2023 UNIDATA COMMUNITY EQUIPMENT REQUEST

A. COVER PAGE

Title: Establishing Weather & Climate Instructional and Research Students Services at Coastal Carolina University Via the Creation of the UCAR Facility for Oceanic & Atmospheric Modeling & Visualization (FOAM-V)

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B. PROJECT SUMMARY

This proposal seeks to establish the online presence of http://weather & climate.ccu.edu as a cornerstone of Coastal Carolina University (CCU) campus and broader community weather/climate data dissemination at Coastal Carolina University (CCU). This will be accomplished by creating http://weather&climate.ccu.edu as an LDM relay and a web-accessible apache front- end server that facilitates users to view, manipulate, and download Unidata derived products (e.g., GOES 16 and 17 data/imagery, and the upcoming [2023] GOES 18 model data/images, analysis data, textual products. [https://www.bing.com/search?pc=U523&q=the+latest+GOES+Satellite%3F&form=U523DF]). A large, dedicated room will house the CCU Unidata student workstations purchased with this funding. (https://www.unidata.ucar.edu/). In addition, this web-accessible server will allow all community members public access to the South-East Atlantic Ecological Network (SEA-EcoNET), and to North American Regional Reanalysis (NARR) archive that the PI and Co-P's have established and are continuing to expand across the Southeast USA and the US protectorates, eg. Puerto Rico. Creation of and the hosting of this new front-end server and student workstations would allow for students in CCU environmental science (and other) classes to conduct undergraduate and graduate student class related projects and also student research and also to enhance student engagement in the PI's, Co-PI's and other CCU faculty current and future operational research activities. Thus the server will run LDM and relay data to the community) to focus on teaching and research by allowing students access to a Jupyter Notebook server for coursework and individual research projects. To date, this access has been on a limited, on demand, basis due to student personal computing resources. Allowing all CCU meteorology, ocean, marine sciences and environmental sciences students access to a Jupyter Notebook server (as a result of this funding) would aid in data-proximate analysis that students will need in the future as geoscience datasets continue to grow in size and number. In addition, the PI and Co-PIs are teaching new courses that employ a variety of weather and climate and environmental data sets, which employ statistical, deterministic and empirical mathematical software to decompose and analyze disparate environmental data. Likewise the server will also allow students to make operational weather forecasts of incoming storm events, utilizing NOAA satellite and in-situ data as well as MADIS and SEA-EcoNet real-time data. The focus of the new courses will be the use of the Python programming language for scientific analysis and plans are to facilitate resources to students through use of a Jupyter notebook server that will serve as a gateway to other Unidata tools (e.g., MetPy, netCDF4). The jewel in the crown is the Visualization of the Data and Numerical Model Output.

C. PROJECT DESCRIPTION

CCU Environmental Sciences Programs focusing on Weather, Climate, Hydrologic, Marine and Earth Systems Science.

1. **The Setting**

    CCU is a public Carnegie R2 institution located in Conway, South Carolina (SC), east of the Myrtle Beach SC metropolitan area. CCU serves roughly 10,000 students and was established in 1954. The CCU Environmental Sciences Programs began in the 1980's and is the longest tenured UCAR program (2009) in the state of SC (with Clemson University having joined in the Fall 2019). The program attracts students from various backgrounds wishing to study meteorology, ocean, marine and environmental sciences with the personal attention only available in class sizes of less than 10. The department has 25 full-time meteorology, marine science, oceanography and geosciences faculty that all teach and perform research as a part of

the university's mission. In addition, many faculty members in the department involve undergraduates in their respective research projects.

2. **Serving the CCU and SC Community**

CCU has been a leader in the dissemination of weather forecast model output since 2015 given the expressed needs of the Office of the Governor of SC and of the SC State Guard, for guidance from Bao, Pietrafesa, Gayes, and Limpasuvan during incoming severe atmospheric storms. Since then, up through 2020, CCU has provided numerical model research tools output of winds, rainfall, coastal and inland flooding and flooding from the mountains to the sea in advance of severe storms, to serve the needs of CCU students, faculty, staff and administration and the State Guard of SC, for evacuation, travel routes, relocation, power company staging, etc. This has been done on an ad-hoc basis by CCU in the past. The funding for the server and workstations would allow for this enterprise to become a research operational tool, providing information, and directed by Bao, Pietrafesa, Gayes and Limpasuvan, and engage other CCU faculty and students; offering real-time operational guidance experience.

3. **Serving the Students**

The proposed server will be available to all courses and student research projects in the College in order to maximize the potential benefit. For example, recent research projects in the department have focused on machine learning as a methodology for applied climatological studies. Had students not have had access to the PI's current research server (purchased through the PI's start-up funds), these projects would likely not have been possible. CCU weather and climate has had a recent history of applied climatological research and this Unidata equipment grant and purchase of a new server would allow this type of research to continue on the ever-growing number and size of geoscience datasets.

4. **Importance of this project**

The CCU meteorology, marine sciences, oceanography and geosciences curriculum uses various Unidata software packages (GEMPAK, LDM, IDV, MetPy, netCDF, THREDDS) that help students obtain a greater understanding of weather, climate and environmental processes through data visualization. These Unidata software packages have been the cornerstone of the PI's and Co-PIs' current research and teaching servers via shell scripting and web-facing map portals. However, these facilities are now saturated with data processing and we will soon be unable to support any additional load from additional students or class projects due to the constant real-time processing of geoscience data (including real-time data from GOES-16 and 17). This proposal would shift all the real-time data processing and LDM relay processes to a new server (http://weather.ccu.edu) to serve as the online face of our geoscience data display and acquisition.

Additionally, this equipment grant would allow for the permanent hosting of the PI's archive of NARR data via a THREDDS server (e.g., http://weather.ccu.edu/narr) that several Unidata community members are beta testing. As a result of this shift, the PI's and Co-PIs 'current atlas server would become the primary resource for department teaching and research as a Jupyter Notebook server. A pilot test of this project will be being implemented in the Fall 2023 semester in a research course (Research Topics in Weather & Climate by Gayes-Bao-Pietrafesa-Limpasuvan) and it is expected that students will really embrace the portability, sharing, and workflows associated with these

research notebooks. This proposal uniquely addresses Unidata's 2023 call for proposals by highlighting the data proximate analysis of large datasets (i.e., GOES-16/17) and projects that aid in the instruction of machine learning techniques on weather/climate data. For example, the computing behind two recent publications to AMS journals on machine learning for purposes of classifying mesoscale convective systems was performed on the PI's atlas.niu.edu server through use of a Jupyter Notebook server. Students enjoy the fact that they do not have to worry about downloading or installing Python software or libraries. They can simply open a web- browser, enter a username/password, and be online coding and performing data analysis in seconds. This greatly reduces the time to science, which is an important aspect of today's research environment.

In addition to the Jupyter Notebook server, the Multi-Geosciences Mapwall would display various visualized manifestations of environmental sciences phenomena, such as GOES- 16 satellite imagery show (eg., Figure 1), in a Public Setting in the main Foyer entrance to the building. Students will be encouraged to interact with the data by downloading the imagery and performing subjective analysis or sharing the imagery with friends/colleagues on social media. This helps spread the word about Unidata and its importance in the geoscience community.
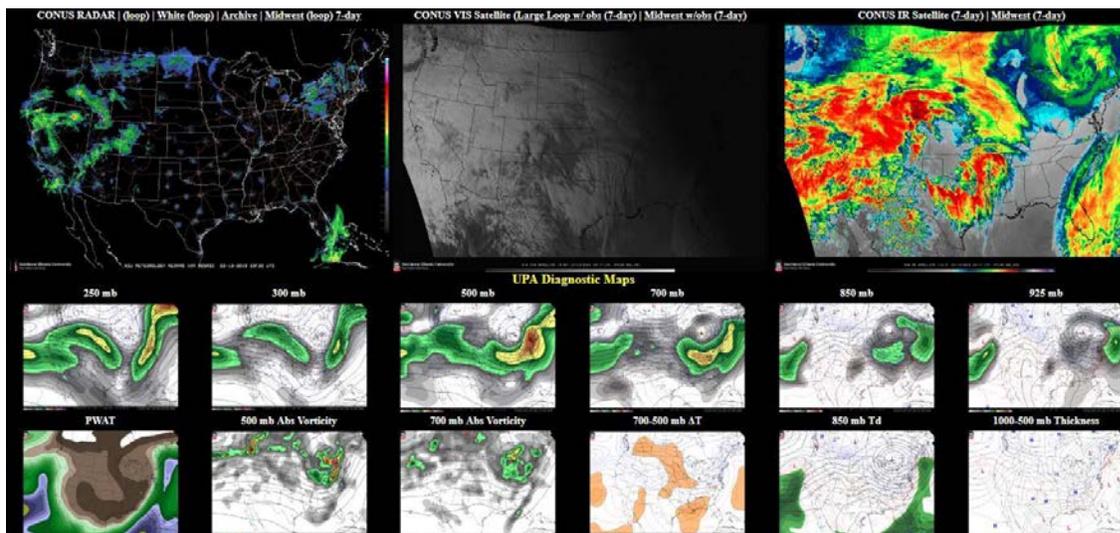

Figure 1. Example of the proposed GEMPAK "Map Wall" portal

To serve such data output to CCU students, along with adding new datasets (GOES-17; GFS-FV3; NARR archive) and meteorological analysis plots, we need a new physical server.

The Gupta College of Science has established a Data Operations Specialist to help facilitate broad access and support for CCU and other generated datasets for university and broader state and stakeholder needs. This position will assist faculty and students with this facility and technical needs as well as University Information Technologies Services staff who aid with higher end computational platforms on campus.

D. BUDGET
CCU proposes the purchase of a Dell Precision 7920 Server Rack ($15,044) for hosting the Jupyter Notebook, produce visualization and transfer Data, six workstations, large format monitor and associated supplies. State contracting here will mandate updated check on current server for specs

identified including the estimation of the need to have a server and workstations that will last well into the future. While no minimum specification is suggested, we feel that this particular model will optimize cost and efficiency, while providing a high-end performance server capable of meeting the unique needs of the CCU Meteorology-Marine-Ocean-Environmental Sciences program. The total cost of the server system is: $15,044.00 and the cost of the ab Workstations is: $12,000.00

The Center for Marine and Wetland Studies at CCU is also actively engaged in facilitating real time environmental observations including met data for education, public applications and extension. This includes establishing a "Smart Reef" Spotter Buoy node feeding wave and wave field derived wind fields along with other environmental variables. The Spotter smart mooring is a $9,800 contribution and we are in discussions with the manufacturer related to forming a third-party instrument connectivity capacity testbed at an inshore site 4 miles offshore from the coast to direct connect data and applications for student, faculty and resource manager's needs. We plan an additional $10,044.00 in direct funds toward the purchase of the proposed equipment and expansion supporting and leveraging the range of remote data feeds and associated data and educational products.

Item	# of Items	Cost Each	Total	UPC Request	CCU Match
Dell Precision 7920 Server Rack	1	$15,044	$15,044	$5,000	$10,044
80-inch TV screen	1	$2,000	$2,000	$2,000	$0
Workstation computers	6	$2,000	$12,000	$12,000	$0
General classroom supplies	N/A	$1,000	$1,000	$1,000	$0
			$30,044	$20,000	$10,044

E. PROJECT MILESTONES

Vendor quotes have already been obtained, which will allow for immediate placement of purchase in late May or early June 2023. This will allow for the project PI, Co-PIs and CCU IT staff to install equipment early in the summer semester while campus activity is at a minimum.

Date	Task
1 Jun 2023	▪ Purchase of the new dedicated weather.ccu.edu server
1 Jul 2023	▪ Delivery and installation of the new server begins
1 August 2023	▪ Providing data to students and community members for years to come