2020 UNIDATA COMMUNITY EQUIPMENT AWARD PROPOSAL

Acquisition of AWIPS II CAVE Client Computing Infrastructure at the College of Charleston

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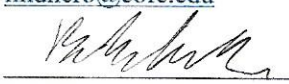
Signature of Co-PI:	
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Amount Requested:	$10,591

1. PROJECT SUMMARY

As a nationally recognized liberal arts and science institution, the College of Charleston (CofC) represents the best of the old and the new in higher education in the United States. The College of Charleston is very proud of being the thirteenth oldest institution of higher education in the United States. Our undergraduate curriculum is such that our students enjoy a thorough grounding in the liberal arts and science, no matter what area they later choose for specialization. Although the enrollment is approximately 11,000 including students from all 51 states and from over 53 foreign countries, our campus environment maintains the feeling of small college.

In addition to our heritage, the College of Charleston is to seeking to address other new demands on US higher education. Recently, the College of Charleston has developed a new program in meteorology and atmospheric physics which is unique in the state of South Carolina. Beginning in Fall 2016, we are the only institution in the state to offer a degree in meteorology which meets all recommended American Meteorological Society guidelines for undergraduate students and Federal Civil Service requirements for the National Weather Service. Furthermore, the College of Charleston is an affiliate member of UCAR, works closely with the local National Weather Service (NWS) office personnel, and has received numerous research grants in meteorology and atmospheric physics. With the recent infrastructure improvements and the implementation of new recruiting strategies for the meteorology program, program enrollment is expected to continue to grow by 30-50% over the next 3-5 years.

The primary goal of this project is to install the Common AWIPS Visualization Environment (CAVE) clients for weather analysis and forecasting classroom settings. The AWIPS II system will be widely used by forecasters at more than 130 weather forecast offices and river forecast centers across the nation in the near future. As one of the meteorology departments training the next generation of operational meteorologists, it is useful to have the AWIPS II system installed in our classroom. Students, therefore, will be able to utilize the state-of-the-art AWIPS II system for learning and conducting weather briefings as well as to better prepare themselves as future meteorologists in weather forecast offices or other agencies.

Adding the AWIPS II clients will enhance our capacity to utilize all different datasets from Unidata as well as locally generated datasets for our classes. Furthermore, it is anticipated that students will use the computing infrastructure in senior research projects and in conjunction with internships done at the local National Weather Service (NWS) office or local TV stations. Moreover, adding the AWIPS II clients will enhance our program's undergraduate research capabilities along with faculty productivity.

It is anticipated that installing the AWIPS II CAVE clients will enhance the learning environment for our undergraduate meteorological education. If this proposal is awarded, we expect to

- Facilitate student training and development with AWIPS-II

- Integrate UNIDATA infrastructure into our program curriculum
- Provide a real-time operational testbed for the AWIPS-II software and for the student-led development of training materials, with the intention of sharing with the community
- Provide students with resource-intensive data visualization in classroom and research activities
- Enhance our community outreach within the Lowcountry, SC region

2. PROJECT DESCRIPTION

A. Background and Goals

The meteorology program at CofC is unique in that it is the only program in South Carolina and one of only a few programs across the United States that exclusively educates undergraduates. The curriculum for the operational meteorology concentration emphasizes both theoretical and applied coursework. Students also receive scientific computing experience throughout numerous courses. It is anticipated that a significant fraction of our students will pursue post-graduate employment with the National Weather Service (NWS) or other private forecasting firms, with smaller percentages interested in broadcast meteorology, environmental science, or continuing their education with an advanced degree and becoming involved in research or academia.

This proposal is aimed to install the next generation Common Advanced Weather Interactive Processing System (AWIPS II) Visualization Environment (CAVE) clients. The College of Charleston has recently completed a full renovation of our current facilities that will provide a great location for the new equipment. In particular, we have new student computing lab rooms, dedicated for our expanding meteorology program. Currently, there are no workstations that are dedicated for a weather analysis laboratory or meteorological data analysis. In order to improve the quality of our program, it will be necessary to install three CAVE clients for instructional purposes. It is anticipated that the new equipment will further enhance our capabilities in teaching, in recruiting, in research, and in community participation.

B. Details of Equipment Required

We are requesting funds for the purchase of computing hardware that would support three AWIPS-II CAVE client machines. The configuration of the CAVE machines is based on Unidata recommendations. Furthermore, the College of Charleston maintains student MATLAB licenses that are available on any workstation within the department. All workstations will be installed with Linux, helping reinforce the Linux environment in the undergraduate curriculum.

The CAVE client, which will be a Precision 3630 Mini Tower, will consist of

- Intel Core i9-9900 (Quad Core 3.60 GHz, 5.00 GHz Turbo) Processor

- 2 x 16 GB (DDR4 2666 MHz) RAM
- 256 GB PCIe SSD
- 2 TB 2.5 inch SATA Hard Drive (5400 RPM)
- Dell 24" Widescreen LCD Monitor
- CentOS/Red Hat 8 Operating System

We would welcome input on workstation hardware before making any purchase if the suggested hardware is not compliant with UNIDATA. We would also be agreeable to a smaller number of CAVE clients depending upon the budget for the UNIDATA committee.

Our program is also collaborating with Michael Dross (the Founder/President of Wright Weather LLC), who is currently an affiliate faculty member at CofC. His expertise in deploying software applications (such as WXP and AWIPS) will allow our program to produce unique, custom weather graphics and products for internal use and for data sharing throughout the community. Michael has already assisted us in establishing the new broadcast meteorology studio at CofC, and he will assist us (in conjunction with the IT department at CofC) in setting up the AWIPS workstations. Furthermore, his connection to local industry will be very useful in extending our outreach to the local community (as discussed in the next section).

C. Benefits to CofC Meteorology Outreach and Education

The faculty in our program is engaged in various outreach activities that actively involve faculty and students. Activities include speaking to high school science classes, serving as faculty mentors for high school capstone projects, and judging science fairs. We believe that this visibility has contributed to our program attracting a large number of women and underrepresented minorities within atmospheric science. Although the proposed equipment will have practical benefits for undergraduate research and education, we believe that this equipment will also aid in meteorological outreach within the Lowcountry, SC region. Following the example of other successful atmospheric science programs (such as Jackson State University), we plan to use this equipment to construct outreach activities that will expose high school students to career paths within atmospheric science. In particular, we would like to use the equipment from this grant to develop a "summer weather camp" in which participants learn the basics of numerical weather prediction and work on team projects with classmates using real-time meteorological data. Thus, we will be able to expose students to meteorological data analysis and forecasting. Without UNIDATA support, it is very unlikely that CofC would be able to purchase this equipment or to develop this outreach program in the foreseeable future.

Our outreach efforts will also be used to establish stronger connections within meteorological industry. Because our program is the only meteorology program in the state of South Carolina, our program is uniquely positioned to partner with the local National Weather Service (NWS) station

in Charleston and the private sector in order to serve our community. If this proposal is funded, we intend (with the assistance of undergraduate students and our collaborator Michael Dross) to set up a custom webpage to disseminate local weather information for the Lowcountry, SC region, which will serve our region well (particularly during the Atlantic hurricane season). This will allow us to coordinate our efforts with the NWS during significant weather events (such as during the Atlantic hurricane season).

Numerous education and professional benefits stand to be gained by expanding our use of Unidata products and implementing AWIPS-II into the curriculum. As previously mentioned, it is anticipated that many of our students will seek employment with the NWS upon graduation. The deployment of AWIPS-II will provide opportunities for those students to gain meaningful experience with software used on a daily basis at NWS Weather Forecast Offices (WFO). While interning and/or volunteering at local WFOs or will always be important for job prospects, integrating the software into our curriculum will allow students and NWS meteorologists a better use of time during the volunteer period. Moreover, this equipment will also be beneficial for students who are pursuing broadcast meteorology careers and careers in the private sector which emphasize numerical weather prediction.

Below is a description of how we expect to expand the use of the Unidata software suite with the proposed equipment:

- PHYS 105 – Introduction to Meteorology: Students are introduced to basic weather analysis and forecasting concepts. In this course, students will be introduced to Unidata products for use in homework assignments or data visualization during lecture. Hence, students will learn the basics of weather analysis using AWIPS-II.

- PHYS 215 – Synoptic Meteorology: Students build on physical and dynamical conceptual models to gain insight into the formation and evolution of synoptic scale weather features. Students partake in a rigorous forecasting practicum in which they compete against their peers and numerical models for "top" forecaster. Students also give daily weather briefings and forecast discussions for various locations across the United States. Currently, students use weather maps/charts/data from various Internet sources. By expanding the use of Unidata products and deploying AWIPS-II, students will generate their own products for use in daily weather briefings.

- PHYS 225 – Climate: Students are introduced to the study of Earth's climate system by analyzing global energy balance, atmospheric radiative transfer, the hydrologic cycle, environmental energy transport, climate sensitivity, and feedback mechanisms. Students will use AWIPS-II to explore larger climatological datasets through plotting and statistical analysis of trends and changes in atmospheric variables.

- PHYS 3XX – Numerical Weather Prediction: Our department intends to create a course in numerical weather prediction. This course will cover the basics of numerical weather models; the influence of model physics on NWP forecasts; the basics of data assimilation; the effective use of high-resolution models; and an introduction to the North American Ensemble Forecast System (NAEFS). The use of UNIDATA programs will be an essential component of this course.

- PHYS 399 – Independent Research: Students across all levels use Unidata software for analysis and visualization of weather data. Data output has been used in conference presentations and reports.

- PHYS 425 – Mesoscale Meteorology: Students build on physical and dynamical conceptual models to gain insight into the physical and dynamical framework of severe convective weather. Students will use AWIPS-II for mesoscale nowcast and forecast discussions, assignments, and Skew-T analysis and visualization in their semester research projects.

- PHYS 457 Satellite Meteorology: Students will use AWIPS-II and the data retrieval techniques discussed in class to infer cloud and precipitation properties directly from the satellite data in visual, near-infrared, and infrared bands.

- PHYS 419/420 – Senior Research: Senior meteorology majors will use Unidata to complete their capstone research projects. Data output will be used in their senior thesis and senior presentation.

Overall, we expect that the installation of AWIPS II will provide CofC students the opportunity to integrate lecture material with actual data and modeled output to help them visualize atmospheric processes. For this reason, it is vitally important that student learn how to use these tools and software in meteorology, which may be used in many aspects in their future professions. This is where the requested CAVE clients become especially valuable, as students will finally gain access to AWIPS-II.

D. Benefits to CofC Faculty Research

Faculty and students in the Meteorology and Atmospheric Physics program are focused on a wide range of research topics, including cloud microphysics, satellite meteorology, severe convective storms, and tropical meteorology. Observational case studies using integrated instruments and numerical simulations comprise much of the research conducted in the program, with efforts supported by both external agencies (e.g., National Science Foundation) and internal programs

(e.g. CofC Faculty Research and Development Lab). Our primary data visualization is with scientific programming languages (MATLAB, FORTRAN, GrADS, etc.).

This is often out of reach for most undergraduates who participate in semester (or slightly longer) projects that demand near immediate results. The proposed equipment would enable interactive data visualization and analysis from a variety of research data sources, further promoting undergraduate research that engages both upper- and lower-division students early in their academic careers. Research in undergraduate science education demonstrate that students engaged in research are more likely to persevere through the challenging parts of the curriculum, making retaining and graduating students more likely.

As mentioned above, we intend to use the workstations to access real-time weather data and climatological data. Furthermore, we intend to use the equipment to run other community models for the purposes of faculty research such as the Hurricane WRF model (HWRF) [for the purposes of tropical cyclone research] and the Regional Atmospheric Modeling System (RAMS) [for the purposes of convective storm research]. Obtaining these workstations will allow us to further integrate our students into our research program and to further promote undergraduate research.

E. Benefits to Unidata

The most valuable aspect of Unidata is the community support, feedback, and assistance when implementing new software and data dissemination techniques into undergraduate and graduate education. More importantly, the Unidata community actively listens to its end users to further improve their software suite. Updating our computational infrastructure to include the deployment of AWIPS-II will allow our faculty and students to use and to provide feedback for Unidata products. The proposed equipment will also allow us to further our participation in the Unidata community and would expand the reach of AWIPS-II within the community. Our program intends to use this hardware to share operational and research data with the community through the server.

One of the essential outcomes of this project is to design a real-time nowcasting and forecasting webpage using MetPy to disseminate this information. Because the faculty in our program have expertise in tropical cyclones dynamics, we will also use the operational data to create custom graphics on our webpage associated with storm surge and coastal flooding forecasting, which will be shared within the community. The full use of the AWIPS system will further enhance community participation.

3. BUDGET

For CofC to become fully capable of utilizing AWIPS-II and extending Unidata visualization and data access, the following computing hardware will be purchased at the following cost:

Quantity	Item	Unit Cost	Total Cost
3	Dell Precision 3630 Mini Tower	1995.47	5986.41
3	Dell 24" Monitor	194.99	584.97
State of SC Sales Tax: (Taxes of 9% on 6,571.38)			591.42
Indirect Costs (47.86% of MTDC on 7,162.80)			3,428.12
Grand Total Requested			10,591

The above costs include a three-year hardware warranty. While there will not be any direct cost sharing by CofC for the above equipment, the PI and co-PI will donate time for the installation, configuration, and maintenance of the system. The PI will also donate time to train other faculty and students in the use of AWIPS-II and incorporation into undergraduate coursework. Specific manufacture quotes are included at the end of this proposal. CofC's Facilities and Administrative rate agreement (47.86% of the modified total direct costs) is federally-negotiated (HHS) and is included. CofC is not exempt from sales and use tax on purchases; that cost is 9% of the computer equipment purchased.

4. PROJECT MILESTONES

Vendor quotes have already been acquired which will facilitate placement of purchase orders immediately upon notification of an award in early July 2020. This will allow project personnel to install equipment early in summer break so that all systems are configured and well-tested before the 2020-2021 academic year begins in August. The new hardware and AWIPS-II will be immediately incorporated into course work during the Fall 2020 semester. The real-time nowcasting and forecasting website is already under development with plans for final release during the 2020-21 academic year. Unidata products would be integrated into the site beginning January 2021, after curriculum improvements have occurred. There are no expected dependencies that may alter the project goals or deadlines.

Precision 3630 Tower

Precision 3630 Tower CTO BASE

Processor

Intel Core i9-9900K, 8 Core, 16MB Cache, 3.6Ghz, 5.0 Ghz Turbo w/UHD Graphics 630

Operating System

Red Hat Enterprise Linux WS v8.0 with 1 YR RHN

Windows AutoPilot

No Windows AutoPilot

Chassis Options

Precision 3630 Tower with 460W up to 90% efficient PSU (80Plus Gold) with SD card reader v2

Video Card

NVIDIA Quadro P620, 2GB, 4 mDP to DP adapter

Memory

32GB 2x16GB DDR4 2666MHz UDIMM Non-ECC Memory

Systems Management

No Out-of-Band Systems Management

Storage Drive

M.2 256GB PCIe NVMe Class 40 Solid State Drive

2nd Storage Drive

2.5 inch 2TB 5400rpm SATA Hard Disk Drive

3rd Storage Drive

No Additional Hard Drive

4th Storage Drive

No Additional Hard Drive

5th Storage Drive

No Additional Hard Drive

Storage Volume

Boot drive or storage volume is greater than 2TB (select when 3TB/4TB HDD is ordered)

Storage Configuration

C6 M.2 PCIe Boot SSD with optional 1-4 2.5 inch HD

Raid Connectivity

No Raid

Keyboard

Dell Multimedia English Keyboard - KB216

Mouse

Dell MS116 Wired Mouse

Teradici Remote Workstation Access Host Card

No Remote Access Host Card

Network Card

No Additional Network Card Selected (Integrated NIC included)

Wireless

No Wireless LAN Card

PCIe I/O Cards

Not selected in this configuration

Serial Port / Parallel Port

No Parallel or Serial Port

Optical or CAC/PIV reader

8x DVD-ROM 9.5mm Optical Disk Drive

Power Cord

US Power Cord

Documentation/Disks

Safety, Environmental, and Regulatory Information (English/French/Multi-language)

Placemat

Quick Start Guide

Operating System Recovery Options

OS-Windows Media Not Included

ENERGY STAR

Not ENERGY STAR Qualified

Optimizer

No Optimizer

Configuration Type

Custom Configuration

Packaging

Shipping Material for MT DAO

Driver

No Wireless LAN

Label

Precision 3630, 460W Reg Label DAO

Canada Ship Options

US No Canada Ship Charge

Processor Branding

Intel® Core™ i9 Processor Label

Optical Software

PowerDVD Software not included

Dell Backup & Recovery

No Dell Backup and Recovery software

UPC Label

No UPC Label

TPM Securty

Dell Precision TPM

Stands and Mounts

No Stand Option

Cables and Dongles

No Accessories

Hardware Support Services

3 Years ProSupport with Next Business Day Onsite Service

Optional Integrated Video or USB Ports

No Additional Port

Microsoft Office

No Productivity Software

Security Software

No Security Software

Non-Microsoft Application Software

Dell Applications for N-Series

External Speakers

External Speaker Not Included

Dell 24 Monitor - P2419H

Dell 24 Monitor - P2419H

Hardware Support Services

3 Years Advanced Exchange Service

Bundle Total:

$10,952.32