THE UNIVERSITY of WISCONSIN MADISON

OFFICE OF RESEARCH AND SPONSORED PROGRAMS

UW Reference # MSN125763

University Corporation for Atmospheric Research

P I: Jonathan Edward Martin

Equipment Modernization for a Geophysical Data Visualization Classroom

This proposal has been administratively approved on behalf of the Board of Regents of the University of Wisconsin System and is submitted for your consideration. Please keep our office advised as developments occur with regard to this application.

We ask that you use the University's above-referenced proposal number in any future correspondence.

Questions regarding administrative matters should be directed to:

PreAward Services by email: preaward@rsp.wisc.edu or by phone: (608) 262-3822.

Questions regarding the technical nature of this application should be directed to:

The Principal Investigator.

Please note the University of Wisconsin – Madison reserves the right to negotiate terms of this proposal prior to final award notice.

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Unidata Community Equipment Awards
Cover Sheet

Equipment Modernization for a Geophysical Data Visualization Classroom

Date: March 12, 2009

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Project Summary

The Department of Atmospheric and Oceanic Sciences at the University of Wisconsin-Madison (UW-AOS) has an excellent undergraduate program that graduates between 18 and 25 B.S students each year, and a graduate program that graduates approximately 15 M.S. and Ph.D. students each year. A significant portion of their education and training involves the use of data analysis and visualization software to interrogate observational data and output from numerical prediction models that are ubiquitous in the atmospheric and oceanic sciences fields.

The UW-AOS department has for many years maintained a computer classroom dedicated to the use of state-of-the-art data analysis and visualization tools in earth sciences courses and research. Software provided by Unidata, as well as other data analysis and visualization tools are regularly used in UW-AOS courses and research. As a result, students graduating from the UW-AOS department have a strong working knowledge of software commonly used in earth science, and can share this knowledge with the broader earth sciences community as they pursue their graduate work or career.

The computer classroom is also regularly used by several groups affiliated with the Space Science and Engineering Center (UW-SSEC), and by groups affiliated with the National Weather Service and the American Meteorological Society's DataStreme Atmosphere program. These programs provide education and experience to K-12 teachers and students, and others. In these programs, teachers and high school students come to the UW for several days in the summer to learn about the atmosphere and the tools and technologies used the field of atmospheric science.

The UW-AOS department currently seeks to upgrade its computer classroom facilities to keep up with the ever advancing visualization technologies and increasing amounts of available observational data, analyses, and numerical weather prediction forecast output. The existing computer classroom is composed of 15 HP workstations (Pentium 4, 1.5Gb RAM, 160 Gb HD) configured to dual-boot Windows XP and Linux. They are networked together with a data/application server (Dual 1Ghz Pentium III, 3 Gb RAM, 1.3 Tb of total disk space) where faculty/student storage, real-time and case study data storage, and applications are hosted. An identical HP workstation serves as an instructor workstation. which is connected to an in-ceiling projector for display. A 6 Tb raid array is used to make current and archived data available to the classroom computers.

These HP machines, acquired in 2005, are of sufficient power to run existing Unidata applications including McIDAS and GEMPAK, and other applications used in AOS classes including Vis5D, grads, and matlab. The current workstations do not have sufficient memory to run next generation software, including the Unidata IDV, to their full potential.

We propose to upgrade the existing workstations along with the instructor workstation from 1.5 Gb of memory to the maximum 4 Gb of memory. The additional memory will enable enhanced use of the Unidata IDV and other emerging data visualization

technologies. Additionally, students would be able to run the WRF or other models utilizing data provided by Unidata to investigate and better understand the earth system and the processes that govern it.

In addition, we would like to upgrade our classroom projection system to accommodate high resolution graphics, for which it is currently has very limited capability. Very detailed 3D displays of data, require a high resolution palette. In a classroom setting, it is important that the instructor be able to display graphics in full resolution used on a monitor, together with the widgets used to control the graphics to adequately demonstrate techniques for applying IDV. Currently, the monitor resolutions are 1024x768 while the projection resolution at the front of the classroom is 1024x768. Moreover, the instructor monitor is an old CRT type while the student monitors are modern LCD monitors. In recent years, projection systems have advanced so that they can better accommodate these high-resolution graphics tools such that the instructor should be able to demonstrate the full power of IDV. We therefore propose to add a 16:9 high resolution (1920x1080 pixel or WSXGA) projection system together with a Cinema style (16:9) LCD monitor for use by the instructor. This will also benefit all classes which use the IDV or other graphics systems that display Unidata data and model output data and enable instructors to project the full real estate of their laptops rather than degrading images in order to project them.

Project Description

A. Details of equipment requested

The equipment requested consists of 4 Gb memory upgrades for the existing 16 workstations in our computer classroom. The upgrade would require 4 1Gb memory modules per workstation, for a total of 64 1Gb memory modules. This memory will be incorporated into the existing computer workstations in the classroom.

For the projection/display upgrade, we request a BENQ W2000-WSXGA projector, an Apple 30 inch flat panel wide-screen display, and an electric 92”x52” wall projection screen. A graphics card upgrade for the instructor machine to one using the NVIDIA GeForce 9600GT chipset is also required to drive the full resolution of the projector.

B. Goals of the project

The primary goals of the project are to increase the available memory in the existing workstations our computer classroom, and to enhance the ability to project 3-D graphics by the instructor. These upgrades will enable the enhanced use of the Unidata IDV and other cutting edge technology in UW-AOS courses, research and outreach.

Currently, GEMPAK is used extensively for our undergraduate senior level and graduate level Synoptic Laboratory courses for current and case study data analysis.

Other undergraduate and graduate courses also primarily use GEMPAK, as well as matlab and grads to analyze and plot earth science data. GEMPAK, matlab, and other tools are also used by students for research.

The Unidata IDV has not yet been fully integrated into the curricula as of this point, in large part because limited system RAM is marginal to effectively run the IDV.

One course (AOS441 – Radar and Satellite Meteorology) has recently been developed using the Unidata IDV as the primary data visualization tool. Besides providing a basic physical foundation for remote sensing, the course also stresses radar and satellite data applications, and students are heavily exposed to quantitative data analysis using remote sensing data. Student evaluations have consistently credited the IDV as being a crucial, exciting and practical component of the course.

Two courses, AOS 452 and 453, make extensive use of the computer classroom for display of Unidata data and model output for use in daily weather discussions and daily lectures. Currently, numerous data sets have available level 2 radar for IDV and model output for use with vis5d, which are critical to the lectures and weather discussions. With the current system, the display of much of this data is awkward with the resolution constraints and the constraints of the small monitor screen that the instructor is forced to work with after preparing the lectures on much more adequately sized display hardware. These compromises strongly discourage the instructor from using the full power of the display software at his disposal. We are proposing a display system that will enable the instructor to match what is available at his/her own desk but cannot now be brought into the classroom.

In recent semesters, as the IDV was pushed harder, limitations stemming from the limited system memory on the workstations became apparent. The IDV would frequently become sluggish, or hang or crash as a result of running out of memory. In spite of this, the IDV has been embraced by the students in this class, to the point where many now prefer to use it as their primary data plotting and analysis tool in other courses. The proposed workstation memory upgrades will allow faculty and students to make better use of the Unidata IDV and other cutting edge data visualization and analysis software and to further incorporate these into UW-AOS courses. The projection upgrades will enable the IDV system to be demonstrated and used as a teaching tool without the frustrating degradation, now necessary in order to fit the graphics on the screen.

The other groups from UW-SSEC, the National Weather Service and American Meteorological Society that also utilize the classroom would also have the option of including the Unidata IDV as a part of their programs. In their programs, teachers and high school students spend several days during the summer learning about earth science topics and the tools and methods used in our field. The teachers then take this knowledge and some of the tools back to their science classrooms to enhance their curriculum. The students can enter college with a better idea of the methods and software tools used in the earth sciences.

One popular use of the computer classroom is the Supercell Thunderstorm contest in the senior level Mesoscale Synoptic Lab course (AOS 453.) Groups of students utilize what they have learned about supercell thunderstorm formation to design idealized soundings that they believe would lead to a strong supercell thunderstorm. These soundings are then used as input to the UW-NMS mesoscale model, and run to determine what kind of storm would form under those atmospheric conditions. The computers are also used to simulate other mesoscale phenomena such as downslope wind events and tropical cyclone genesis. The memory upgrade will allow the model to be run at a more state-of-the-art resolution than it is now and to display the results at their full resolution rather than a degraded product necessary with the current memory constraints. Moreover the enhanced projected display capability will enable students to project their results at adequate resolution needed to see details of the flow patterns simulated.

Another use of the workstation upgrades in the computer classroom will be to allow students to write and run numerical models for use in AOS 471 – Numerical Techniques in Weather Prediction. In the past, students have learned how to run the Penn State/NCAR MM5 mesoscale model in addition to its associated pre- and post-processing programs. With the modernized computer classroom, we anticipate running the NCAR WRF model in that class. Again, three-dimensional model output will be able to be displayed with these projection and memory upgrades.

C. Benefits to research/education

The primary benefit to research and education will be an environment where the latest tools can be utilized to analyze and visualize the increasing amount of earth science data and model output that has become underutilized as a result of inadequate hardware capabilities. Thus far, faculty and students in the UW-AOS department have been limited in their ability to utilize new technologies including the Unidata IDV. This is primarily due to insufficient memory in the existing workstations. The proposed memory upgrade will improve the performance of existing software, and enable the enhanced use of the Unidata IDV and other emerging analysis and visualization tools in our classes and research.

In addition, instructors rarely bring to the classroom their most useful model output because of the inadequacies and resulting frustrations of using the display tools now available. This problem will be largely reduced by the acquisition of these more advanced projection technologies.

D. Added value to Unidata community at large

With the ability to run state-of-the-art data visualization and analysis software, undergraduate and graduate students will leave the UW-AOS department with a strong knowledge of these tools. These graduates will be taking this knowledge with

them to graduate school at other Unidata institutions, or to their careers in research, education, or operational meteorology. As a result, scientists, students and others within the field of earth sciences as well as other industries that depend on earth science graduates (airlines, the insurance industry, energy industries, agriculture, etc) will further expand the use and knowledge concerning the use of these tools.

One example of such community benefit, the use of GEMPAK at UW-AOS increased dramatically in the mid 1990's when a new faculty hire brought brought to the UW the knowledge of GEMPAK that he acquired during his undergraduate and graduate years at other institutions that had been using GEMPAK in their classes and research. Now, GEMPAK is widely used in UW-AOS courses and research.

Another example of the benefits to the community will be increased ability to demonstrate some of the very detailed views that we have of weather processes, radar images, model output data sets of hurricanes, tornadoes, and other severe weather that we simply have now way of displaying to large groups. We often have open houses that are well attended by the public, but for which we rarely show some of the interesting graphics that we have because thay cannot be adequately displayed. These upgrades will greatly improve this situation.

Outreach programs conducted by UW-SSEC, the National Weather Service, and the American Meteorological Society and their attendees will also benefit from the memory upgrade. The K-12 teachers that take advantage of these programs will have a better opportunity to become familiar with Unidata analysis and visualization tools, and incorporate these tools into their curricula. Similarly, students taking part in these programs will enter college having already been exposed to Unidata software and available data.

E. Relationship to existing computing facilities and resources, and departmental plan

There are two primary sets of computing resource types in our department. Most of our faculty research groups have their own private computer and data storage systems, which are used for their research. The proposed upgrade applies to a communal computer classroom, which is used by all for the education and training of our undergraduate and graduate students. These computers are occasionally utilized by graduate students for their research during off peak times (summer, winter and spring break, etc)

The proposed memory upgrade will enhance the existing workstations and increase their functional lifetime, delaying the need to completely replace the workstations with new hardware.

This upgrade will also allow us to experiment with other shared computing platforms, such as using an MPI architecture to run larger model simulations across several of the machines, or incorporating them into the CONDOR pool on campus.

Budget

The equipment required for the memory upgrade component consists of 64 1Gb 240 pin DDR2 PC2-5300 DIMM modules. The average current price for these DIMM modules is currently $26 per DIMM, for a total cost of $1664.

For the projection upgrade component, we are requesting a BENQ W2000 -WSXGA projector ($4112.79.), an Apple 30 inch flat panel display ($1599.00), an electric wall screen 92x52 inches for $814, and an NVIDIA GeForce 9600GT chipset video card upgrade for the instructor workstation ($105.16). This upgrade will bring the classroom demonstration facility to state of the art.

The total cost of these purchase is $8295. Overhead/indirect costs of 48.5% bring the total proposed funding request to $12318.

UW-AOS will provide the labor and personnel required to install the memory, and to make any necessary configuration changes to the existing workstations to enable them utilize the additional memory. UW-AOS will similarly provide labor to install the upgraded projection system.

Line Item Budget:

Item	Quantity	Unit Cost	Total
1 Gb 240 pin DDR2 PC-4200 HP OEM DY652A	64	$26	$1664
BenQ W2000 WXSGA projector	1	$4113	$4113
Apple 30” Widescreen flat panel display	1	$1599	$1599
Electric wall projection screen 92”x52”	1	$814	$814
NVIDIA GeForce 9600GT video card	1	$105	$105
Total Equipement			$8295
Overhead/indirect costs		48.5%	$4023
Total Equipment and Overhead/indirect costs			$12318

Project Milestones

The proposed equipment will be ordered as soon as possible prior to the Summer of 2009. The memory and updated projection system will be installed and configured in early Summer of 2009 and ready for use by NWS and AMS classes later in the Summer, 2009 and in AOS courses by the Fall semester, 2009.