Proposal Title:

Weather Research Laboratory Expansion at ULM

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Project Summary:

This proposal requests the funding to purchase computer workstations to expand the weather research laboratory in the Department of Geosciences at University of Louisiana Monroe (ULM). Currently, we have several workstations that utilize the Weather Event Simulator (WES) software by the National Weather Service (NWS) and GEMPAK/N-AWIPS, McIDAS, and IDV from Unidata for classroom, laboratory experiments, and research. However, many students utilizing one workstation tends to hinder the ability to fully learn and participate in weather analysis. More workstations are needed to ensure the individual student accomplishes the classroom tasks and gains the intended knowledge. This improved weather research laboratory would also serve as a community learning tool. Ideas to reach the community include a website with weather maps and analysis and invitations to local K-12 classes to learn about weather through workshops which would integrate GEMPAK and IDV demonstrations. These workshops are essential in order to introduce the application of math and science in the Lower Mississippi Delta region where historically, math and science education is underprivileged and underfunded on the K-12 level.

Project Description:

The Atmospheric Sciences program at ULM is requesting funds to advance their weather research laboratory. The weather research laboratory (WRL) serves as a gateway learning tool for the undergraduates in the program. It is the integrated technology classroom that introduces students to case-studies and encourages research and exploration of weather phenomenon and analysis. With these characteristics in mind, the project's aims once the new hardware is obtained are threefold:

1. To update curriculum of current Atmospheric classes specifically Kinematics Laboratory, Dynamics Laboratory and Synoptic Meteorology.
2. To design and upkeep a website where the regional community can gain access to weather maps and analysis
3. To design and implement teacher/student outreach workshop which highlight atmospheric sciences and the application of traditional science and math to a broader audience.

Currently, the WRL houses 5 workstations dedicated to weather analysis and case-studies. These workstations have been purchased within the year and are Dell Precision Workstation T7400 nSeries which includes a Quad Core Intel® Xeon® Processor and with over 3 terabytes of data storage. ULM has paired with the National Weather Service at Shreveport and been granted access and use of the Weather Event Simulator software. These workstations also include GEMPAK/N-AWIPS, McIDAS, and IDV from Unidata. These are essential software tools that are utilized daily and illustrate weather, weather analysis, and operational forecasting. Undergraduate students are expected to have a working knowledge of computer applications in meteorology and the software employed provides exemplary and extensive knowledge in this area. The WRL is capable of housing 20 workstations with full internet access and access to the departmental server. It is also a classroom dedicated to the Atmospheric Sciences program and equipped with a screen and projector. Plans to update the classroom to include a SMART board for interactive lecturing and learning are ongoing.

It is worth noting that the Atmospheric Science program at ULM is the only program in the state which offers a degree in atmospheric sciences. It has been recognized as a program of excellence within the state by the Board of Reagents. In fact, designated programs of excellence are defined as flagship programs which build and sustain competitive advantage through statewide collaboration and leadership. The program is small, only 60 undergraduates, and on average, 10 students graduate per year. The University of Louisiana at Monroe is located in the Lower Mississippi Delta region which is historically an economically disadvantaged area. Nevertheless, ULM is committed to serving as a gateway to diverse academic studies for citizens of the Lower Mississippi Delta. Through the continued development of mutually beneficial partnerships involving other universities, governmental, business, and a variety of community-based agencies, ULM has placed priority on research and service in which the post-secondary educational needs of the area's citizens, business and industry are addressed and expanded. ULM's atmospheric science program is striving to provide a quality education which emphasizes current techniques of weather analysis and research.

Aim 1: Curriculum Redesign and Computer Integration

At present the atmospheric students at ULM are using lab manuals with old case studies and dated analysis methods to examine the dynamics of the atmosphere. Computer applications are stressed at every level with instructor demonstrations in lab or lecture. However, typically the students have not been required to use computers until their senior year. As a program, ULM realizes this approach is not effective and has been hard at work to obtain the equipment suitable for current weather research and analysis. Using the Weather Event Simulator (WES), GEMPAK/N-AWIPS and IDV, we are slowly integrating computers and software application into laboratory use beginning on the sophomore level. However, it is difficult for students to have sufficient time for weather analysis with only five dedicated workstations. Meteorology labs that make use of the WRL, in general, require an individual hand-analysis and a group computer project usually involving the GEMPAK software.

With more workstations, instruction can improve for many meteorology courses offered at ULM. Dynamic Meteorology Laboratory I & II will be redesigned to have the students create analysis of different fields to understand the dynamics of synoptic scale systems at all levels of the atmosphere. This is particularly important for the students to relate the information to Quasi-Geostrophic and Baroclinic Instability Theory. It has been observed that students grasp the dynamic concepts readily but sometimes fail to identify the concept when viewing real weather scenarios. The plan for integrating this into dynamics lab is thru GEMPAK/N-AWIPS . As a Unidata user, data comes into our departmental server and current atmospheric conditions can be analyzed and synoptic/dynamic concepts can be emphasized.

Kinematics lecture also needs to be redesigned to include the integration of computers. An example of this would be the instruction of calculating kinematic fields. Examples and homework would be begin by hand, but with an expanded WRL, students can utilize IDV to examine the various wind fields and create (derive) new fields to better understand atmospheric motion like vorticity and divergence. In addition, other case studies can be analyzed using GEMPAK with an emphasis on kinematic motions. Several laboratory exercises can be created to help the student learn the meteorological processes. The aforementioned software tools (large scale flow displays) will enable the students to relate kinematic flows to cyclogenesis, frontolysis and jet dynamics. The fields produced can be fused with satellite and radar imagery in order to view the weather with the changing kinematic fields over time using GEMPAK. Wind profiler

data and 3-D isosurfaces of different fields can be view during lab using IDV. The result will vastly improve the students' perspective and understanding of the many components of the atmosphere system.

The combination of WES, GEMPAK and IDV will enable students to view case studies in 2-D and 3-D perspective for Synoptic I & II. The case studies and associated labs with these software tools will allow the students to view necessary fields (e.g., Isentropes, Isentropic Potential Vorticity[IPV], Moisture Convergence, Theta-e Ridges etc) that produce severe weather events at all scales. The students will write scripts (like in GEMPAK) to produce and diagnose meteorology fields for 8 case studies during each semester. Synoptic scale and mesoscale weather events can be analyze in greater detail to determine cause and effect.

A breakdown of the Synoptic plan includes:

1st semester: 8 cases: 5 related to midlatitude cyclogenesis and frontogenesis and rapidly deepening lows. 2 related to snowstorms over the Midwest and 1 Nor'easter

2nd semester: 8 cases: Examine case studies related to Miller's Convective Outbreak Patterns and identify mesoscale features (stability, moisture convergence, convergence boundaries, outflow patterns) within each case. These meteorological fields will be overlaid on top of satellite imagery and radar displays.

Aim 2: Website Development

The Department of Geosciences maintains their own server and has been hoping to redesign their website. This aim is a perfect opportunity to see the redesign come to fruition. While the website is dedicated to the department, we would like to provide weather data that the regional area can use. This is especially useful for interested students, current students, and anyone in the area with a weather interest. The departmental server provides access to data. By sharing this data with the community by providing weather maps and analysis, the atmospheric science program continues to highlight the designation of excellence within the state of Louisiana. This would also serve as a good teaching tool for webpage development and maintenance in our undergraduate program whereby the students would be encouraged to participate in development and upkeep.

The weather data on our webpage would be of help to K-12 educators. In this region, there are several funded projects on the K-12 level that focus on weather. One particular project is called Project SKY HIGH in the Simsboro High School: Lincoln Parish School District. Project SKY HIGH focuses on the study of the atmosphere for junior high and high school students. Experiments include profiling the boundary layer with rockets. As a supplemental tool, current atmospheric conditions could then be downloaded by Simsboro High School from our site.

Aim 3: Outreach K-12 Workshop

The impact of the proposed aim of developing K-12 workshops is intended to bring atmospheric sciences and the application of traditional science and math to a broader audience. This is important due to the unique weather events, from hurricanes to tornados, experienced in our state. This project is geared towards elementary and secondary education teachers and students

specifically to strengthen math, physical science, chemistry, and physics. The last part of the project will be providing the teachers with new content knowledge combined with pedagogy specifically in meteorology by utilizing IDV.

The workshop will focus on weather events within the Northeast Region of Louisiana. Ideas for case-studies to explore are Hurricane Gustav and several severe thunderstorms within the last 2 years that have struck the region. The workshop will begin with a brief tutorial of the IDV software and its capabilities. Teachers and students would then be directed to the data of the case study and would be encouraged to begin to explore the event using IDV. After sufficient investigation, teachers and students will be asked a series of questions intended to launch the discussion of the controlling factors of the weather event. Attention to basic chemistry, mathematics, and physics would be given when explaining the weather events. By providing new content for the K-12, an enhancement and hopefully a desire to learn about math and science would be initiated. A question and answer session would follow to promote knowledge exploration.

Budget:

Description	*Quantity*	*Unit Cost*	*Total*
Dell Precision Workstation T7400 nSeries (2.66GHz,2X6M L2,1333), Red Hat Enterprise Linux WS v5, 4 GB memory, flat screen monitor, DVD-R			
	5	$3600	$18,000
Total Requested			**$18,000**
ULM Infrastructure Match*	--	---	($15,000)

The infrastructure, in-kind match, includes the existing computer laboratory, the facilities, and the expertise of the ULM Computing Center. Equipment threshold as determined by ULM's federally negotiated Facilities and Administrative Costs is $1000. Therefore, ULM is not claiming any indirect costs associated with this proposal.

Project Milestones:

Since the WRL already exists and there is ample capable to add more workstations, there is no foreseeable project deterrent. In order to fully complete the project successfully, the following is a management and timeline plan. This plan ensures all project aims are met in an orderly fashion.

June 2009: Order computer workstations; start redesign of website.

July 2009: Set-up workstations in weather research laboratory

August -September 2009: Solicit interest from local K-12 schools for Weather Workshops via our School of Education and our Outreach center

Fall Semester 2009: Implement planned curriculum changes in Atmospheric Sciences classes; design teacher/student workshops; have students participate in website maintenance and further development.

October 2009: Offer teacher/student workshops

December 2009: Ensure new website is completely online and functioning.