

**THE PLYMOUTH STATE METEOROLOGY DOW PROJECT
(PSUMET-DOW)**

Dr. Sam Miller
Associate Professor of Meteorology
Plymouth State University

Plymouth State University, in Plymouth, New Hampshire, requests a 21-day (preferred dates Feb 7 through February 28, 2014; flexible) campus deployment of a Doppler on Wheels (DOW). The DOW will be used for *classroom instruction* (about 15 graduate students in our *Radar Meteorology* and *Mesoscale Meteorology* courses, and about 70 undergraduates in meteorology core curriculum courses), *outreach* (we will give tours of the facility to about 90 undergraduates in our general education Weather and Climate course, and about 100 K-12 students from Plymouth area primary and secondary schools), and *research* (approximately 15 undergraduate and graduate students in our *Mesoscale Meteorology* course, and about 10 graduate students *Radar Meteorology* course will use the data produced during the period requested as the basis for semester-length research projects). DOW data may also prove useful in our program-wide project to study cold-air damming and mixed-phase precipitation in central New Hampshire.

The Plymouth State Meteorology DOW Project has the following primary objectives:

1. Education. Enhance instruction in graduate courses MT5340 *Radar Meteorology* and MT5480 *Mesoscale Meteorology*; and undergraduate courses MT4510 *Senior Research*, MT4500 *Undergraduate Research*, MT4480 *Mesoscale Meteorology*, MT4330 *Current Weather Seminar*, MT3280 *Synoptic Meteorology II*, MT3230 *Atmospheric Thermodynamics*, and ESP2110 *Introduction to Environmental Science and Policy II*.

Radar Meteorology (MT5340) will be the primary course to use the DOW. This course provides a broad overview of the hardware and theory behind the application of meteorological radar data. The course begins with a short history of radar meteorology, followed by a brief summary of the radar hardware and theory applicable to meteorological use and interpretation – beam spreading, ducting, anomalous propagation, etc. The differences between reflectivity, Doppler, and polarimetric measurements are discussed. Much of the remainder of the course is used to cover the different levels of WSR-88D data, the available products for each level, algorithms used to automatically analyze these data, and applying these data to real world problems, such as quantitative precipitation estimates and severe local storms detection. One element this course has lacked is direct, hands-on experience with Doppler radar hardware and operations. Bringing the DOW to our campus, during the semester when MT5340 is taught, will greatly enhance the educational experience of graduate students studying weather radar. They will be able to see the radar in action, learn how to operate it themselves, and design small field campaigns to collect data for their own semester-length research projects using the data developed by the radar.

Bringing the DOW to Plymouth will also enhance the educational experience of our undergraduate meteorology majors enrolled in *Senior Research* (MT4510), *Undergraduate Research* (MT4500), *Mesoscale Meteorology* (MT4480), *Synoptic Meteorology II* (MT3280), *Atmospheric Thermodynamics* (MT3230), and *Introduction to Environmental Science and Policy II* (ESP2110). The combined enrollment in these courses is about 70. In addition, Plymouth State Meteorology is embarking on a new student-oriented multi-course collaborative project to measure cold-air damming (CAD) events in central New England. These CAD events often result in wintertime mixed-precipitation events in the region's complex terrain. Small differences in elevation in the

alternating valleys and ridges often result in differing precipitation phases (such as snow, ice pellets, and freezing rain) over relatively short horizontal distances. Access to the DOW, should we be fortunate enough to experience a CAD event during its deployment here, will greatly assist with our ability to characterize precipitation types and intensities inside and outside the classroom. We envision students enrolled in all of these courses could be given tours of the DOW and subsequently assist in this research project through data collection, selection of radar volume scans, and data analysis. Students in *Synoptic Meteorology* would use the data collected to complete case studies of the event. Students in *Mesoscale Meteorology* and *Atmospheric Thermodynamics* (who learn about predicting precipitation phase using thickness profiles) would add additional data types by using portable temperature sensors and our portable radiosonde system to launch weather balloons, respectively, in order to better characterize the temperature, dew point, and wind profiles during the event.

Should we not experience a CAD event during the DOW's deployment in Plymouth, we will almost certainly have plenty of alternative mesoscale and synoptic-scale weather events to study; snow squalls, upslope snow events, frontal passages, and mesoscale precipitation bands within Nor'easters are all regular events during the winter. We can also drive the DOW 20 miles north, to Franconia Notch, a narrow canyon running through the White Mountains. The cloud cover, visibility, precipitation type and intensity, temperature, wind, etc. are often very different within Franconia Notch than conditions recorded at airports to the north and south of the Notch. The deployment of the DOW in each of these examples would provide fruitful educational opportunities for students in all the aforementioned courses.

2. Outreach. We will use the DOW to introduce PSU students majoring in other fields, elementary, middle and high school students, and members of the general public, to science and technology.

We propose to park the DOW in front of our student union building, in the geographic center of the campus. With approximately 4,500 full-time equivalent undergraduates, and 3,500 graduate students enrolled at Plymouth State, the DOW presence will assure broad exposure of STEM subjects to these future professionals. We will also give tours of the facility to students enrolled in *Weather and Climate* (MTDI 1200), our general education, introductory-level course. Two sections of this course will be taught, with a total enrollment of about 90 students. The DOW will be discussed beforehand in the classroom, along with a few general principles of weather radar, so that their time actually at the DOW will be utilized most effectively. In the past we have had one or two students each semester change their majors to meteorology after taking *Weather and Climate* (and its predecessor course), and we anticipate that introducing them to the DOW could increase this number.

PSU has a formalized STEM Initiative; the purpose being to bring more STEM-related experiences and exposures to elementary, middle and high schools in the region. We have communicated the DOW proposal to these partners and are planning for those teachers and classes to visit the facility. Ideally, we would have many more students visit the DOW if it were sited at the Plymouth school complex (co-located elementary, middle, and high schools). Finally, we will provide opportunities for members of the general public (in Plymouth and several surrounding towns) to visit the DOW, with a faculty member assisting with organized tours, and staff of the Mount Washington Observatory will incorporate DOW and radar information into their outreach programs. A University press release will be disseminated to the White Mountains and Lakes Region communities advertising the DOW and inviting all residents and businesses to participate.

3. Research. As discussed above, we are embarking on a project to observe, measure, and better-predict the onset of cold-air damming (CAD) events in northern New England, the mixed-phase precipitation events that often result during the wintertime, and the external meteorological forces that eventually cause the breakdown of the highly-localized cold domes. This project will

involve graduate students, undergraduates, and members of the Plymouth State Meteorology faculty and staff. Should we be fortunate enough to experience one of these CAD events during the DOW's deployment in Plymouth, we will combine data developed from the radar installation with thermodynamic profiles recorded with our own portable radiosonde system and other meteorological observation platforms.

Facility Request Form for Educational Activities

Part I: General Information

| | |
|-------------------------|---|
| Requestor Name | Samuel T. Miller |
| Institution and Address | Department of Atmospheric Sciences and Chemistry Plymouth State University MSC 48 17 High Street Plymouth, NH 03264-1595 |
| Phone and Email | +1 (603) 535-2811 stmiller@plymouth.edu |

Part II: Project Description

| | |
|--|--|
| Project Title | Plymouth State Meteorology DOW Project (PSUMet-DOW) |
| Project Location | Plymouth, NH and surrounding area |
| Start and End Dates of Field Deployment | 7 Feb 2014 – 28 Feb 2014 (flexible) |
| NSF Facilities requested (type and # of systems) | One Doppler-On-Wheels (DOW) |
| Number of Expendables requested (if applicable) | None |

Part III: Educational Activities Description

| | |
|---|--------------------------------------|
| Number of students involved | Graduate: 10+ Undergraduate: 160+ |
| Desired training activities conducted by Facility Staff incl. time in the field | None |
| Desired teaching activities conducted by Facility Staff incl. time in the field | None |
| Additional special requirements that pertain to Facility support | None |
| Ancillary/Oppportunistic K-12 Outreach Activities ¹ | 100+ |

Part IV: Operational Requirements

| | |
|---|---|
| Please specify data access needs (e.g. real time) | Real-time and recorded (during period of deployment) reflectivity, radial velocity, and spectrum width recorded by DOW, in any format |
|---|---|

¹ Please note that NCAR and NSF **strongly** encourage additional educational activities that focus on K-12 audiences to expand NSF Facilities outreach even further.

| | |
|-------------------------------------|--|
| | available. |
| Please specify data analysis needs | PI has some experience with radar data analysis using GR2Analyst and IDV, but may request some assistance following the project. |
| Please specify communications needs | |