Unidata Community Equipment Awards Cover Sheet

Proposal Title: Enhancing Data Sharing at the University of North Carolina Asheville to Foster Interdisciplinary Education, Research, and Community Outreach

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B. Project Summary

The University of North Carolina Asheville (UNCA) is the designated public liberal arts university in the North Carolina university system. The Department of Atmospheric Sciences is a relatively small academic program at UNCA, with 4 full-time faculty and approximately 60 majors. We value our strong undergraduate research program and classroom rigor, both of which have been quite effective despite our limited computing resources. Classroom space expansion has presented us with a unique opportunity to expand and enhance our ability to integrate Unidata software into our classes and undergraduate research program. It also presents us with the opportunity to serve IDD and our own local data to the wider community. These data include upper air soundings from field campaigns, surface data from our new ground station, and WRF model results run on a local Linux cluster.

Our current facilities include a synoptic laboratory, research room, and access to an older generation Linux cluster. The synoptic lab is used primarily for classroom instruction. It contains 6 Dell Windows machines that run Linux within a virtual machine. Our small research room has two Linux machines running Red Hat, two Windows XP machines, and a department server. We also have an older Linux computer that serves as our LDM data ingest machine.

The current hardware/software configuration is clumsy to use. We use GEMPAK in at least 4 different classes. In order for students to use it, they must first start a VM session on the Windows machine, bring up a terminal, and connect to our LDM server. The LDM server also runs our only working version of GEMPAK (it is an older version of Linux that ran GEMPAK binaries – we have not been able to compile recent GEMPAK source distributions on other machines). All student work must then be saved onto the LDM machine in a sub-directory, instead of on the department server.

During the 2010-11 school year, our department will be sharing a new computing lab with the Department of Computer Science (CSCI). We see this as a great opportunity not only to improve how we use existing Unidata software, but to:

1. Integrate IDV into our research and classroom curricula,
2. Serve our field study, surface observation, and unique model data to the community via a THREDDS server, and
3. Collaborate with CSCI as they continue their development of robotics, which could lead to novel weather observation platforms for southern Appalachia.

We are proposing to populate the new lab with 16 machines that will run GEMPAK, IDV, and robotics design software from CSCI. The lab will serve as a research area for students to work on their projects and classroom assignments. Data will be served to the lab (and outside) by a new THREDDS/LDM server.

C. Project Description

a. Meeting Unidata Goals

With the new equipment, our department will be able to transition from a peripheral user of Unidata software to one whose curriculum and research program fully integrate GEMAPK, IDV, LDM, and THREDDS. It will also allow us to collaborate with the UNCA Department of Computer Science in an effort to develop new observation capabilities for the data sparse mountains of Western North Carolina. The proposed project addresses each of the review criteria as follows.

1. Intellectual and Technical Merit

As one of the few institutions in the United States that exclusively offers an undergraduate program in meteorology, the UNCA Department of Atmospheric Sciences serves an important educational purpose. Our focus on the preparation of students for work in the National Weather Service, private sector, or

graduate school requires extensive technical training in both the classroom and for student research. In addition to several of our traditional courses, we now offer four computer-focused classes that rely on a robust computer infrastructure. Two of these classes (GIS in Meteorology and FORTRAN in Meteorology) are taught in a remote computer lab in another building due to the small number of available seats in our department. Another programming class (Advanced Programming Techniques) is typically completed off campus, partially because of our limited resources.

The proposed machines will directly serve students in two departments at UNCA, as well as others who enroll in our courses. Data served through THREDDS will be useful to many others in the meteorological community, including forecasters, students, and the public. For example, forecasters at three National Weather Service Offices (GSP, RNK, and MRX) will more easily integrate sounding data provided by our winter storm field campaign (see Section C2) for operations and case study research.

2. Broadening the Unidata Community Scope and Capabilities

Our faculty and undergraduate research projects (highlighted in Section C6) have produced (and will continue to produce) a large amount of data that will be of interest to the Unidata and meteorological community. In 2007, we produced a boundary layer profile dataset using a 150 ft. tethersonde flown in coastal South Carolina as part of a boundary layer experiment. From 2007 through the present, Dr. Doug Miller has conducted field campaigns throughout Western North Carolina and Eastern Tennessee. Rain gauges have been installed on numerous ridge tops throughout the region to fill in gaps in the surface rain observation network. Rawindsondes have been launched during winter storm events. The sounding data are used by the local National Weather Service (NWS) forecasters for real-time forecasting, as well as for research purposes. During the summer of 2010, Dr. Christopher Godfrey will be installing an automated surface station at a high altitude location. This will produce a research-quality set of surface observations.

Our department currently does not have an efficient way of distributing these and other data (e.g. LDM feed) to the community. The proposed THREDDS server will provide a convenient way of making case study and modeling data easily available for class and research activities.

3. Enhancing Participation in the IDD

At present we participate in the IDD through the ingestion of upstream data. We do not serve IDD data to downstream sites, nor do we make our IDD data available to the outside. With the addition of the THREDDS server, we will make all of our IDD data available. The server update will also give us larger storage space and allow for the intake of larger datasets that we are unable to save at this time (e.g. radar imagery and data).

4. Advancing Technology

Over the last few years, UNCA Computer Science faculty have taught several robotics courses. In some of these courses, students use kits, such as Lego Mindstorms or Parallax Boe-Bots, to develop robots. In other courses, students have programmed microcontroller boards and machined robot components with computer numeric control (CNC) mills. Many of these courses were created to introduce first-year students to the general principles of design. Several conference presentations have described the success of these efforts.

One significant component of robotics courses within universities (and high schools) is "reading" the immediate environment and reacting to it. Electronic components for measuring light, sound, and temperature are frequently included in student projects within robotics courses. Decades ago, Computer Science students were excited to write programs to read punch cards. More recently, their programs were reacting to mouse clicks. Now they want to process "real world" data.

Collecting data is a common goal of courses in both Computer Science and Atmospheric Sciences. The two departments believe that sharing this computer lab will increase the interaction between the faculty and students of both departments and should lead to interdisciplinary undergraduate research projects.

Presently, the Computer Science department has one small, and crowded, computer lab which simply does not have room for robots to roam. This new lab will work well for the handful of robotics courses taught at UNCA each term. The ATMS Department will work closely with CSCI on student projects to use the robotics technology for meteorological applications. For example, the production of low-cost unmanned aerial vehicles (UAVs) with mounted sensors will lead to high-density observations of our mountainous terrain that will be served via the new data server.

5. Contributing to Education

Most faculty members in our department rely on GEMPAK for data analysis and visualization in their classes and research program. Courses that use GEMPAK include: Computer Applications in Meteorology (ATMS 261), Radar and Satellite Meteorology (ATMS 315), Mesoscale Meteorology (ATMS 316), and Synoptic Meteorology I and II (ATMS 410 and 411).

Several factors (familiarity with GEMPAK, computational power, GEMPAK integration in our curriculum) have delayed the adoption of IDV as a more prominent feature in our department. The availability of a new laboratory for research and instruction presents a convenient opportunity to make the transition to IDV. With the uncertainties of the GEMPAK integration and availability of traditional GEMPAK functionality into AWIPS-II, we are seeking to involve IDV into our daily instruction and undergraduate research projects. The addition of the new machines will provide immediate IDV capability while we configure the newer machines in the department that have the capability of running IDV. Students will be trained on IDV through our established curriculum (“Computer Applications in Meteorology”, “Advanced Computing Techniques”). We will continue to use GEMPAK alongside IDV, since all of our current students have been trained on its use.

6. Contributing to Research

UNCA has a long tradition of undergraduate research and is the founding university of the National Conferences on Undergraduate Research (NCUR). NCUR hosts an annual conference where hundreds of undergraduates from around the United States present their research. The Department of Atmospheric Sciences at UNCA supports undergraduate research in meteorology through both funded faculty projects and independent student research. This is a special opportunity that is not offered to many undergraduate students at larger institutions. Our current undergraduate research projects include:

- Rawindsonde launches during winter storm events in the southern Appalachia (Northwest Flow Snowfall 2009-10 Project)
- Installation of rain gauges on local mountains (NASA PMM)
- Site determination and installation of a new mountain surface station
- Modeling of the Meridional Overturning Current and how it may be impacted by climate change
- A convective warning utilization study to determine how people receive, interpret, and respond to severe weather warnings
- Development of a computer algorithm to identify tropical cloud clusters from global IR imagery (NOAA CCDD)
- Data analysis of ocean wind vector retrievals in hurricanes (NASA ROSES)

These projects and others not listed here require computing sources that currently have limited availability. GEMPAK is used in a number of projects and we have not been able to compile a working version on more than one machine. If successful, this proposal will double our computational capacity and accelerate progress on student research projects.

b. Technical Specifications of Proposed Equipment

The new lab computers will run a Virtual Manager (VM) on top of Windows. This allows for students to access easily both Windows and Linux environments for class work and research. The large 22-inch displays will simplify visualization. All machines will have more than sufficient processing speeds to run the latest versions of IDV and other high-demand visualization software.

c. Integration of Computers into Existing Infrastructure

This project will effectively double the number of machines in our department and support seamless integration into existing resources. Our current lab computers are set up in the same fashion as the proposed machines – a Windows base with VM running on top for Linux applications. Faculty and students are already familiar with the computer setup, facilitating a smooth transition.

Some work will be required to transition the older machines to "see" and use data from the new THREDDS/LDM server. Much of this can be done before the new lab is finished (see Section E); we do not anticipate any technical issues that will prevent integrating the new machines into our existing computing environment.

D. Budget

1. Justification

The proposed hardware will be set up by members of the technical staff at UNCA. All Unidata software setup will be done by the PI on this proposal, Dr. Chris Hennon. Chris has set up and maintained our department's LDM server and GEMPAK versions for the past four years. Technical support is provided by the technical staff at UNCA. All support costs are included in the price of the machines.

Lab space will be shared by the Department of Computer Science at UNCA. They will maintain all software related to the robotics program and periodically use the laboratory for small classes.

UNCA has a site license for Red Hat Enterprise Linux; there is no cost to run the operating system on the machines. All machines will be added to the campus computer refresh program. Machines will be replaced every 4 years at no further cost to the department or Unidata. ***Therefore benefits will be sustainable in perpetuity****.*

2. Breakdown

Description	Cost Each	Quantity	Total
Dell OptiPlex 780 Ultra Small Form Factor. Intel Core Duo E8400 with VT (3.0 GHz) 4 GB DDR Non-ECC SDRAM, 1066 MHz 22" Display 160 GB Hard Drive Windows Operating System	$1,377.90	16	$22046.40
Dell Linux THREDDS/LDM Server 8 GB DDR, 500 GB Hard Drive, 19" display	$1314.10	1	$1314.10
Cost Sharing (UNCA)			$(3000)
Cost Sharing (ATMS)			$(1000)
Total Cost of Proposal			$19360.50

E. Project Milestones

Renovations on the building that will house the new computer lab are out to bid and will begin this summer. According to university officials, construction is expected to last 12 months. The computer lab will be available for set up during the summer of 2011 and ready to use in the fall 2011 semester.

During renovations, the Department of Atmospheric Sciences has existing lab space available to set up the new machines and configure them with the latest Unidata software. Students will have immediate access to the equipment once they are set up. There is therefore no risk that delays in construction will prevent the immediate use of the computers.

The project milestones can be summarized as follows:

June 2010: Notification of award

Summer 2010: Machines ordered and set up by UNC Asheville technical staff. Renovations begin for new computer lab.

Fall 2010: THREDDS/LDM server established. Department machines networked to new data server. Local faculty training for IDV and THREDDS orientation. Real-time IDD/LDM feed transition from existing server.

Spring 2010: Migration of locally-produced WRF model output, rain gauge/snow intensive observation field study, and surface station data to THREDDS server for access by the community. Integration of IDV into course work.

Summer 2010: Renovations complete on new student lab. Machines moved to new space.