IOP-19 Summary of Operations
14 February 2010, 1200 UTC – 15 February 2010 1800 UTC

Authors: Rauber, Brown, Knupp

1. Summary of storm evolution

The IOP-19 storm was associated with a short wave propagating around the polar vortex over Hudson Bay. The strong wave aloft was associated with a sharp arctic front with a strong high pressure center to the west. The front passed by the radars during the flight and was easily detected by a sharp drop in temperature. The upper level wave produced a weak surface cyclone as it rounded the southern side of the polar vortex. The precipitation pattern formed a distinct comma cloud with the wraparound moving across southern Illinois and Indiana between 1800 UTC on 14 February and 1200 UTC on 15 February. This storm was the first in which we tried flying the aircraft between two vortacs with the ground based equipment oriented along the line between the vortacs and the MAX scanning RHIs along the line. The strategy worked perfectly and we were able to develop a complete 2D cross-section using all of the facilities.

2. Locations of instrumentation platforms

MIPS Location: 38º 12' 34.89" N 86 º 51' 51.91" W
MIPS Time of Operation: 2010 UTC 2/14/10 to 1800 UTC 2/15/10
MAX Location: 38 º 9' 55.36" N 87º 1' 52.08" W
MAX Time of Operation: 0200 UTC 2/15/10 to 1600 2/15/10
MISS Location: 38 º 00' 43.79" N 87 º 32' 15.67" W
Profiler Time of Operation: 2100 UTC 2/14/10 to 1700 UTC 2/15/10
UM Location: Not used. System was being repaired.
RF-12 Flight operations: 0300 UTC- 1145 UTC 15 Feb 10

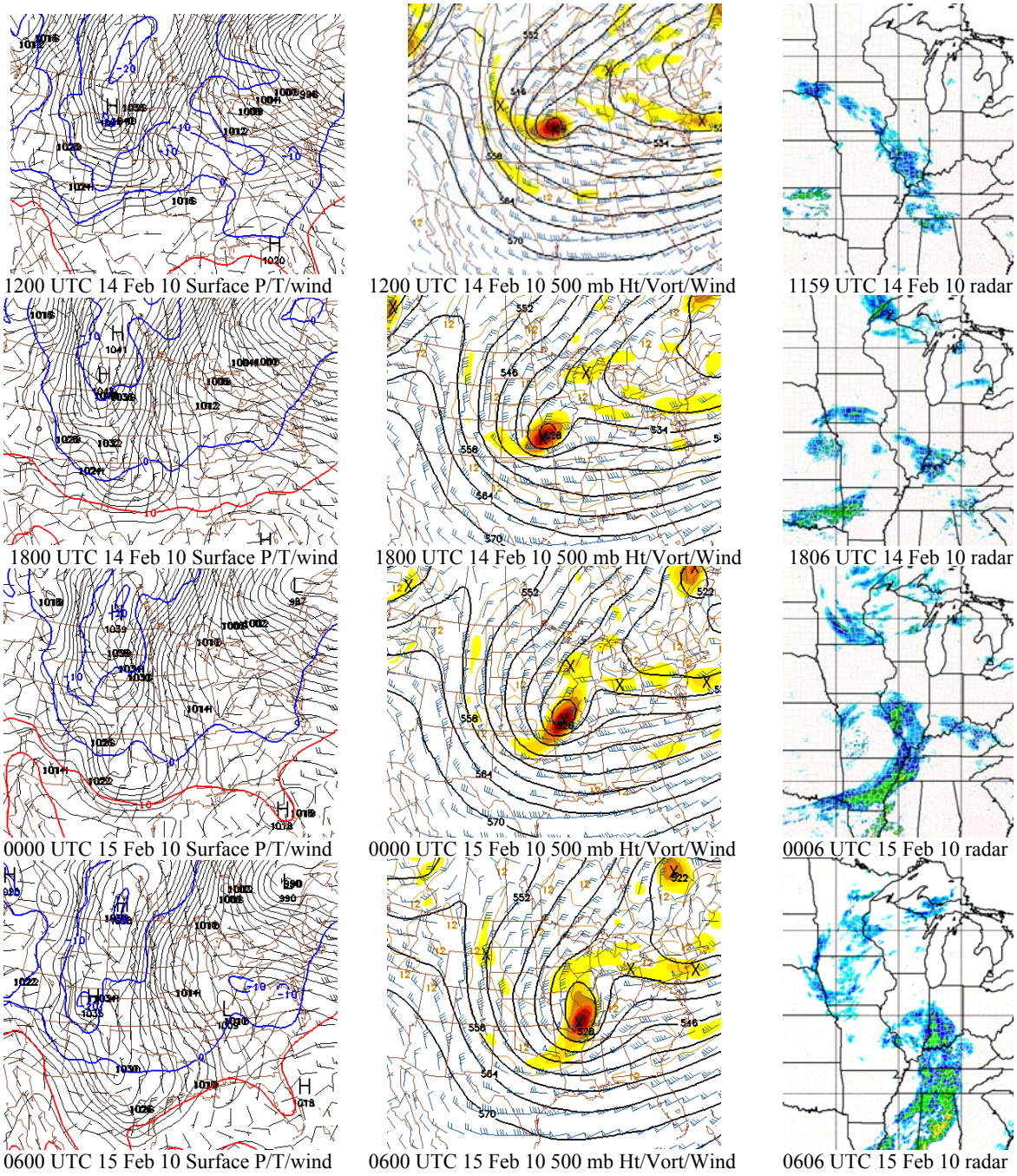
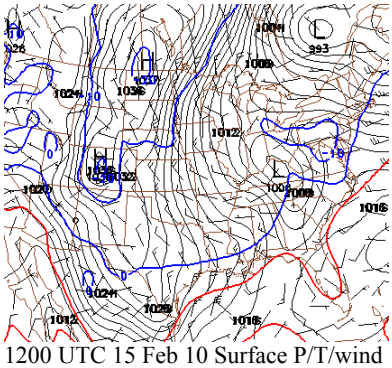
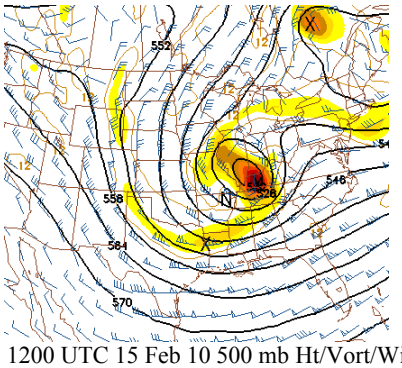
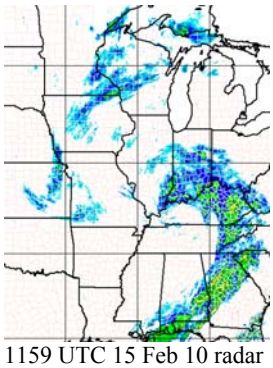
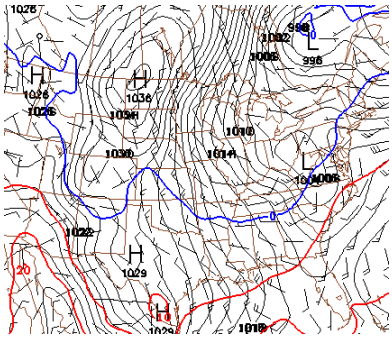


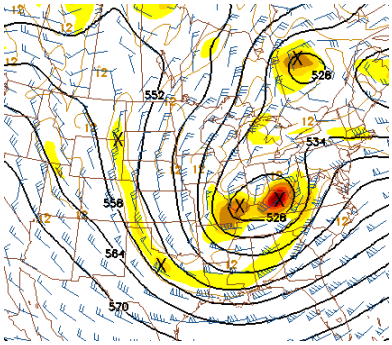
Figure 1: Evolution of the IOP-19 storm at the surface, 500 mb, and radar echoes from 1200 UTC 14 Feb 10 through 0600 UTC 15 Feb 10.

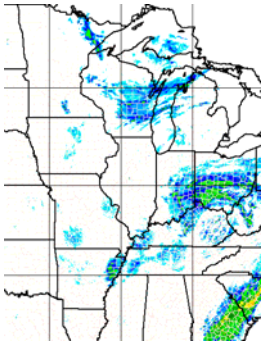

1200 UTC 15 Feb 10 Surface P/T/wind

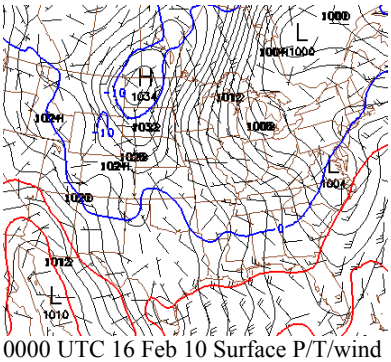

1200 UTC 15 Feb 10 500 mb Ht/Vort/Wind

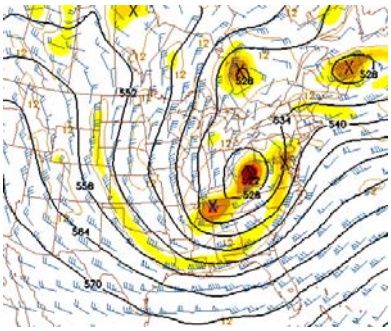

1159 UTC 15 Feb 10 radar


1800 UTC 15 Feb 10 Surface P/T/wind


1800 UTC 15 Feb 10 500 mb Ht/Vort/Wind


1754 UTC 15 Feb 10 radar


0000 UTC 16 Feb 10 Surface P/T/wind


0000 UTC 16 Feb 10 500 mb Ht/Vort/Wind

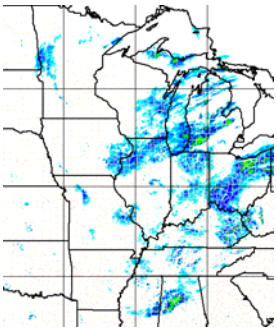

0000 UTC 16 Feb 10 radar

Figure 2: Evolution of the IOP-19 storm at the surface, 500 mb, and radar echoes from 1200 UTC 15 Feb 10 through 0000 UTC 16 Feb 10.

3. Precipitation over research area

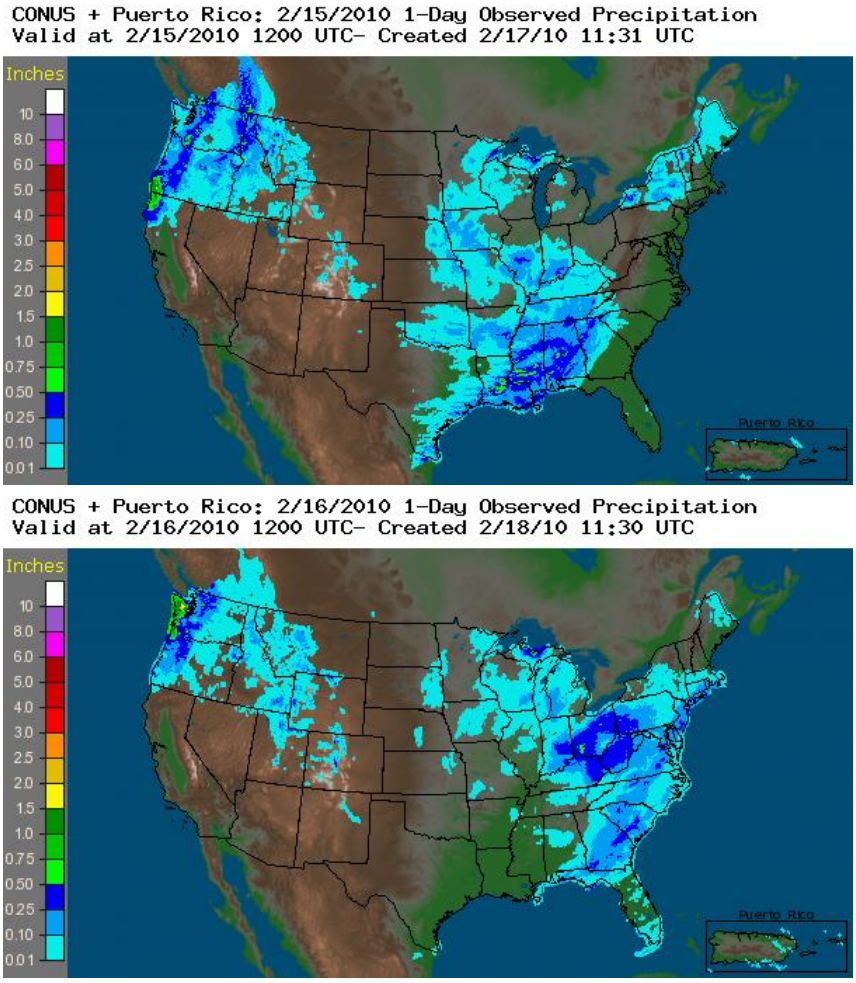


Fig. 3: 24 Hour precipitation ending at 1200 UTC 2/15/10, and 1200 UTC 02/16/10 over the United States

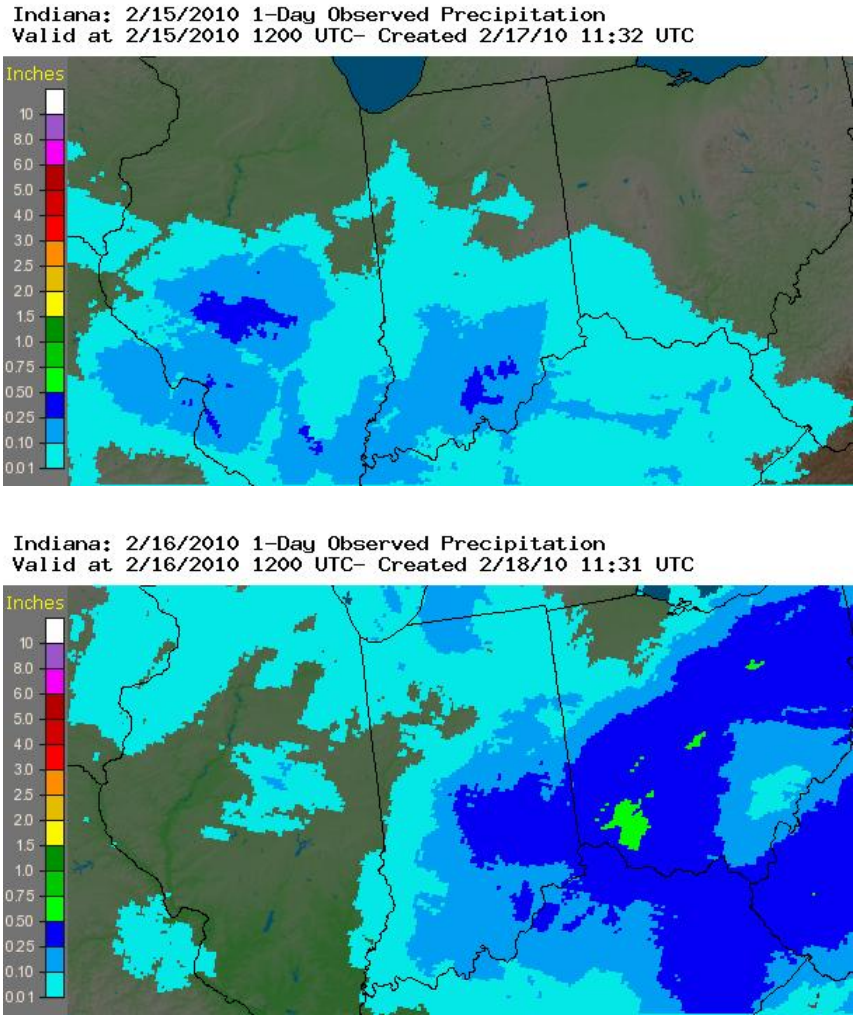


Fig. 4: 24 Hour precipitation ending at 1200 UTC 02/15/10, and 1200 UTC 02/16/10 over Indiana.

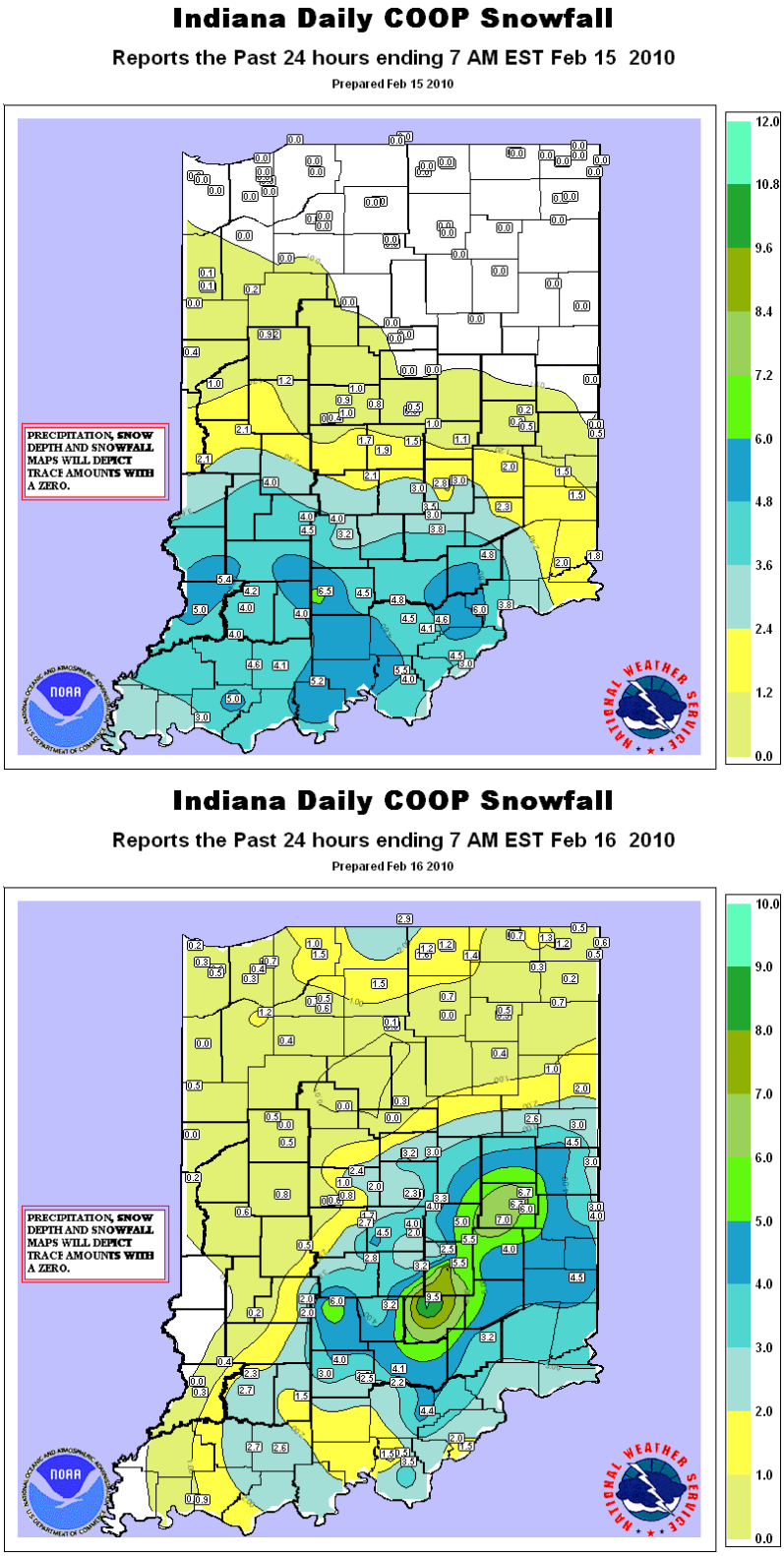


Fig. 5: 24 hr snowfall ending at 1200 UTC 15 February and 1200 UTC 16 February in Indiana for the IOP-19 cyclone

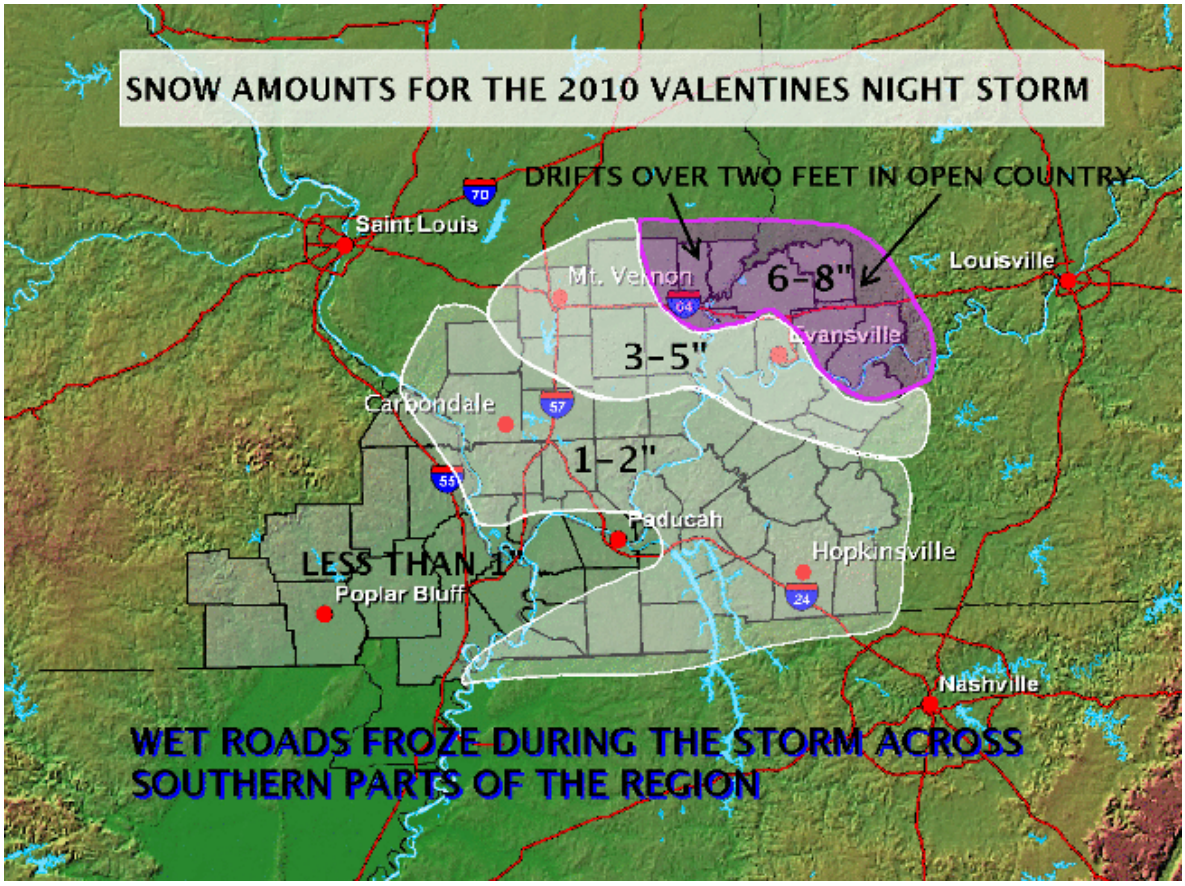


Fig. 6: Total storm snowfall in Kentucky for the IOP-19 cyclone

SNOWFALL REPORTS FOR INDIANA

INCHES	LOCATION	ST	COUNTY	TIME
10.00	NASHVILLE	IN	BROWN	0530 PM
10.00	EDINBURGH	IN	JOHNSON	0530 PM
10.00	COLUMBUS	IN	BARTHOLOMEW	0131 PM
9.50	BLOOMINGTON	IN	MONROE	0900 PM
9.50	HAYDEN	IN	JENNINGS	0411 PM
9.00	SEYMOUR	IN	JACKSON	0636 PM
9.00	ELLETTSVILLE	IN	MONROE	0513 PM
9.00	SCIPIO	IN	JENNINGS	0259 PM
8.70	3 S PARAGON	IN	MORGAN	1052 PM
8.50	SEYMOUR	IN	JACKSON	0920 PM
8.00	GREENWOOD	IN	JOHNSON	0636 PM
8.00	3 SE ODON	IN	DAVIESS	0242 PM
8.00	COLUMBUS	IN	BARTHOLOMEW	0131 PM
7.50	BLOOMINGTON	IN	MONROE	0636 PM
7.50	SHELBYVILLE	IN	SHELBY	0430 PM
7.40	MEDORA	IN	JACKSON	0700 AM
7.00	3 S PARAGON	IN	MORGAN	1159 AM
6.50	1 SE SHELBYVILLE	IN	SHELBY	1137 AM
6.50	WILLIAMS	IN	LAWRENCE	0821 AM
6.30	BICKNELL	IN	KNOX	1034 AM
6.10	IND INT`L AIRP	IN	MARION	0636 PM
6.00	KNIGHTSTOWN	IN	HENRY	0648 PM

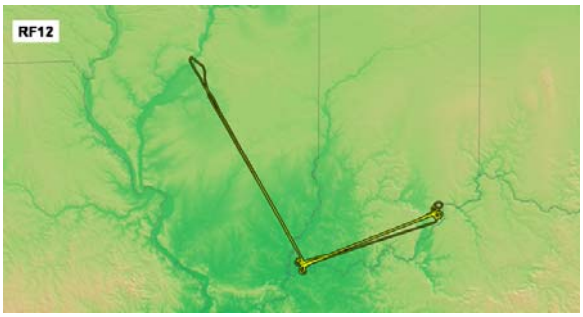
6.00	NEW WHITELAND	IN	JOHNSON	0354 PM
6.00	COLUMBUS	IN	BARTHOLOMEW	0229 PM
6.00	VINCENNES	IN	KNOX	0756 AM
5.80	NEW CASTLE	IN	HENRY	0600 PM
5.50	CLAY CITY	IN	CLAY	0636 PM
5.50	GREENSBURG	IN	DECATUR	0312 PM
5.50	BRAZIL	IN	CLAY	1044 AM
5.30	6 S TERRE HAUTE	IN	VIGO	0636 PM
5.30	2 SW PRAIRIETON	IN	VIGO	0212 PM
5.30	7 N SPENCER	IN	OWEN	1135 AM
5.00	STRAUGHN	IN	HENRY	0412 PM
5.00	JASONVILLE	IN	GREENE	1046 AM
4.90	SHELBYVILLE	IN	SHELBY	0327 PM
4.70	7 S SPENCER	IN	OWEN	0904 AM
4.60	BROWNSBURG	IN	HENDRICKS	0930 PM
4.50	FARMERSBURG	IN	SULLIVAN	0636 PM
4.50	WASHINGTON	IN	DAVIESS	0821 AM
4.20	MCCORDSVILLE	IN	HANCOCK	0312 PM
4.20	2 E BROOKLYN	IN	MORGAN	1100 AM
4.00	BRAZIL	IN	CLAY	0636 PM
4.00	1 N CLERMONT	IN	MARION	1050 AM
4.00	BEDFORD	IN	LAWRENCE	0622 AM
3.80	2 S CASTLETON	IN	MARION	0700 PM
3.50	2 NW AMO	IN	HENDRICKS	0904 AM
3.50	FRANKLIN	IN	JOHNSON	0815 AM
3.30	TERRE HAUTE	IN	VIGO	0839 AM
3.10	MCCORDSVILLE	IN	HANCOCK	0430 PM
3.00	INDIANAPOLIS	IN	MARION	0636 PM
3.00	DALEVILLE	IN	DELAWARE	0418 PM
3.00	NEW CASTLE	IN	HENRY	1230 PM
3.00	FRANKLIN	IN	JOHNSON	0700 AM
3.00	CARLISLE	IN	SULLIVAN	0647 AM
2.80	MCCORDSVILLE	IN	HANCOCK	0155 PM
2.70	2 S CASTLETON	IN	MARION	0116 PM
2.50	3 NW CARMEL	IN	HAMILTON	0636 PM
2.50	FISHERS	IN	HAMILTON	0240 PM
2.50	MCCORDSVILLE	IN	HAMILTON	1200 PM
2.50	SHELBYVILLE	IN	SHELBY	0550 AM
2.50	BLOOMINGTON	IN	MONROE	0500 AM
2.20	MCCORDSVILLE	IN	HAMILTON	1030 AM
2.10	2 SE CASTLETON	IN	MARION	1046 AM
2.00	INDIANAPOLIS	IN	MARION	0831 AM

4. Flight Summary

The C-130 coordinated with the ground based radars. The flight track was aligned between two vortacs, PXV and ABB, in southern Indiana. The MAX was placed midway between the vortacs, and performed RHI scans along the line in the direction of the aircraft, switching sides as the aircraft cross the radar site. The MAX peformed a volume scan for dual Doppler with Evansville while the aircraft turned over the vortacs. The aircraft performed a stacked pattern at altitudes from 25000 to 9000 ft. Two complete stacks were performed.

C-130 Flight RF-12 Flight track

Overlays on the radar composites were not available for this flight because the Satcom system onboard the aircraft did not transmit position data to the ground. The track below shows the flight strategy. The track occurred between 0300 and 1145 UTC, 15 Feb 10.



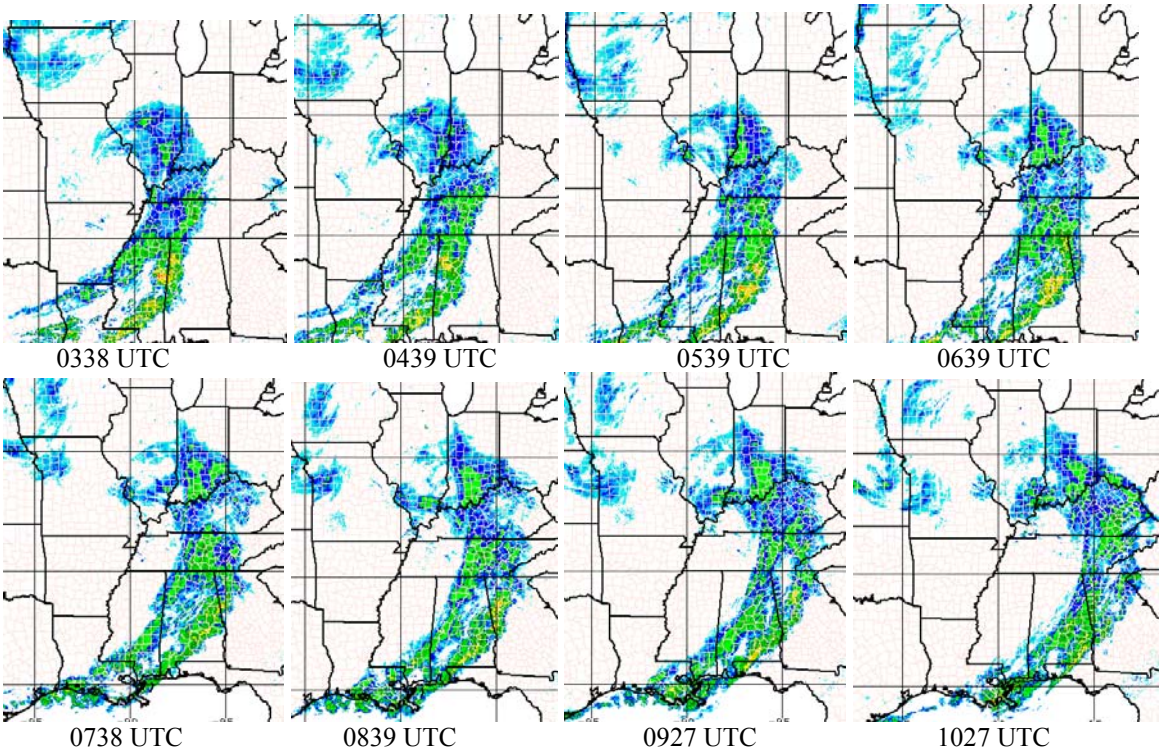
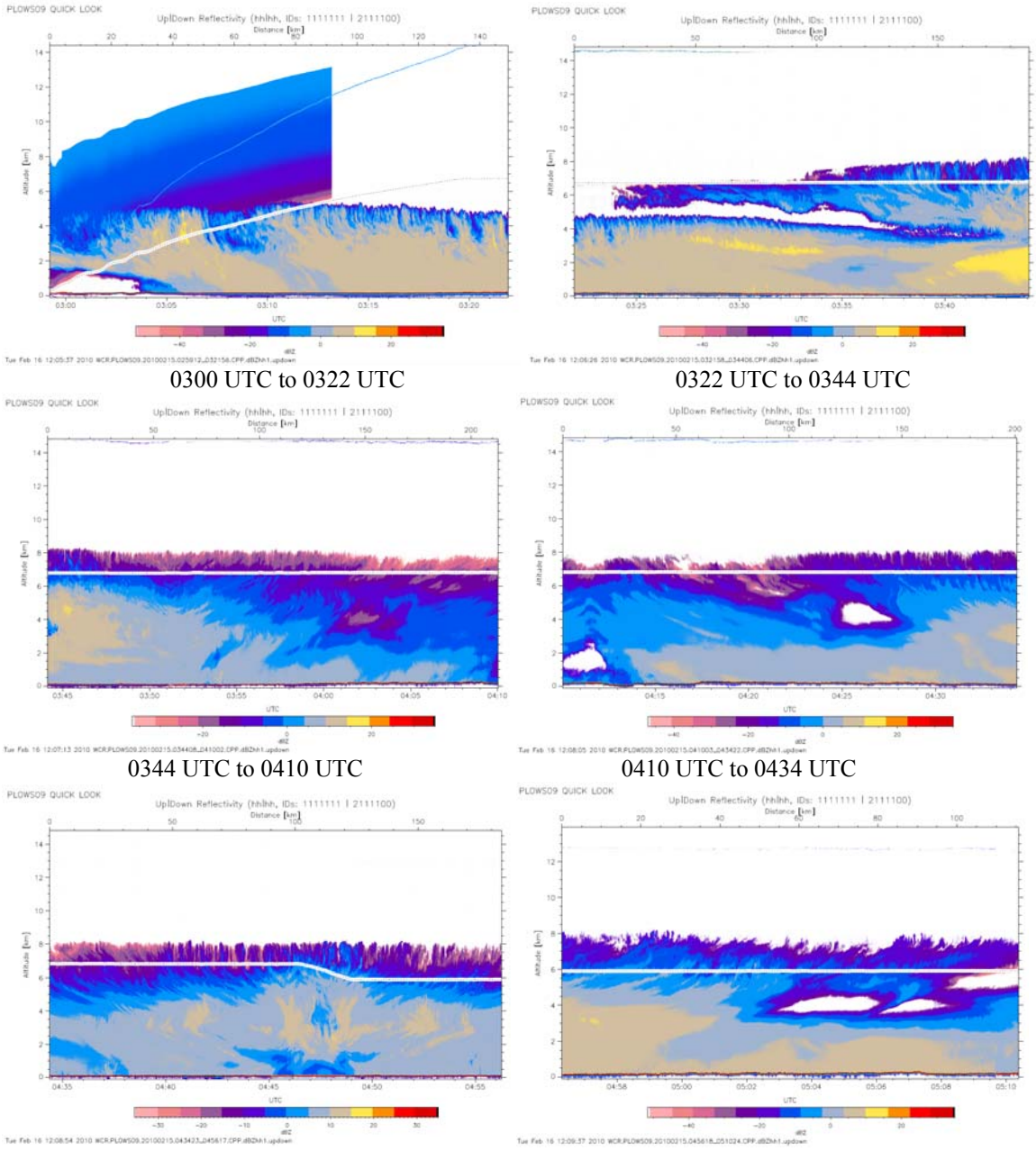


Figure 7: Flight track (top) and radar images during the period of the C-130 flight from 0338 UTC 15 Feb 10 through 1027 UTC 15 Feb 10.



0300 UTC to 0322 UTC

0322 UTC to 0344 UTC

0344 UTC to 0410 UTC

0410 UTC to 0434 UTC

0434 UTC to 0457 UTC

0457 UTC to 0511 UTC

Fig. 8: Wyoming Cloud Radar Quicklook of radar reflectivity between 0300 UTC 15 Feb 10 and 0511 UTC 15 Feb 10.

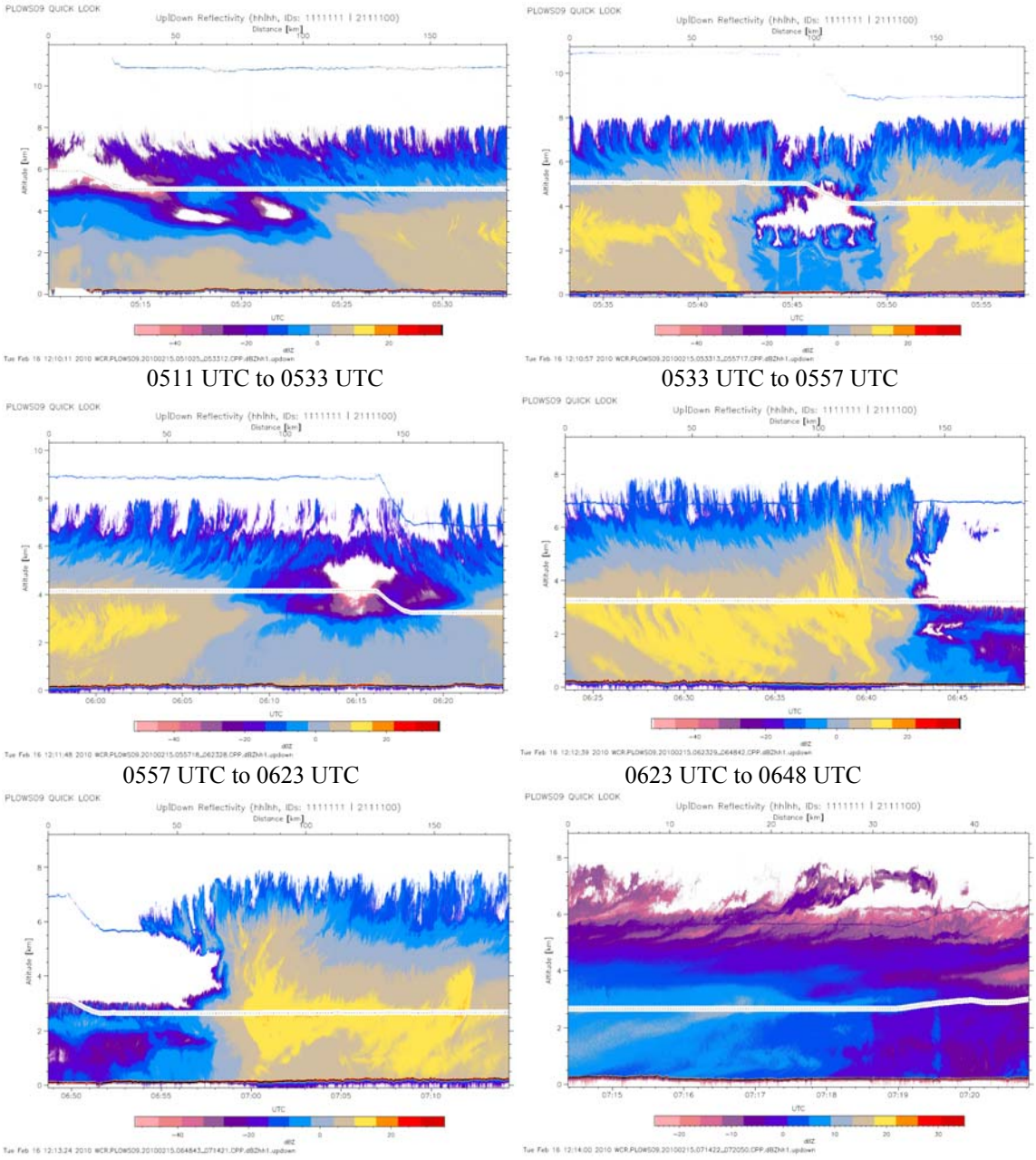


Fig. 9: Wyoming Cloud Radar Quicklook of radar reflectivity between xx UTC 0511 15 Feb 10 and 0722 UTC 15 Feb 10.

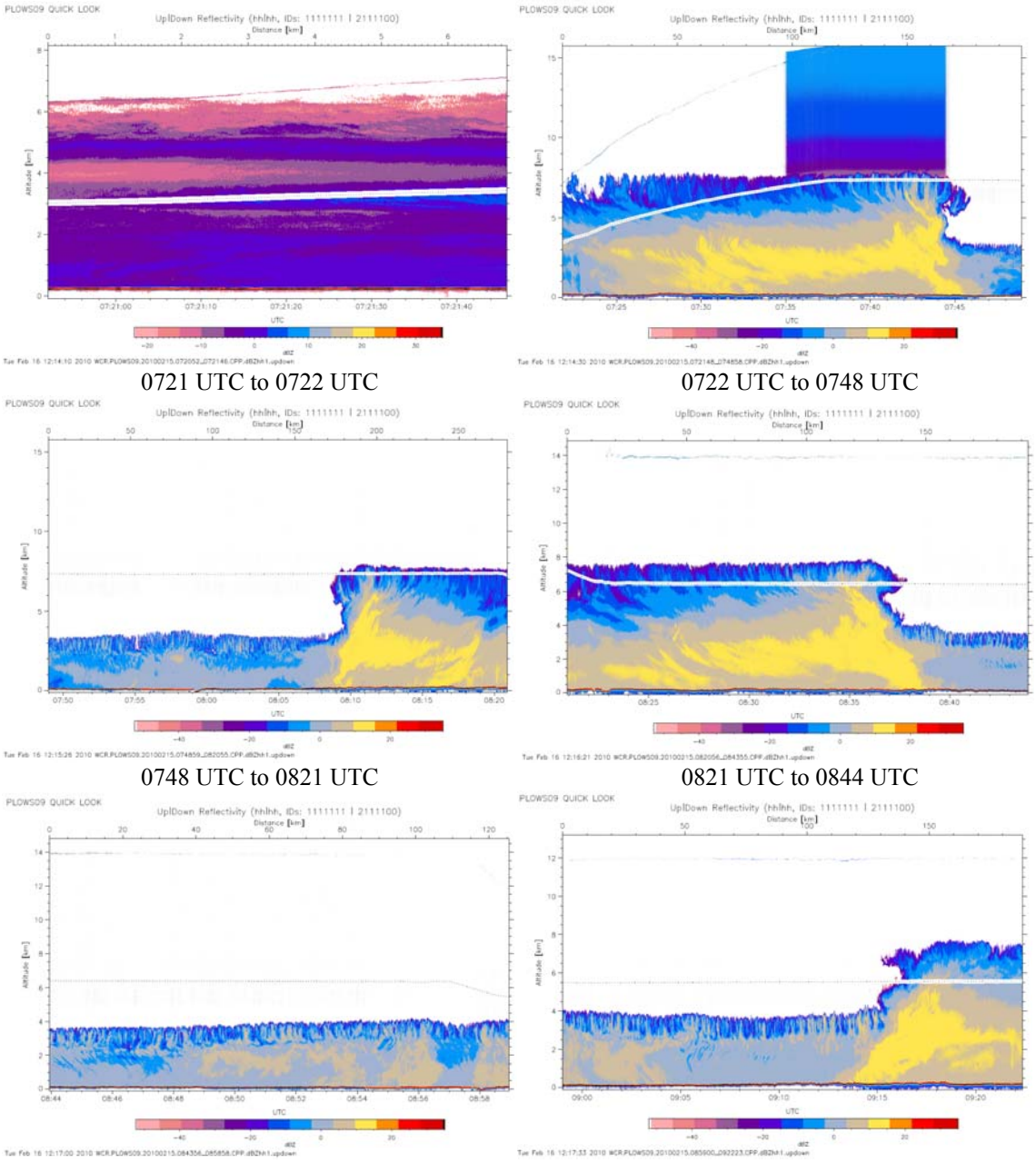


Fig. 10: Wyoming Cloud Radar Quicklook of radar reflectivity between 0721 UTC 15 Feb 10 and 0922 UTC 15 Feb 10.

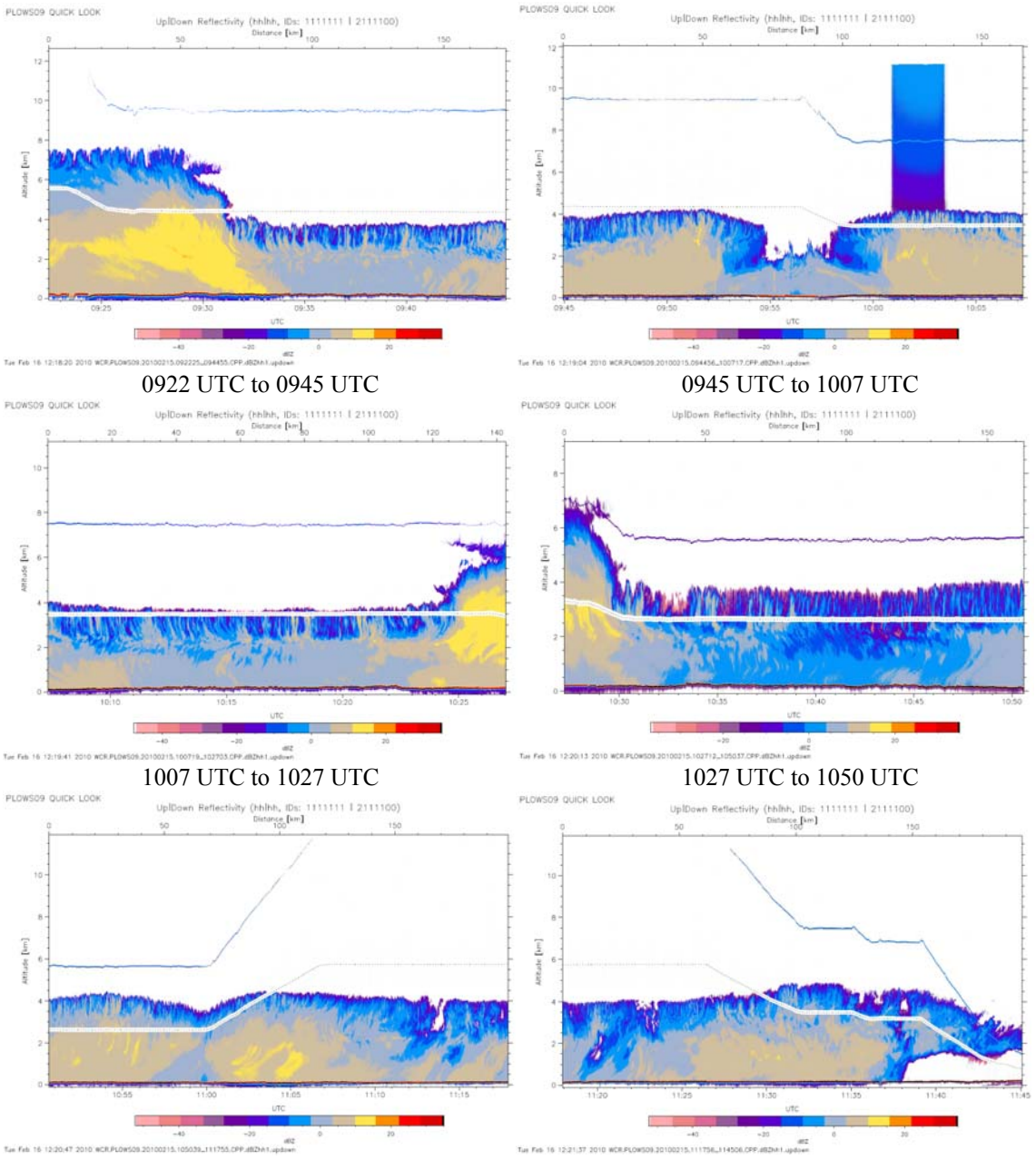


Fig. 11: Wyoming Cloud Radar Quicklook of radar reflectivity between 0922 UTC 15 Feb 10 and 1145 UTC 15 Feb 10.

5. MIPS operations:

The MIPS was located at the Holiday Inn Express in Ferdinand, IN. The MIPS 915 MhZ profiler had a problem with an amplifier that led to severely attenuated signal strength throughout the IOP. As a result the data from this IOP are unusable. No plots are shown.

The MIPS XPR radar operated well and had no problems with attenuation since the snow was not wet. The data all appear to be in great shape. All other systems operated well, except that the hot plate had some dropout periods.

6. MAX operations: The MAX was operated differently from previous IOPS. During this IOP, the MAX was located along the line between Vortacs ABB and PXV in southern Indiana. The MIPS was located along this line about 20 km east of the MAX and the MISS along the line about 50 km west of the MAX. As the aircraft approached the MAX from one of the vortacs, the MAX performed RHIs along the flight path. As the aircraft passed overhead, the MAX RHI direction was switched 180 degrees to the opposite side to continue RHIs along the flight path. While the aircraft was turning at the VORs, the MAX did a volume scan coordinated with the VCP-11 scan of the 88D at Evansville. This procedure continued for the duration of the flight, close to 8 hours. Example MAX RHIs are shown below for ρ_{hv} and Z_h.

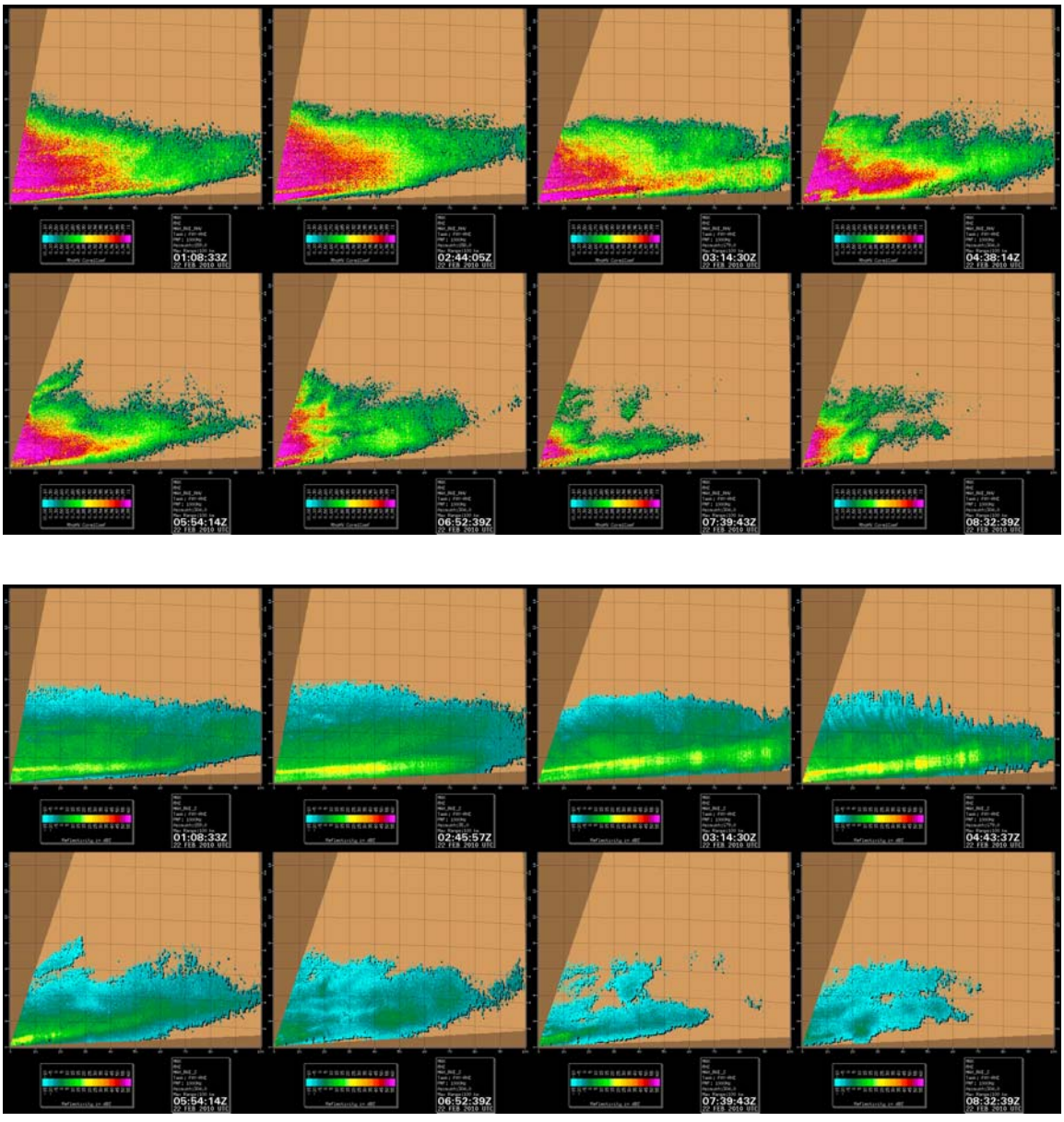


Fig. 12: Series of MAX radar RHI scans of ρ_{hv} (top) and Z_h (bottom) through the system at different azimuth angles between 0108 and 0832 UTC on 15 February 10.

7. MISS 915 MHz Profiler

The MISS operated from a hotel just south of the Evansville Airport in Evansville, IN. Operations went smoothly with no problems for the 915 MHz profiler.

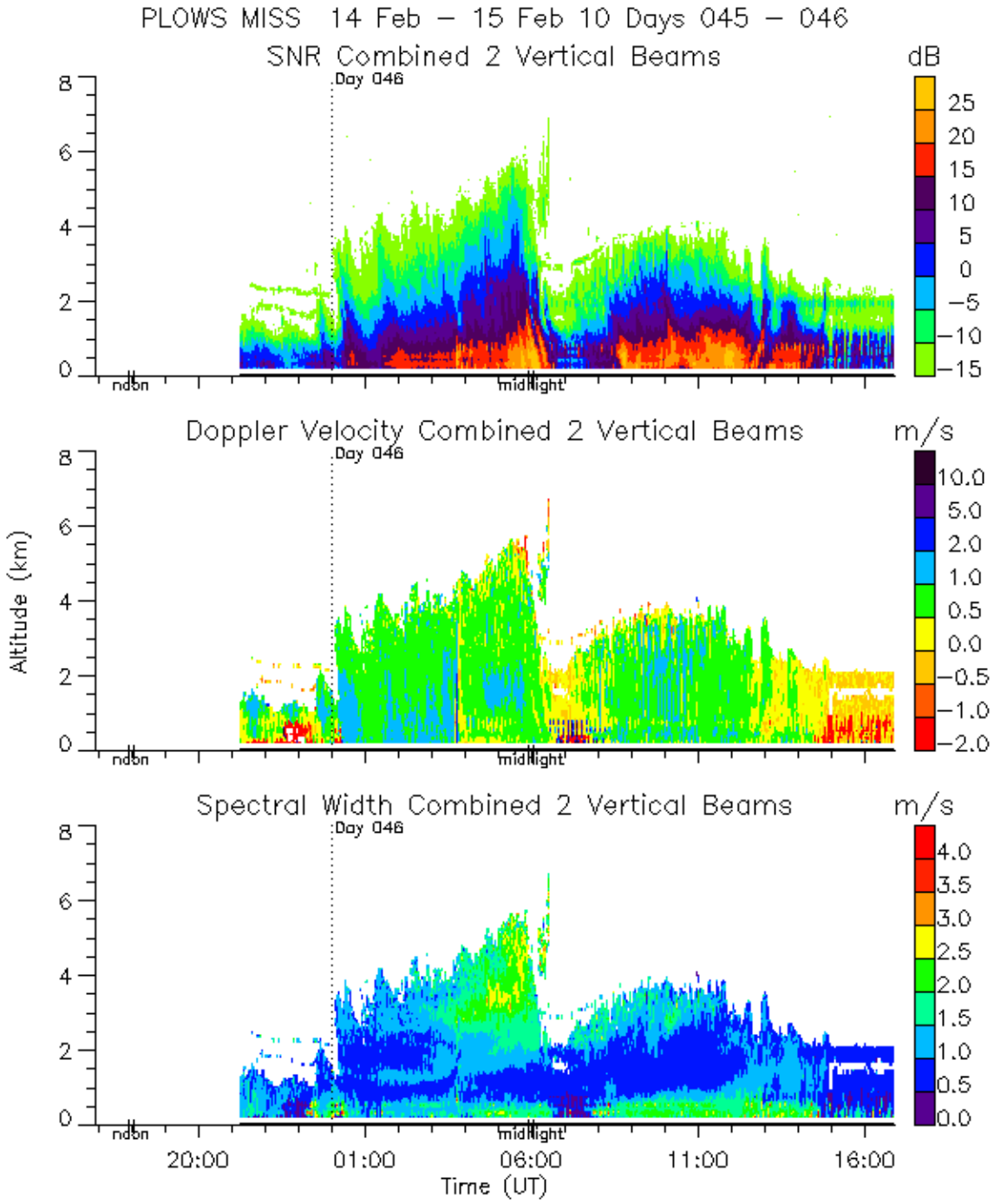


Figure 14: MISS 915 MHz Profiler Winds
for the period of operation 1700 UTC 14 Feb 10 through 1700 UTC 15 Feb 10

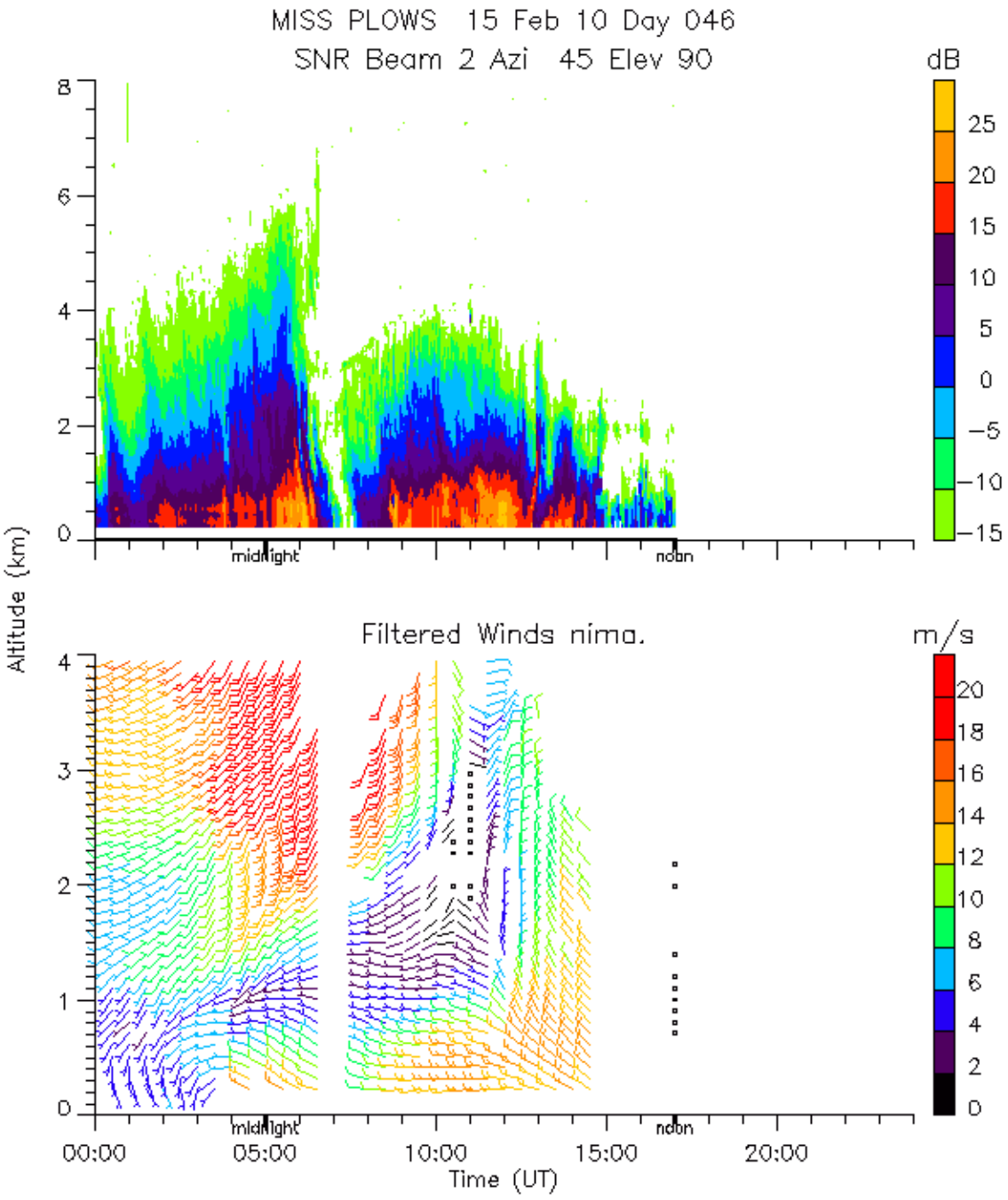


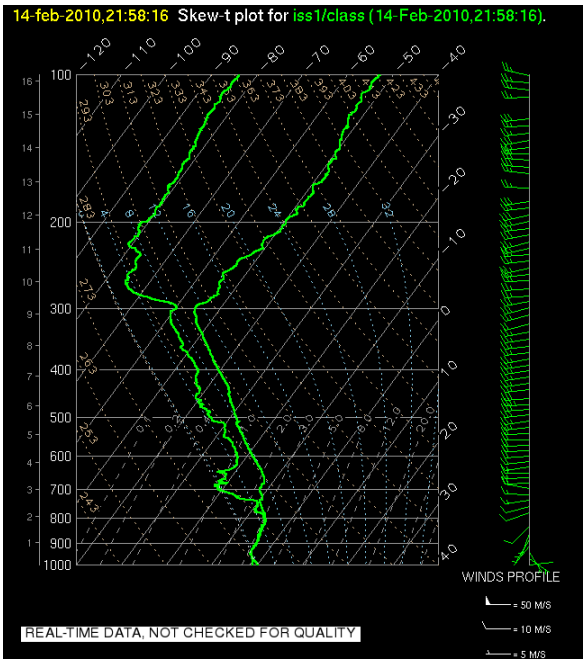
Figure 10: MISS 915 MHz Profiler SNR and Winds
for the period of operation 0000 UTC 15 Feb 10 through 1500 UTC 15 Feb 10

8. Rawinsondes

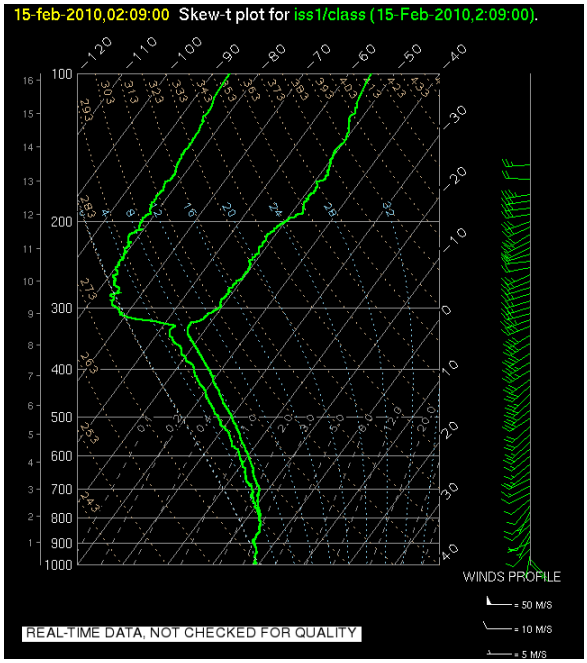
Rawinsondes were launched at the MISS site in Evansville, IN on a 2 hourly schedule. The following soundings were launched

DATE	Launch	Nominal Date and time		Status
2010 02 14	**2158 UTC**	**2010 02 14**	**2200 UTC**	**Good**
2010 02 15	**0209 UTC**	**2010 02 15**	**0230 UTC**	**Good**
2010 02 15	**0329 UTC**	**2010 02 15**	**0400 UTC**	**Good**
2010 02 15	**0532 UTC**	**2010 02 15**	**0600 UTC**	**Good**
2010 02 15	**0731 UTC**	**2010 02 15**	**0800 UTC**	**Good**
2010 02 15	**0926 UTC**	**2010 02 15**	**1000 UTC**	**Good**
2010 02 15	**1134 UTC**	**2010 02 15**	**1200 UTC**	**Good**
2010 02 15	**1339 UTC**	**2010 02 15**	**1400 UTC**	**Good**
2010 02 15	**1533 UTC**	**2010 02 15**	**1600 UTC**	**Good**

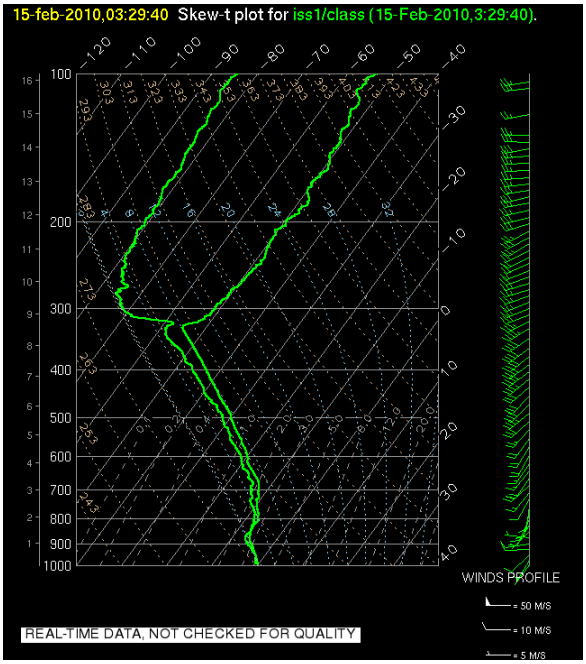
Rawinsondes were launched not launched by Missouri during this IOP because of equipment problems.



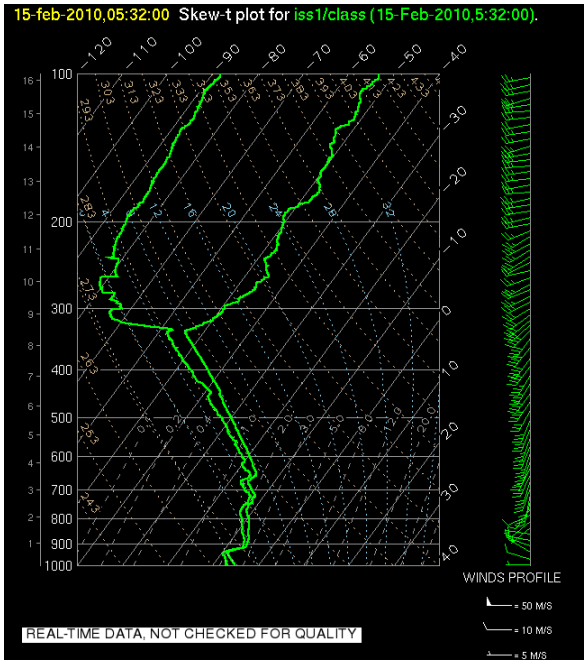
MISS Sounding 2200 UTC 14 Feb 10



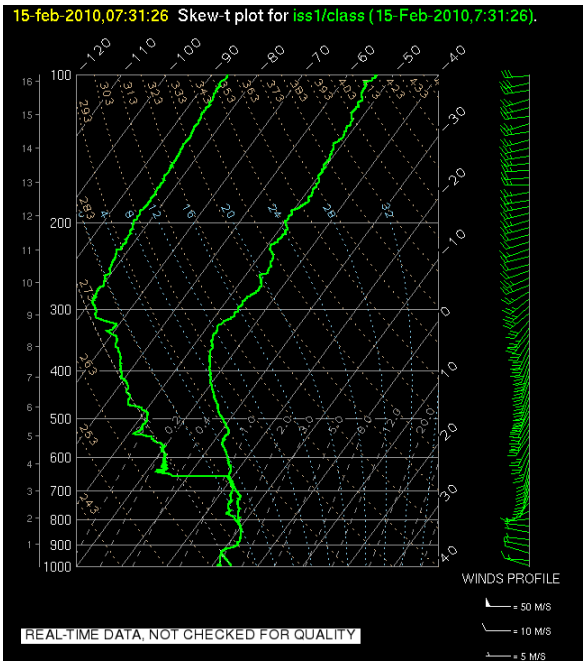
MISS Sounding 0200 UTC 15 Feb 10



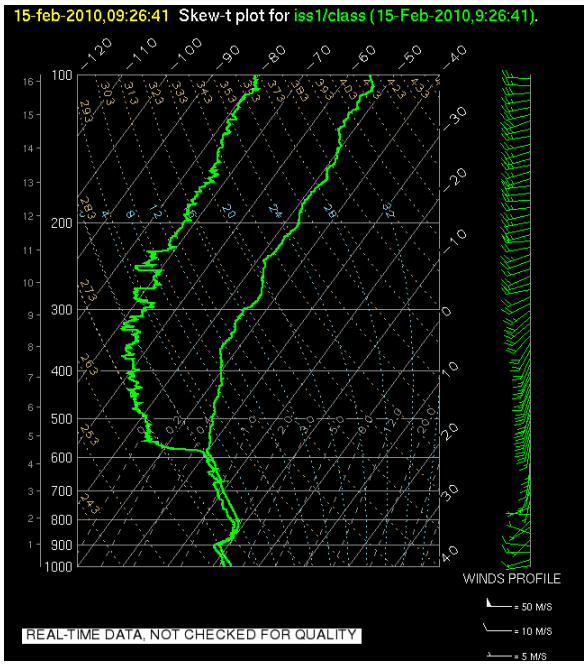
MISS Sounding 0400 UTC 15 Feb 10



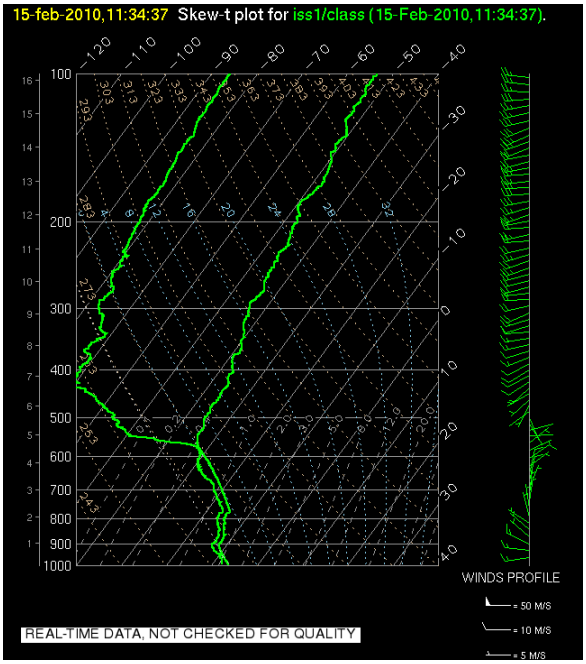
MISS Sounding 0600 UTC 15 Feb 10



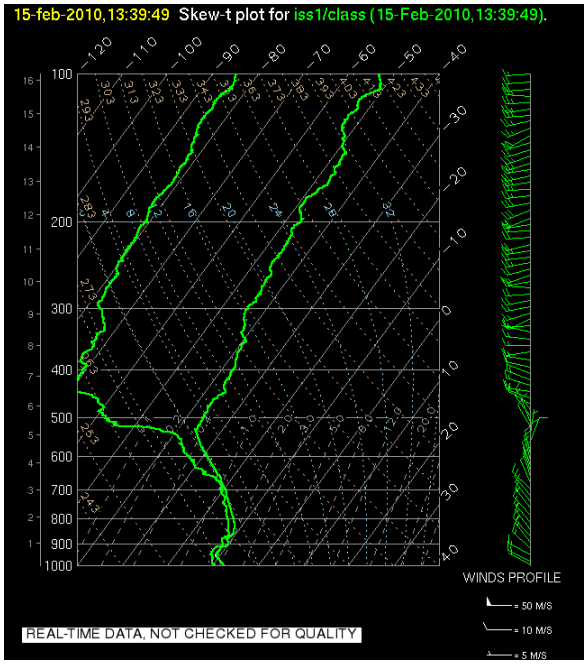
MISS Sounding 0800 UTC 15 Feb 10



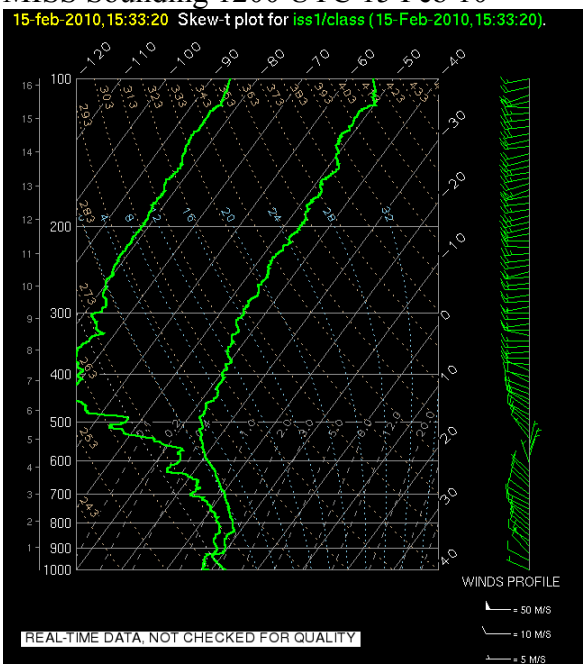
MISS Sounding 1000 UTC 15 Feb 10



MISS Sounding 1200 UTC 15 Feb 10



MISS Sounding 1400 UTC 15 Feb 10



MISS Sounding 1600 UTC 15 Feb 10