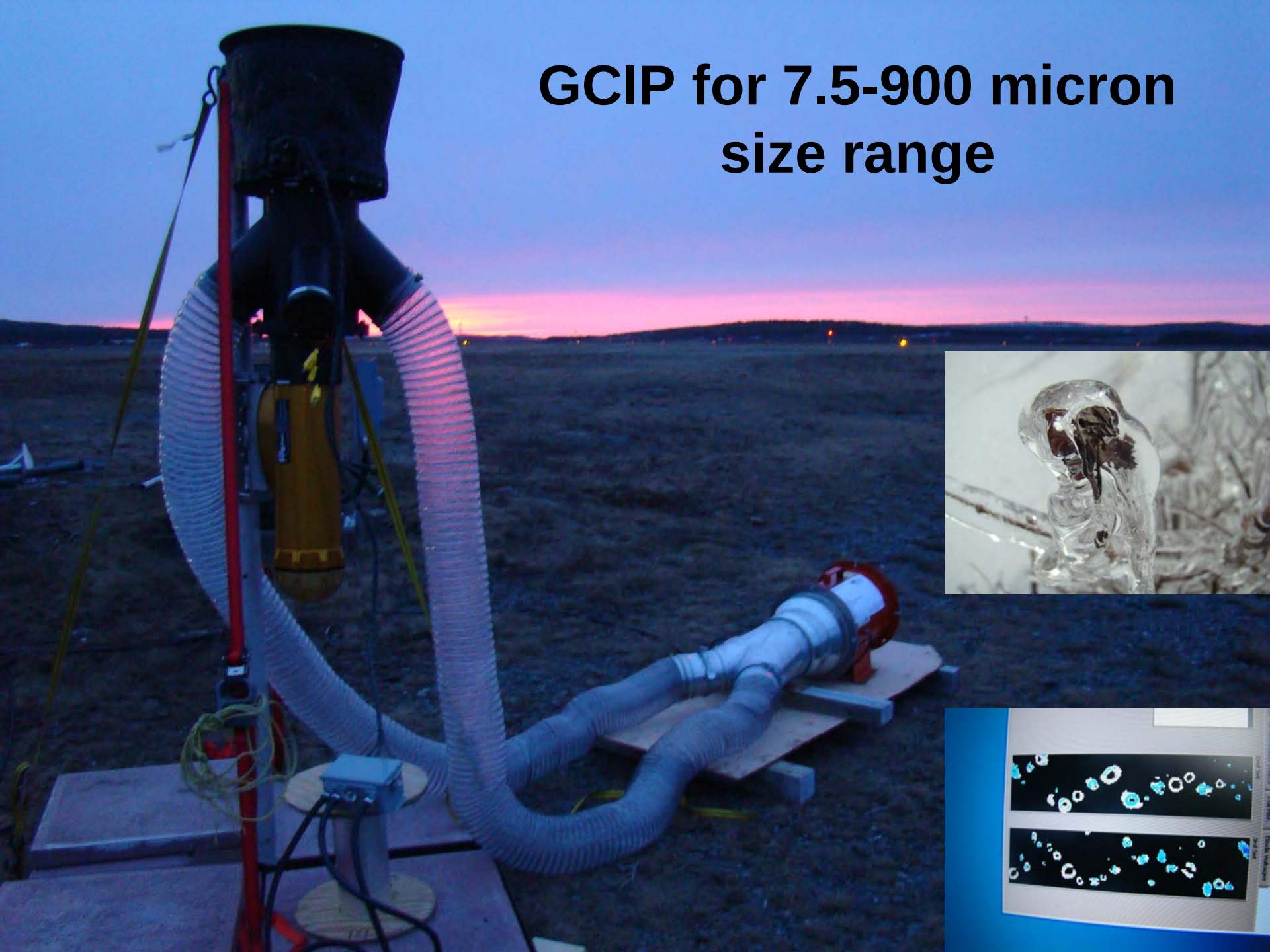
APRIL 10 2008/ICE FOG (FMD measurements)



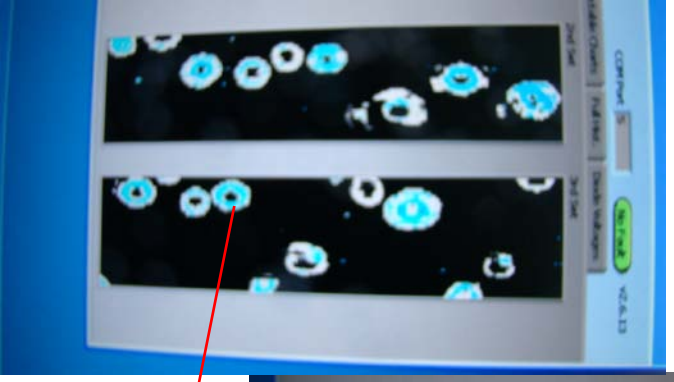


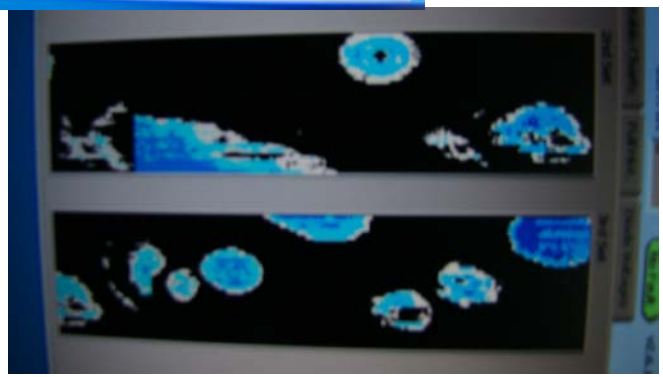


GCIP for 7.5-900 micron size range



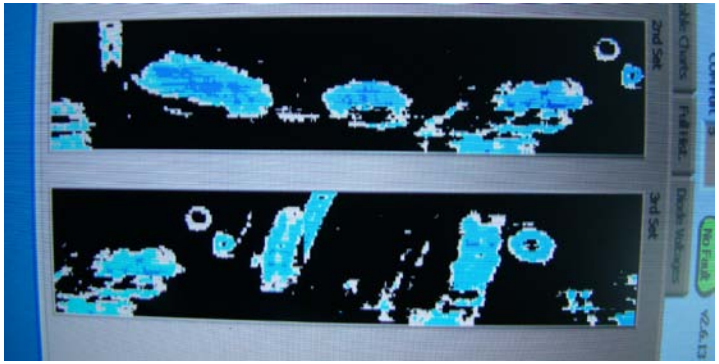
GCIP IMAGES ON APRIL 27 2009, ST JOHN'S, NFL

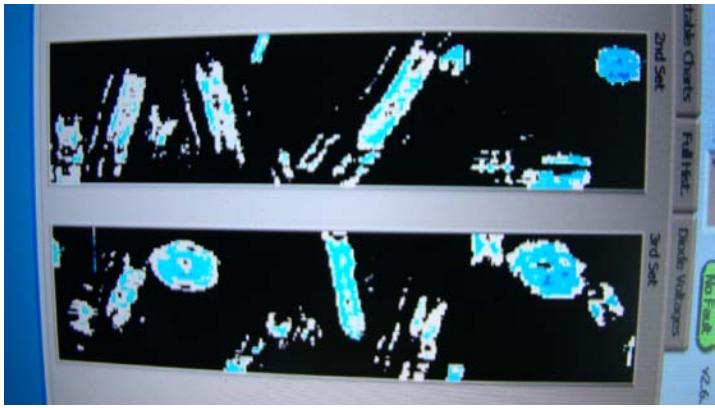




- TRANSITION FROM DRIZZLE TO FREEZING/ICE PARTICLES

200 MICRON





Conclusions

- Surface observations can tell us if there were hydrometers at the surface that can affect heat/moisture budgets.
- Precip formation is related to cloud processes
- Light precip, e.g. ice fog/light snow/blowing snow, occurs at least 50% of time (<1 mm/hr).
- Ice fog/blowing snow affected aircraft missions at about 25% of time.
- Not all precip sensors measure light precip.
- Significant diffs exist in extinction measurements at the surface and likely same for aircraft ext sensors.