

# ***Summary of MIPS data sets***

*Kevin Knupp and Ryan Wade  
University of Alabama in Huntsville*

OWLeS Science Meeting  
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# Objectives of the presentation

- Describe the MIPS data acquired during the OWLeS field campaign
- Provide preliminary explanation of physical processes

# ***Overview of the MIPS configuration for OWLES***

## **1) MIPS remote sensing instruments**

- a) X-band Profiling Radar (XPR) – down between 19 and 24 Jan
- b) 915 MHz Doppler wind profiler (915) – operational throughout
- c) Microwave Profiling Radiometer (MPR) – operational throughout; cold bias in the T and water vapor retrievals, but integrated vapor and liquid good
- d) Ceilometer (Vaisala CL 51) – operational throughout
- e) Doppler Wind Lidar (DWL) – part of MIPS deployment for IOPs 1-4 and 6-7, then operational on the Shineman Center observation platform for IOP 9 and after.

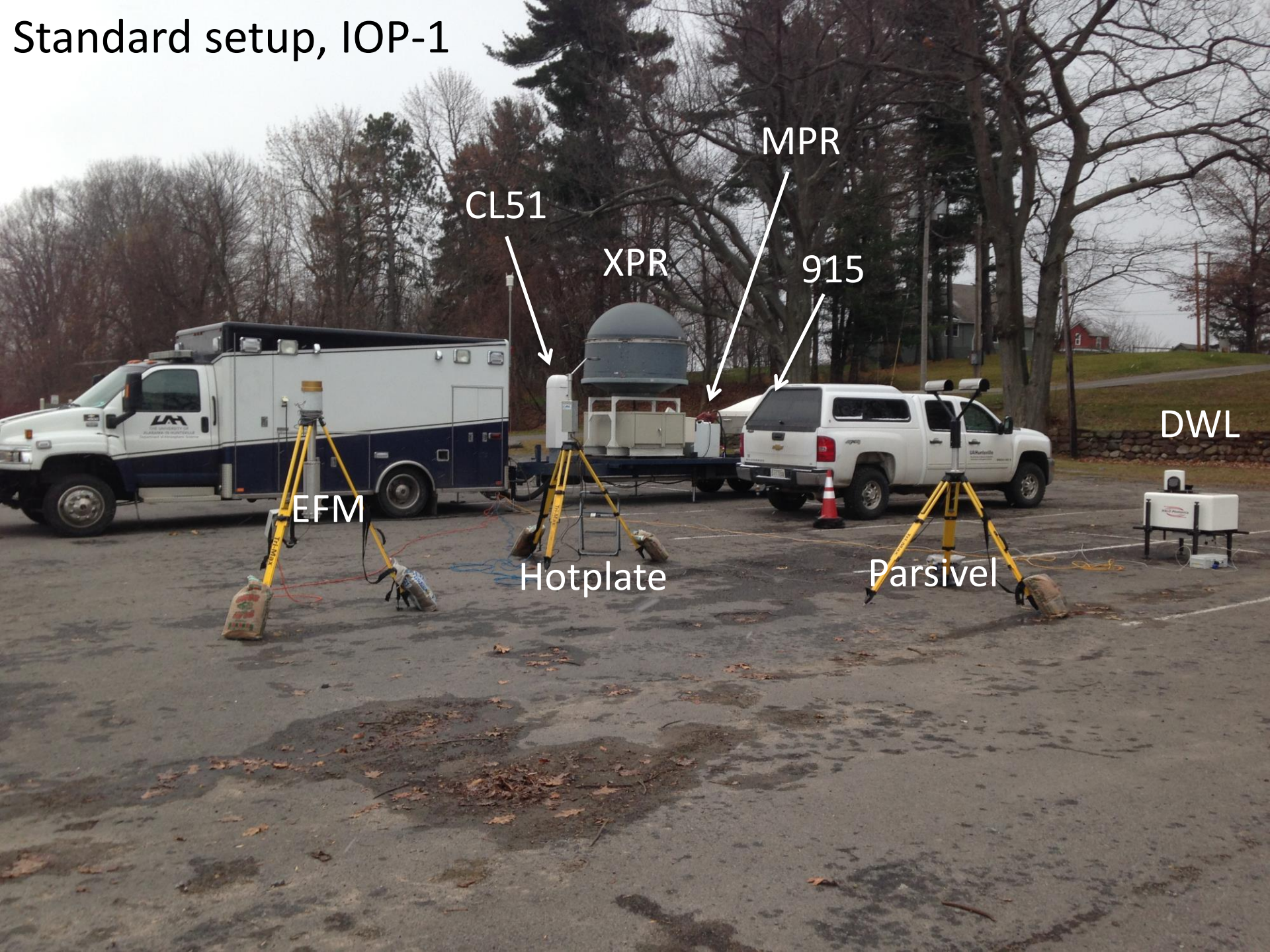
## **2) MIPS surface-based in situ instruments**

- a) Parsivel Disdrometer – occasional problems
- b) Hotplate Precipitation gage – operational throughout
- c) Electric field mill – mostly inoperational
- d) WXT-520 (T, RH, wind, pressure) down for several IOPs
- e) Precipitation Instrumentation package operated with MIPS and on Shineman Ctr

## **3) Instrument(s) at the Shineman Center**

- a) Time lapse camera (IOP 4 and after)
- b) Doppler wind lidar (after 9 Jan) – vertically pointing and profiler mode after
- c) Precipitation Instrumentation package (PIP)

# Standard setup, IOP-1



CL51

XPR

MPR

915

EFM

Hotplate

Parsivel

DWL



In situ instruments on other side of trailer

915

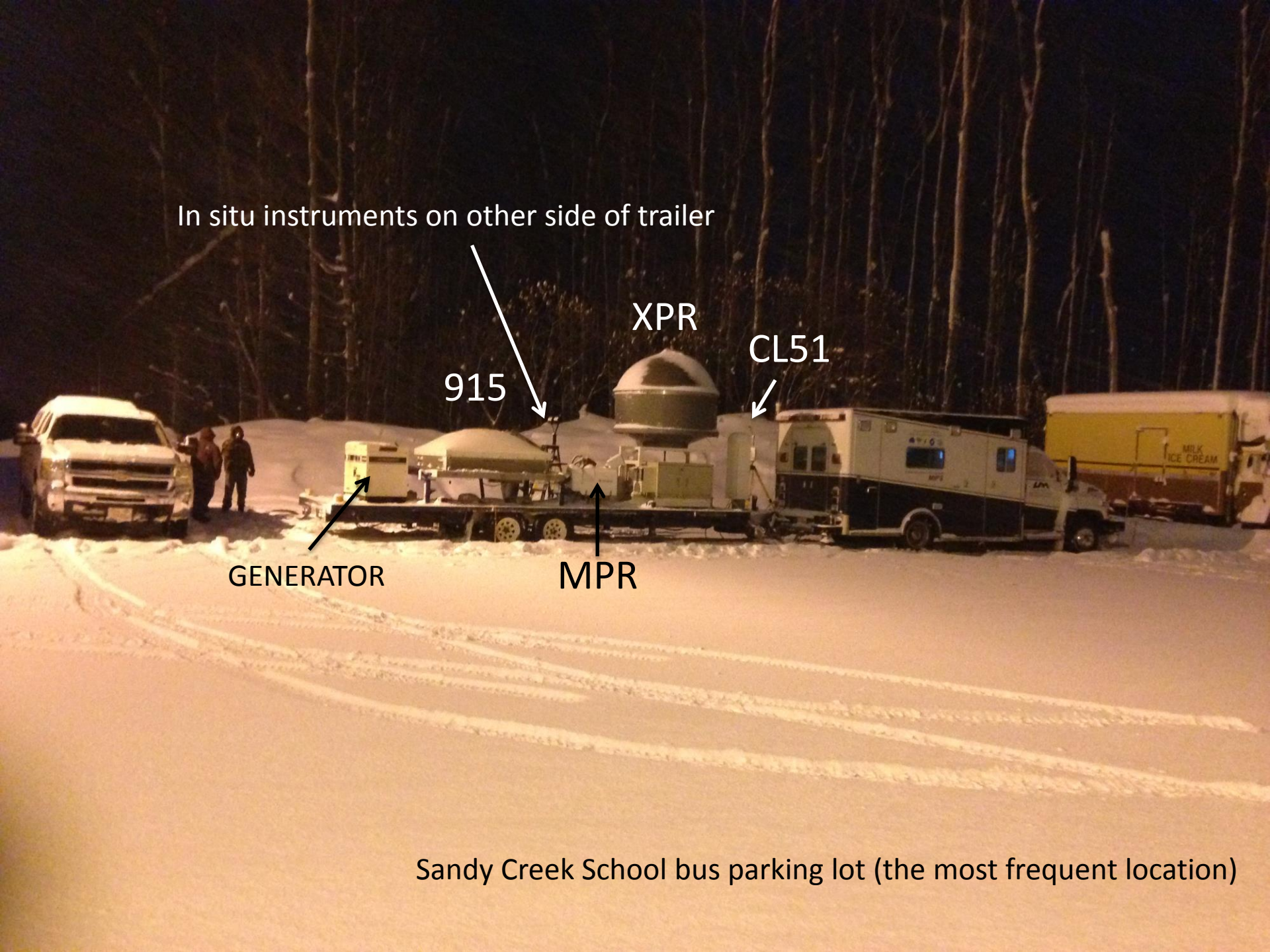
XPR

CL51

GENERATOR

MPR

Sandy Creek School bus parking lot (the most frequent location)





# Operations inside the MIPS van

It was not  
always this  
easy





# Digging out IOP-22

van

Trailer on  
the right

01/28/2014 00:54

## ***MIPS operations summary during OWLES: Some problems***

Diesel generator failure (fuel filter became clogged on several occasions)  
weather related (cold)

Broken belt in MIPS van (this belt drives many engine and van components)  
weather related (cold?) (down for IOPs 8-10)

Broken wheel bearing in MIPS trailer (down for two IOP's, operated for two  
at Sandy Creek)

Failed power supply in XPR computer (cold?)

NCAR electric field mill was not functional – configuration problems

WXT-520 had broken cable

corrosion from road chemicals

MPR provided measurements of T, RH, p (1 min resolution)

Occasional cable problems with the Parsivel disdrometer (cable connection)



But many operations went well!

Abundant data on unique observations of lake-effect snow

Score chart on the next frame provides an overview of the MIPS operations





Data files from the instruments that experienced no down time indicate the MIPS availability

**December**

5  
6  
7  
8  
10  
11  
12  
13  
14  
15  
16  
18  
19

**January**

5  
6  
7  
8 ← gap  
13  
14  
15  
16  
18  
19 ← gap  
23  
24  
26  
27

# ***915 MHz Doppler wind profiler***

## **Data:**

- a) Spectra files (binary) – example: D13350a.SPC/H13350a.SPC
  - vertical beam every 10-30 s
  - Doppler spectra
- b) Moments files (binary)
  - SNR, radial velocity, spectrum width
- c) Consensus wind files (ascii): 10 min and 30 min
  - u, v, and W ( $W = w + V_T$ ) (also quality number for u, v, W)
- d) Data formats will be available on the field catalog

## **Products:**

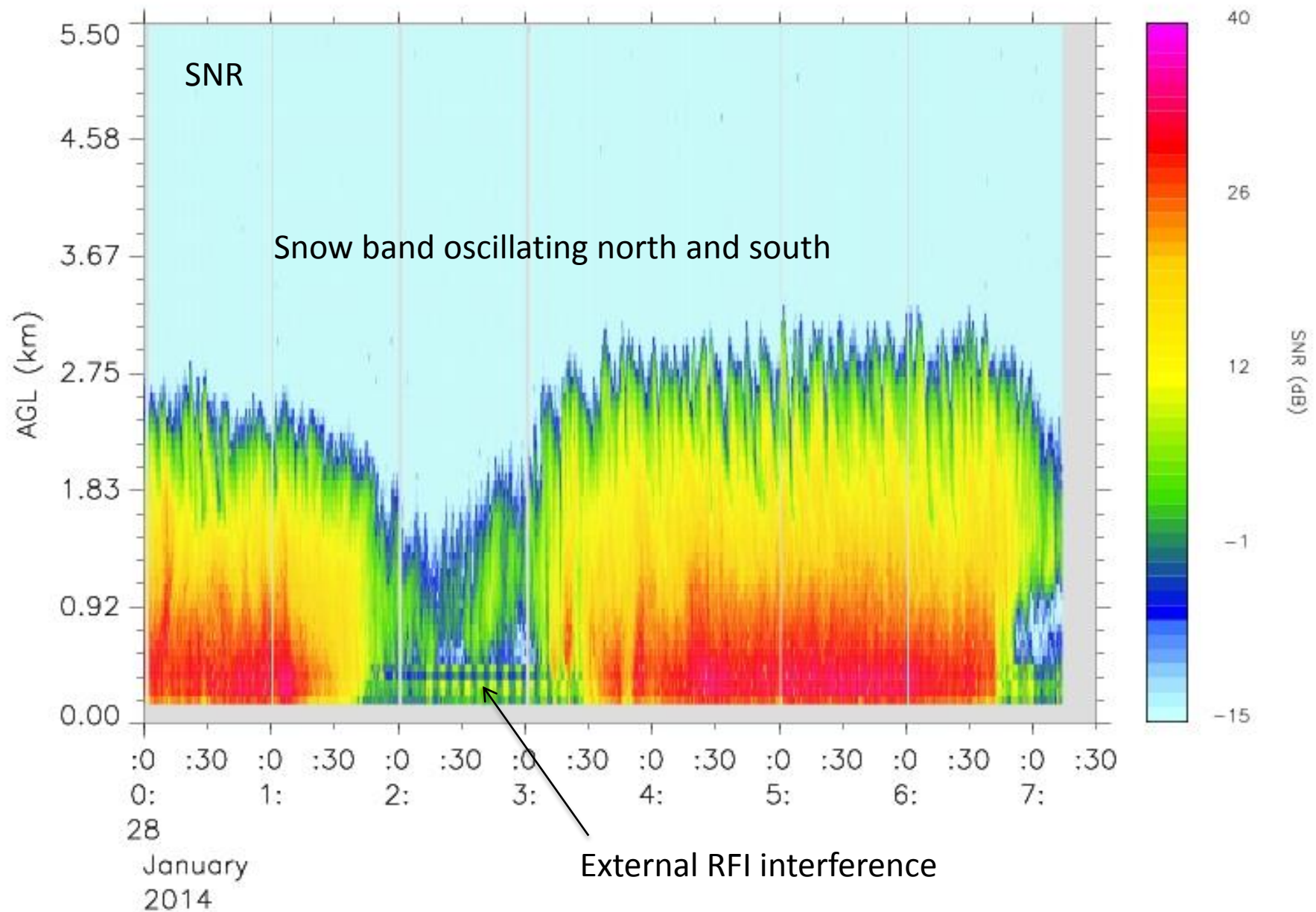
- a) Time vs height sections of
  - 10 or 30 min winds
  - moments (SNR, W, SW)
- b) Examination of spectra (proftool software; PV-Wave license)
- c) Vertical profile plots of moments (proftool)
- d) Time series plots of moments at a selected height (proftool)

Examples on the following frames

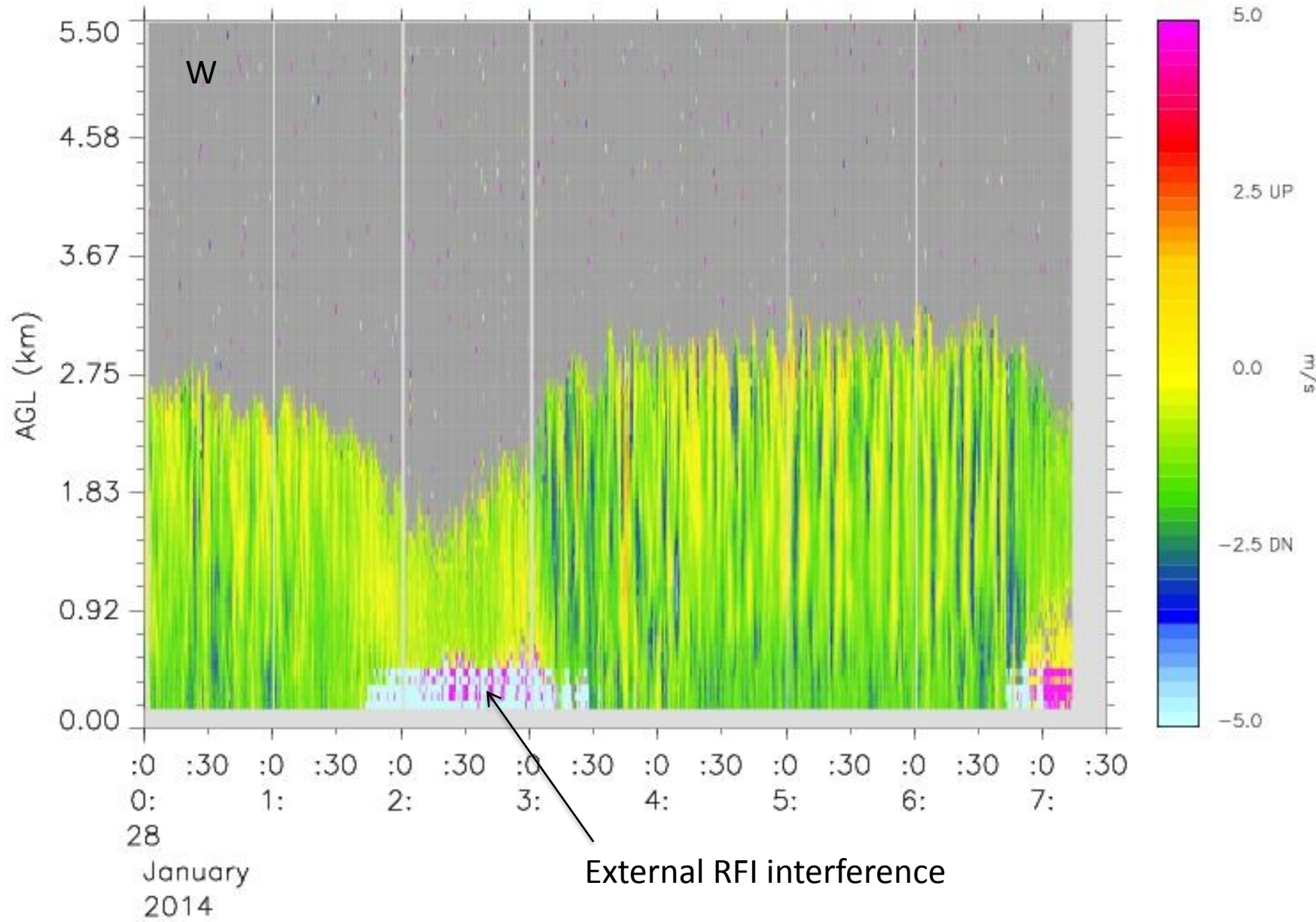


# IOP 22 (27-28 Jan) – SNR

The 915 was set to a shorter 10-s dwell time after 19 January

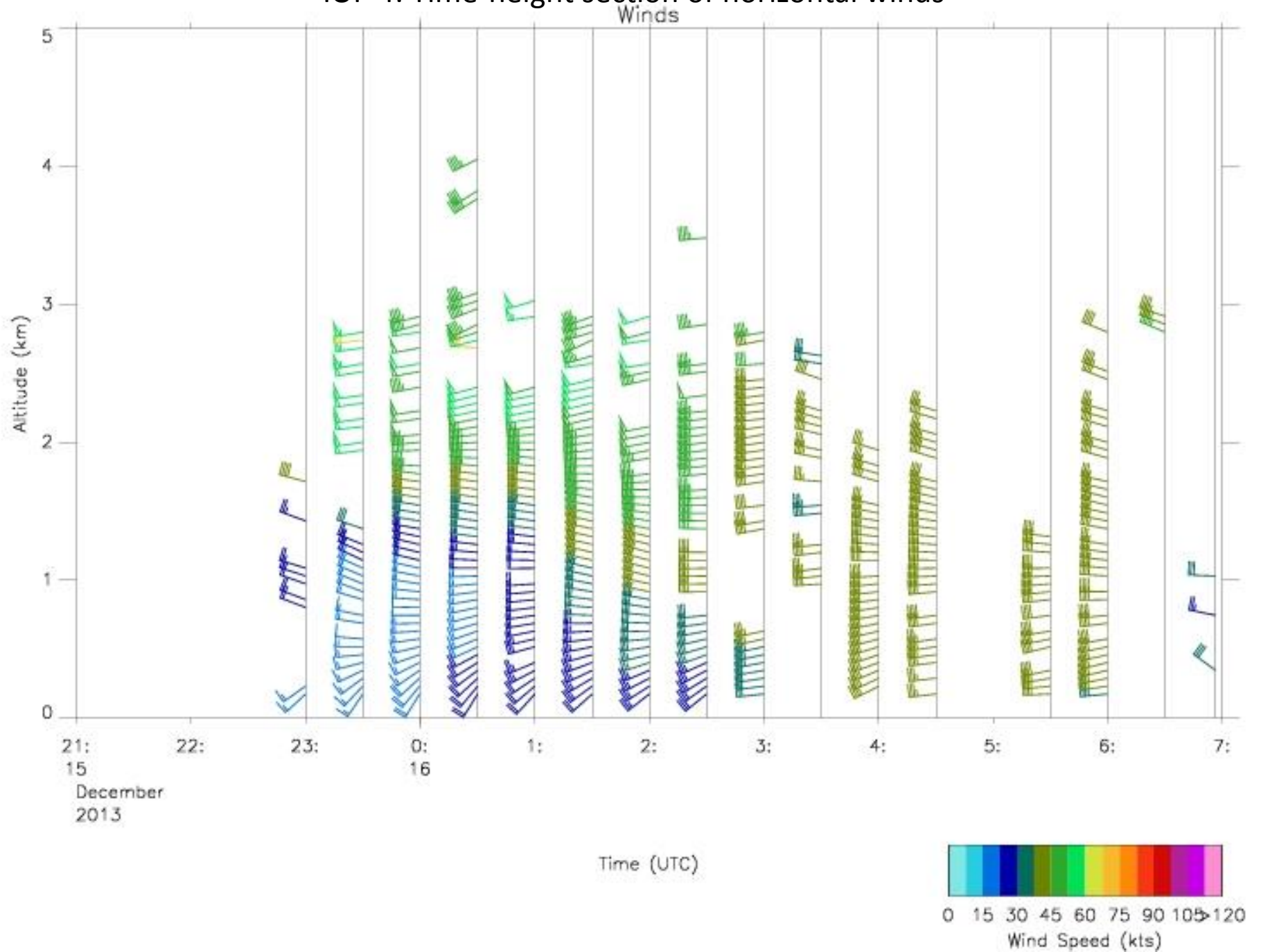


# IOP 22 (27-28 Jan) – VEL





# IOP 4: Time-height section of horizontal winds



# 915 reprocessed winds, 12/16/13 (Prefrontal)

1387173013 Consensus @ Mon Dec 16 05:50:13 2013 UTC

1387172428 Data Start Time @ Mon Dec 16 05:40:28 2013 UTC

1387173013 Data End Time @ Mon Dec 16 05:50:13 2013 UTC

Ht (m) U (m/s) uconf V (m/s) vconf W (m/s) wconf

175	16.35	0.11	1.44	0.81	0.05	1.00
232	16.49	0.10	2.34	0.79	-0.05	1.00
289	16.64	0.10	3.23	0.81	-0.14	1.00
346	16.78	0.57	3.87	0.80	-0.23	1.00
403	17.15	0.51	4.08	0.72	-0.36	1.00
460	17.68	0.47	4.18	0.16	-0.54	1.00
517	18.21	0.50	3.88	0.94	-0.70	1.00
574	18.73	0.55	3.17	0.86	-0.83	1.00
631	19.09	0.63	2.59	0.85	-0.89	1.00
688	19.10	0.46	2.19	0.81	-0.83	1.00
745	19.00	0.13	1.84	0.98	-0.75	1.00
802	19.11	0.61	1.20	0.98	-0.77	1.00
859	19.41	0.66	0.50	0.99	-0.78	1.00
916	19.68	0.92	-0.01	0.98	-0.76	1.00
973	19.73	0.31	-0.79	0.96	-0.77	1.00
1030	19.64	0.55	-1.55	0.97	-0.75	1.00
1087	18.91	0.76	-1.83	0.97	-0.48	1.00
1144	18.24	0.62	-2.46	0.94	-0.39	0.92
1201	17.72	0.58	-3.17	0.82	-0.39	0.91

# 915 reprocessed winds, 12/16/13 (Post-frontal)

1387176608 Consensus @ Mon Dec 16 06:50:08 2013 UTC

1387176021 Data Start Time @ Mon Dec 16 06:40:21 2013 UTC

1387176608 Data End Time @ Mon Dec 16 06:50:08 2013 UTC

Ht (m)	U (m/s)	uconf	V (m/s)	vconf	W (m/s)	wconf
--------	---------	-------	---------	-------	---------	-------

175	14.50	0.46	-9.93	0.29	-0.05	0.98
-----	-------	------	-------	------	-------	------

232	14.17	0.46	-9.93	0.30	0.00	0.99
-----	-------	------	-------	------	------	------

289	13.84	0.46	-9.93	0.33	0.05	0.86
-----	-------	------	-------	------	------	------

346	13.80	0.36	-9.72	0.41	0.07	0.85
-----	-------	------	-------	------	------	------

403	13.89	0.78	-9.28	0.61	0.12	0.82
-----	-------	------	-------	------	------	------

460	13.93	0.10	-8.43	0.72	0.19	0.80
-----	-------	------	-------	------	------	------

517	13.66	0.49	-7.27	0.81	0.27	0.78
-----	-------	------	-------	------	------	------

574	13.86	0.35	-6.25	0.40	0.22	0.82
-----	-------	------	-------	------	------	------

631	13.83	0.37	-5.36	0.19	0.18	0.83
-----	-------	------	-------	------	------	------

688	13.79	0.72	-4.24	0.65	0.18	0.82
-----	-------	------	-------	------	------	------

745	14.37	0.53	-3.80	0.46	0.12	0.84
-----	-------	------	-------	------	------	------

802	14.79	0.62	-3.68	0.00	0.09	0.88
-----	-------	------	-------	------	------	------

859	15.40	0.62	-3.45	0.00	0.08	0.80
-----	-------	------	-------	------	------	------

916	15.69	0.89	-2.82	0.76	0.17	0.73
-----	-------	------	-------	------	------	------

973	15.67	0.28	-3.29	0.76	0.28	0.65
-----	-------	------	-------	------	------	------

1030	15.53	0.43	-4.06	0.67	0.38	0.66
------	-------	------	-------	------	------	------

1087	15.54	0.37	-4.59	0.42	0.43	0.73
------	-------	------	-------	------	------	------

1144	15.33	0.47	-5.15	0.22	0.41	0.29
------	-------	------	-------	------	------	------

1201	15.45	0.29	-5.71	0.13	0.30	0.00
------	-------	------	-------	------	------	------

## ***CL51 ceilometer***

Two products (data files, 15-s resolution):

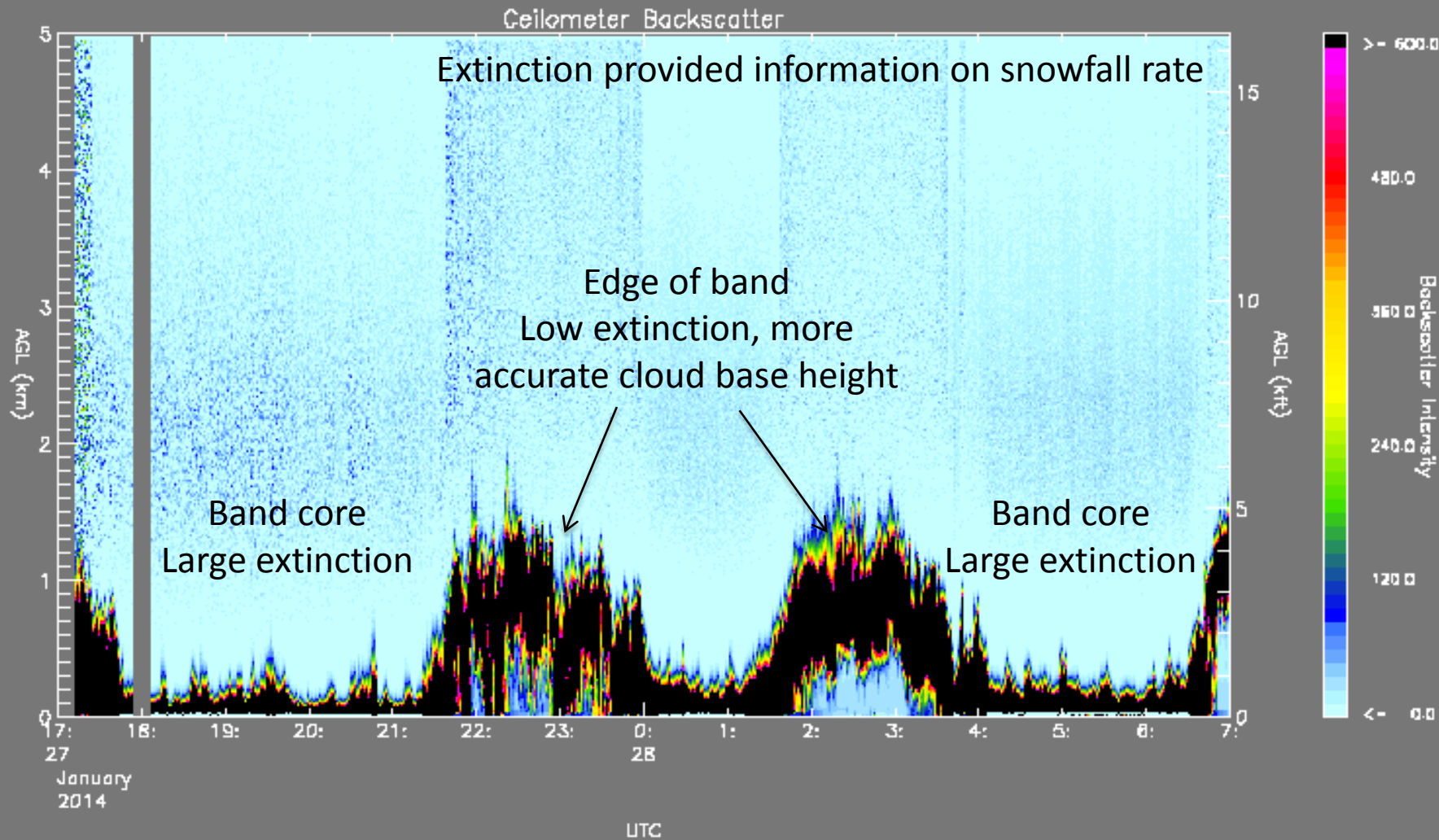
- 1) Backscatter intensity profile (ascii)
- 2) Cloud base, up to three cloud base heights (ascii)

Again, documentation will be on the field catalog and our MIPS web site:

clo\_data\_description.doc  
readme.ceilometer



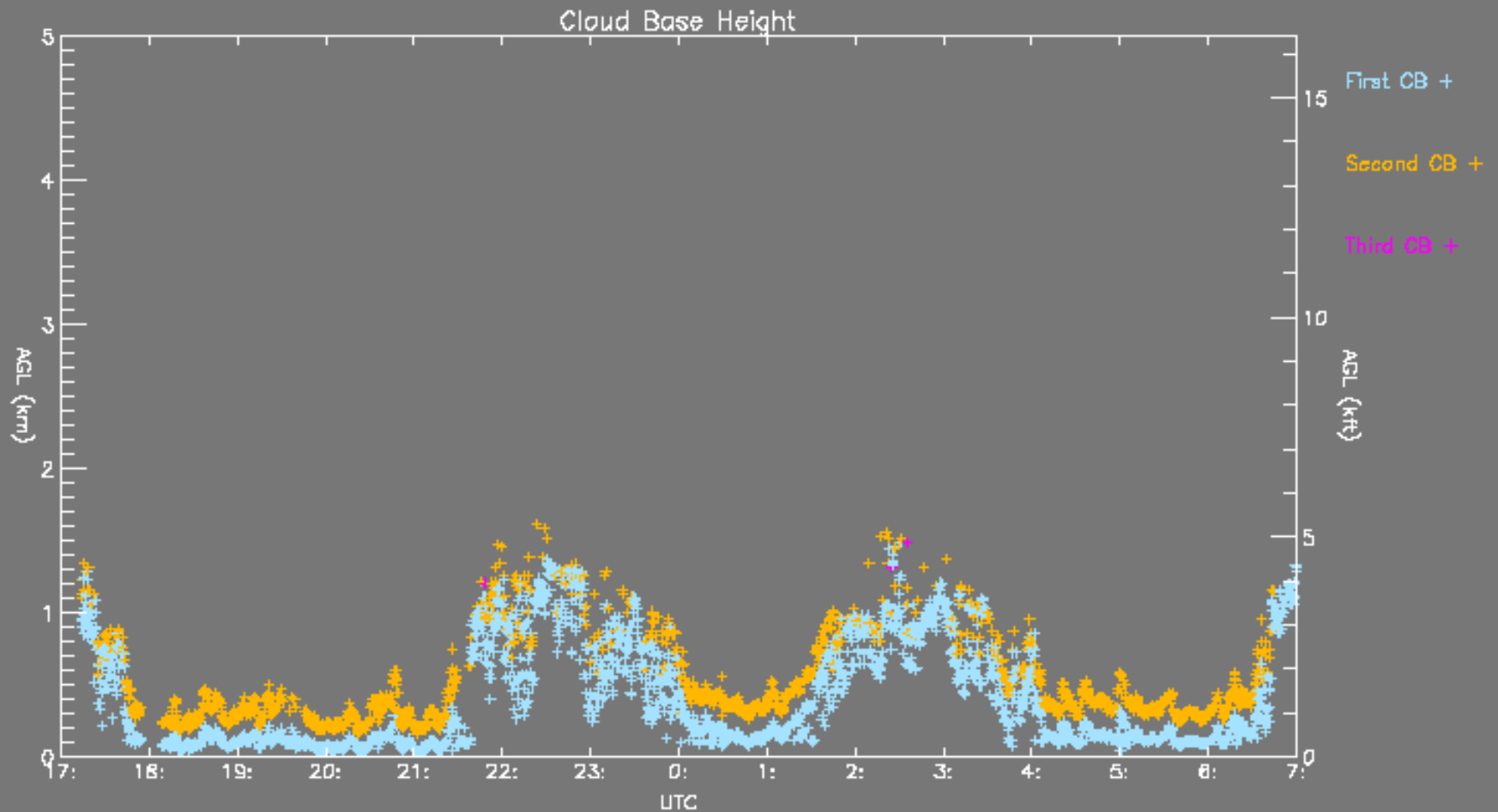
# CL51 Attenuated backscatter, IOP-22



01/27/2014

01/28/2014

# Cloud base (first, second, third) , IOP-22



01/27/2014

01/28/2014

# *Doppler wind lidar*

## File days

December: 5, 6, 7, 8, 10, 11, 12, 13, 15, 16

January: 6, 7, 8, 9, 14, 16, 17, 19, 21, 22, 23, 24, 25, 26, 27, 28

## Operational modes:

- Vertically pointing only when deployed with the MIPS
- Vertically pointing and 180° RHI initially at Shineman
- Vertically pointing and wind profiler mode starting on 16 Jan
  - 3 beams as in 915 profiler (vertical, 30° nadir angles with 90° separation in azimuth)
  - Cycle: vertically pointing for 9 min, profiling mode for 1 min

# ***Microwave profiling radiometer (MPR)***

Usually 1 file per Julian day

Format: ascii

File contents:

- a) Time series of T, RH, p,  $T_{IR}$ , rain, IWV, ILW
- b) Profiles (time-height sections) of T, RH,  $\rho_v$ ,  $\rho_{liq}$

$\Delta t = 1 \text{ min}$

Notes:

- IWV and ILW appear to be good (physical consistency)
- Inconsistent cold bias in T profiles; will be working on this, but we need soundings for comparison



# X-band Profiling Radar (XPR)

Raw data have a .SCAN extension; one file per run time (as long as the xpr runs continuously without breaks; restarting the XPR creates a new file. (The temporal resolution is 0.17 s.)

Processed data have been reformatted to universal format (uf)  
- about 5 min of data per file (binary)

Examples in the following frames

# ***Hotplate precipitation gage***

One data file per IOP

ascii format, 1 s temporal resolution

Has a warm-up time, so beginning of file may have zeroes

Example record:

T 001,1390847029,0000000,10.70,00000.26,-08.1,-03.4,01.2\*3C8C

X xxx, time code, , rate, accum ,  $T_{top}$  ,  $T_{bot}$  ,wind spd

# ***Webcam***

Pointing towards lake from Shineman Ctr observation platform

5 megapixel camera,

Dec 10, 12, 14, 16, 16, 17, 18, 19, 20, 21, 22, 23, 24, 28, 29, 30, 31

Jan 1, 2, 3-, 4-, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20,  
21-, 22 23, 24, 25, 26, 27, 28

Format: jpeg, mp4

# *Parsivel*

10 s sampling

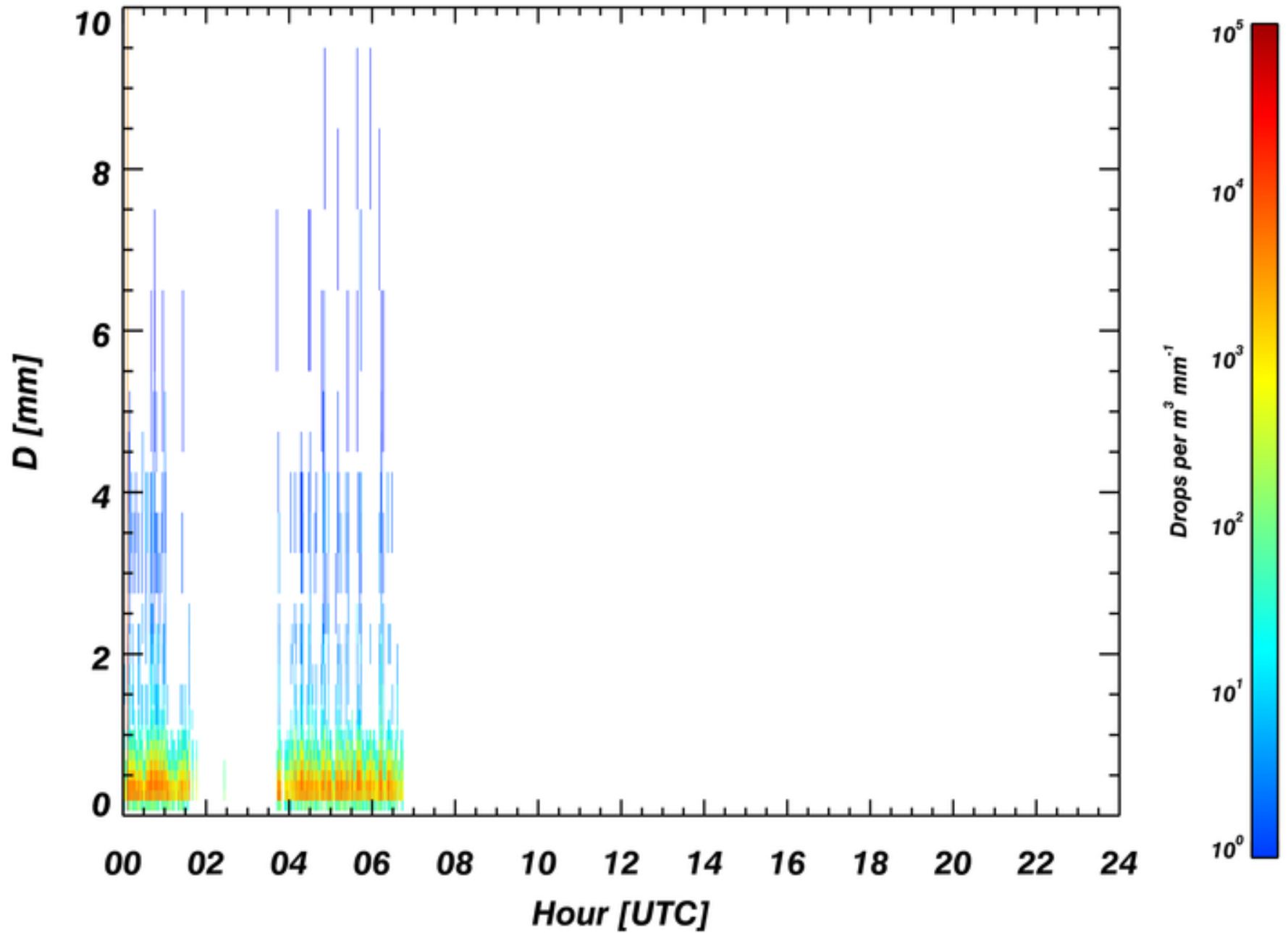
Ascii file

Provides:

- a) size spectrum: number of particles per particle size interval
- b) terminal fall speed
- c) plots of size vs fall speed can delineate particle habits  
(graupel, dendrites, etc.)

IOP 22

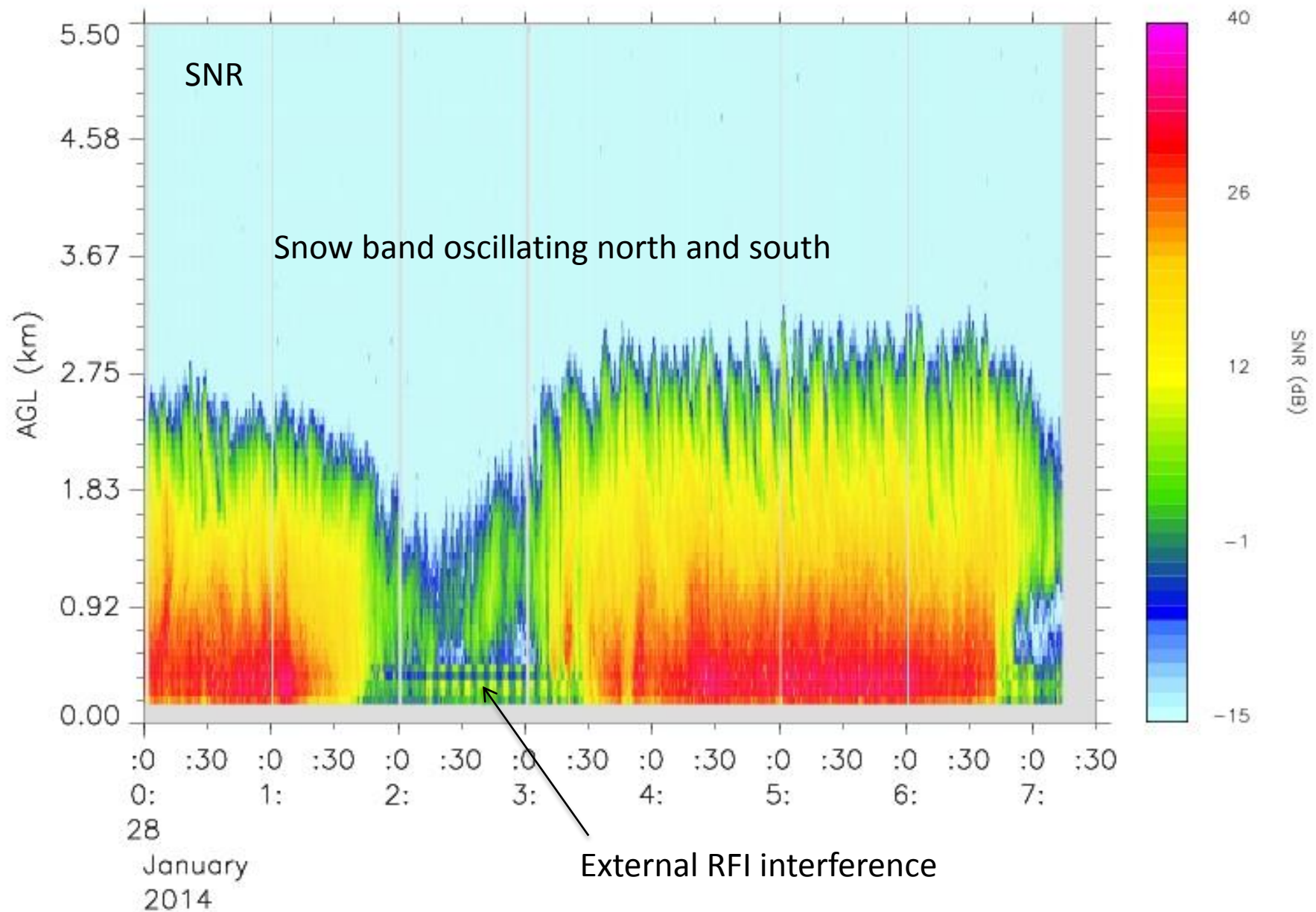
Parsivel<sup>2</sup> 2014 01/28





# IOP 22 (27-28 Jan) – SNR

The 915 was set to a shorter 10-s dwell time after 19 January



# ***Summary of the MIPS IOPs***

## ***The “A” cases:***

IOP 1 (A) – convection structures were very well resolved (but not much precip was generated)

IOP 2 (A+) – waves atop convective elements in a LLAP band

IOP 4 (A) – LLAP band passage over MIPS along cold front

IOP 5 (A) – redevelopment of the east end of a LLAP band over the MIPS, with much graupel

IOP 6 (A) – data collection ended early due to van belt failure, but data collection in progress during lightning in close proximity

IOP 14 (A) – broken wheel bearing, but collected data from Sandy Creek

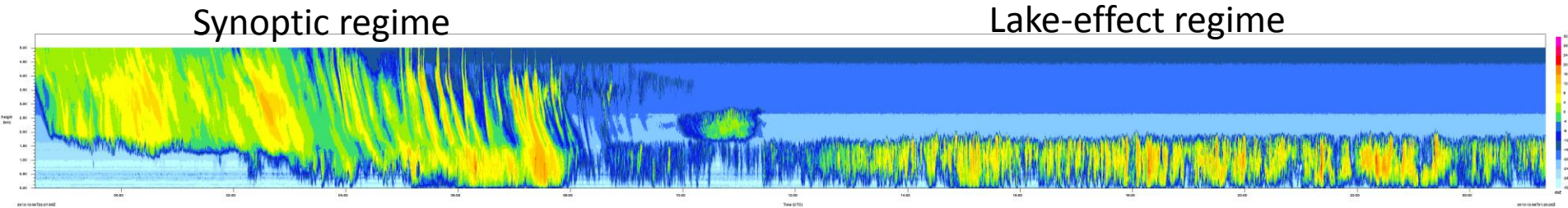
IOP 15 (A) – data collection of frontal passage from Sandy Creek

IOP 22 (A+) – long term sampling of LLAP band, all instruments functional, snowfall total ~14 in)



# IOP 1 (A)

Even though this was a “warm-up” IOP, interesting structures on convection were sampled. The MIPS started ops on the previous evening to sample “synoptic” snow to examine the contrast with convective lake-effect snow. This is shown in the following XPR image:



Height: 0-5 km AGL

Time: 2200 UTC 12/8 to 0200 12/8 (Total: 28 hr)

All instruments operational (no PIP, no time lapse)

# IOP 2 (A+)

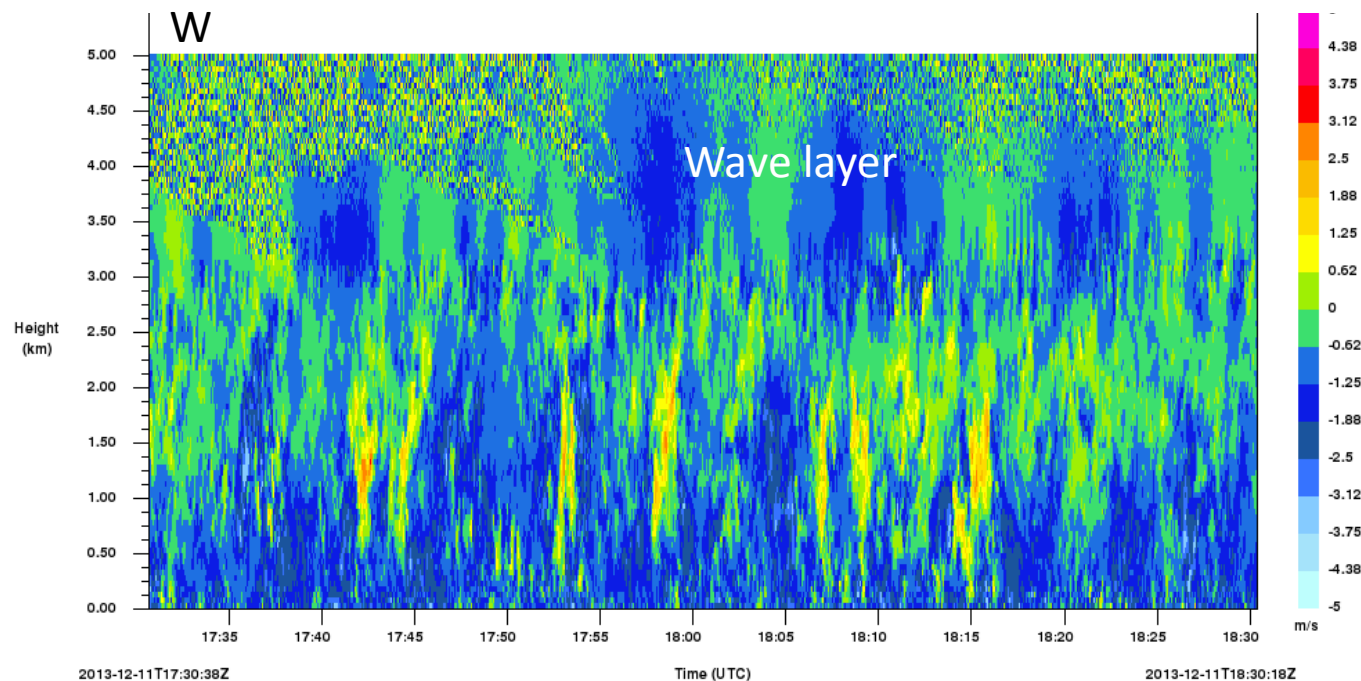
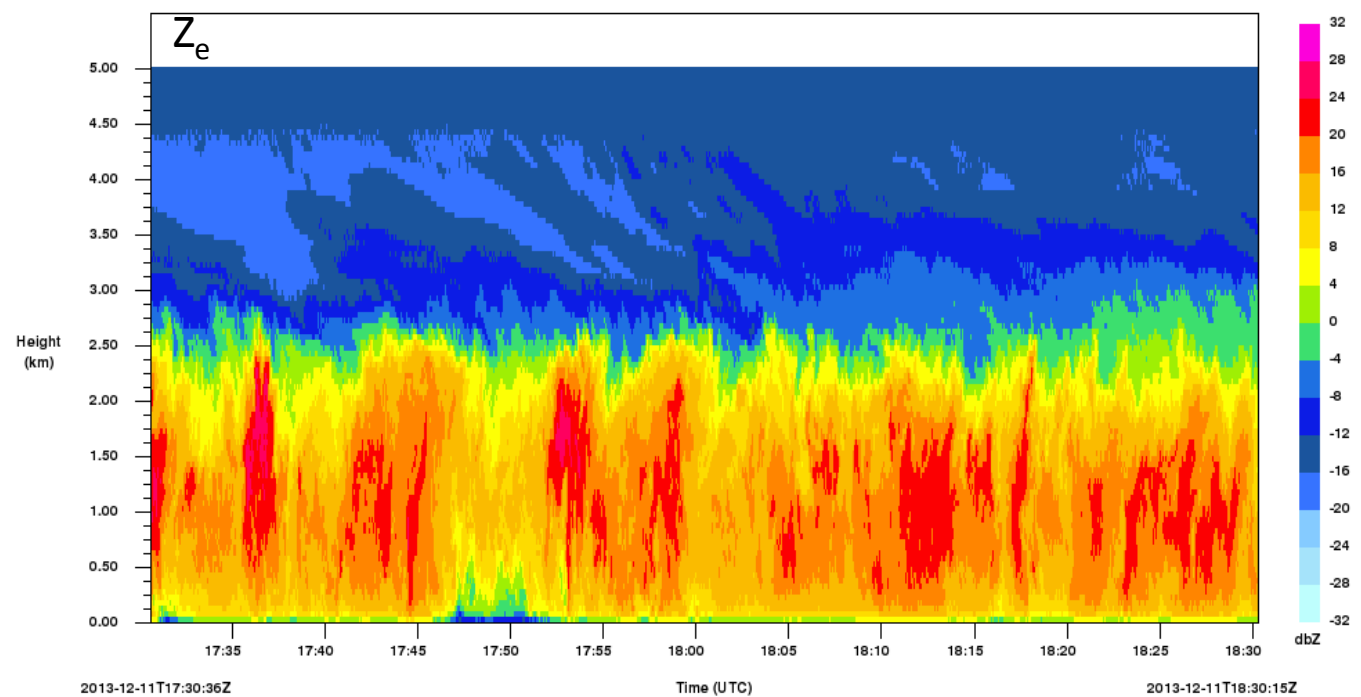
- 11 December 2013
- Gravity waves above the cloud-topped mixed layer
- XPR observations are shown in the following two frames



# XPR

1-h time-height  
1730-1830 UTC

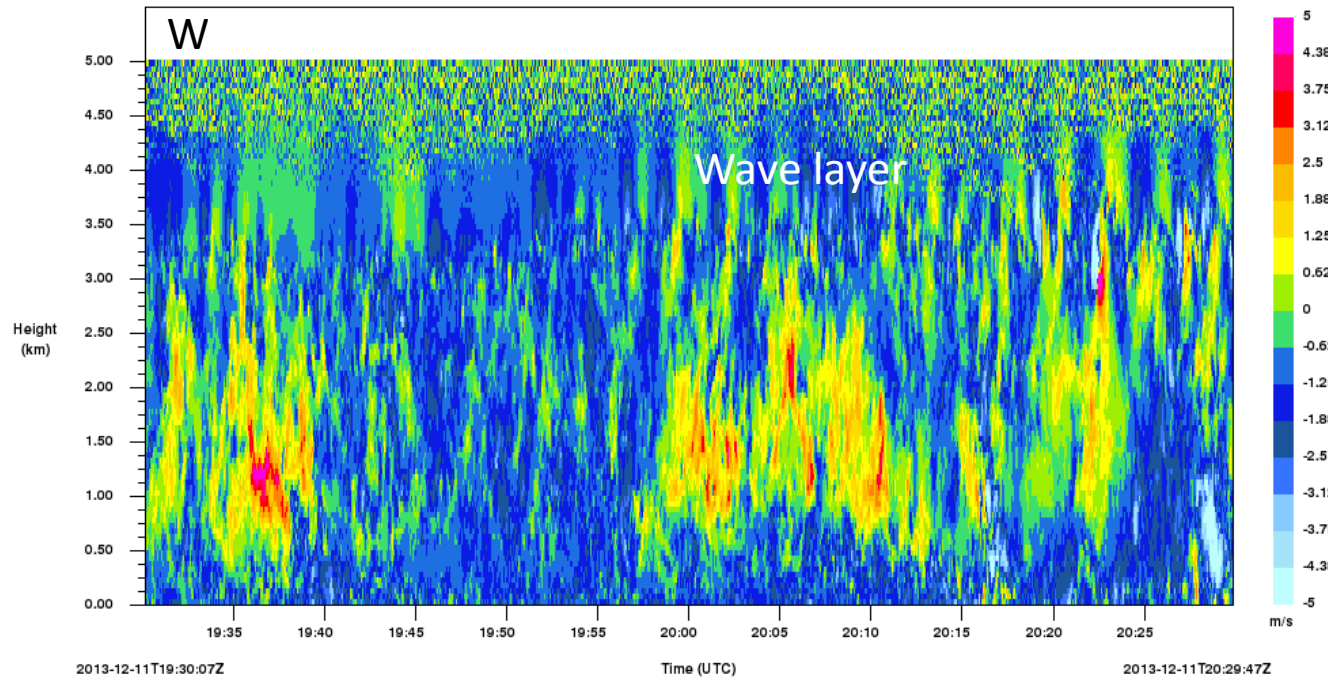
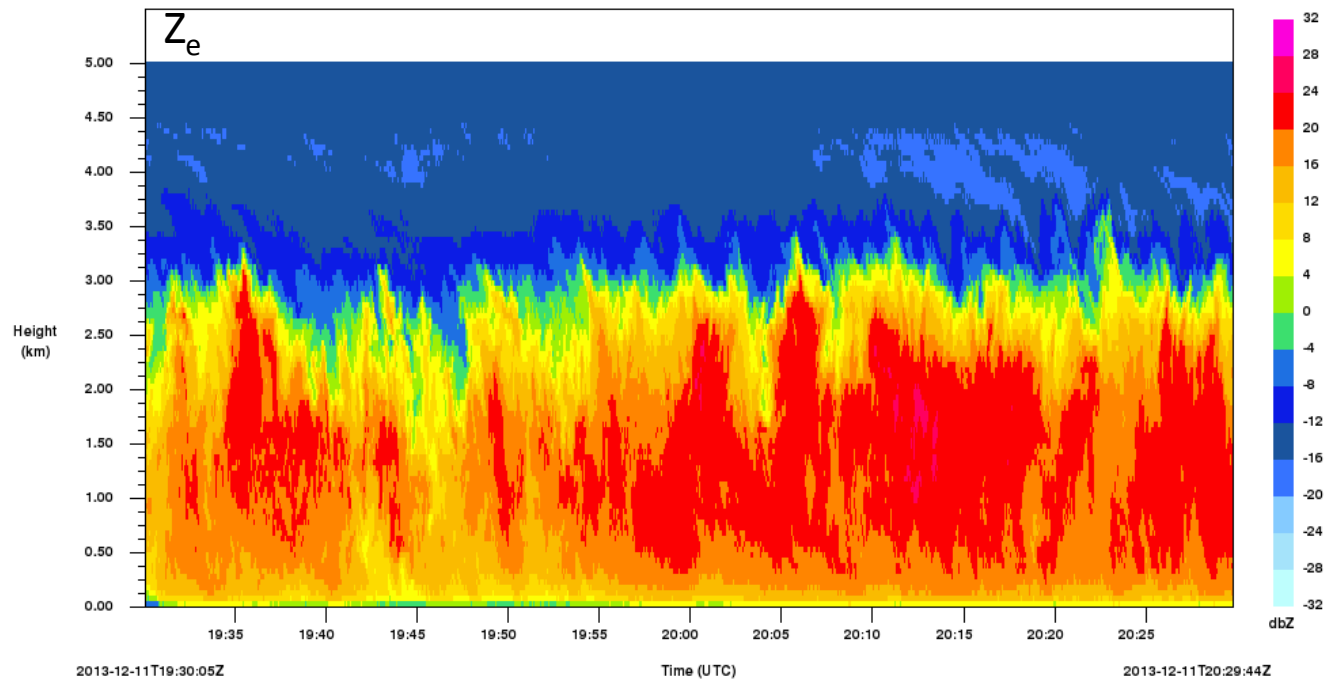
- Relatively intense convection, topped by gravity waves
- A layer of ice cloud (very low Z values,  $\sim -10$  dBZ) are shown above the cloud-topped mixed layer
- Note:  $W = w + V_T$



# XPR

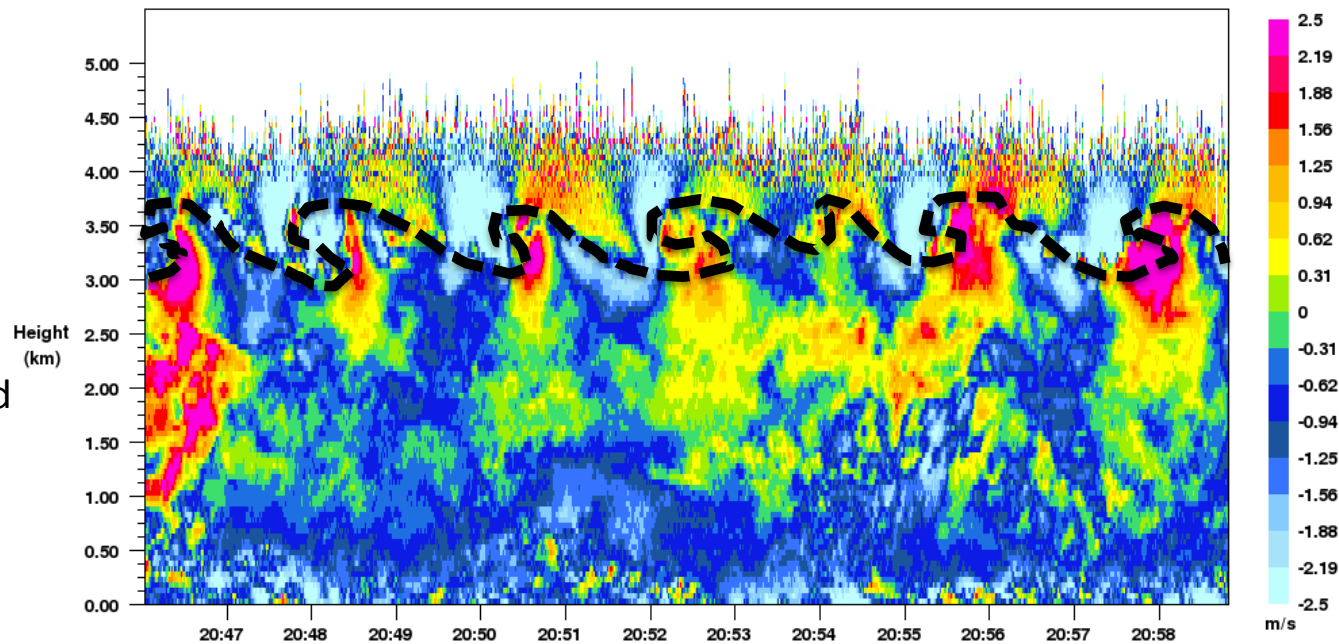
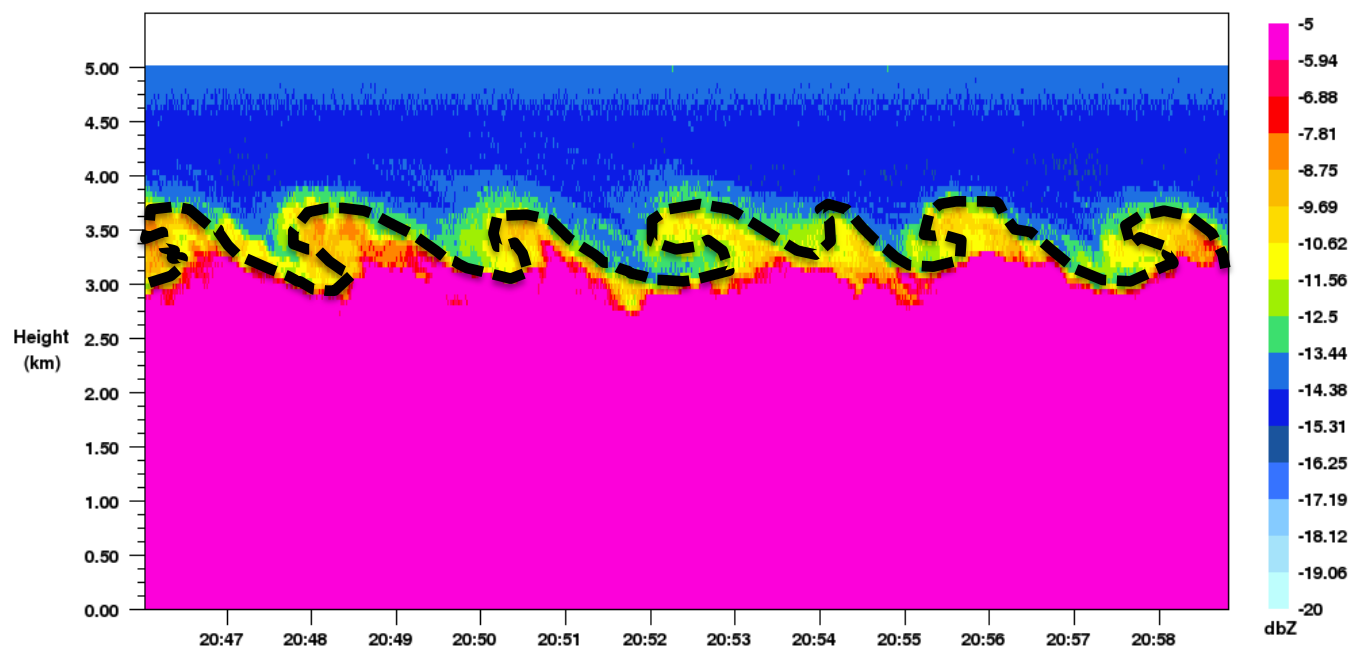
1-h time-height  
1930-2030 UTC

- Convection is more intense, gravity waves have shorter period



IOP-2  
(Sandy Creek)  
2045-2100 UTC

- 15min Time-Height cross-sections of Reflectivity (Z) and Vertical Radial Velocity (Vr)
- Relatively intense convection, topped by gravity waves
- A layer of ice cloud (very low Z values of  $\sim -10$  dBZ) existed above the cloud-topped mixed layer



Heavy snow during IOP2



# IOP 4 (A)

- 15 December 2013
- LLAP band formed over MIPS (located on Oswego campus) and moved northward; remained over lake for several hours
- Rapid southward movement over MIPS along cold front near the end of the IOP
- Details will be provided by Ryan Wade this afternoon



# IOP 5 (A)

- 18 December 2013
- Initial squall was sampled by the MIPS
- Unexpected intensification of a band over the MIPS near the end of the IOP
- Graupel was prevalent in the most intense convective cells (temperature within the cloud-bearing layer was warmer)

IOP-5 (Sandy Creek)

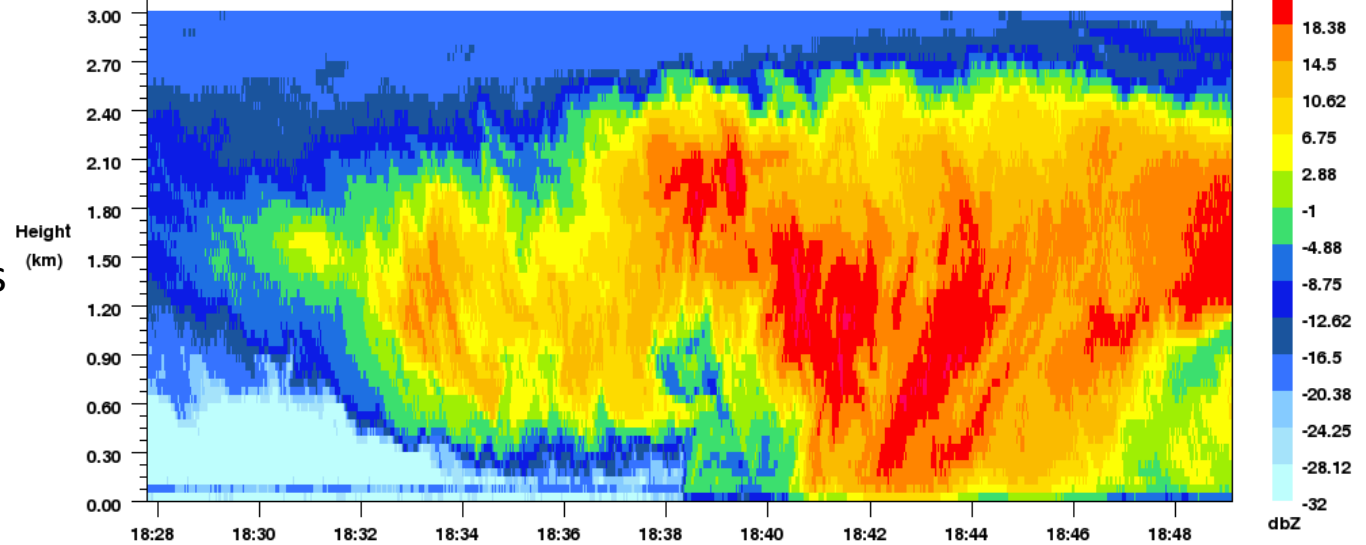
18 Dec

1828 – 1848 UTC

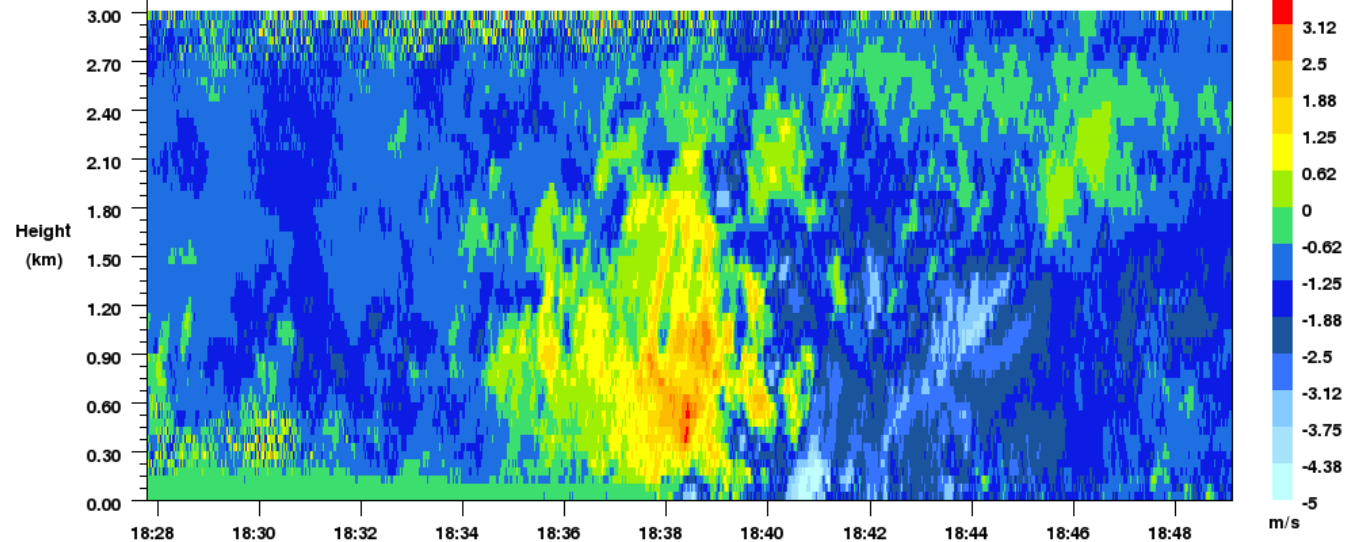
Snow squall

- 20min time-z sections of Z & W
- Initial squall accompanied by gust winds and graupel
- Weak echo region, updraft followed by downdraft
- similarity to QLCS.

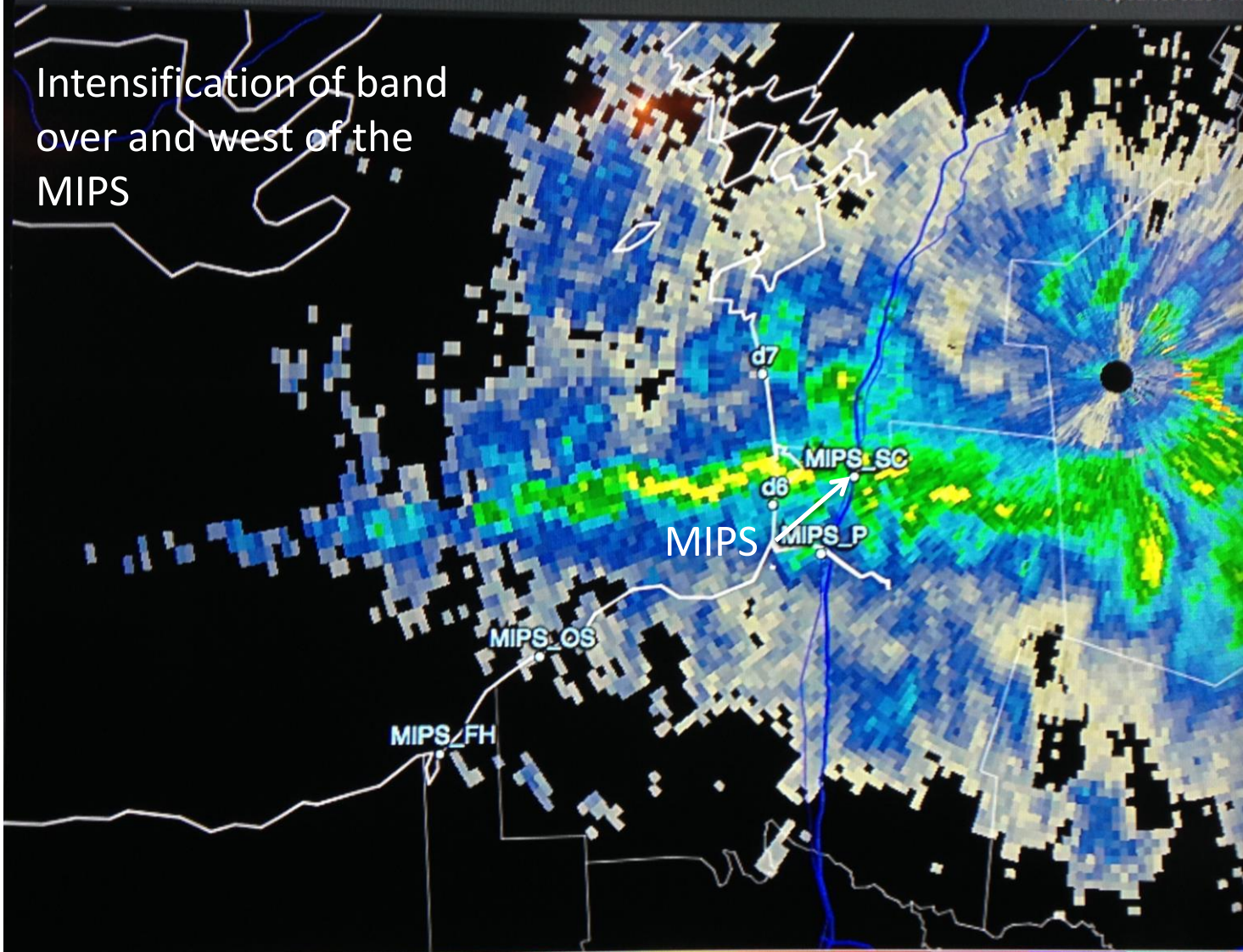
**Refl. – 18 Dec 2013**

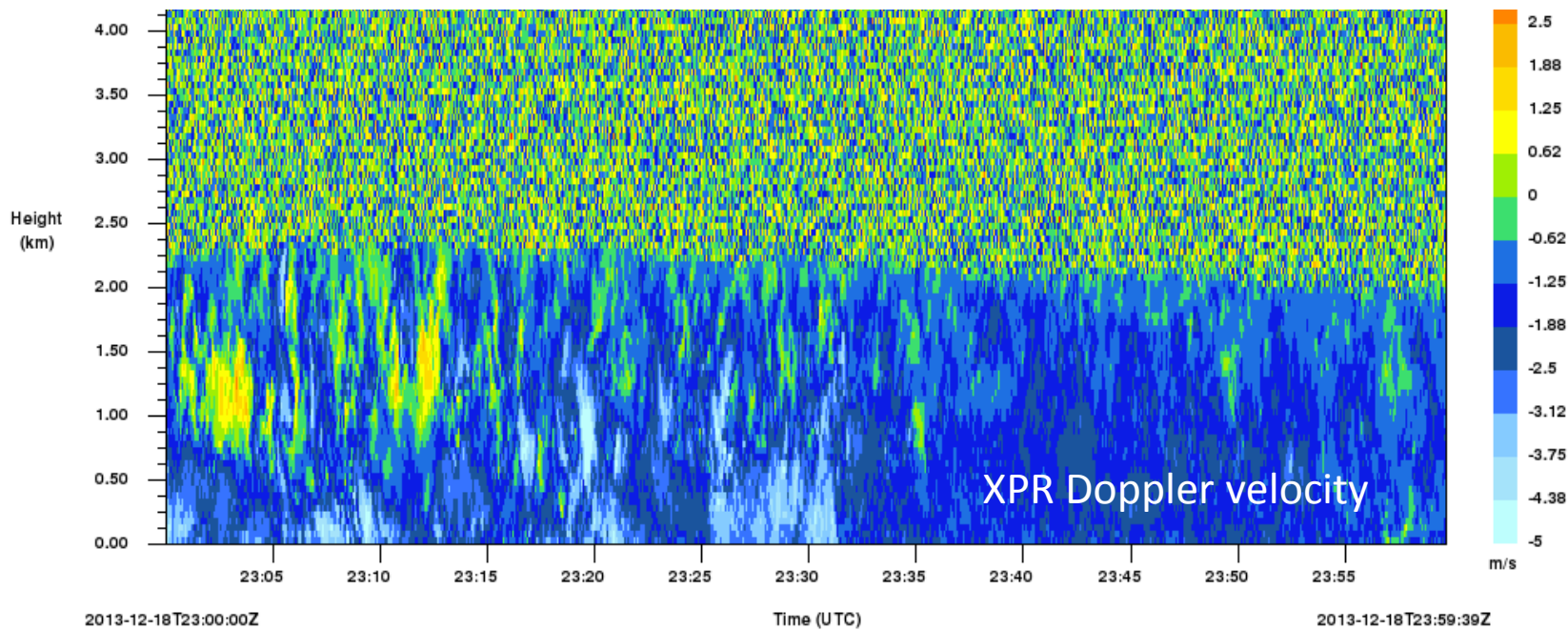
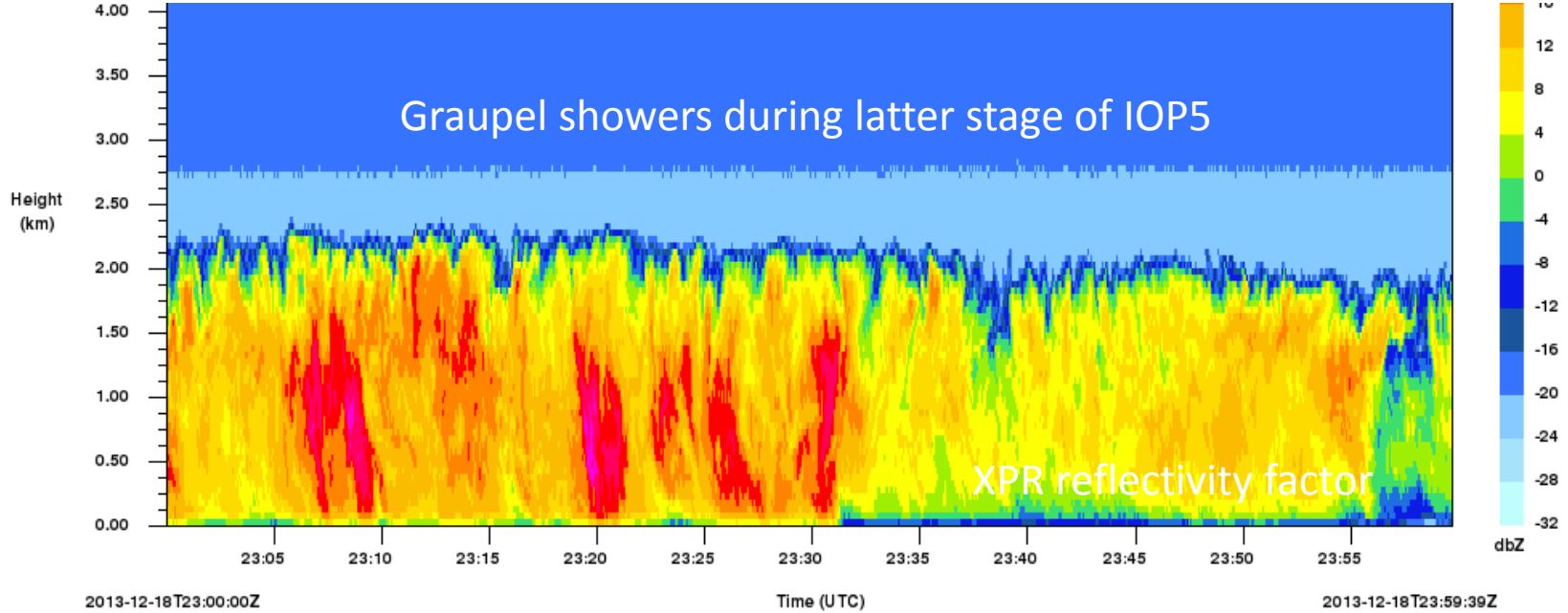


**VVel. – 18 Dec 2013**



Intensification of band  
over and west of the  
MIPS







# Prevalence of graupel during the latter stage of IOP5





# Parsivel disdrometer measurements are characteristic of graupel

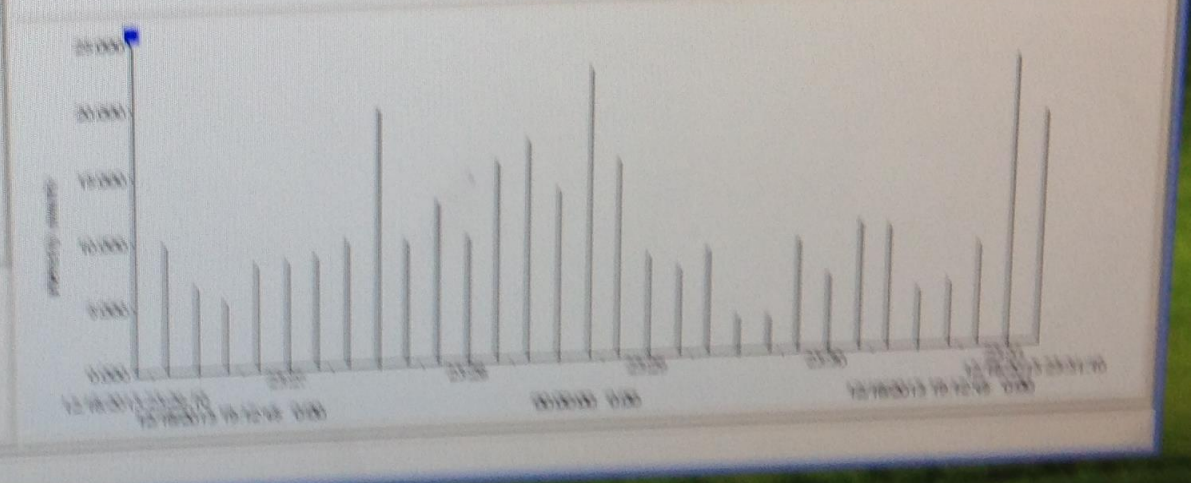
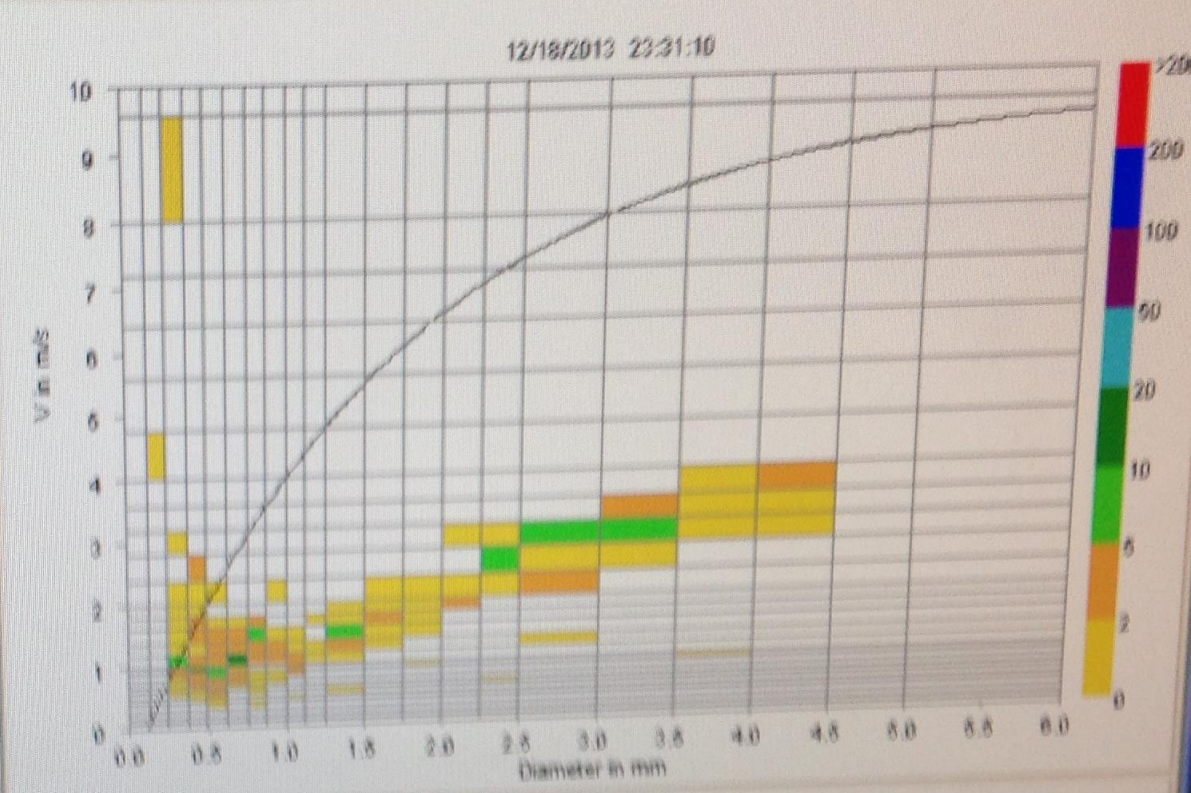
Current Weather  
12/18/2013  
23:31:10  
Heavy Small Hail



Current Status | Static Info

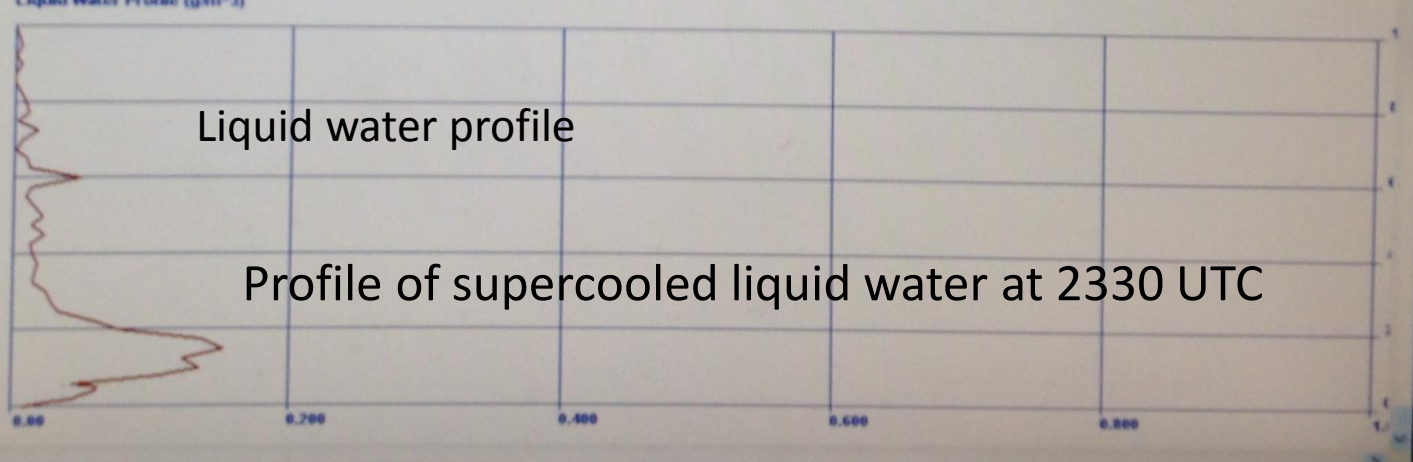
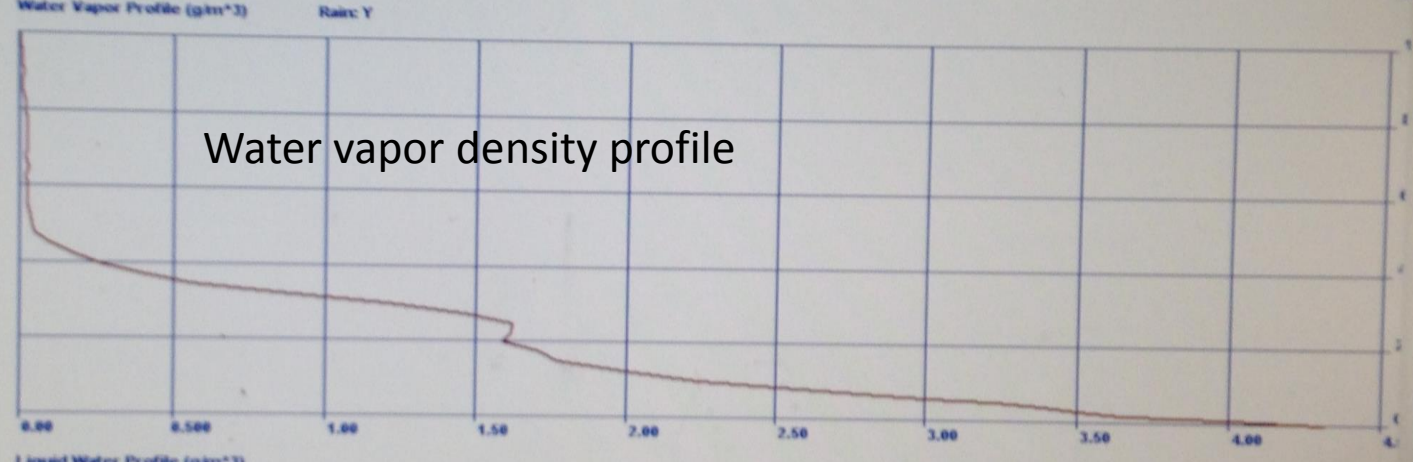
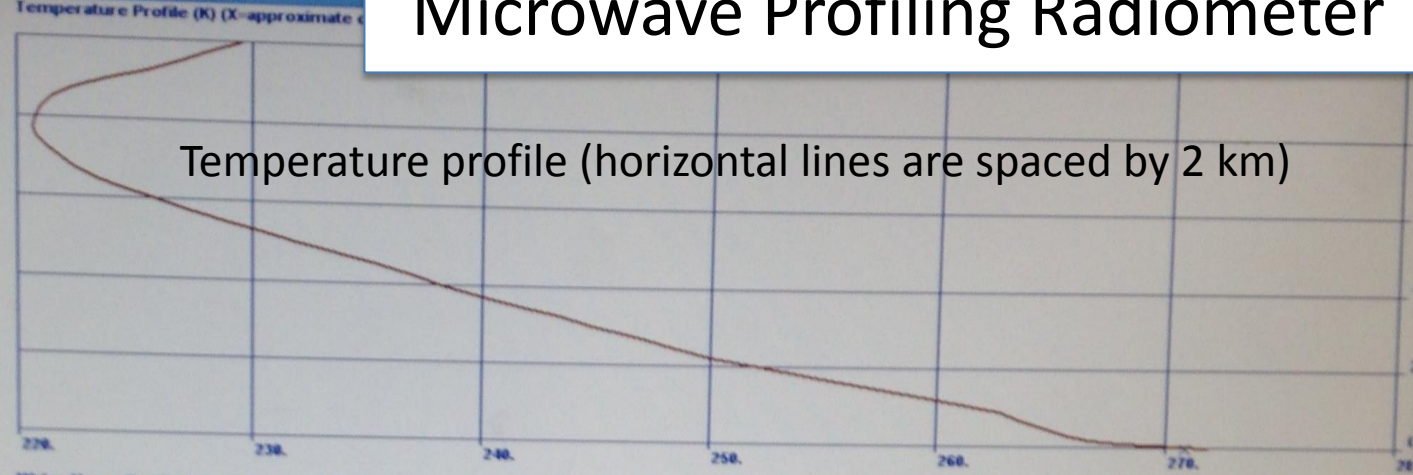
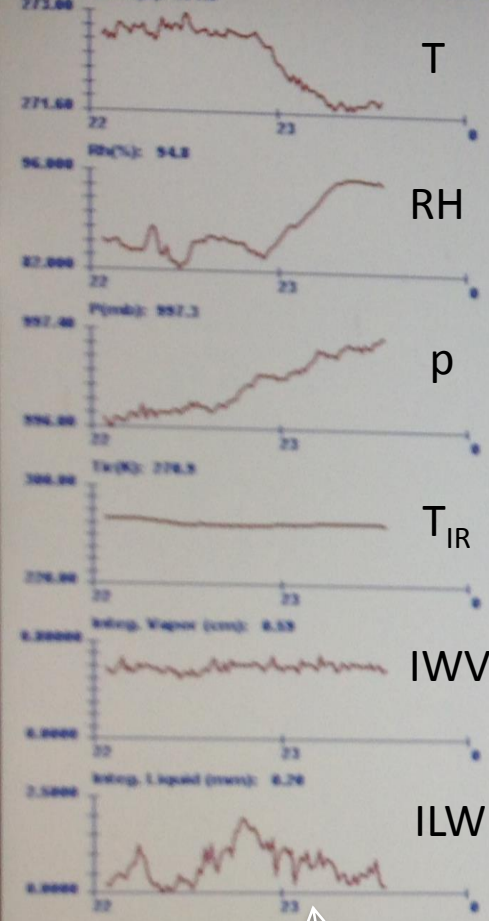
Name	Value
Intensity (mm/h)	0017.845
Precipitation since start (mm)	0012.55
Weather code SYNOP WaWa	88
Weather code SYNOP WW	88
Weather code METAR/SPECI	4GS
Weather code NWS	SP
Radar reflectivity (dBz)	38.447
MOR Visibility (m)	00310
Measuring interval	00010
Signal amplitude of Laserband	25427
Number of detected particles	00281
Temperature in sensor (°C)	-04
Heating current (A)	2.00
Sensor voltage (V)	10.4
Sensor status	0

Time Range: 5 min





# Microwave Profiling Radiometer



Integrated liquid water remained high, peak value of 1.4 mm

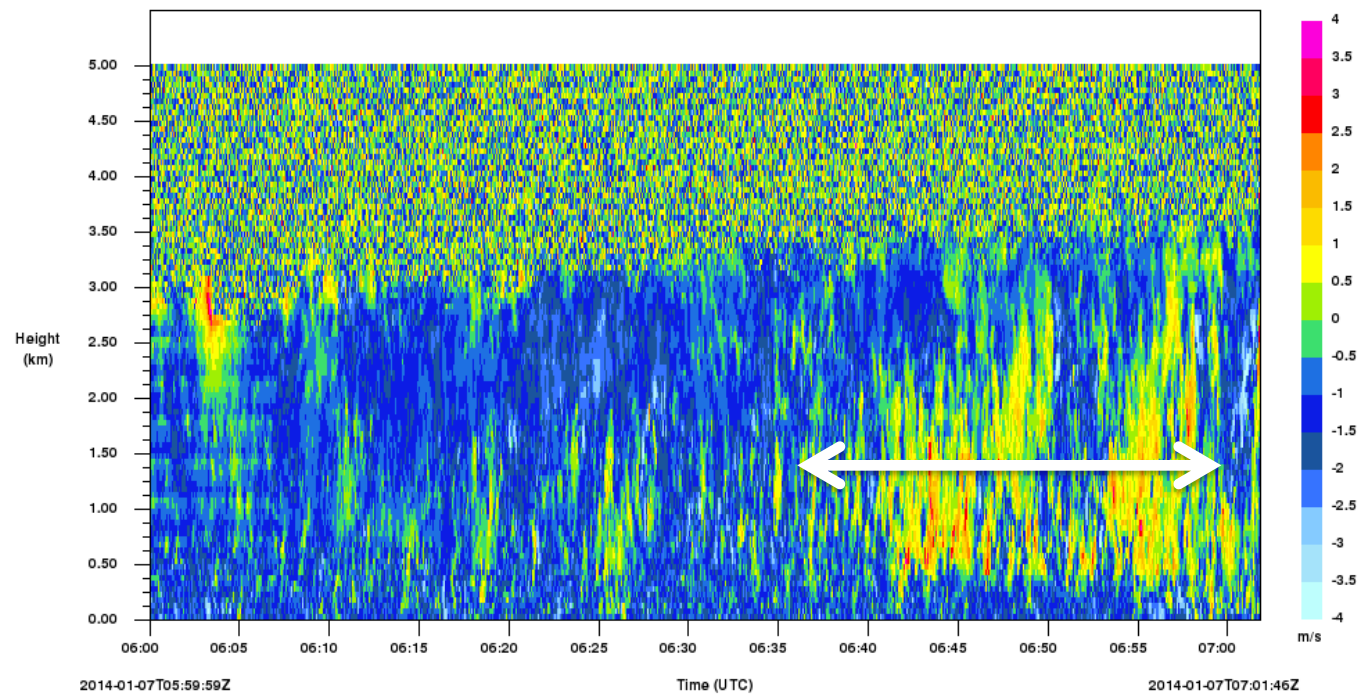
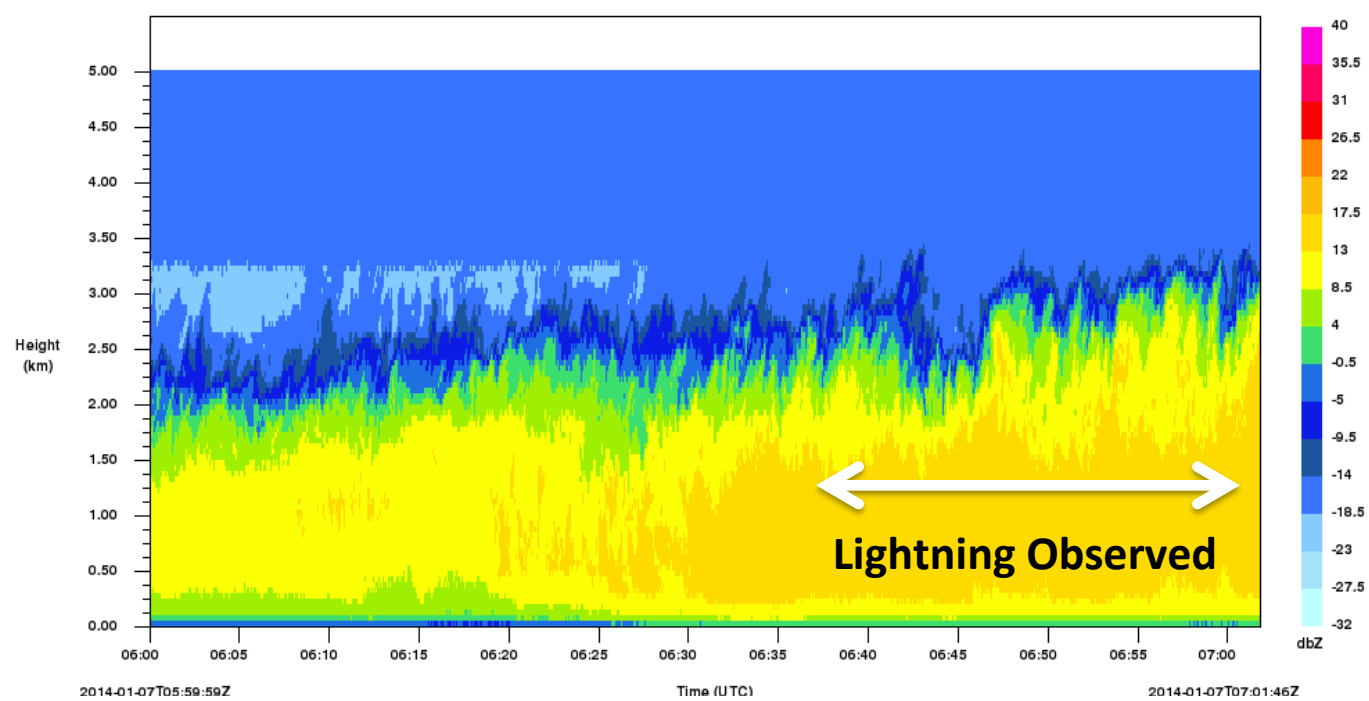
Black body cal in Progress...  
CURRENT ACTION:  
00 OCMD

Type Q to quit  
after current file

# IOP-7 (Sandy Creek)

07 Jan  
0600-0700 UTC

- 1-h t-z sections of Z & W
- Lightning observed at MIPS, and sounding/snow teams.
- Velocity trends toward sustained updrafts of 4-6 m/s.



IOP 22, Mexico City, 27-28 Jan (A+)

1700 (1/27) – 0700 (1/28)

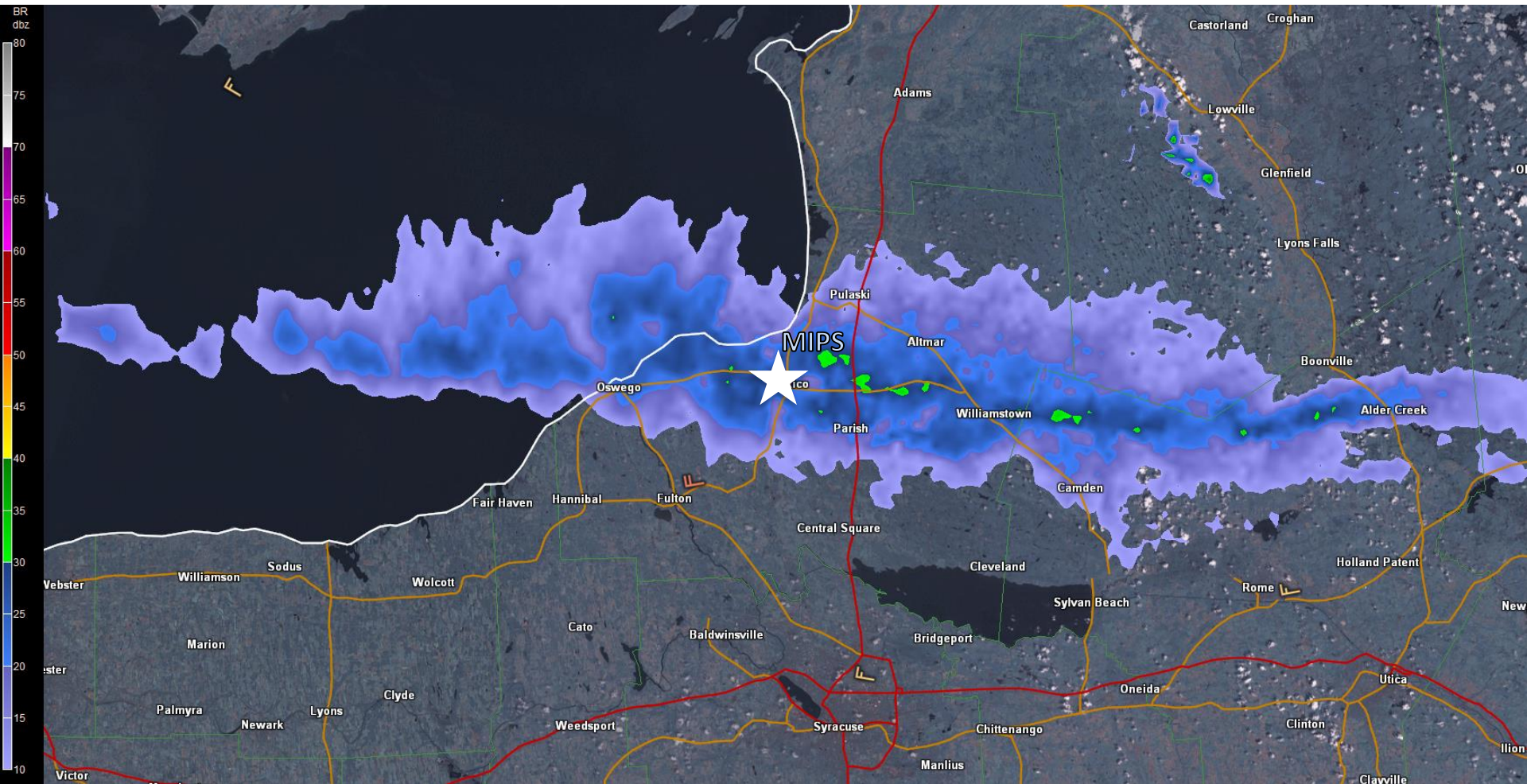
Most complete IOP -> all instruments worked

See previous frames on 915 products



IOP-22 (Mexico) - 27 Jan 2014 - 2050 UTC

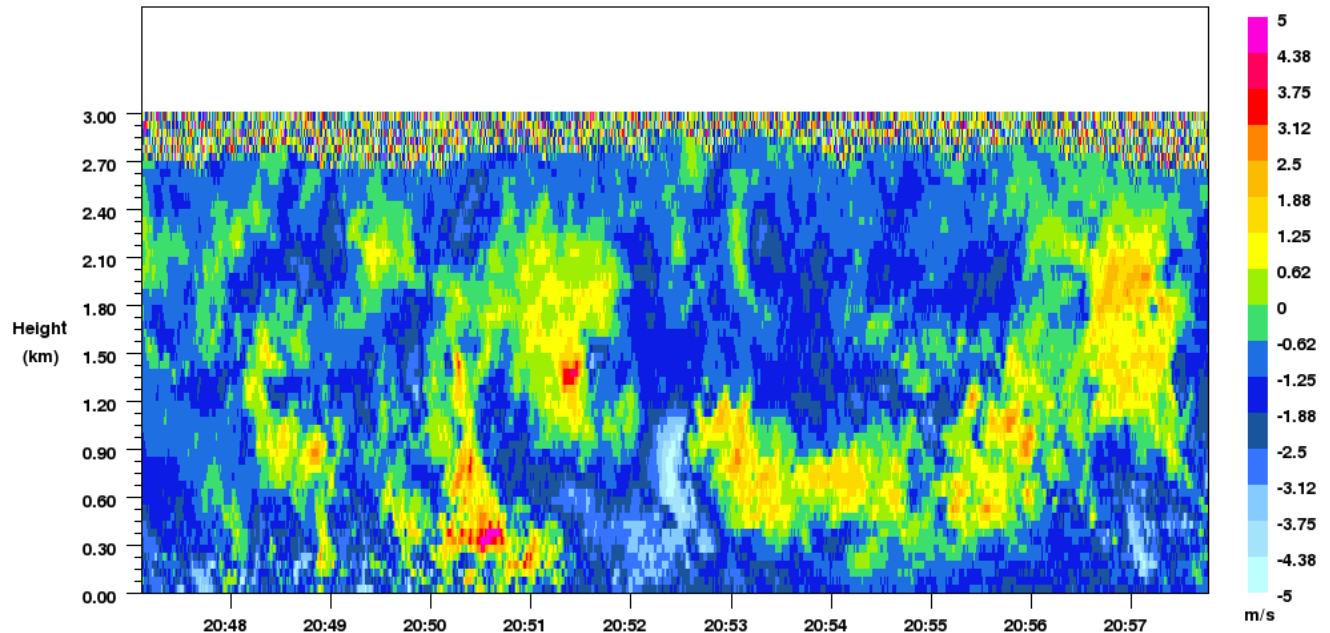
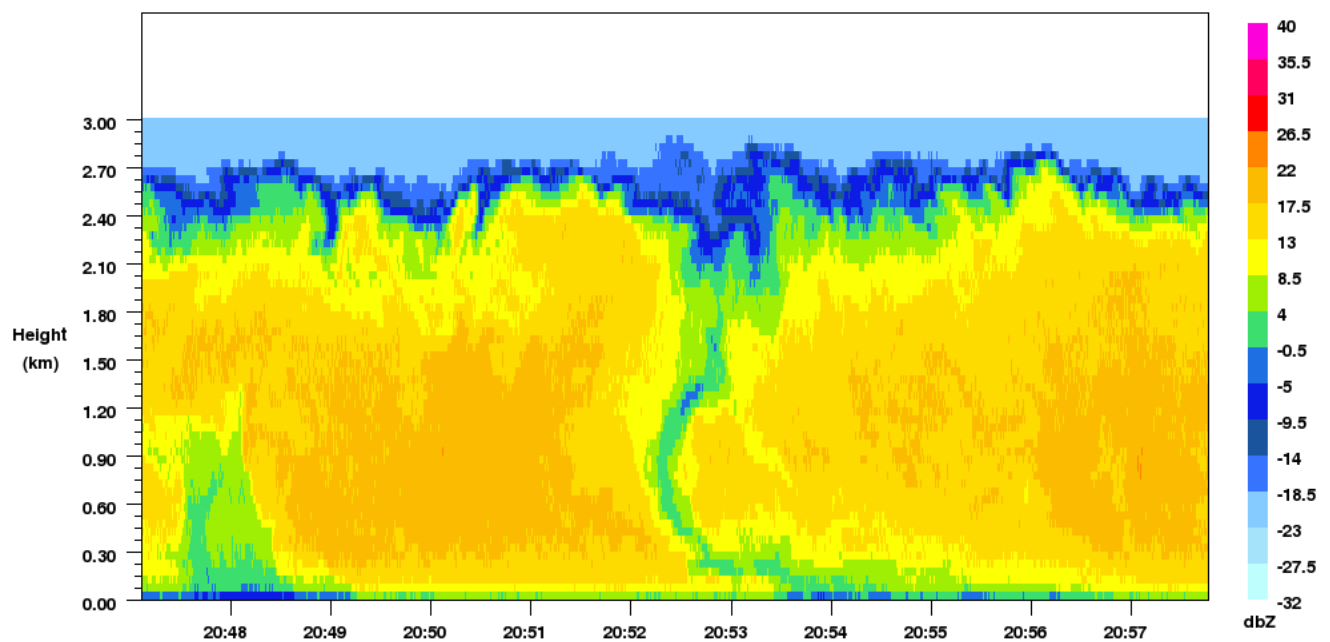
LLAP band which persisted for ~24 hours.



IOP-22 (Mexico)  
27 Jan  
2050 UTC

- Low reflectivity ribbon in the vertical coincides with up & down couplet in velocity.

- These features are consistent with the time a gust-front type feature passed over the MIPS site at Mexico NY.



## ***Status of MIPS data sets***

**915** – 80%, still 3 cases that are having issues with NIMA2 processing

**Ceilometer** - 100%

**XPR** - 70% - Finish making images

**MPR** - 0% - Waiting for further data sets to be QC'd. Data files can be accessed to examine in situ and integrated fields.

**DWL** - 50% - Need to make images

**Camera** – 100% (no QC needed)

**WXT-520** - 50% - Need to make images; raw data available

**EFM** - 95%

**Parsivel** - 100%

**Hot Plate** - 30% - need to make images; raw data available

**PIP** - 50% - 1/2 of images created



# Contacts for questions

- Kevin Knupp  
[kevin@nsstc.uah.edu](mailto:kevin@nsstc.uah.edu)
- Ryan Wade  
[rwade@nsstc.uah.edu](mailto:rwade@nsstc.uah.edu)
- Dustin Phillips  
[phillips@nsstc.uah.edu](mailto:phillips@nsstc.uah.edu)