Upgrading Meteorological Analysis and Visualization Capability

A Unidata Community Equipment Grant Proposal
March 14, 2011

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March 14th, 2011

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B. Project Summary

The goal of the proposal is to provide viable platforms for running Unidata programs for classroom instruction and research. This will increase awareness and usage of Unidata products by university participants (students and faculty), and the community at large. The proposal seeks to acquire funds to distribute observational data measured at the University of South Florida (USF) and upgrade the equipment of USF's Meteorological Laboratory. This laboratory is located within the Department of Geography, Environment, and Planning on the Tampa campus and presently has outdated workstation computing facilities for both undergraduate and graduate instruction, scientific research and outreach. USF is striving to provide the best curricula, research and training facilities, and a Unidata Equipment Award would substantially aid this process.

Funds will be used to acquire fifteen high end computers (capable of running both Windows and Linux operating systems) and monitors as well as one color printer. One of the new computers will be outfitted with the THREDDS server to distribute real time weather observations from our roof-top station to the Unidata community. In addition, these observational data will be made publicly available via RAMADDA for use by forecast agencies such as the National Weather Service and shared with the Citizen Weather Observer Program (CWOP). The remainder of these acquisitions will allow the users of the laboratory to run complex visualization and computational software (through the use of Unidata's IDV and other products) at high speeds suitable for live use in educational instruction and outreach, and will dramatically increase the geoscience research capability of the University of South Florida.

C. Project Description

1. Introduction and Overview

We are requesting funds to support the educational and research goals of Unidata and USF. As one of the fastest growing research universities in the country, USF is well equipped intellectually to be at the forefront of research into rapidly changing urban, coastal and global environments. However, to do so, the current significantly outdated computing resources in the Meteorology Laboratory are in need of replacement.

Funds from Unidata will be used to acquire (1) a set of high end HP workstations capable of quickly displaying and running advanced software packages, with one workstation that will receive and distribute data from the roof top weather equipment via THREDDS and RAMADDA, (2) wide screen monitors to be paired with each workstation, all to be sited in the Meteorological Laboratory and (3) a color printer.

USF, a metropolitan-based research-intensive university, has earned a growing academic reputation as a model urban research university. It is now the nation's ninth-largest university, with more than 46,000 students. The university is one of the nation's top 63 public research universities, according to the Carnegie Foundation, and one of Florida's top three research universities. USF is one of only 39 public colleges and universities designated by the Carnegie Foundation as being most engaged with their communities, and one of only ten public research universities designated as both "very high research" and "community engaged."

USF is transitioning into a Tier-1 university within the Florida State University System with its associated higher standard of undergraduate admission and graduate research. The initiative has given impetus to the department's own efforts to restructure the Geography curricula and design new courses that build on the expertise of new faculty and the demand of students. Higher standards of scholarship require equal standards for instruction. We recognize the importance of, and are committed to, equipping students with the tools to make a greater contribution to their professions. Thus, we would like to take advantage of the technological resources and acquire the resources capable of integrating real-time satellite, lightning, and Doppler radar data into courses offered by departments at USF with a geosciences emphasis.

2. Proposed Equipment Acquisition and Implementation

2.1 Current outdated configuration

The department has three computer labs. Two of them are dedicated GIS labs and one is the dedicated Meteorological Lab. Therefore the proposed system accounts for approximately 1/3 of the department's laboratory computing resources. The facilities in the GIS labs were recently replaced by funding from ESRI summer workshops.

The current equipment is years behind which prevents the use of applications that require typical processing by today's standard.

- 15 workstations: (includes 1 computer for receiving data from the roof top weather station)
- Microsoft Windows XP SP3
    - 10 with 2.4 GHz Pentium Processors
        - 6 with 512 MB RAM, 4 with 1 GB RAM
    - 3 with 2.8 GHz Pentium Processors
        - 1 with 512 MB RAM, 1 with 1 GB RAM, 1 with 2 GB RAM
    - 2 3.0 GHz Pentium Processors
        - Both with 1 GB RAM
- 15 CRT monitors (screen resolution 800 x 600 dpi)
- 1 HP 2500CM printer that doesn't work

The laboratory at present is equipped with adequate desks and seating for each of these workstations, with power and LAN connections to each location. One of the workstations is at the front of the room for presentation and lecturing purposes, and is remotely connected to a ceiling mounted LCD projector.

2.2. Description of Proposed Equipment

15 New workstations (HP Compaq 8000 Elite CMT - High End Unit) will dramatically increase the processing power and physical memory of the current computers by including Intel Pentium 3.0 GHz core 2 quad processors and 8 GB of DDR3 RAM. These features, along with the significantly more powerful integrated video cards and an upgrade to Microsoft Windows 7, will allow for fast and smooth real-time use of resource-intensive software not possible with the workstations presently in place. New LCD monitors (Dell Pro P2311H) on each workstation will increase viewing area from 13" to 23" diagonally per monitor, improve screen resolution from 800x600 to 1920x1080 dpi and provide a side-accessible USB hub. The flat screen design reduces the overall footprint of the device on the desk allowing for greater use of the workspace, is certified EPA Energy Star compliant, and utilizes less power than the older monitors as well. A printer (HP Color LaserJet CP3525n) will allow for swift laboratory production of high-quality graphics given a 1200x600 dpi black or color output at up to 30 pages per minute. The acquisition of new workstations will bring sufficient resources to make each a dual boot system, running both Windows 7 and Linux.

2.3 Personnel

The PI (Assistant Professor) and Co-PIs (Graduate Students) will be developing educational materials to demonstrate the capabilities and applications of these packages. The PI, Dr. Collins, recently received the Southeastern Division of the Association of American Geographer's Excellence in Teaching Award (2010) and the Undergraduate Teacher of the Year Award (2007-2008) where USF recognized the innovative and

creative approaches taken by the professor to teach Meteorology, Climatology, Earth System Science and Introduction to Physical Geography.

David Roache, one of the Co-PI's, started his Ph.D. in August (2009) and was recently honored with the Dewey M. Stowers Award for Excellence in Meteorology (2011). He has successfully co-authored two papers which are currently in press as well as a third in review. With his master's degree obtained from Plymouth State University (PSU), he has been greatly exposed to Unidata products. Further, as a teaching assistant first at PSU, then at USF for MET 4012C, and now as a graduate assistant and instructor of MET 4002C (Climatology), he is well qualified to co-write the educational materials.

Charles Paxton, the other Co-PI is also a doctoral student and the Science and Operations Officer at the Tampa Bay area National Weather Service office. Charles earned his undergraduate and master's degrees in meteorology from the Florida State University. Charles has authored numerous papers and several have incorporated Unidata software for visualizations. Charles has taught installation, configuration, and running the WRF model internationally where he stressed the utility of using Unidata products for visualizations.

2.4. Management and Maintenance

The PI will be the main supervisor of the Meteorological Laboratory facilities. The Department of Geography, Environment, and Planning has recently hired (December, 2010) its own full-time IT support specialist, Jason Simms. Jason was an outstanding applicant for this position. With his advanced programming skills in several languages and sound knowledge of Linux as well as Windows Operating Systems, he more then met our preferred qualifications for the position. Jason has been assigned a 50% load for the Meteorological Lab due to the department's support of the instruction and research coming out of the lab (and from the PI). He will assist in the installation of the computers ensuring each is set up to the existing network infrastructure required to obtain data in real time. Reliability of the computers will be ensured by our IT support specialist through preventative maintenance of the workstations in the laboratory. Jason works closely with the College of Arts and Sciences Computing Services Unix administrator and the Director of Academic Computing.

2.5. University Commitment

The University of South Florida is committed to having a state of the art Meteorological Lab. The Center for 21st Century Teaching Excellence has already awarded Dr. Collins internal grants to support the purchase of hand-held weather equipment (such as psychrometers) and the development of materials to provide active learning experiences to the students with the use of this equipment. These materials are already in use for MET 4012C (undergraduate Meteorology). USF recently fully supported the acquisition of an LCD screen and mounting brackets. In addition, USF commits the PI and the Department of Geography, Environment, and Planning's IT support specialist to this project.

3. Benefits to the University and to Unidata

3.1 Impact on Teaching and Educational Program

Meteorology naturally lends itself to visualization of data in multiple dimensions. The upgrade of our department's computer system will allow students to overlay observations and numerical model forecast fields onto satellite and radar imagery, interactively create cross-sections of a host of parameters, and visualize weather systems from a user-selected three-dimensional perspective, including color animation. This can be accomplished by using software packages such as IDV, GEMPAK, and GR2 Analyst.

In addition, many programs native to meteorology are best suited to be run in a Linux environment. To this end students in the Meteorology class (MET 4012C) will be able to receive instruction from basic command line Linux to meteorological software run in Linux such as IDV, McIDAS, GEMPAK, GrADS

and NCL. This instruction would be unique to this course, as it is not presently offered elsewhere in the entire USF system, and would be of tremendous value to the students in providing hands on experience with state of the art software in the technical environment in which they are used for research and the field at large.

We are at an opportune moment in which our ability to view and analyze data, and thereby understand atmospheric processes, has never been greater. The Unidata software provides visualization tools to (1) overlay data diverse types, (2) effectively depict the three-dimensional spatial structure of the atmosphere, and (3) animate the displays to show atmospheric evolution in real-time. Four-dimensional multivariate visualization is vital to mastering many difficult geophysical concepts and interactions. Our students need to be on the forefront of this technology if they are to reach their potential and make useful contributions to their professions and society. Several of the PI's graduate and undergraduate students have received external and internal awards in recognition of their research (conducted with the PI and Co-PI's and collaborators such as the Tampa Bay NWS). These students are going on to masters programs in meteorology, are getting involved in more directed research or are taking student positions with the NWS and the media. As such they need to be competitive and prepared, having some of the same opportunities which students from a meteorology program receive. These high-end workstations will also allow us to install the AWIPS-II that we expect to be forthcoming from Unidata, and to provide at least one EDEX server to support them.

The technological merit will be realized through greatly increased utility of existing programs and capability to run higher end Unidata technologies. The addition of Unidata resources will enhance the education and training of students, increase awareness and usage of Unidata products by students, faculty and the community at large, and provide for interdisciplinary research across all of USF. The goal is to provide more robust and state of the art hands-on exercises using examples from current ongoing research.

The PI and the Co-PI's are working on several projects that will incorporate the greater utility of the new systems and software. Several high resolution WRF numerical modeling case studies require detailed visualizations to illustrate mesoscale evolution of tornado development and local drainage flows. This will be accomplished using the new resources from the grant. One of the goals is to teach students the basics of modeling through hands-on configuration running of the WRF model. Then the runs will be visualized using IDV. Then classroom exercises will be developed for teaching the use of the Unidata software and how to visualize general atmospheric structure and new concepts derived from these high resolution cases. This methodology provides new approaches to classroom and individual instruction. The researchers are also studying hurricane patterns that correlate atmospheric variables to development and dissipation of systems. It is the visualization of these variables that helps to explain the processes involved.

3.2. Contribution to Research

Research at USF involves the interaction between the atmosphere, the environment (land, ocean, vegetation, rivers and lakes) and the human population. Research in these areas will be greatly aided by enhanced computing facilities in various ways. In addition, the new equipment from this proposal will allow more interdisciplinary collaboration within and outside the department. It will allow professors and students to integrate IDV into interdisciplinary projects such as between hydrological and meteorological sciences. Recently the PI invited an international researcher from Brazil to join her in the Meteorological Lab for 2 months (Spring 2008). This resulted in a successful collaboration (and friendship), a paper published in the Journal of Climate, several conference presentations and a multitude of opportunities for all parties (and the PI's students). It is the aim of the PI (and one of the missions of USF) to have state of the art facilities encouraging increased international collaboration.

Another collaborative project to develop a coupled ocean-atmosphere model ensemble with researchers within the USF Department of Geography, Environment and Planning, USF College of Marine Science and the Florida State University Center for Ocean-Atmospheric Prediction Studies and Department

of Meteorology will also require enhanced visualization capabilities to interpret model output. One of the Co-PI's has already contacted Unidata regarding input of oceanographic model data into IDV and using this interface to display and interpret coupled ocean-atmosphere model ensemble data. The new methods for data visualization will enhance our innovative research and similar research by others. This will also provide an opportunity to produce and provide new bundles for the output including for the oceanographic ensemble portion.

Further technological merit will be found in the cross training of many disciplines within the University. The Department of Geography, Environment and Planning is in the College of Arts and Science, the largest college at USF, and encompasses Geography, Environmental Science and Policy, and Urban and Regional Planning programs. In addition, the Department of Geography works closely with the College of Marine Science and the departments of Chemistry, Geology, Environmental and Occupational Health, and Anthropology (to name a few). We address urban, coastal and global environmental issues from an interdisciplinary perspective and prepare our students to work in these areas. The collaborative process is sometimes initiated through the highly attended Environmental Research Interdisciplinary Colloquium lectures http://www.sgs.usf.edu/eric_lectures.php. The dual boot systems provide the flexibility to run many department specific applications independently then tie these to Unidata processes to gain maximum utility. This will contribute to Unidata community capabilities. For example hazardous chemical or disease migration tied to meteorological output that reflects conditions conducive for spread will contribute to the enhancement of the community capability. This will broaden the Unidata community scope and capabilities by making the tools and data sets available for collaboration via RAMADDA with these other disciplines. The contribution to education will be through a variety of methods from one-on-one to classroom instruction to NWS webinars and USF poster symposiums to exhibiting research at a spectrum of geoscience conferences and in journal articles using Unidata products in the research. It is the goal of the PI to not only have her students be actively engaged in research to co-author manuscripts, but also to provide the students skills to write grants.

3.3. Outreach and Auxiliary Users

An automated weather observing array is currently present on the roof of the Geography, Environment and Planning Department facilities. The machine that the data relays to is outdated and often the feed gets interrupted. This grant will also make it possible to update that machine, and it specifically will be dedicated to running RAMADDA to share our observations with the Unidata community. In addition, we will arrange for that data to be publicly available for use by forecast agencies such as the National Weather Service and shared to the Citizen Weather Observer Program (CWOP) and Meteorological Assimilation Data Ingest System (MADIS). This will enhance our participation in the field of Internet Data Distribution (IDD). These efficient methods of sharing our data and analyses through electronic media will allow widespread dissemination and potential discussion of our research results in serving a broader community purpose and fostering the potential for future collaboration. After installation and implementation of all equipment we will submit an article to the Unidata community E-newsletter to disseminate the outcomes of the implementation of the new equipment and data sharing.

The PI has been recognized for community outreach, particularly through her service as President for the West Central Florida Chapter of the American Meteorological Society (WCFLAMS). USF is the only university in this region offering upper level Meteorology/Climatology courses. As such, the facilities play host to numerous meetings of the WCFLAMS which are organized by Dr. Collins. For example, the laboratory was used to show WCFLAMS members the software GR2 Analyst. However, only 21 day trial versions could be downloaded to the machines due to the cost of the software (an advantage of Unidata products). In addition, the laboratory and workstations have been used in the past few years to host the WCFLAMS Chapters' annual "Teach the Teacher" workshops (organized by Dr. Collins with support from the WCFLAMS members). The goal of the workshops was to give high school and middle school teachers

experiment and computer lab exercise ideas, as well as knowledge which they could in turn pass on to their students.

Dr. Collins recently received a Conference Coordination Grant (CCG) from the College of Arts and Sciences (USF) to host a workshop on the theme of weather and climate forecasting. The workshop had both a teaching and research component attracting 85 participants coming from the Hillsborough County High Schools and Middle Schools, USF (professors and students particularly from the Meteorology class 4012C and the Climatology class 4002C), other local colleges and universities, and the WCFLAMS membership. If awarded a Unidata grant, the PI will apply for another internal CCG to hold a 2 day workshop in Spring 2012. Workshop day 1 will be the WCFLAMS Chapters' "Teach the Teacher" event in the Meteorological Lab to demonstrate Unidata's IDV application through educational instructional materials. Workshop day 2 will be aimed at the WCFLAMS membership at large and USF faculty from many related disciplines to encourage widespread usage of the McIDAS-V and Unidata's IDV application.

The added value that this project will bring to the Unidata community at-large will be realized in several areas. The new equipment will permit newer capabilities in the data and visualization and participation in IDD. This will be two way with new Unidata data coming in and local observations and model data outbound into the user community. New model output, tools and bundles related to the unique mix of interdepartmental collaboration will provide meaningful new implements into the Unidata community.

D. Budget

The proposed equipment will fulfill most projected hardware requirements for the next five years when considered together with the other equipment (LCD screen) described in Section 2.5. Given the current state of the Florida economy, internal funding for large scale equipment purchases is limited, making this grant essential. Price quotes from vendors (including educational discounts) are current as of 14 March 2011. The budgetary costs outlined below to be covered by Unidata are for the physical hardware only. Computer maintenance will be provided by IT support specialist, Jason Simms, who is located in the Department of Geography, Environment and Planning.

No.	Item/Specifications	Unit Price	Total Price	Unidata
15	HP Compaq 8000 Elite CMT - High End Unit	$992	$14,880	$14,880
	Intel Core 2 Quad Q9650 SIPP Processor 3.00 GHz, 12 MB L2 cache, 1333 MHz FSB			
	4GB PC2-6400 DDR3 (PC3-1333) 2 x 2GB Memory			
	1TB 3.5" 7200 rpm SATA 3.0 Gb/s NCQ, SMART IV			
	ATI Radeon HD 4650 (1GB DH) PCIe x16 Graphics Card			
14	2GB 1333MHZ PC-3-1060 Memory	$72	$1,008	$1,008
14	Dell Pro P2311H 23" Monitor 1920x1080 / 60 Hz Screen Resolution	$224	$3,136	$3,136
	Total Equipment Costs		$19,024	$19,024
1	Material and supplies (MS) HP Color Laser Jet CP3525n Printer 1200 x 600 dpi	$663	**$663**	**$663**
	Total Direct Costs		**$19,687**	**$19,687**
	***Total Indirect Costs (47% of materials and supplies (47%*663 = $312)**		**$312**	**$312**
	Total Costs		**$20,000**	**$20,000**

E. Project Milestones

June 2011:

Order equipment and set up for our weather data to be sent electronically to the shared community.

July - August 2011:

Receive equipment and set up Meteorological Lab. PI and Co-PIs work on the development of instructional materials focused on developing computer skills and familiarity with Unidata products.

September – December 2011:

Implement labs in Meteorology 4012C course. PI will submit application for internal Conference Coordination Grant. Begin to integrate THREDDS server to provide local and regional data.

January-April 2012:

Implement labs in Climatology 4002C course. Utilize RAMADDA to provide easy access to data, case studies and related materials. Organize workshop materials and advertise workshop.

March 2012:

Host workshop to demonstrate Unidata's IDV application and McIDAS-V.

April 2012:

Submit article to the Unidata community E-newsletter on the outcomes of the implementation of the new equipment, the workshop and data sharing.

May 2012 - onwards:

Continue being actively engaged in the Unidata community, applying for further external grants (noting our new state of the art facilities) and conducting collaborative research in the Meteorological Lab. Offer future outreach opportunities using the Meteorological Lab and Unidata products.

No other conditions such as space or deadline constraints exist that should alter this schedule.





Current computer and printer facilities in the Meteorological Lab.