

***Final Report for the Doppler on Wheels Observations of New England Winter Storms (DONEWS)  
Project***

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***4/14/2011***

During the time period from 1 to 18 February, 2011, a Doppler on Wheels X-band, dual polarization and dual frequency mobile radar was deployed at Lyndon State College (LSC). The two objectives for this educational project were to teach students in the LSC junior-level Remote Sensing course how Doppler weather radars work. The second objective was to expose the greater Lyndon community to the radar and how it has been used in past projects to collect data on high impact weather events such as hurricanes and tornadic storms. A summary of these activities follows.

***Community Outreach***

A number of community outreach activities were executed while the DOW was at Lyndon. They are listed below in chronological order.

5 February, 2011

The DOW technician gave a presentation to local high-school science teachers and a few of their students. Approximately 20 teachers and students were in attendance. The technician discussed the basic theory for how the DOW works and presented some DOW data on tornadic storms and hurricanes that demonstrated the DOW capabilities. The teachers and students were able to view the DOW after the presentation.

9 February, 2011

- a. Dr. Joshua Wurman arrived at Lyndon State College in the early afternoon and gave a presentation to students in the Weather and Astronomy class taught at the St. Johnsbury Academy. The St. Johnsbury Academy is a local, private high school. After Dr. Wurman's presentation, students were allowed to see the DOW and climb inside the truck.
- b. Later in the afternoon, Dr. Wurman gave a presentation to Atmospheric Science seniors in the LSC Thesis course. Dr. Wurman presented research results on tornadoes and hurricanes derived from DOW data.

10 February, 2011

- a. Dr. Wurman gave a presentation to students at Lyndon Institute, another local private high school. The Lyndon Institute students were also given the opportunity to view the interior and exterior of the DOW.
- b. Dr. Wurman then gave a presentation on radar technologies to the LSC Atmospheric Science Remote Sensing students. This is a junior-level course that discusses the theory, application, and interpretation of Doppler weather radar data.

- c. The final presentation by Dr. Wurman was to the broader LSC and local community. Approximately 100 people from LSC and the local area attended this talk. Similar to the other presentations and the local high schools, Dr. Wurman discussed how Doppler radars work and presented DOW data on tornadic storms and hurricanes.

11 February, 2011

The last outreach activity was at a local elementary school in Littleton NH. The DOW was driven to the school. A brief presentation was made to the students on what the radar is, how it operates, and what it is used for. Students in the 4 – 6 grades were then given the opportunity to view the inside of the truck and watch the antenna spin.

In summary, a large number of outreach activities were executed while the DOW was at Lyndon. Students at the elementary, high school, and college level were exposed to the facility and data it collects. Many in the local community, including high-school science teachers, also had the opportunity to view the radar and attend presentations given by the DOW technician and Dr. Wurman. The DOW was also highlighted in the news on local TV stations (WCAX and FOX 44, both in Burlington, VT) and on Vermont Public Radio.

### ***DOW Operation by LSC Remote Sensing Students***

During the first week that the DOW was on campus, students, faculty, and staff were trained on how to operate the DOW radar and drive the truck. A total of 11 students and two faculty were trained on how to operate the radar.

Students in the Remote Sensing course were responsible for forecasting winter storms that could be sampled by the DOW. Students needed to predict the start and end time of measureable precipitation. Moreover, due to the complex nature of the local topography, students also needed to predict the flow direction and resultant nature of the precipitation. For example, under southeast or northwest flow regimes, orographic precipitation would be expected with the Green and White Mountains, respectively. Southwesterly flow would likely be associated with wide-spread stratiform precipitation. Once the flow direction was established, deployment sites were then picked to sample either orographic or wide-spread stratiform precipitation. Students used Google Earth to help with deployment site selection along with knowledge of the local area.

Once the precipitation start and end time and deployment location was established, the students would then create a schedule of radar operators to operate the radar during the duration of the observation period. Commonly, teams of two students would operate the radar for two-hour shifts.

During the deployments, students were responsible for creating scan strategies to best sample the observed precipitation. They were also responsible to taking routine (typically every 15 minutes)

weather observations so that the nature of the observed precipitation could be used to help interpret the radar data.

In total, the students deployed the DOW three times during DONEWS. On 2 February, the DOW was deployed approximately four miles north of the college to sample a winter storm that produced about 7-8 inches of dry snow over a period of about 11 hours. On 8 February, the DOW was deployed near the Canadian Border NW of Richford, VT to sample orographic precipitation over the Jay Peak area. Finally, the DOW deployed on 14 February at the same location as on 2 February to sample a sharp cold front that was about to pass through the area. Imagery illustrating the nature of the DOW data collected during each deployment follow in a series of slides that were presented by the students in the Remote Sensing course at the 36<sup>th</sup> Northeastern Storm Conference in Taunton, MA, 13-15 March, 2011.

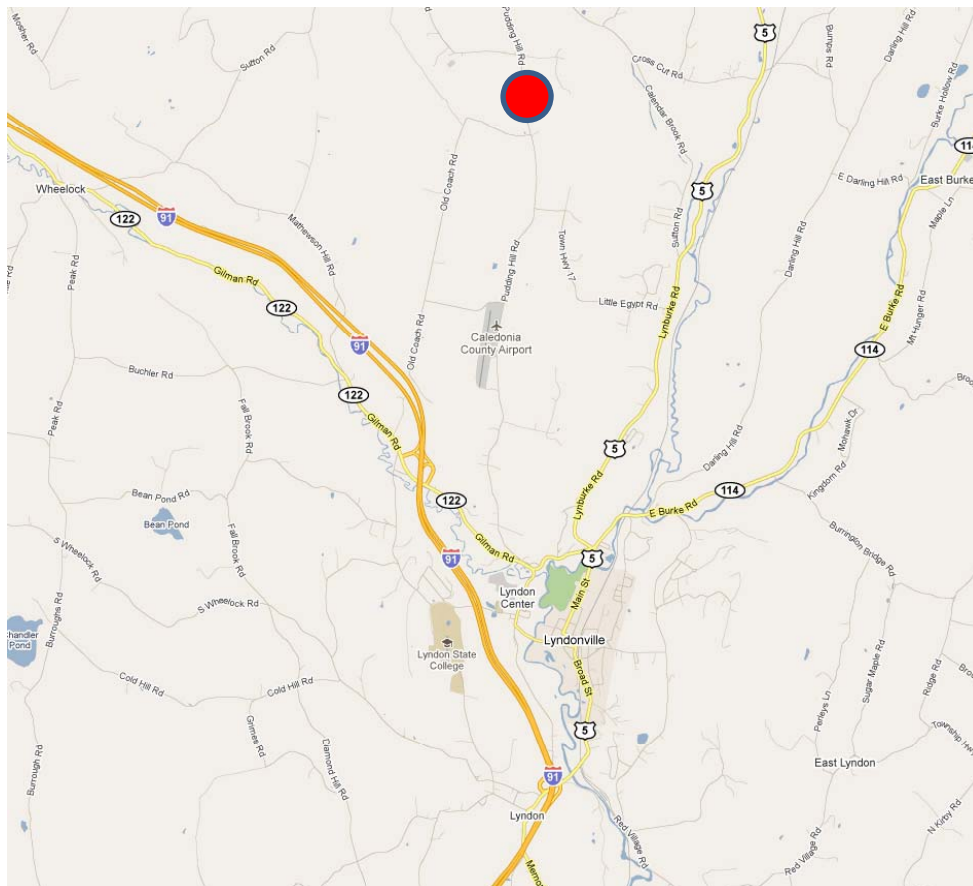
Select slides from a student presentation given  
at the 36<sup>th</sup> Northeastern Storm Conference –  
Taunton, MA 13-15 March, 2011

*Three successful deployments:*

*2 February, 2011 – 11 hours of dry snow (7-8 inches of accumulation)*

*14 February, 2011 – rain changing to snow with passage of a sharp cold front*

*The red dot below shows the location of these two deployments*



*Three successful deployments:*

*8 February, 2011 – Orographic snow over the Jay Peak region*

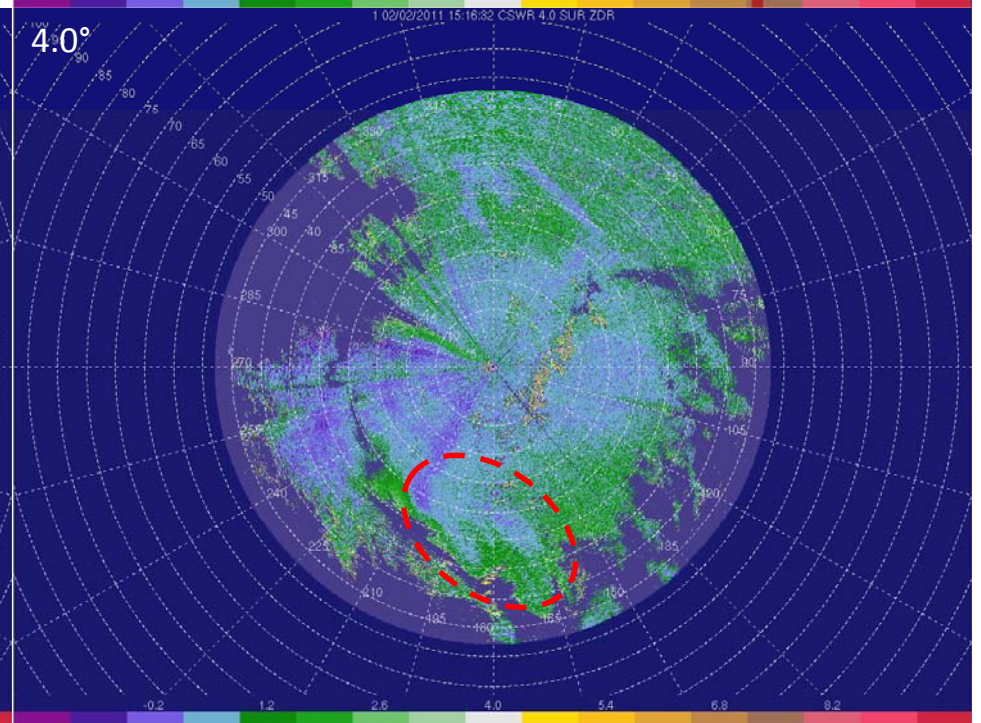
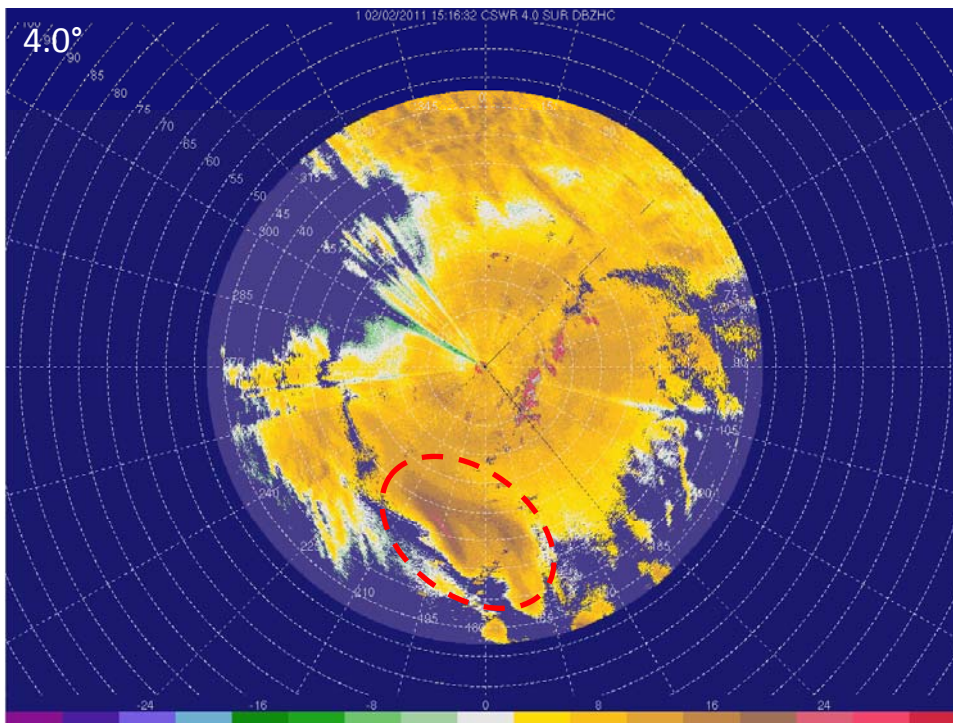
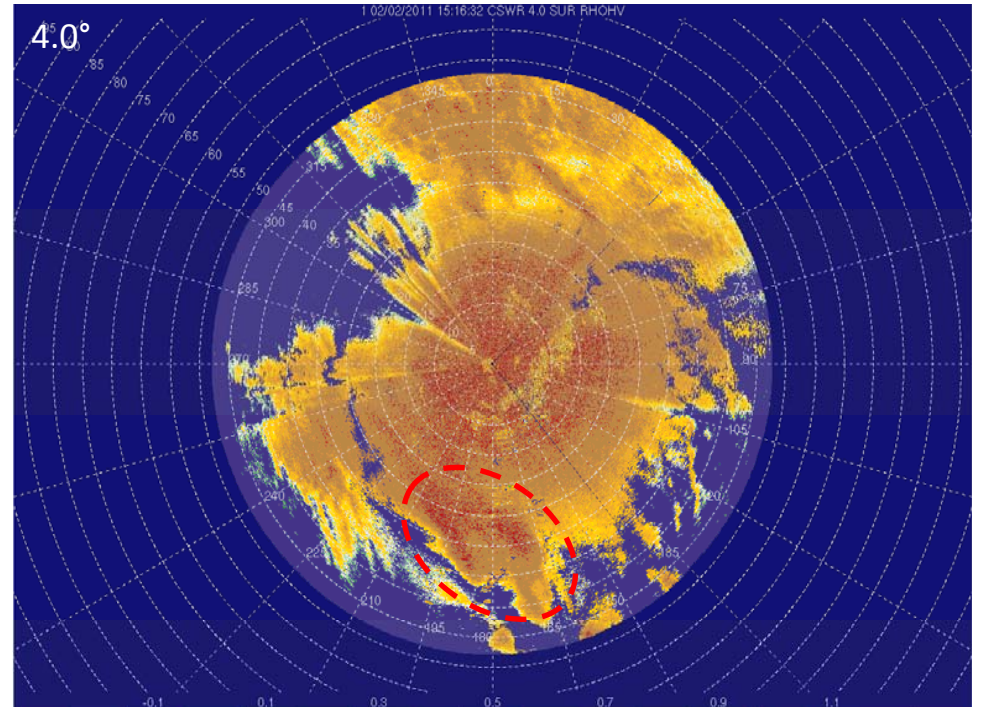




## Data examples collected in stratiform snow – 2 February, 2011

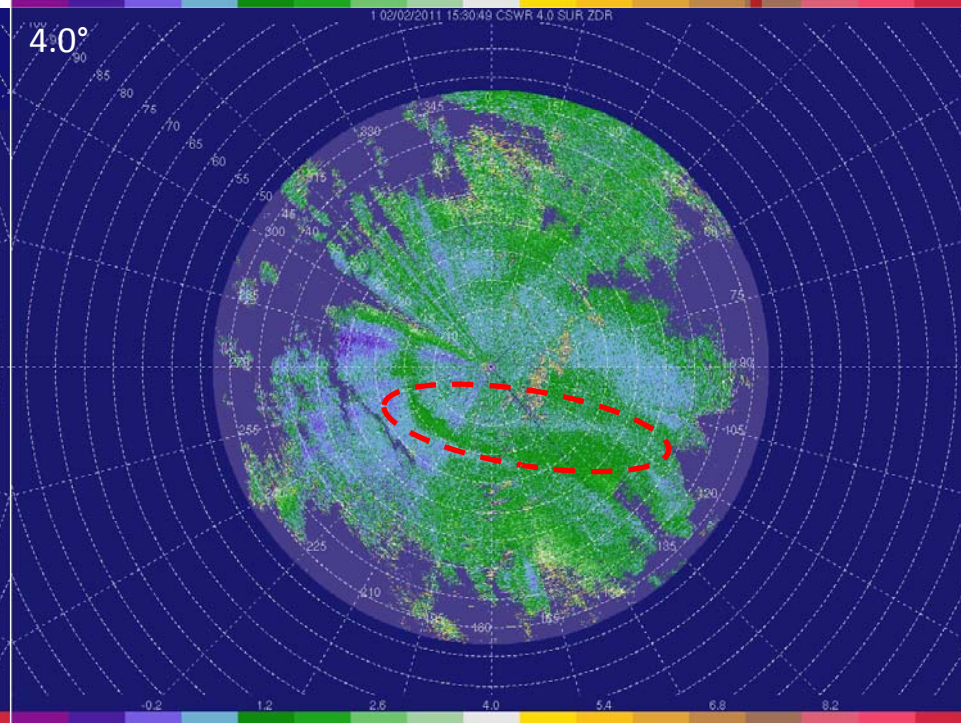
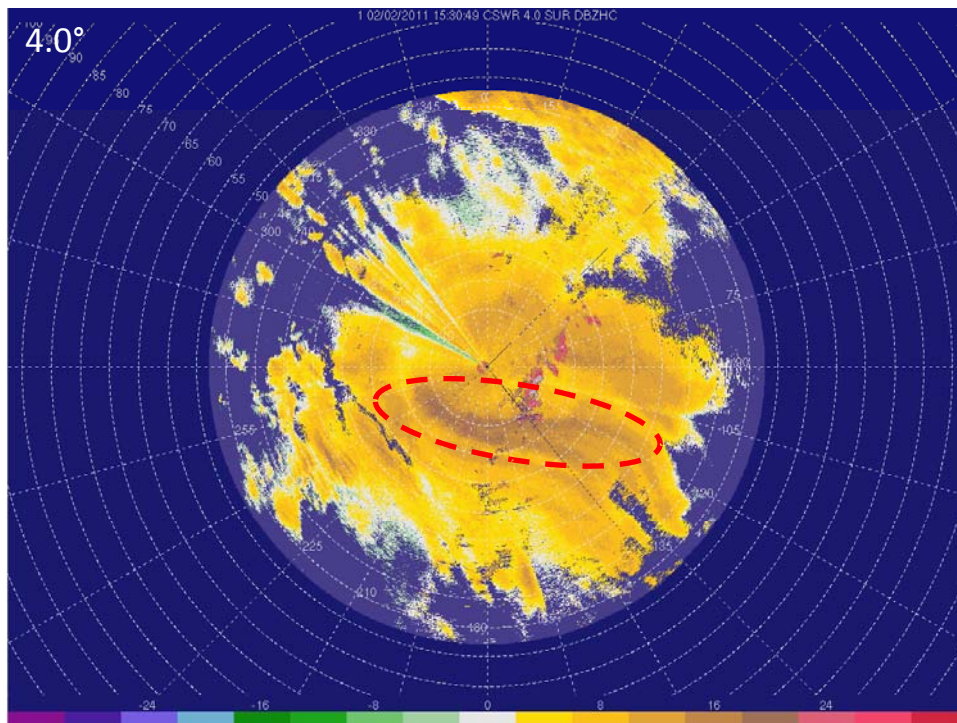
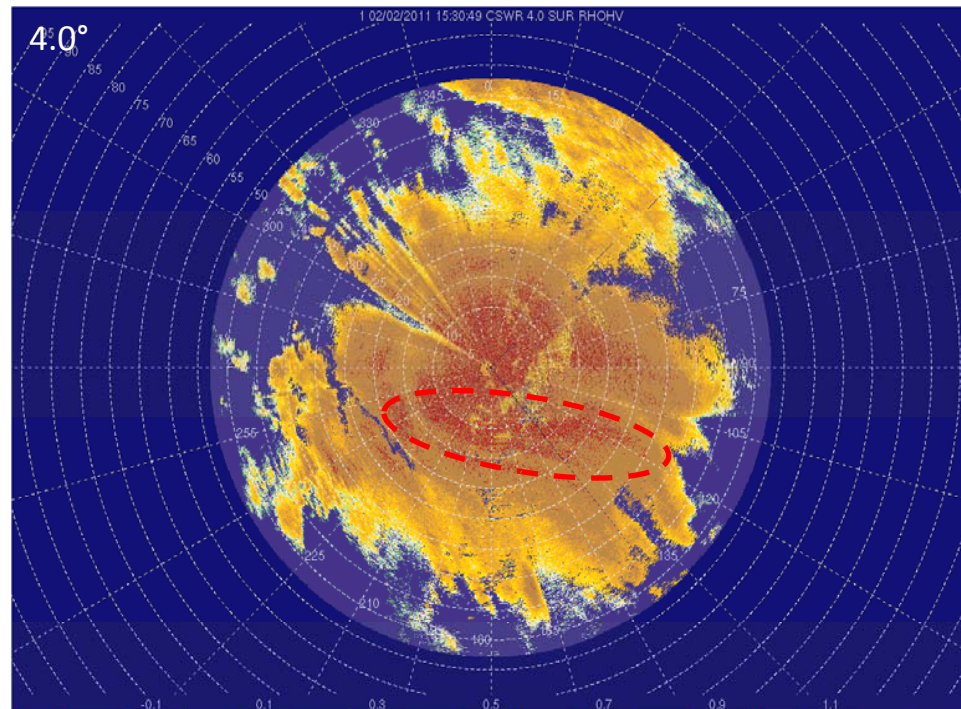
- Higher DBZ in annotated band approaching the radar from the southwest.
- Values of CC are smaller in annotated band than in the surrounding stratiform precipitation.
- Values of ZDR are higher in annotated band than in the surrounding precipitation.

# 15:16:32





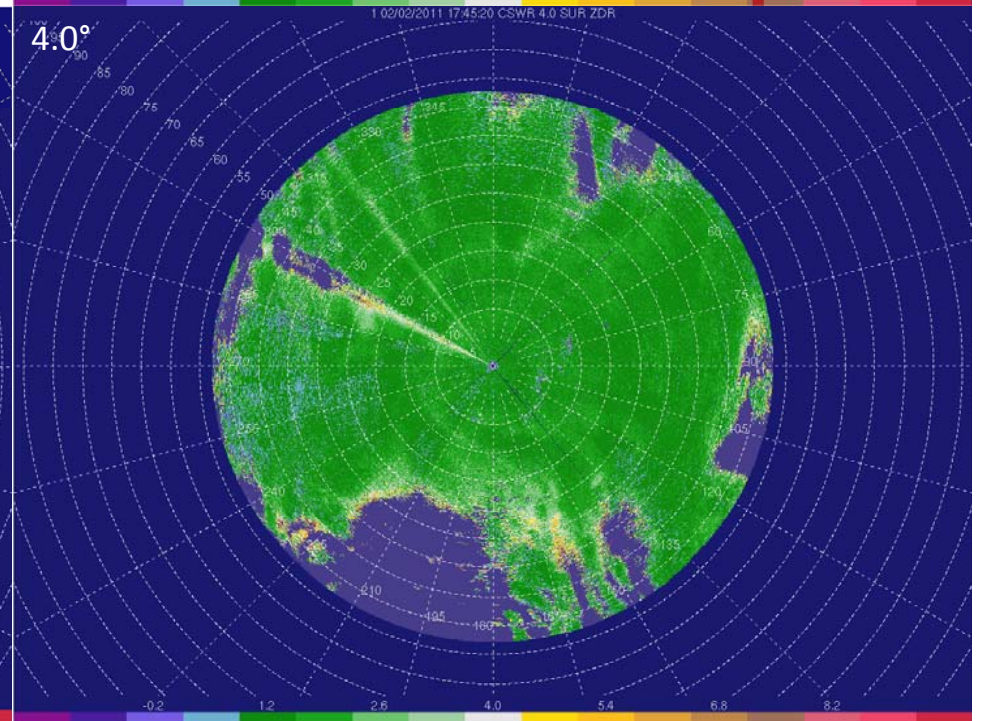
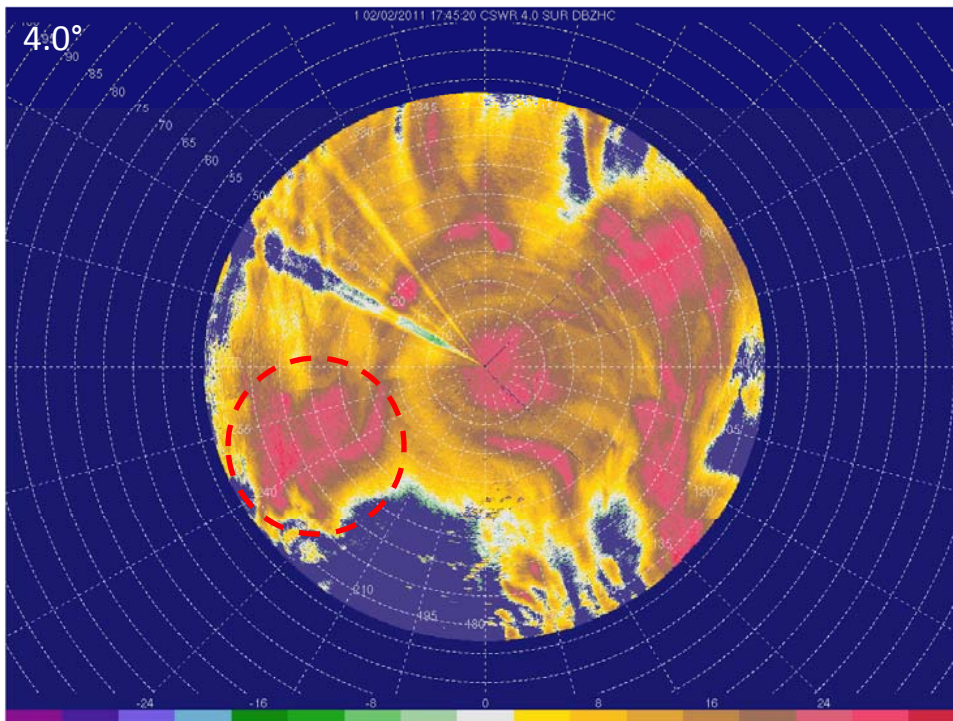
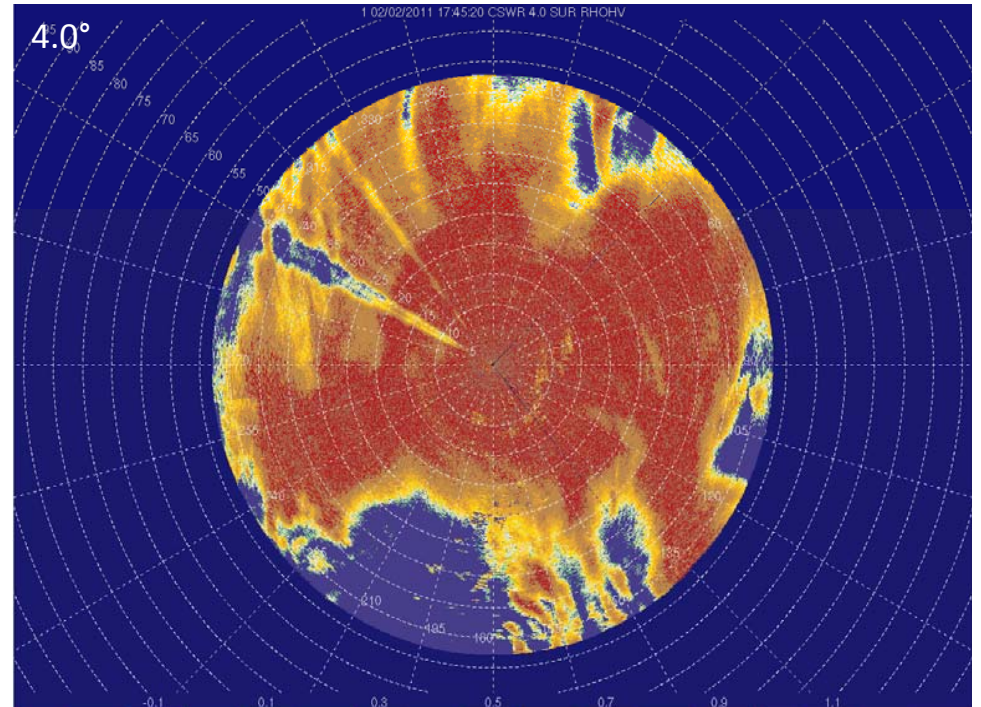
15:30:49





- CC indicating dry snow.
- Note that ZDR is nearly the same throughout the entire surveillance despite heavier bands in and around the radar.
- Watch the annotated feature(s).

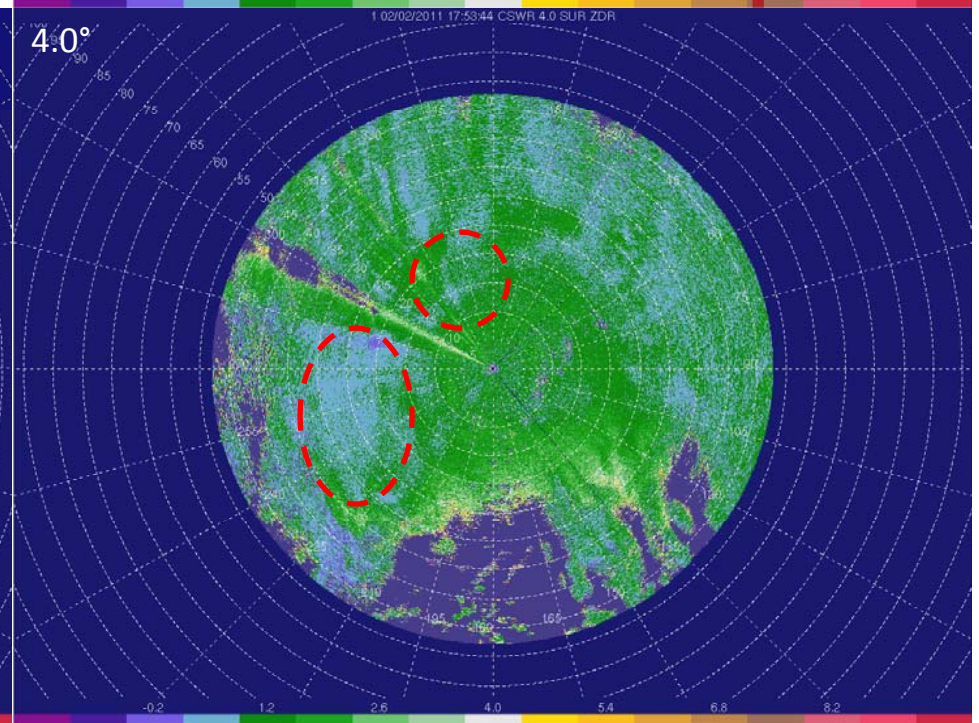
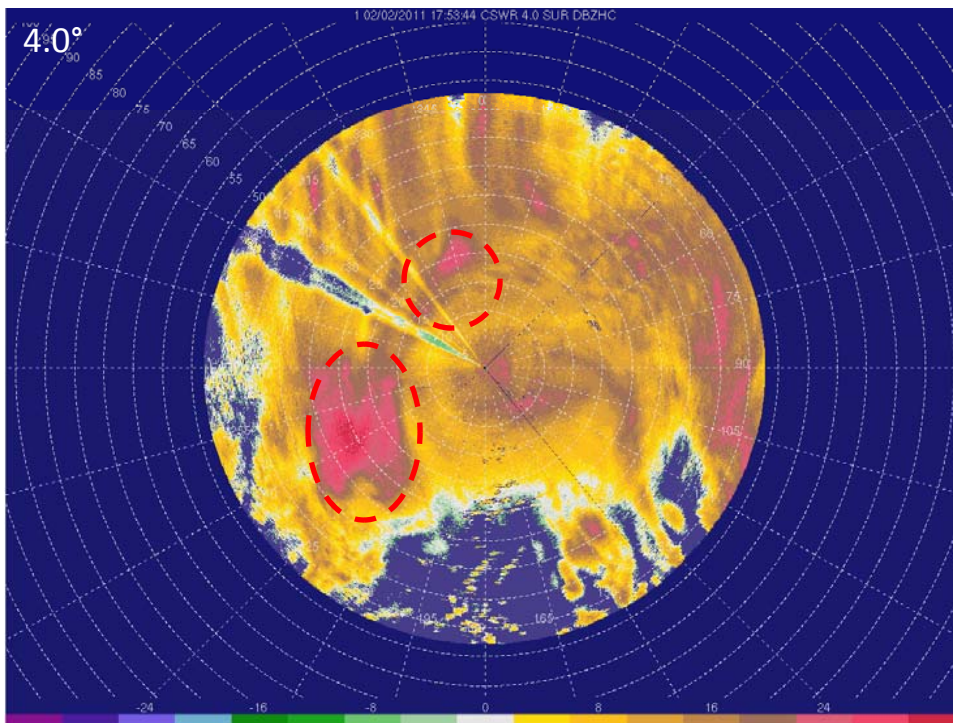
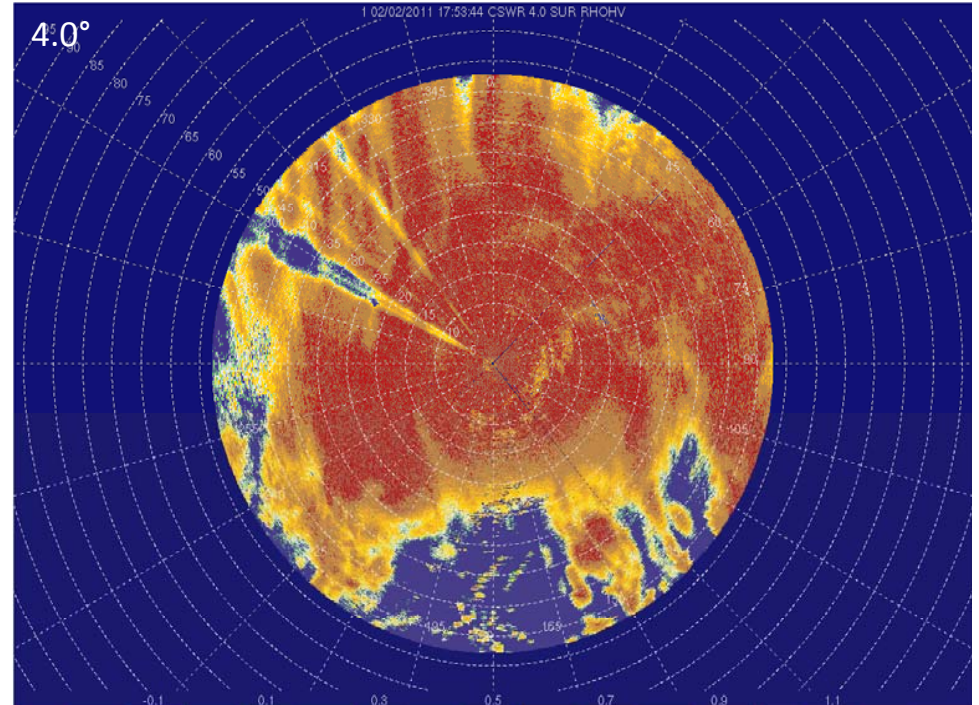
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- Note that values of ZDR are now smaller within the annotated features than surrounding precipitation.
- This indicates at this time the snow is drier within the annotated bands than the surrounding precipitation.

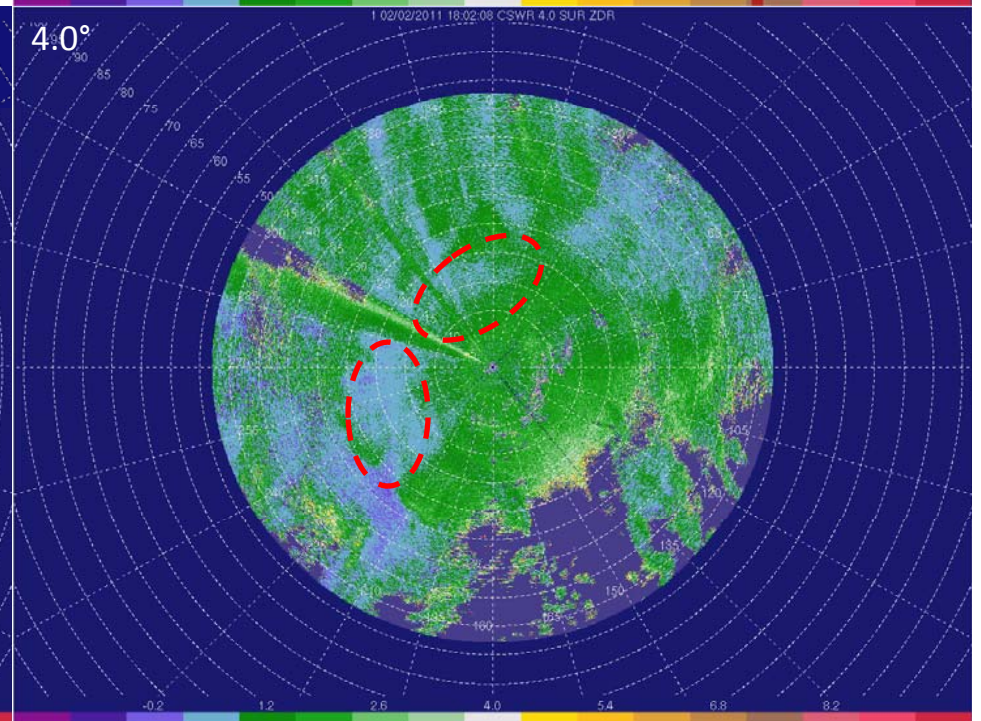
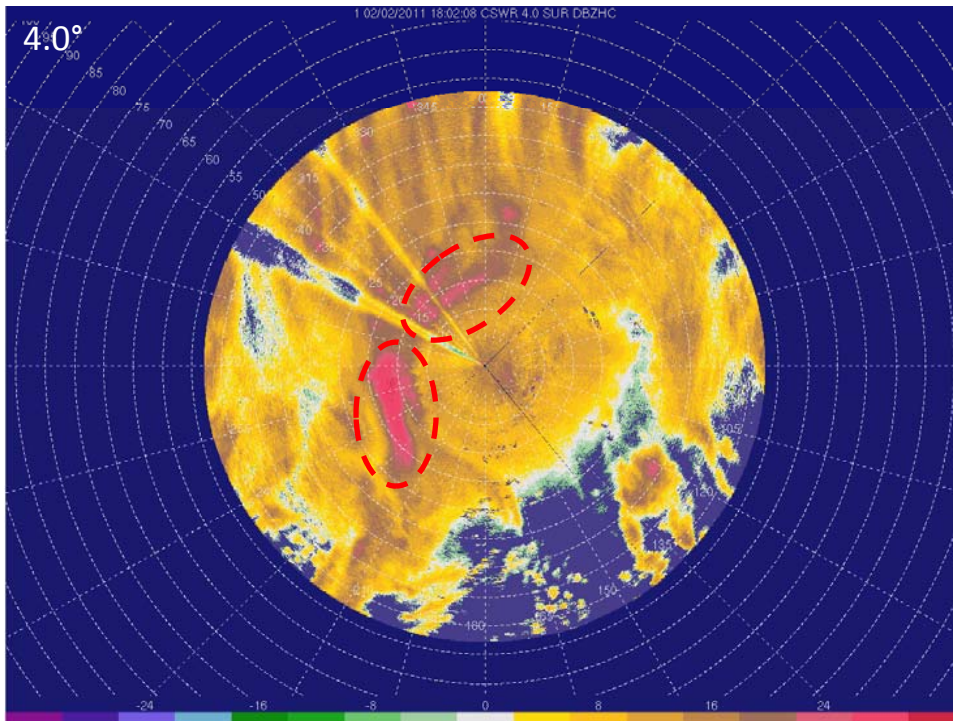
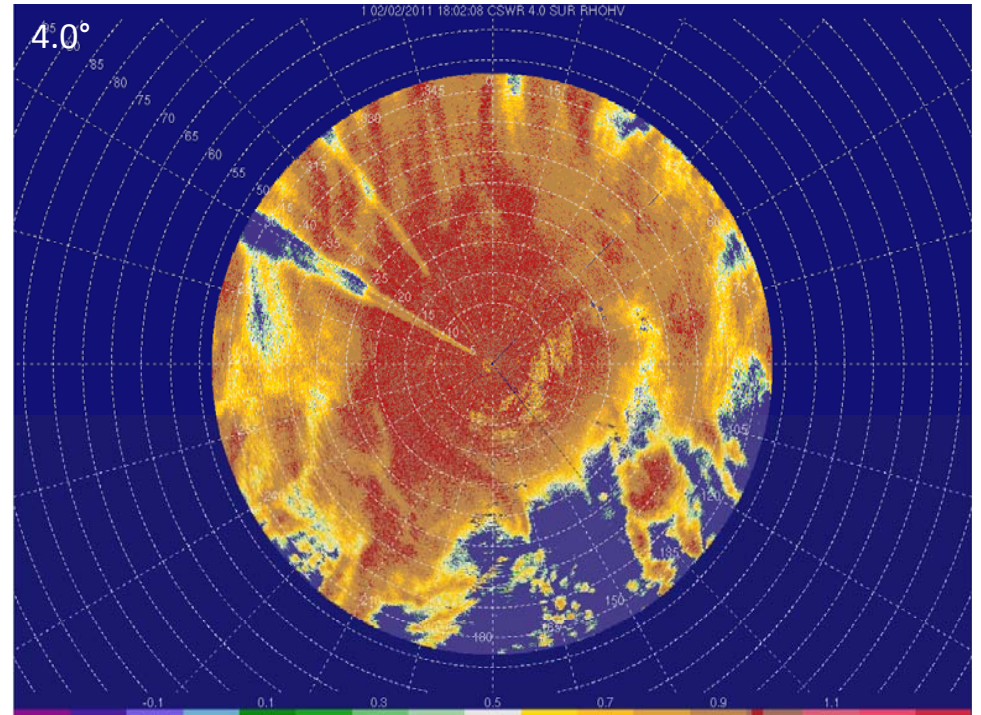
**17:53:44**





- Note that while values of ZDR are smaller within the annotated features, there are also areas of smaller ZDR in weaker bands.

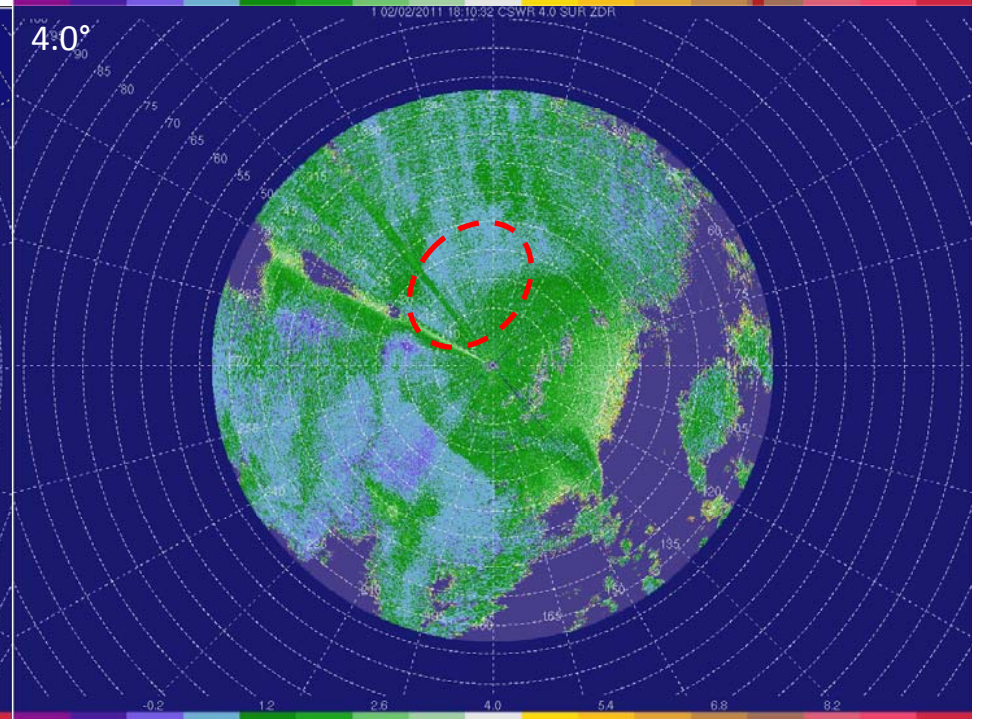
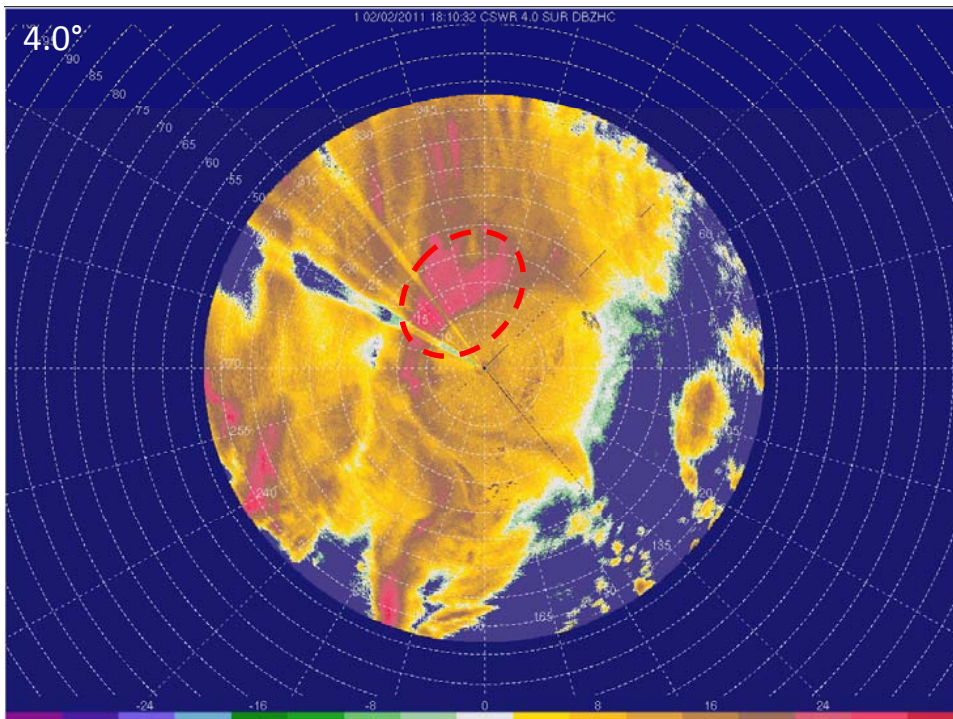
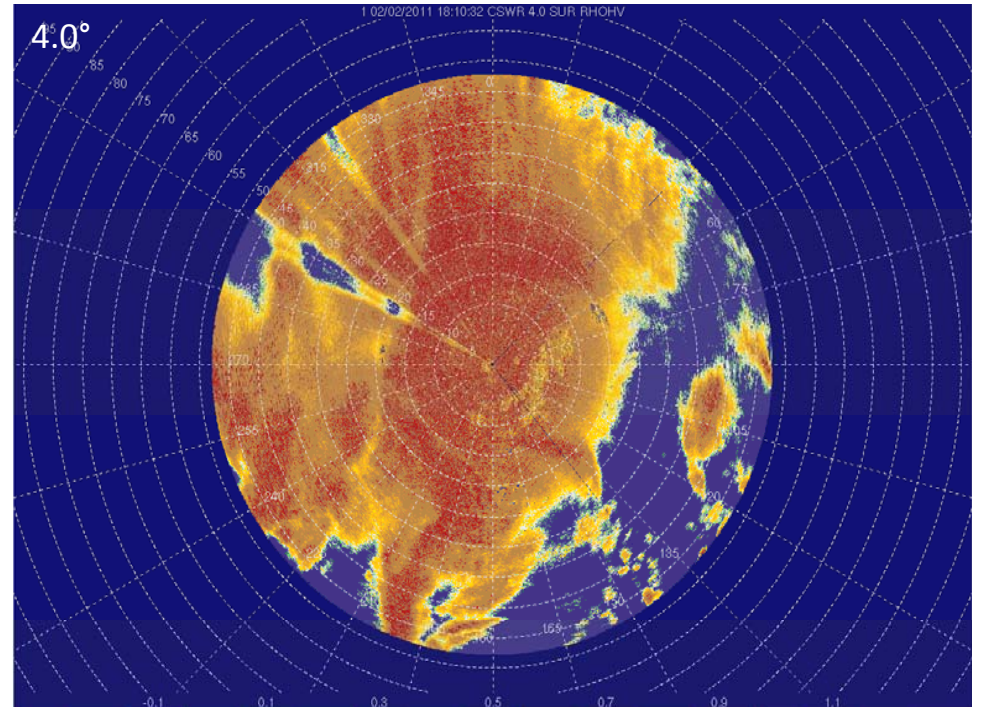
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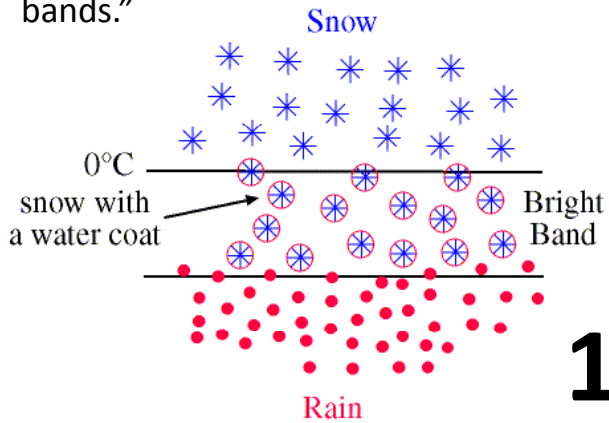
- CC values of around 0.9 to 0.95 remained fairly constant throughout this timeframe indicating dry snow.
- Note that while values of ZDR are smaller within the annotated features, more lower values of ZDR are spreading over the area.
- This indicates that the snow in the overall surveillance is trending towards a different crystal habit with increased moisture.

**18:10:32**

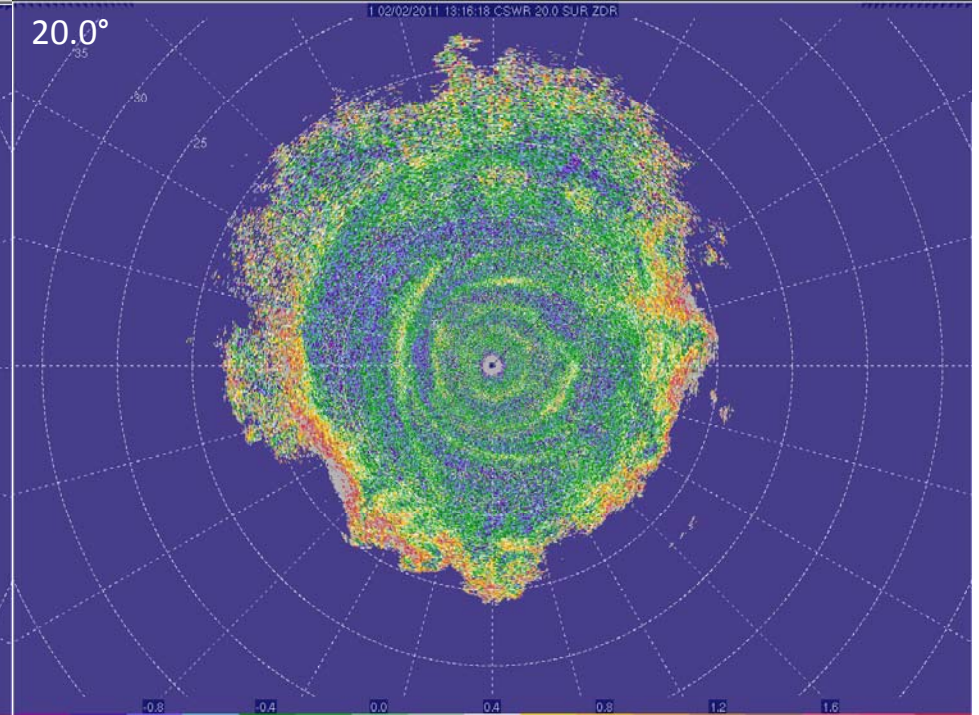
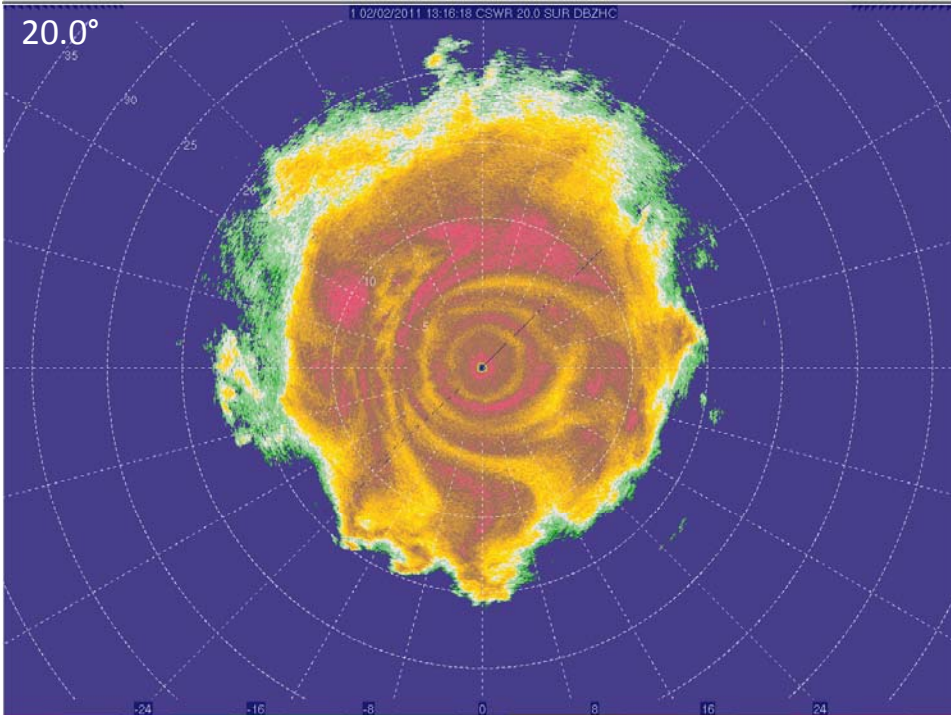
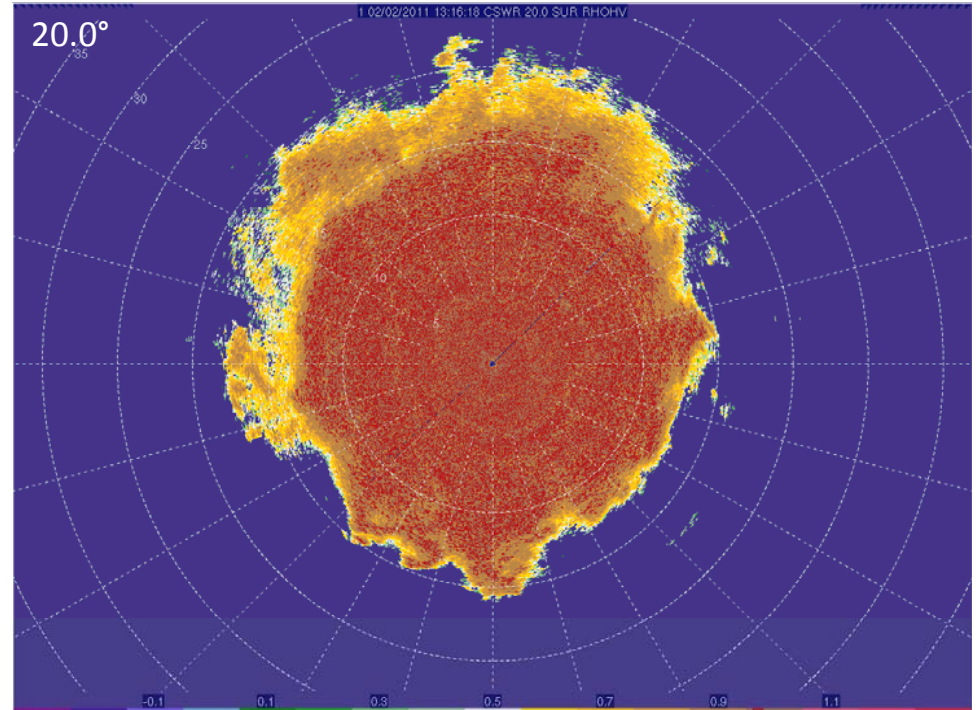




When snow falls through a melting level it acquires a coat of water so that the radar sees it as a larger drop. This is indicated by higher reflectivity returns known as “bright bands.”

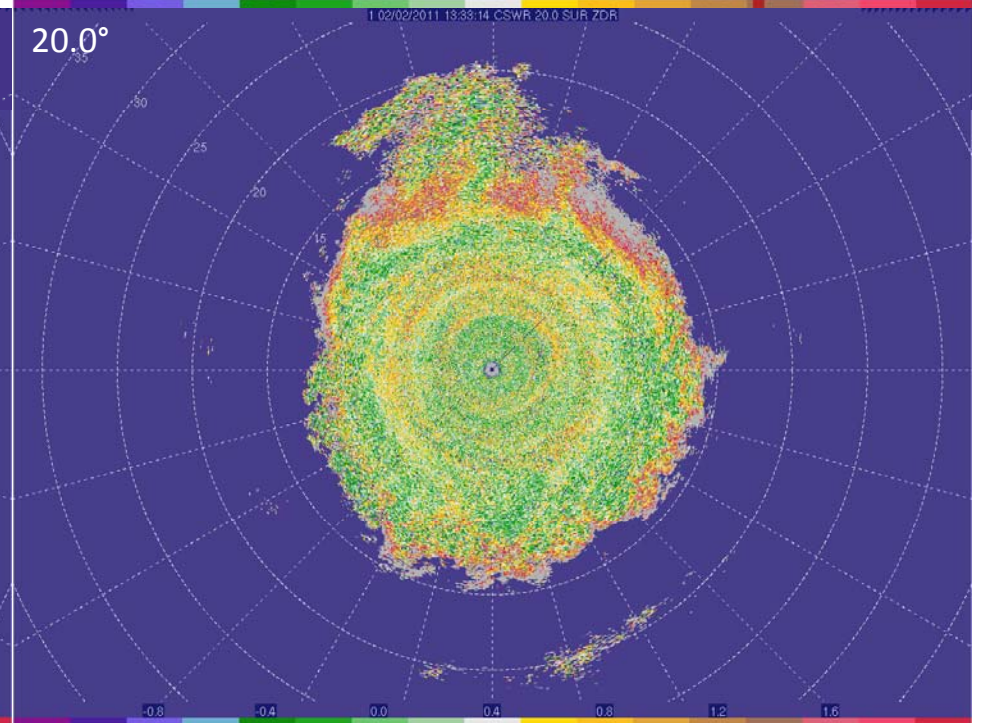
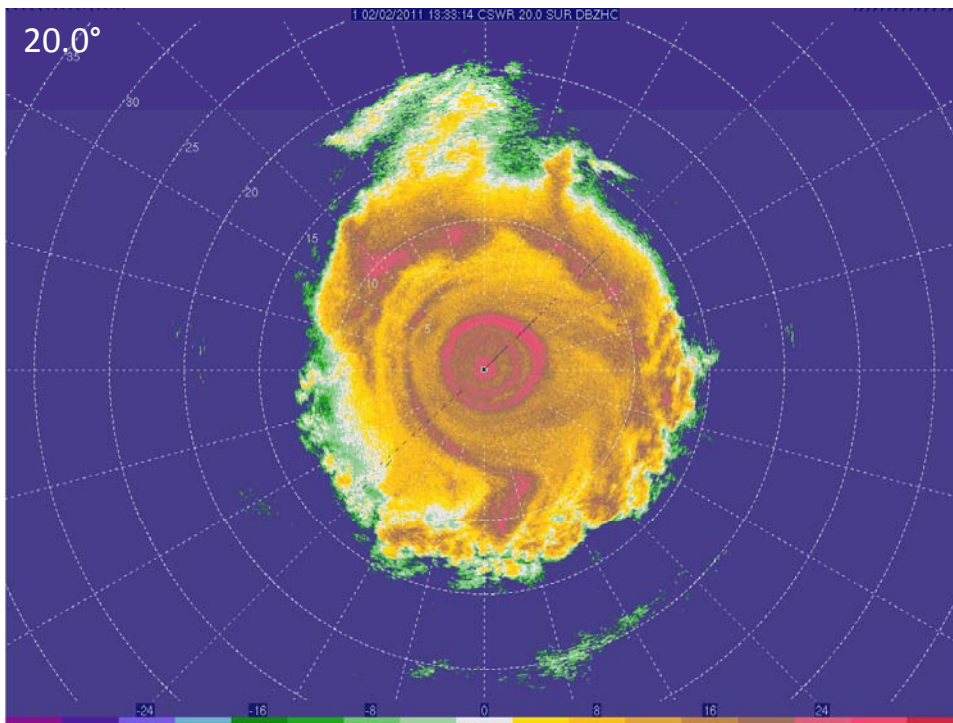
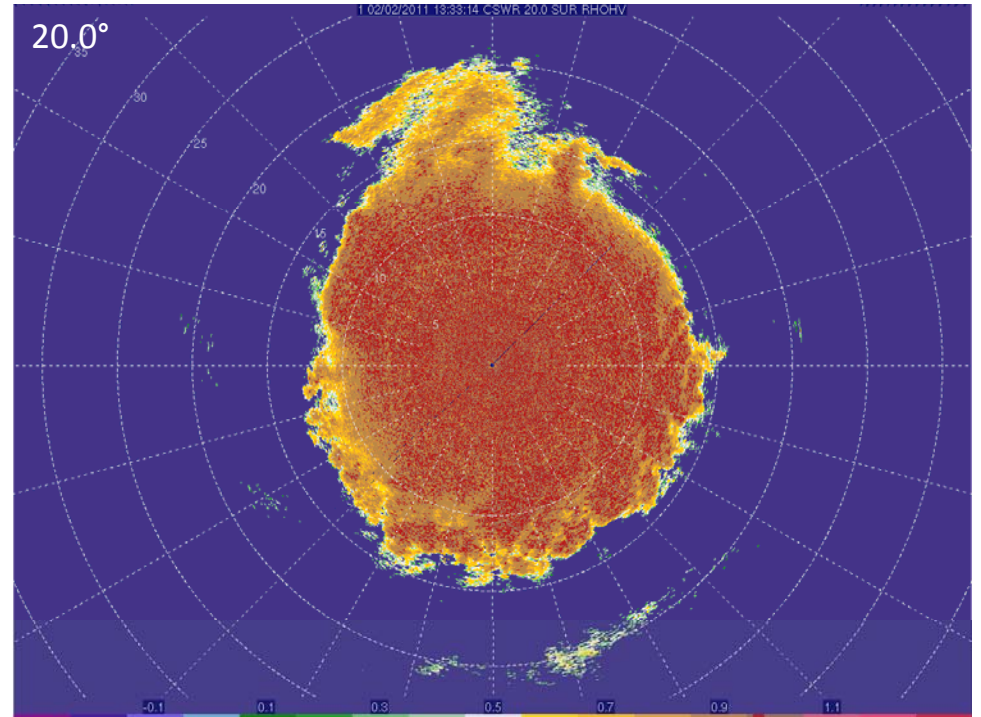


**13:16:18**

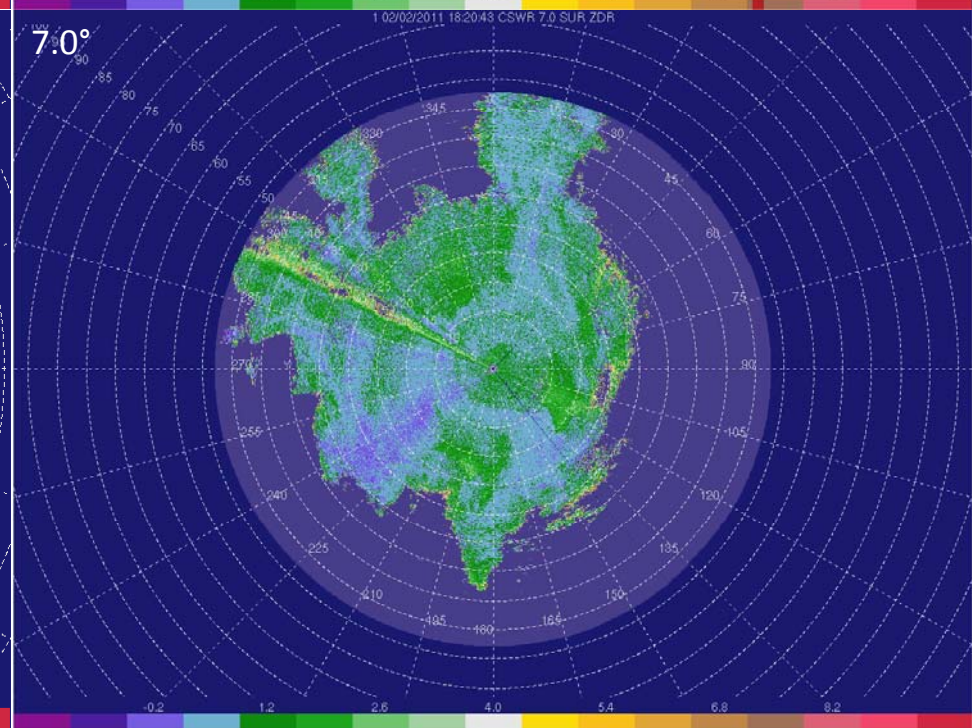
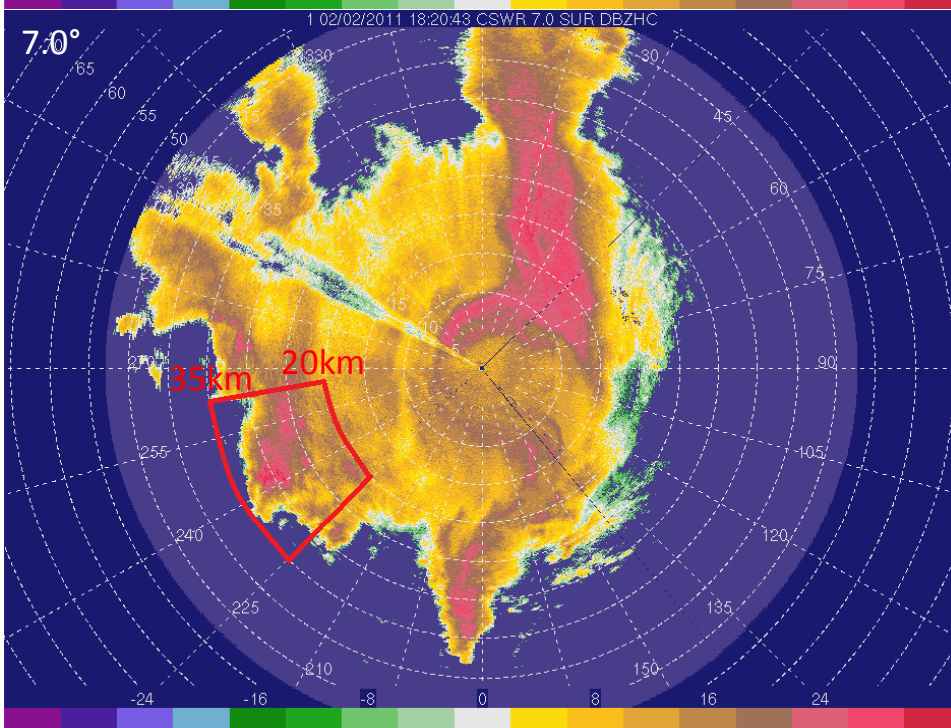
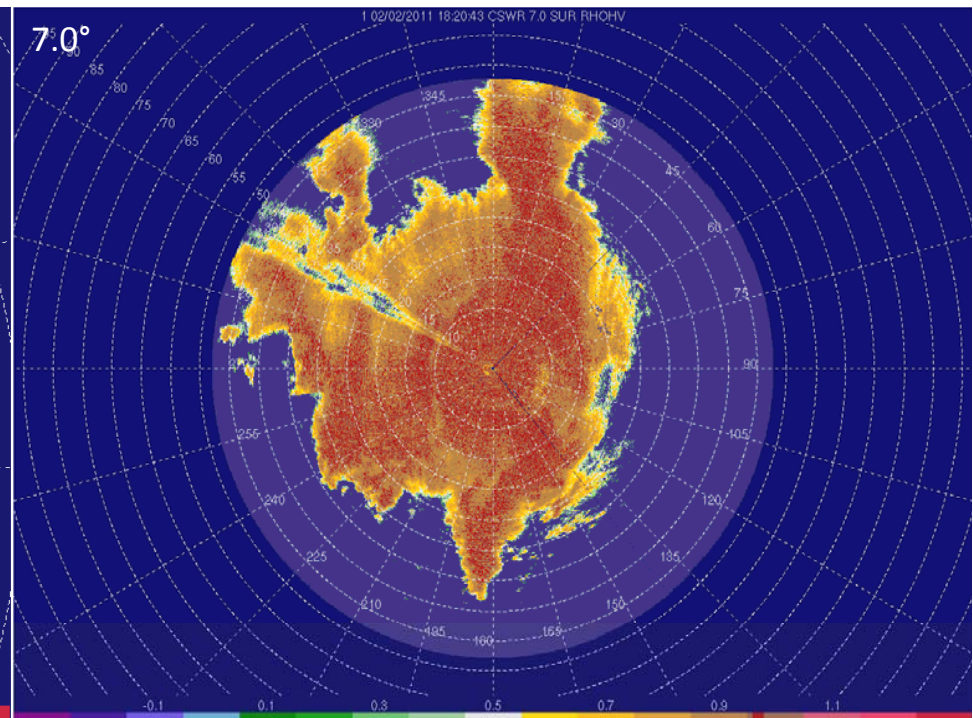
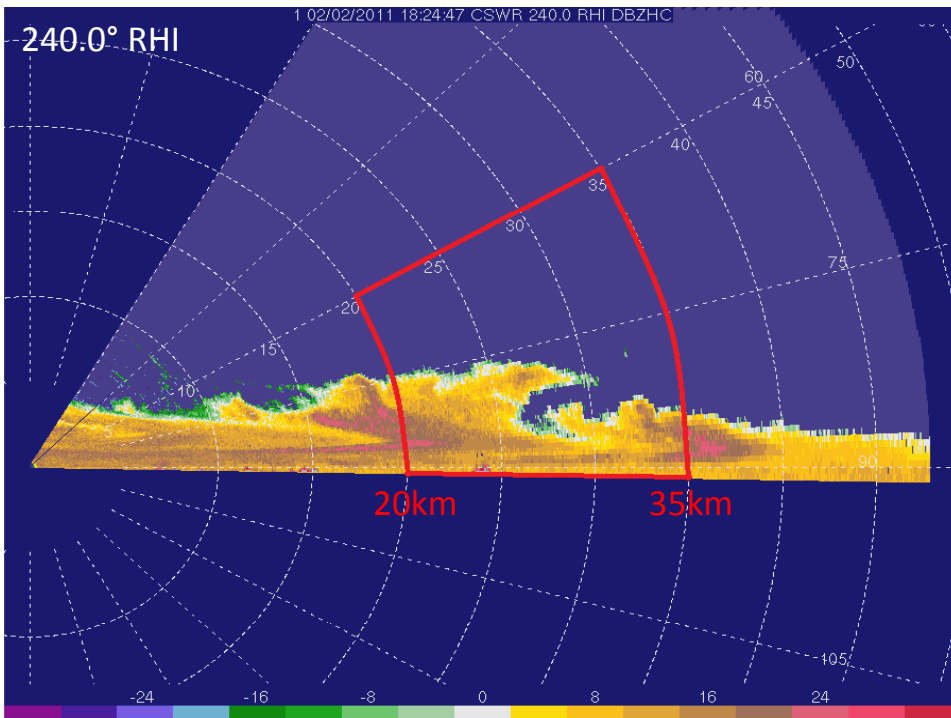


- Here we can see that the bright band is defined quite well in the reflectivity and ZDR fields.
- Although subtle, the bright band can also be seen in the CC field.

**13:33:14**







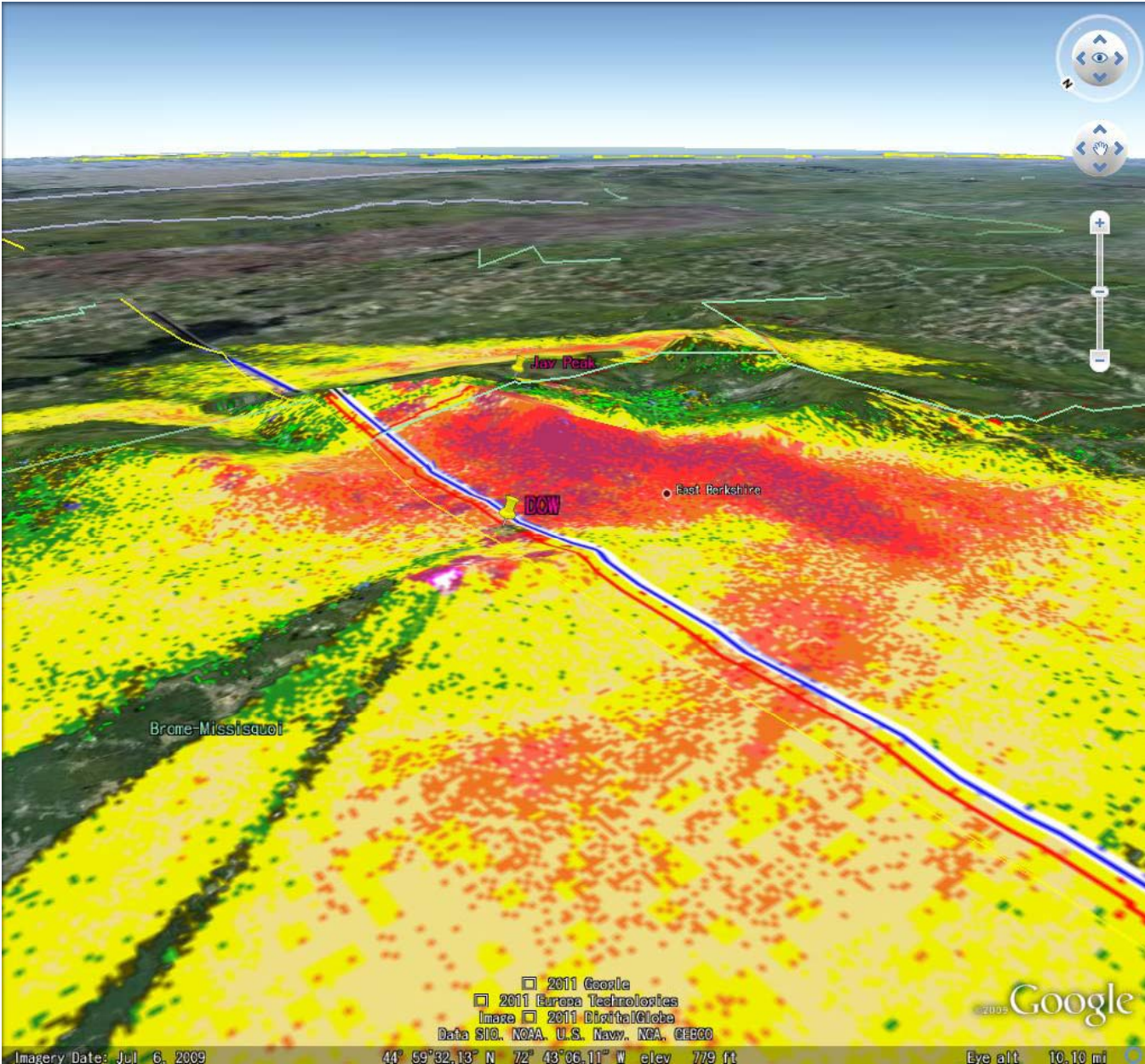


*8 February, 2011 – Orographic snow over the Jay Peak region*



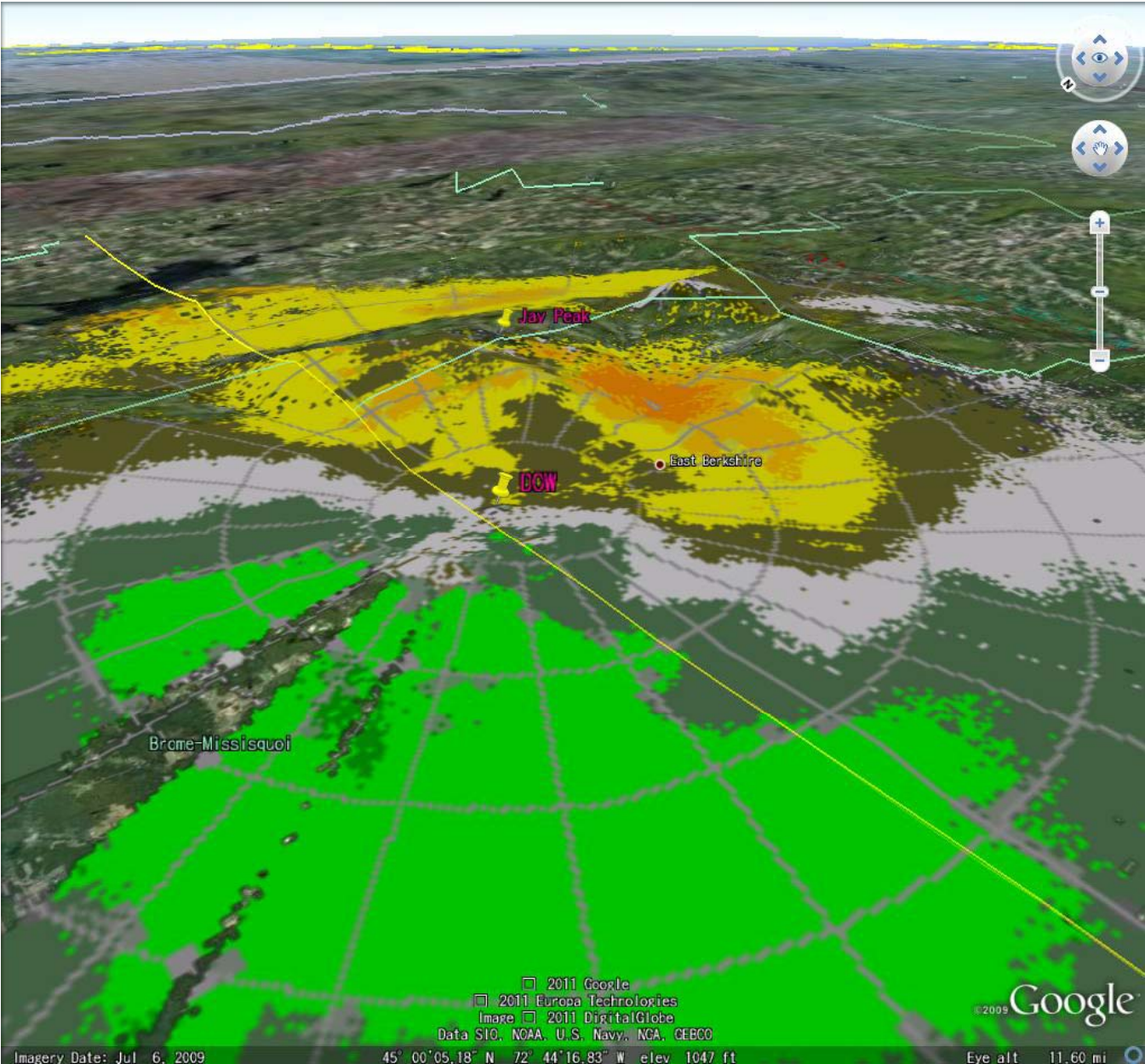


Notice precipitation enhancement on windward side of mountains in this overlay of DOW reflectivity over terrain in Google Earth.





Notice the flow enhancement to the right( west) of Jay Peak. This is flow channelling through a local pass in the mountains.





Notice the flow enhancement in the lee of the high terrain. This clearly shows how stable flow accelerates as it moves over a topographic barrier.

