Final Report for the Doppler on Wheels Observations of New England Winter Storms (DOWNEWS2) Project

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During the time period from 30 January to 17 February, 2012, 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 and interpretation of the dual-polarization variables. 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.

4 February, 2012

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.

16 February, 2012

a. Dr. Karen Kosiba from the Center for Severe Weather Research (CSWR) gave a presentation on current 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.
b. Dr. Kosiba also gave a presentation to students in the senior level Mesoscale Meteorology course. The presentation focused on current research using DOW data related to tornadoes and hurricanes.
a. The last presentation by Dr. Kosiba was to the broader LSC and local communities. Approximately 50 people from LSC and the local area attended this talk. Dr. Kosiba did a very nice job at explaining what Doppler radars are, why the DOWs were built and field projects that the DOWs have been involved with. Some tornadic storm and hurricane data were also presented. The talk was very well received.

DOW Operation by LSC Remote Sensing Students

On the first day (30 January, 2012) that the DOW was on campus, all 13 juniors in the Remote Sensing course were trained on how to operate the radar. In addition, two sophomore transfer students, three seniors, and three faculty were also trained on radar operation.

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 addition to setting up scan sequences, the students were able to transmit two different pulses. The first was a shorter 0.4 microsecond pulse that was transmitted with a pulse repetition frequency of about 2600 Hz. The second was a longer 1 microsecond pulse transmitted with a smaller 1050 Hz PRF. Students were encouraged to use both pulses during the deployments to see how pulse length affects the radar sensitivity and how the PRF affects the Nyquist velocity.

In total, the students deployed the radar during five IOPs (Table 1). Unfortunately, the weather was rather benign while the DOW was deployed at LSC. Despite the fact that the students deployed the DOW for over 42 hours, data collected in precipitation was limited to the first and last IOPs along with the last hour of the 11 February deployment. Select notes from the student log book for all of the IOPs follows.

31 January – 1 February – This was a long mission on a storm that was warm enough to produce rain for much of the deployment. However, later in the day, the rain began transitioning into wet snow and snow. Unfortunately, only one channel with one frequency was working on this day so no dual-polarization data was collected.

7 February, 2012 – Weak orographic enhanced snowfall was anticipated with a weakening polar front moving into the region from the northwest. Only a short period of precipitation was observed during the last hour of the deployment. Interestingly, the students noticed enhanced reflectivity from what appeared to be chaff early in the deployment.

8 February, 2012 – The students noticed in previous deployments that the DOW was sensitive enough to observe clouds and some clear air data due to Bragg scattering. So, it was decided to deploy the DOW on a day when a strong radiation inversion was expected to test the hypothesis that the strong inversion would produce enough Bragg scattering for the DOW to observe. Thus, one hour before sunrise on 8 February, 2012, the DOW was deployed in a valley with a strong radiation inversion in place. Unfortunately, the DOW produced no meteorological return. The students learned that moisture must be present in sufficient amounts to produce the clear-air return detectable by the DOW.

11 February, 2012 – The DOW was again deployed on another weakening cold front that was moving in from the northwest. Unfortunately, the precipitation that was forecast with frontal passage did not materialize. As such, the students scanned a low and mid level cloud layer for much of the deployment.

17 February, 2012 – The last deployment was associated with an occluding low and attendant occluded front. Light precipitation (snow) was observed during the entire 11.5 hour deployment. The DOW captured the occluded frontal passage. Students created a Velocity-Azimuth Display (VAD) analysis of the winds for the entire deployment documenting the flow associated with the frontal passage (Fig. 1).

Table 1. List of all missions executed during DOWNEWS2.

IOP Date	Time Period	Mission	Location
31 January – 1 February	13:28 – 04:52 UTC	Stratiform rain transitioning to snow	Caledonian County Airport, Lyndonville, VT (44.592082°, -72.009761°)
7 February, 2012	08:47 – 12:47 UTC	NW flow orographic enhancement	Whitefield, NH Municipal Airport (44.3667°, -71.5579°)
8 February, 2012	11:35 – 12:18 UTC	Clear air low-level inversion break up	Lyndonville, VT (44.5506°, -71.9813°)
11 February, 2012	03:26 – 14:11 UTC	NW flow orographic enhancement	Whitefield, NH Municipal Airport
17 February, 2012	01:54 – 13:27 UTC	Occluded frontal passage	Caledonian County Airport, Lyndonville, VT

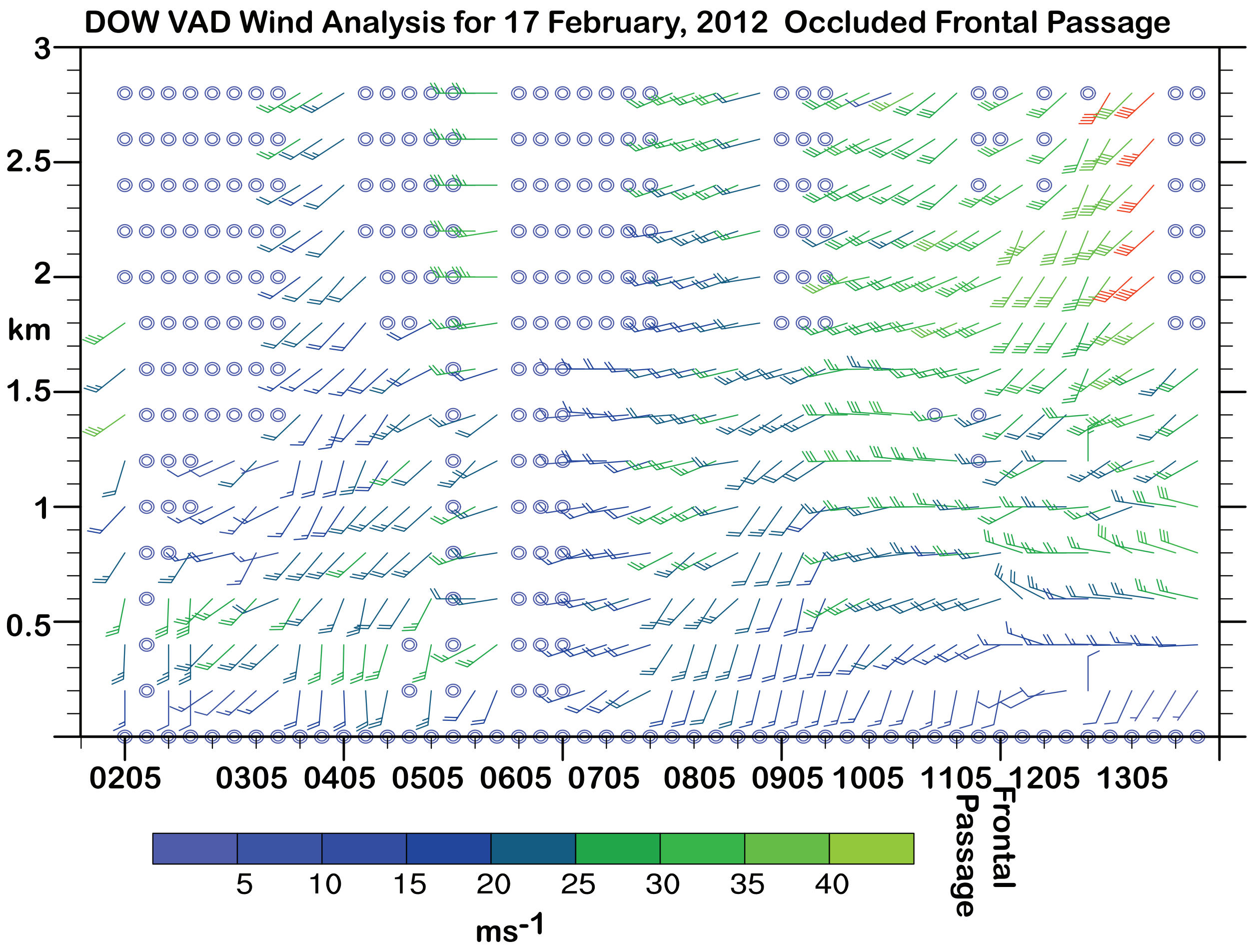

Figure 1. VAD winds generated from the DOW radial velocity data. Heights are above radar level (ARL). Full and half barbs are 10 and 5 knots, respectively. Times are given in UTC.