Request Form

Part I: General Information

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Part II: Project Description

Project Title	The 2nd University of Nebraska DOW Education and Outreach (UNDEO-2) Project
Project Location	Lincoln, Nebraska
Start and End Dates	March 27-April 10
NSF Facilities Requested	1 - Doppler on Wheels
Number of Expendables Requested	None

Part III: Educational Activities Description

Number of Students Involved	Education: ~85 → ~15 in *Radar Meteorology,* ~30 in *Severe and Unusual Weather,* ~40 in other educational components Outreach: ~20 college students, ~300 grade school students
Desired Training Activities Conducted by Facility Staff	2 days of training to operate the DOW. One technician will also remain in Lincoln during the entire deployment.

Part IV: Operational Requirements

Data Needs	Archived radar data in DORADE format In-situ observations collected by tornado pod
Data Analysis Needs	Processing with Solo software and dual-Doppler analysis may require limited assistance following the project
Communication Needs	No special communication needs

The 2nd University of Nebraska DOW Education and Outreach (UNDEO-2) Project

1. Introduction

The University of Nebraska[1] is requesting a 14-day on-campus deployment of a Doppler on Wheels (DOW) for classroom-instruction and hands-on experience with a cutting-edge radar system. The 2nd University of Nebraska DOW Education and Outreach (UNDEO-2) project has two principal objectives:

1. *Education*: To provide undergraduate and graduate students in *Radar Meteorology* an opportunity to use a sophisticated research radar to collect data for student research projects
2. *Outreach*: To exhibit a new and valuable platform in the NSF deployment pool to a broad audience of current and future scientists and members of the general public.

a. Education

The education objective of this project is composed of four components. The principal component is providing the ~15 students enrolled in *Radar Meteorology,* a course for upper-level undergraduate majors and graduate students in the University of Nebraska – Lincoln (UNL) Meteorology/Climatology program of the Department of Earth and Atmospheric Sciences, the opportunity to use the DOW and analyze the data collected. Students will be trained to operate the DOW and data will be collected during at least one intensive operations period (IOP) somewhere in the US Central Plains. Students will then use these data in research projects that culminate in a final term paper. Graduate students in the Meteorology/Climatology who took a radar meteorology course as an undergraduate (~3-5 additional students) will also be invited to receive training in DOW operations. The second education component is a Q&A session administered by Dr. Josh Wurman during his on-campus visit. This Q&A session will be held during the *Radar Meteorology* class time and is designed to allow students to ask specific questions about the fleet of DOWs and DOW deployments. The third component is a Stout Series seminar to be given by Dr. Wurman to the students and faculty of the Department of Earth and Atmospheric Sciences. The final component of the educational objective of this project is the exhibition of the DOW to non-major undergraduates enrolled in *Severe and Hazardous Weather*, a general education course in the Meteorology/Climatology program. Students will get to see the DOW in person and Dr. Josh Wurman will provide a brief overview of DOW operation.

b. Outreach

The principal component of the outreach objective is a presentation to be given by Dr. Josh Wurman at the 11th annual Central Plains Severe Weather Symposium (CPSWS). Organized by Dr. Ken Dewey, the CPSWS targets a broad audience primarily composed of members of the greater-Lincoln community but also includes students and faculty from the Meteorology/Climatology program as well as students enrolled in general education courses taught within the program. The CPSWS also attracts employees of the nearby NWS office in Omaha/Valley and the Air Force Weather Agency (AFWA) at Omaha's Offutt AFB. Dr. Wurman will discuss how the fleet of DOWs was used in the second Verification of the Origins of Rotation in Tornadoes Experiment (VORTEX-2) that took place in 2009 and 2010. The DOW will also be exhibited at this event. The second component of the outreach objective is the

[1] The University of Nebraska – Lincoln has been a UCAR member since 1979.

exhibition of the DOW at several Lincoln-area grade schools. These exhibitions will be given by the DOW operator during the week following the IOP.

2. Differences from the First UNDEO

The first UNDEO took place in November 2008[2]. While the principal objectives of UNDEO-2 are the same, there are several significant differences between the two projects that are summarized here.

- One of the lessons learned from the first UNDEO was that the principal outreach event needed to occur on a weekend to maximize the turnout. The Central Plains Severe Weather Symposium is an ideal forum for the outreach portion of the project not only because it occurs on a Saturday but because it has an established audience.
- Another lesson learned from the first UNDEO was that limiting the primary IOP to southeast Nebraska too severely restricted the options for data collection during a 14-day on-campus deployment. One solution is to increase the project length from 14 to, say, 21 days. However, the more economical and possibly more effective strategy is to expand the target area to include more than just southeast NE. In UNDEO-2, the IOP will be executed anywhere within ~800 km of Lincoln that targetable meteorological phenomena are predicted for the predetermined date of the IOP.
- The date of the IOP is to be set prior to the beginning of the semester which, in contrast to the first UNDEO, should ensure full class participation in the data collection.
- Dr. Wurman's presentation to all Meteorology/Climatology undergraduates will be replaced by a presentation to the entire Department of Earth and Atmospheric Sciences.
- The *ad hoc* elementary school visit that occurred during the first UNDEO has been formalized in UNDEO-2 and, with advanced planning, will be extended to more grade schools.

3. Educational Goals and Activities

The main goal of the educational component of this project is to significantly advance student understanding of weather radar theory and applications through the operation of a cutting-edge research radar and analysis of the data collected. The proposed project aims to achieve this goal through the following:

1. Students in *Radar Meteorology (RM)* will be trained by a staff member of the Center for Severe Weather Research (CSWR) to operate the DOW
2. Students in *RM* will complete a "lab" exercise that uses the DOW for a guided exploration of fundamental concepts in radar theory
3. Students in *RM* will develop an experiment design to use the DOW to collect data necessary to answer a small collection of basic scientific questions
4. Students in *RM* will execute the experiment in at least one IOP
5. Students in *RM* will use the data collected to craft individual and small group research projects
6. Dr. Wurman will administer a Q&A session for the *RM* students.

[2] More information on the first UNDEO, including the final report, can be found at www.eol.ucar.edu/deployment/educational-deployments/undeo.

The student projects will likely draw from the following list of topics:

- Evolution of meso-γ scale waves along a front
- Bright band identification and interrogation
- Ground-clutter changes due to anomalous propagation
- Clear air detection as a function of radar parameters
- Kinematic vertical structure of a front
- Downbursts and vortices as manifested in Doppler radar data

Most of the topics are focused on basic concepts in radar meteorology. This simplicity is imposed deliberately to ensure that both undergraduate and graduate students are able to complete the work in ~1 month's time following the IOP.

Approximately two-days of training are anticipated for the ~15 students in *RM* and 3-5 additional students in the Meteorology/Climatology program. Immediately following the training, 1 day will be reserved for the students in *RM* to complete an exercise developed to further acquaint them with the operation of the DOW and to enable exploration of fundamental concepts in radar theory. The exercise is included as a supplement below.

Prior to the planned IOP, students in *RM* along with instructor/PI, Dr. Houston, will develop a general experiment design that will enable the collection of the data that they will need for the execution of their individual research projects. In this planning meeting the students will choose the phenomena they intend to target and the scanning strategies necessary to collect the data.

The date for the IOP will be set ahead of time to ensure that all students can participate. It is anticipated that travel will be necessary. "Laboratory Fees" are to be collected from all students enrolled in *RM* as part of their tuition/fees. These funds will be used to cover the travel and lodging expenses for the students.

Radar operations during the deployment will be performed by the students working in shifts. The cooperative nature of such an activity has the ancillary benefit of fostering teamwork amongst the students. The IOP will also engender a sense of ownership of the data; a perception that will invariably add value to both the data sets and the projects that are crafted from them.

4. Schedule

10 March	Student project abstracts due
17 March	IOP planning meeting.
27 March	DOW arrives on campus
28-29 March	DOW operation training
30 March	DOW lab exercise
1-3 April	IOP
4-8 April	Supplemental DOW data collection in the Lincoln area and outreach events at local grade schools
6 April	Dr. Wurman arrives on campus
7 April	9:30 – Dr. Wurman administers Q&A for students in *Radar Meteorology* 2:00 – Dr. Wurman exhibits DOW to students in *Severe and Unusual Weather*
8 April	Dr. Wurman gives Stout seminar to Department of Earth and Atmospheric Sciences
9 April	Dr. Wurman presents at the Central Plains Severe Weather Symposium
10 April	DOW leaves campus
27 April	Student term papers due

5. Outreach Goals and Activities

The proposed outreach component will serve to educate a general audience by exhibiting results from NSF-supported storm-scale research. The principal mechanism for satisfying this objective will be a talk given by Josh Wurman at the Central Plains Severe Weather Symposium. The DOW will also be exhibited at the Symposium.

6. Assessment of Student Learning

The success of this program and identification of opportunities for improvement will be assessed using the following vehicles:

- Anonymous survey of the students
  Students will be asked to evaluate how well the learning objectives were met and will also be asked to make recommendations for improvement. The survey used in the first UNDEO is included as supplementary material below.
- Graded assessment in *Radar Meteorology*
  Student learning will also be measured through standard assessment tools (final exam, project report, etc.)

7. Supplementary Material

a. DOW Exercise

METR 463/863 DOW Exercise

Assigned:
Due:

1. Pulse Repetition Frequency sensitivity

   → Execute two sector scans with two different PRF values.

   A. Note the PRF values and calculate the maximum unambiguous range for each PRF.

   B. Qualitatively describe the change in the character of the reflectivity and velocity fields. **Include screen captures of each field for both PRFs.**

2. Beamwidth

   A. Note the beamwidth from the specifications of the DOW

   B. Assuming a typical antenna efficiency for a circular, parabolic reflector, calculate the theoretical beamwidth of the DOW antenna system.

   C. How would the theoretical beamwidth change if the wavelength was 10 cm instead?

   D. How much closer to a target would the DOW need to be if sampling required a beam diameter of 10 m?

3. Dwell time sensitivity

   → Execute two sector scans with two different dwell times.

   A. Note the dwell times used.

   B. Describe qualitatively the impact of dwell time changes on the reflectivity field. Discuss the result in relation to the sensitivity of reflectivity to the dwell time that is predicted theoretically. **Include screen captures of reflectivity for both dwell times.**

   C. Describe qualitatively the impact of dwell time changes on the velocity field. Discuss the result in relation to the sensitivity of velocity to the dwell time that is predicted theoretically. **Include screen captures of velocity for both dwell times.**

b. Student Survey from the First UNDEO

Student Survey of DOW Deployment

1.	Josh Wurman's talk to the Meteorology/Climatology majors	Very poor	1	2	3	4	5	Very good
2.	Josh Wurman's lecture to *Radar Meteorology*	Very poor	1	2	3	4	5	Very good
3.	Length of the on-campus deployment of the DOW	Too short	1	2	3	4	5	Too long
4.	Helpfulness of Justin Walker	Not helpful	1	2	3	4	5	Very helpful
5.	Involvement of students in the strategic planning of the deployments for data collection	Too little	1	2	3	4	5	Too much
6.	Involvement of students in the actual deployments for data collection	Too little	1	2	3	4	5	Too much
7.	Overall benefit of the DOW visit	No benefit	1	2	3	4	5	Very beneficial
8.	Overall enjoyment during the activities associated with the DOW visit	No enjoyment	1	2	3	4	5	Very enjoyable