Proposal Title: Transitioning to the IDV-CAVE: Improving Classroom Technology for Meteorology

Date: 3/4/2014

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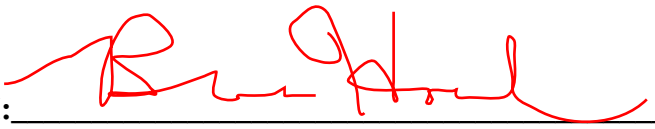
Signature of PI: 

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Project Summary

The Judd Gregg Meteorology Institute (JGMI) at Plymouth State University seeks to provide an enhanced learning environment for our B.S. and M.S. students by upgrading the workstations in our weather lab and providing a dual boot environment allowing students to run meteorological software applications in both Windows 7 and CentOS Linux. The upgrade will provide improved data analysis and visualization for meteorology students utilizing IDV and other software applications as well as introducing the new capability of students being able to run the AWIPS II CAVE clients for the purpose of learning operational forecasting methods and techniques similar to what is/will be in use at NWS offices across the country.

In the event of receiving an award, JGMI would be pleased to host a Unidata Regional Workshop similar to the one hosted in 2008 (see http://vortex.plymouth.edu/workshop/) using the new technology, assuming there is demand from the community with a focus on either IDV or AWIPS II.

Project Description

Equipment requested

Twenty-five Dell Optiplex 9020 MT workstations with nVIDIA GeForce GTX 745 graphics cards capable of dual-monitor visualization would be purchased to facilitate the lab upgrade. The existing dual monitors for each current workstation would be retained, thus providing cost savings by reusing existing display monitors and input peripherals. Each workstation would be configured to dual-boot into either Windows 7 (to allow for usage of existing software such as GR2Analyst and ArcGIS) or CentOS 6 for access to CAVE. Software capable of running in either platform (IDV, Matlab) would be installed on both platforms.

The CentOS/MS-Windows platform is chosen over the Mac platform for several reasons:

- Significant cost savings in comparison to the Mac platform
- Superior compatibility with the AWIPS II client and other Unidata software packages
- Easier integration into existing university domain-based authentication infrastructure
- Compatibility with other scientific software packages for which we have existing site licenses such as GR2Analyst and ArcGIS which are only available under the MS-Windows platform.

Goals of the project

1. Upgraded hardware will provide performance improvements over current infrastructure and will allow for JGMI to remain current with technology for meteorology classes and research, replacing machines which are no longer under warranty and have already been prone to multiple disk failures and memory errors.

2. Currently, IDV enjoys wide ranging use among students and faculty for both classroom activities and research. The software features a dual-window design for both Dashboard

(data selection) and Map Window (data visualization). Our current hardware was purchased with a dual monitor display configuration to take full advantage of the dual window design. However, the current machines have issues displaying IDV due to the use of ATI graphics hardware, with Map Window often times "greying out" and showing maps with spurious lines (see section 5.2 of the IDV FAQ for additional details). This frustrates students & faculty alike, with one user stating "I love IDV for what it can do, I hate IDV for what it does". In attempting to troubleshoot the issue, one IDV/McIDAS-V developer claimed that there were "more issues with ATI cards and Java3D than any other graphics card." The graphics hardware specification for this project (nVIDIA GeForce GTX 745 with native OpenGL) is designed to resolve the issue.

3. Meteorology students should be familiar with the actual tools utilized within NWS. Previously, this meant that students utilized NOAA/ESRL's Fx-net software which simulates the AWIPS I DTD experience. Fx-net is no longer formally supported by NOAA/ESRL. As AWIPS II nears completion of nationwide deployment at WFOs across the country, it is critical that students desiring to work at NWS have the ability to continue to practice with the actual tools they will encounter during their career.

4. In the last few years, great strides by JGMI have been made in developing new real-time products with IDV to replace similar products produced in legacy software packages WXP and Gempak. Some of these were on display at the Unidata booth at the AMS Annual Meeting in Phoenix. The new technology will enable additional development which will benefit web users as well as well as the greater Unidata community.

Benefits to research/education

The workstations will support a multitude of activities to support classroom activities, research, and participation in the Unidata community. Presented is a sampling of courses, research projects and community activities which will be positively impacted with the proposed hardware improvements:

Synoptic Meteorology I/II: Students use the workstations as much as 40 hours a semester during class meetings for exercises in meteorological analysis and forecasting, often in real-time. Students receive an intense introduction to Gempak GUI and IDV programs in Synoptic I. Some routine activities in Synoptic II include using IDV to create cross sections and 3D isosurfaces to investigate the structure of mid-latitude jet streams, downloading gridded analyses for case studies and displaying model fields. Students also use the NOAA/ESRL legacy software package fx-net which simulates the AWIPS I DTD environment. The new hardware will allow exposure and hands-on with the AWIPS II CAVE client and continue existing efforts utilizing IDV.

Computer Applications in Meteorology: This course designed for graduate students serves as an advanced introduction to software applications including IDV, Gempak, LDM, NCL, and Unix/Python programming. Students spend the majority of the class period on laboratory

assignments. It is envisioned that with the new technology, students would gain additional experience in working with the AWIPS II environment and investigating advanced analysis techniques.

Numerical Weather Prediction/Mesoscale Meteorology: Workstations are actively used for evaluating GRIB and netCDF model data via openDAP servers in the analysis of instability, wind shear, and moisture transport with IDV and NCL, including visualization of WRF model output. Additionally, efforts are underway to incorporate GIS technology into the curriculum.

Satellite/Radar Meteorology: These graduate courses make extensive usage of both IDV and McIDAS-X. Students use both packages to retrieve, visualize and probe both WSR-88D radar data and brightness/temperature values in satellite imagery. The new hardware is envisioned to encourage development of automated probe techniques for bulk imagery datasets, allowing new discoveries of remotely sensed meteorological phenomenon.

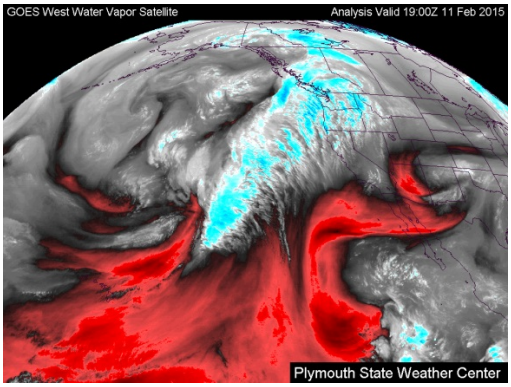
Research Activities: As the only institution in New Hampshire with B.S./M.S degree programs in meteorology, JGMI/Plymouth State University actively participates in wide array of projects investigating various topics of interest to the atmospheric science community. Each project makes extensive usage of workstations for data gathering and analysis. Partners include Mount Washington Observatory, Cold Regions Research and Engineering Lab, Hubbard Brook Experimental Forest, NASA/KSC, and NH EpSCOR . Some recent projects include:

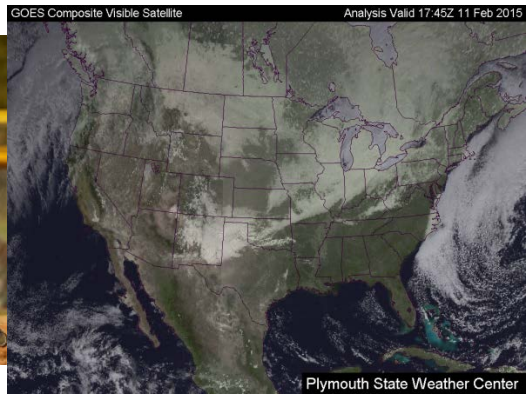
- Coupling Fast All-Season Soil Strength Land Surface Model with WRF to Assess Low-Level Icing in Complex Terrain
- Dual-Polarimetric Radar Characteristics of Convective-Wind Producing Thunderstorms Over Kennedy Space Center
- A Climatological Study of Winds at Mount Washington, New Hampshire
- Testing a Yukon, Canada ice core accumulation rate as a proxy for poleward moisture flux through the Gulf of Alaska
- Characterizing atmospheric conditions that lead to high stream flow events in a Hubbard Brook watershed
- The Influence of Landfalling Atmospheric Rivers on U.S. West Coast Precipitation During February 2014
- Examining in-cloud convective turbulence in relation to total lightning and the 3D wind field of severe thunderstorms

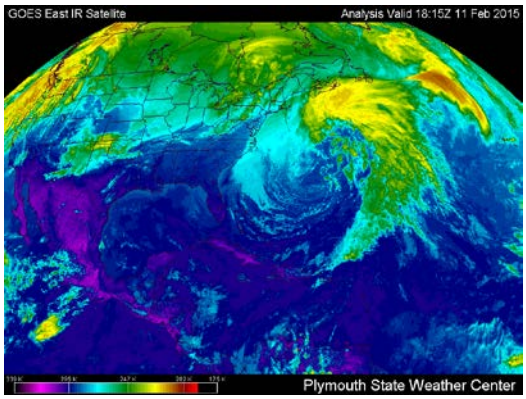
Community Activities: JGMI faculty and students enthusiastically give back to the both the local campus community as well as the national community by creating a variety of products. Two activities are highlighted:

- Since 2014, JGMI students have been involved in providing weather information for the Plymouth State Athletics Department, including meteorological forecasts for practices, hoime/away sporting events, and travel. This provides students with real world experience and increases forecasting abilities while providing a valuable service which might otherwise require additional budgetary resources. The new workstations will allow this activity to continue without interruption.

- In an effort to modernize existing legacy products produced in WXP, one JGMI student utilized IDV to create new versions of satellite and radar imagery. These new IDV products are produced in real-time with the ISL and displayed on several monitors throughout our building as well as on our website. Techniques for producing the imagery have been distributed via the *idv-users* email distribution list with plans to also include on the Unidata RAMADDA server for bundle/ISL script distribution to serve as an example for others. Hardware supplied by the equipment grant will increase these development activities and provide opportunities to explore the transition from real-time legacy Gempak products to AWIPS II.







Relationship to existing facilities & resources

JGMI has been successful at building a robust computational infrastructure by obtaining multiple servers to support classroom, research and community activities. This includes a dedicated NOAAPORT Satellite Receive System which allows for real-time relay of data to the IDD, operational servers to provide mass storage and web access to our long running archive of surface and upper air data, as well as a 72 node WRF cluster with Infiniband network connectivity. Servers are housed in a dedicated room with adequate HVAC and UPS facilities, Internet II connectivity, as well as both disk based and tape backup capabilities for critical datasets.

The challenge our institution currently faces is repopulating our existing classroom workstation cluster to provide the necessary resources for students to access the existing infrastructure. Despite multiple efforts, JGMI has not been successful in obtaining funding for classroom technology. In order to meet a $4.5M budgetary shortfall in the current fiscal year and balance the budget, Plymouth State has made extraordinary across the board cuts in both budget and personnel, severely hampering the institution from keeping the current classroom technology current. The proposed equipment will fulfill classroom hardware requirements for the next 5 years.

Each new workstation would have network access to existing JGMI server infrastructure. Existing hardware is already in place to serve as the proposed EDEX server. The server is currently running Centos 6.6 (64 bit) and features 9 TB of RAID-5 storage, 32 GB memory, and 16 core Intel Xeon 5672 Processor with @ 3.20GHz (12MB cache), which more than satisfies EDEX system requirements. The server is already configured with LDM software and has been ingesting data via our own in-house NOAAPORT system (with redundancy provided to/from the IDD) for several months.

The classroom environment housing the workstations has dedicated power/Ethernet connectivity for each seat. Recently, JGMI added a LCD projector adjacent to the computer cluster area, allowing for improved instruction. Students are able to use computers 24/7 and are encouraged to use empty seats even while classes are in session.

It is intended to reutilize the existing dual monitors for each workstation which will provide cost savings for the project. Existing computers which are being replaced will be transitioned for usage by our graduate students for email/word processing and other areas which require minimal computing power, representing an overall life cycle for each computer of 7-9 years to maximize technology investment.

Budget

	Unit Cost	Quantity	Total
Dell Optiplex 9020 MiniTower PC	$790.32	25	$19,758.00
Intel i5-4590 Quad Core 6 MB 3.3 Ghz			
8 GB 1600 Mhz DDR3 Memory			
500 GB SATA Hard Disk			
nVIDIA GeForce GTX 745 4GB Video Card			
No monitor			
PSU Cost Match (25%)			($4939.50)
TOTAL UNIDATA EQUIPMENT REQUEST			$14,818.50

Institutional contribution to the project will be in the form of project management and total waiver of indirect costs, as well as a 25% match towards the equipment. The JGMI Technology Manager will oversee all aspects of the project, including procurement/vendor negotiations, hardware installation, network configuration, EDEX server and CAVE client software installation and testing. .

Project Milestones

May 2015: Install AWIPS II EDEX Data Server on existing server.

June 2015: Initiate procurement of workstations.

July 2015: Receive, install and configure new workstations for dual boot. Install software applications including CAVE client.

August 2015: Test CAVE client connectivity with EDEX Data Server. Instruct faculty on CAVE usage.

September 2015: Fall semester classes begin

December 2015: Report on equipment usage to Unidata for inclusion in community newsletter