

A Proposal to Update Computing Hardware to Support Weather and Climate Initiatives at Saint Louis University via Unidata Activities

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Funds requested: \$6016.90
Matching funds from University: \$12,600
March 12, 2009

1. Project Summary

The Department of Earth and Atmospheric Sciences at Saint Louis University (SLU) currently utilizes weather information and graphical display tools via Unidata in support of its educational and research initiatives. These include, but are not limited to, coursework in support of SLU's meteorology program and research projects focused on modeling studies (e.g. the WRF and HYSPLIT models). The current generation of computers supporting the Unidata system is six years old and is becoming a liability in not only supporting these initiatives, but also in supporting new initiatives such as climate change and public outreach.

An example of the limitations of our current computer system is found in the synoptic meteorology lab, which is geared towards fostering student competency in weather forecasting. Presently, students are limited to how many images they can show to support their forecast discussions; this is especially true if they want to display three-dimensional images via IDV. The inability to load appropriate images coupled with the slowness of the system is also a problem for developing other applications such as outreach activities and climate change. The SLU Meteorology department hosts numerous outreach visits from diverse groups such as the boy scouts, the girl scouts, various elementary and high schools, and after school programs such as the St. Louis Science Junior Academy. An upgraded computer system would allow us to put together appropriate graphical presentations to educate the importance of meteorology and climate change to these groups. Our capability to reach an even greater segment of the St. Louis population is likely to be enhanced given a developing collaboration with the St. Louis Science Center to develop education products on extreme weather events and climate change.

2. Project Description

2.1 Equipment Details

We propose to replace the existing system, which is six years old, with ten Sun Ultra 24 Workstations containing 1 Intel* Core2 Duo Extreme E8600 (Wolfdate) 3.3Ghz, 1333Mhz, 1GBDIMMs (Unbuffered, ECC, DDR2-667). Standard with the machine are one 250GB 7,200 rpm SATA 3.0Gbps HDD, pre-installed with Solaris 10, Update 4, NetBeans, Sun studio 12 One NVIDIA Quadro FX 1700 Graphics Accelerator, One DVD-Dual, (Write/Read DVDs/CDs. DVDs in + formats, on both layers). To increase our ability to utilize IDV, we also propose to purchase an additional 4GB of RAM. Given that our current system set-up does not utilize energy-saving monitors, we also intend to upgrade our monitors to 22-inch Widescreen LCD. Finally, we also are opting to replace our keyboards with Unix-style keyboards which are more familiar to the students than the standard Sun keyboards.

This system replaces the ten 1 Ghz Sun Microsystems Ultra-5 computers containing 1.5GB of memory. Current machines will subsequently be used to support our growing undergraduate/graduate population.

2.2. Overall Goals of the Project

The project maximizes usage of Unidata products to accomplish three goals: 1) improve the classroom experience for SLU's meteorology students 2) enhance SLU's ability to provide meteorology and climate outreach to the greater St. Louis community and 3) To facilitate departmental research (especially in applications related to the WRF and HYSPLIT model). Accomplishing these goals will enhance current initiatives (e.g., classroom experiences and research activity) and enable the development of a new initiative to educate the public in meteorology and climate change. For example, a common public misconception is to confuse weather and climate (e.g., if I had a cold winter, how could there be global warming?). Improved display of Unidata products coupled with a greater ability to run climate tools such as EdGCM will ensure accomplishing this new initiative.

SLU's meteorology curriculum not only demands undergraduate students to understand meteorological concepts, but also to communicate them in an organized, concise manner. We feel this is necessary to prepare them to face the challenges of entering the forecast world. One major drawback of our current system is the inability to efficiently use and display IDV so students can utilize this tool in their forecast discussions. By the end of their senior year, our students should have acquired the experience to make their own decisions on what products to display to make good forecast discussions. Unfortunately, our current system does not allow students to fully demonstrate this ability. Note that this issue is not only a problem for Synoptic Meteorology, but for any of our classes that exploit the Unidata system such as Map and Chart Analysis, Weather Forecasting, and Synoptic Climatology.

While outreach plays a prominent role in SLU's meteorology program, the limitations of our computing system does not allow us to show off Unidata's capabilities to the community at large. The proposed upgrade to our computer system would allow us to develop inclusive graphical displays designed to teach the public about weather and climate. For example, we intend to use the Unidata system to illustrate extreme weather events to K-12 and the public via case studies. This will teach people on how extreme weather develops and how forecasters make decisions to protect life and property. The lesson will conclude with a description of how the intensity and frequency of extreme weather events may be altered due to climate change. This will teach people the differences between weather and climate. Any education package developed at SLU will be made available to the Unidata community at large.

2.3 Education and Research Benefits

The proposed system will have a direct impact on current teaching and research within the Department. Most undergraduate and graduate courses make use of the current meteorology computer laboratory and would benefit from these upgrades. However, several courses will be dramatically enhanced by the proposed improvements to the laboratory, including the projection system. Benefits to education, research, and outreach are as follows:

Undergraduate Classes:

EAS - 211 Map and Chart Analysis: This is a course taken by undergraduates as a prelude to synoptic meteorology. Improved access to Unidata will allow students to more extensively analyze weather situations utilizing IDV and GEMPAK.

EAS-253: Physical Climatology: Students currently use EdGCM to evaluate climates of the past, present, and future via EdGCM. However, EdGCM runs slowly on the current machines. Upgraded computers will allow students to run more climate case studies and to utilize IDV to examine climate change three-dimensionally.

EAS - 350 Computational Methods in Meteorology: Computational techniques in Meteorology is designed to introduce students to computational tools and techniques. These computational techniques are discussed with specific meteorological problems in mind. IDV and GEMPAK help students to better understand and assess numerical model output.

EAS - 420 Synoptic Meteorology I: Students are required to analyze case studies of various weather phenomena. More efficient use of IDV will allow them to describe the three-dimensional aspects of weather systems (e.g. isentropic lift).

EAS - 422 Synoptic Meteorology II: Students utilize IDV and GEMPAK/NMAP to create forecast discussions. Computer upgrades will expand the ability of students to provide complete discussions.

EAS - 465 Weather Forecasting: Students utilize IDV and GEMPAK/NMAP to analyze current weather and to make forecasts. The ability to show more products will help students to increase their ability to make more detailed and reliable forecasts.

Graduate Classes:

EAS - 520 Numerical Methods of Prediction: Better use of IDV will allow students to visualize numerical model diagnostics in three dimensions.

EAS - 524 Tropical Meteorology: Greater application of IDV and GEMPAK/NMAP will allow students to provide a more detailed analysis of tropical waves/tropical cyclones. A more efficient presentation of case studies of hurricanes will also enable students to better understand the physical mechanisms governing the genesis, development, and dissipation of tropical cyclones.

EAS - 570 Convection in the Atmosphere: Improved utilization of IDV will allow students to display three-dimensional diagnostics related to convection (e.g., isentropic lift). An expanded ability to store images from GEMPAK/NMAP will also enable students to receive a more complete analysis of case studies of convective events.

EAS-593 Synoptic Climatology: This class focuses on extreme weather events, teleconnections, and the climate/weather connection. Improved capability to utilize GEMPAK/NMAP and IDV will be beneficial not only from understanding real-time weather events, but also applying this knowledge to the mean climate (e.g. climatology of storm tracks).

Research:

SLU utilizes several models to support scientific research. Upgraded computers would greatly serve these purposes. Examples of SLU research that would benefit include:

- The impacts of the Saharan Dust Layer on Tropical Waves via the WRF model
- Analysis of EPV and its application to Heavy-Banded Snow using the HYSPLIT model
- Continued development of an analog system to assist in forecasting winter weather events
- The climatology and variability of storm tracks in NOAA/NCEP's CFS model

The above research projects would benefit from improved computer resources through more efficient running of models and a greater availability of Unidata three-dimensional products.

Outreach:

Given its location in a major metropolitan area, SLU is in a particularly advantageous position for its meteorology program to enhance educational outreach. Our program currently hosts many student groups such as the girlscouts, the boy scouts, K-12 schools, and after school programs such as the St. Louis Science Junior Academy to learn about meteorology and climate. Unfortunately, our current state of computer power results in the underutilization of our weather computer lab to be used as an education tool. A more efficient use of Unidata products will allow us to develop demonstration packages to better teach weather and climate concepts to these groups. Recent efforts by our department to collaborate with the St. Louis Science Center on the impacts of extreme

weather events on climate change will also open up our outreach capability to even a greater audience.

Products Developed for Unidata Community:

A common misconception in educating students and the public on climate change is the distinction between weather and climate. A particular interest to the public is how extreme weather events (e.g. heavy snow, floods, heat, and drought) impact their lives. To help bridge this knowledge gap, we intend to develop an education package utilizing Unidata case studies to demonstrate extreme weather events and how they relate to present climate and potential future climate change. Once developed, this package will be made available to the general Unidata community.

2.4 Relationship of Proposed Hardware to Existing Facilities

The Department of Earth and Atmospheric Sciences has extensive computing resources. The proposed computers would make up about 10% of the existing computers on the Department's network. The network includes Sun workstations, Microsoft-based PCs, Macintoshes, and Linux-based computers. The Department currently runs its own mail, web, time, and domain name servers. It also has three application and seven file servers. Our Department presently has two Beowulf clusters to support numerical modeling and has recently begun to install a geographical information systems laboratory.

The meteorology computer laboratory was initially funded by a Unidata equipment grant in 1995. This laboratory has since become a critical aspect of the meteorology program's teaching and research activities. We expect to maintain a UNIX-based laboratory in the foreseeable future. As with our previous Unidata equipment grant, we expect the University to fund upgrades to these machines during the next five years.

The existing workstations in the laboratory will be distributed to graduate students and used around the department for general display machines. This meteorology computer laboratory is separate from the other University general computing laboratories which are Microsoft-based PCs and are not suited for Unidata-related activities.

2.5 System Management Competence

The Department computer systems administrator (Eric Haug) has been with the Department since 1973. He has designed, set up, and installed the Department's network and servers. He manages all the systems and has extensive experience with Sun Workstations. He provides assistance to Charles Graves who manages the Unidata software packages and IDD. Between these two individuals, the computer and

meteorology knowledge is more than sufficient to install, manage, and effectively use the Unidata software and the data distributed by the IDD.

3. Budget

The Sun Ultra 24 computers will be purchased utilizing Saint Louis University matching funds. This will limit Unidata's cost to approximately \$6000.00.

| Item | Quantity | Unit Cost | Total Cost |
|--|-----------------|------------------|-------------------|
| Sun Ultra 24 Workstation 1 Intel* Core2 Duo Extreme 3.3Ghz, 1333Mhz FSB One 1GB DIMMs One 250GB 7,200 rpm SATA 3.0Gbps HDD | 10 | \$1365.35 | \$13653.50 |
| 22-inch Widescreen LCD Monitor 1680x1050 resolution | 10 | \$248.17 | \$2481.70 |
| Type 7 UNIX Country Kit. RoHS-6 (Lead-Free) Compliant. | 10 | \$41.50 | \$415.00 |
| X-Option 4GB Memory Kit (2x 2GB unbuffered ECC DDR2-667) | 10 | \$206.67 | \$2066.70 |
| Total: | | | \$18616.90 |
| Saint Louis University Matching Funds: | | | \$9600.00 |
| Saint Louis University Department Funds: | | | \$3000.00 |
| Cost: | | | \$6016.90 |
| Total Unidata Request: | | | \$6016.90 |

4. Project Milestones

July 2009: Order computers

August 2009: Implement new computer system. This will include the installation of LDM, NAWIPS, McIDAS, and IDV.

September 2009-May 2010: Construct a weather/climate education package to be used in outreach demonstrations

June 2010: Make education package available to the Unidata community