

**Final Report**

**on the**

**\$6,800 Award to the Project Entitled**

**Meteorology Laboratory Computer Upgrading for  
Teaching Science Education, Aviation, Earth Sciences  
and Geography Majors and Minors**

**Submitted**

**by**

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**to**

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Unidata Community Equipment Grants Program**

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## **1. Introduction**

This report describes the process of implementation and usage of the \$6,800 grant received from the Unidata Equipment Award Program. The project requested funds to upgrade the Meteorology Laboratory at Western Michigan University to improve teaching and research. As an incentive for receiving this award, the WMU College of Arts and Sciences granted me an additional \$5,000 for more PC's, and approved my earlier request for a Sun Blade 150 workstation. Additionally, the Geography Department Lucia Harrison Endowment Fund approved my proposal of \$5,000 for a computer science student to assist with purchase, installation of the computers, and the installation and maintenance of the Unidata software to be used in the laboratory.

This Meteorology Laboratory upgrade is serving three meteorology classes: GEOG 225- Introduction to Meteorology and Climate, taught every semester, with 80 to 120 students; GEOG 306 – Atmospheric Environment and Society taught every other year with an enrollment of 12; and GEOG 521 – Studies in Climatology and Meteorology for seniors and graduate students, with enrollment of 10.

## **2. Fall Semester 2003 activities**

### **2.1. Equipment purchase and set up**

The proposal was submitted to the Unidata Equipment Award Program on May 8, 2003 and the award letter was received on July 18, 2003. However, I was out of the country until the beginning of the fall semester, when I found out about the award. After the formalities between WMU and Unidata Equipment Award Program were complete, I was able to purchase the computers by October 10, 2003.

One Dell Pentium GX270T, 2.8GHz, 2.0GB, 80GB and five 2.8GHz, 1.0GB, 40GB with M992 19" Monitors were installed and made functional within the WMU wireless Internet campus connection. The Sun Blade 150 workstation had been installed earlier in the semester and was already running LDM6 and McIDAS-X 2004. By mid-October, the Integrated Data Viewer – IDV was downloaded to the PCs, and the teaching assistants began learning how to use the software.

### **2.2. Training of teaching assistants**

After installation of the IDV, two teaching assistants and one computer lab assistant started learning how to use the newly-released software. Don Murray, accepting the invitation to present a paper at the Association for American Geographers East Lakes/West Lakes Conference held in Kalamazoo, 16-18 October 2003, attracted the attention of many participants, but especially the graduate students assisting with the meteorology class. After his oral presentation, Don had a 2-hour session of hands-on training at the meteorology lab. This training prepared the teaching assistants with the introduction of IDV in the classroom and in the laboratory exercises. The first time that the weather forecast was presented in the GEOG 225 class using the animation and the

three-dimensional options of the IDV the whole class emitted a loud “WOW”. Students were literally fascinated with the visualization of weather. Understanding the relationship between the surface weather systems and the upper air dynamics became much easier. The change in attitude and level interest in weather discussion that occurred in the classroom of 80 students was very noticeable.

### **3. Spring Semester 2004 activities**

#### **3.1 Activities using the Meteorology Laboratory facilities**

Even though there was a great deal of student interest in learning meteorology with the IDV, there still were not enough computers able to run the software in the 20-student lab sessions. However, in March 2004, I received authorization from the College of Arts and Sciences to purchase three additional Dell Pentium GX270T, 2.8GHz, 2.0GB, 80GB computers. Presently, the Meteorology Laboratory has nine PC's and one Sun Blade 150 workstation.

The increased number of computers allowed for development of new laboratory exercises. Activities on understanding mid-latitude cyclones and hurricanes were developed using the IDV. Also, exercises on El Niño developed by VGEE, and the Ackerman and Whittaker Applets on tornadoes and lightning were introduced as part of the laboratory activities.

Undergraduate research papers in GEOG 306 were presented using the IDV. These included storm reconstruction using RADAR level II data that was imported from the Sun workstation receiving the IDD datastream. From SSEC and NCDC archives, students requested data to display weather parameters related to events such as severe weather conditions associated with war, fatal sports accidents, and "derecho" storms in Kalamazoo.

#### **3.2 Spring 2004 activities as they relate to a plan to change GEOG 225 teaching methods in fall 2004.**

As a pilot test, new teaching techniques were introduced in the GEOG 225 classroom during the spring 2004 semester. These techniques were selected as the result of class observation during fall 2003 which were aimed at identifying areas where student learning could be improved by a changing teaching approach. Bi-weekly discussion of the science education literature related to meteorology, and to teaching and learning in large classrooms, supported and guided these changes. The activities that were introduced included:

1. Assessment questions at the beginning and end of the semester
2. Ten-minute weather report and forecast with student participation using the IDV as a visualization tool
3. Application of the discovery learning technique, through modeling of the atmospheric environment in the laboratory

4. Reading assignment before chapter is presented in class
5. Identification of misconceptions at the beginning of each chapter
6. Ten-minute group discussion on misconceptions
7. Short essay on what the students learned at the end of the class

#### **4. Fall Semester 2004 activities**

Activities implemented in the GEOG 225 course curriculum both in lecture sessions and in the laboratory were continued during the fall semester 2004. In addition to this introductory meteorology class, GEOG 521 was taught in the Meteorology Laboratory. Graduate and undergraduate students, including geosciences majors and doctoral students were introduced to the IDV for weather forecasting. As in GEOG 306, some of the semester projects were presented projects using the IDV. These included urban heat island effect and the use of the IDV in the geology classroom on earth mantle convection.

#### **5. Research Application**

Two graduate students are currently working on their master's theses using the Meteorology Laboratory computers and software facilities. One study is on synoptic climatology of heavy precipitation in southwest Michigan. Upper air data from NCDC is being displayed using the IDV. The other is on the assessment of learning meteorological phenomena using the IDV versus using conventional methods, such as, lab manuals and internet resources. Both of these theses are expected to be completed by June 2005.

#### **6. Paper Presentations and Seminars**

As an outcome of this award, seven papers on the use of the IDV in the classroom to improve student learning were presented in national and international professional meetings. The list of these paper and presentations follows:

1. E. Cutrim, R. Nogueira, P. Kimosop, and K. Jayaraman, 2004: Using IDV to Teach Meteorology to Non-Science Majors. Unidata Regional Workshop, June 6-8, 2004, Millersville, PA.
2. Cutrim, E. C., Mitchell, J. S., and Nogueira, R., 2004: Promoting Long-Lasting Learning in the Teaching of Meteorology to Non- Science Majors using Real-Time Datastream, Integrated Data Viewer and Interactive Technologies. 6th International Conference on Computer-Aided Learning (CAL) and Distance Learning in Meteorology CALMET 2004, Boulder, CO.
3. Cutrim, E., Ramamurthy, M., Yoksas, T., and Murray, D., 2004: Unidata: Atravessando Fronteiras Internacionais com uma Visão Interdisciplinar do Sistema-Terra. XIII Congresso Brasileiro de Meteorologia, 29 August-3 September, 2004, Fortaleza, Brazil.

4. Nogueira, R. and E. Cutrim, 2004: Visualização de Ciclones Extratropicais Utilizando IDV – Visualizador de dados Integrados. XIII Congresso Brasileiro de Meteorologia, 29 August-3 September, 2004, Fortaleza, Brazil.
5. Cutrim, E. C., Nogueira, R., and Mitchell, J. S., 2005: Teaching of Meteorology to Non- Science Majors using Real-Time Datastream, Integrated Data Viewer and Interactive Technologies. 85th AMS Annual Meeting, 14th Symposium on Education, 9-13 January 2005, San Diego, CA.
6. Cutrim, E. C., Mitchell, J. S., Kits, K., and Nogueira, R., 2005: Enhancing Student Learning of Meteorology with Computer-Aided Interactive Technologies. 52nd Annual Michigan Science Teaching Association Conference, 3-5 March 2005, Detroit, Michigan.
7. R. Nogueira and E. Cutrim, 2005: Applications of IDV in the classroom, Symposia in Education, European Geophysical Union, 24-29 April, 2005, Vienna, Austria.
8. Cutrim, E. C., K. Kits, J. Mitchell, and R. Nogueira, 2005: Changing Teaching Techniques and Adapting New Technologies to Improve Student Learning in an Introductory Meteorology and Climate Course, Symposia in Education, European Geophysical Union, 24-29 April, 2005, Vienna, Austria.

## **7. Further Outreach**

Besides the presentations described in the previous section, seminars on teaching with the IDV were presented by the PI at the Geography Department Fall 2004 Seminar Series and at the Maranhão State University - UEMA's Geography Department in San Luis, Brazil. Furthermore, because of his solid understanding of weather, strong interest in learning new technologies and frequent use of the IDV in the classroom my graduate student, Ricardo Nogueira, became an "expert" in this software. His participation in the Millersville Workshop sharpened his skills and equipped him to serve as a multiplier to the teaching of meteorology using the IDV as a tool. In fact, I encouraged Mr. Nogueira to introduce the IDV to the Brazilian meteorological community and sent e-mail messages to my colleagues at the Brazilian Institute of Space Research–INPE, and to the Federal University of Rio de Janeiro–UFRJ. As a result of these contacts, during summer 2004, Mr. Nogueira presented seminars and hands-on workshops at INPE, at UFRJ and at FUNCEME in Fortaleza.

## **8. Conclusion**

This Unidata Equipment award has allowed me to tell a success story of a seed falling in fertile soil. The external funding encouraged WMU to further update the meteorology laboratory. Hence, the \$6,800 NSF/Unidata award nearly tripled. State-of-the-art laboratory equipment and free access to the newly developed software with the availability of real-time data attracted good graduate students and motivated them to learn, to teach, and to do research. The discovery learning through modeling of environmental systems technique was possible to implement with the updated lab. The

timing of this award combined with the release of the IDV and with my participation in the WMU NSF grant “Enlisting, Equipping, and Empowering – E3 – Project: A Program for Preparation of Middle School Teachers” allowed for the presentation of this educational and research activity in many scientific meetings.