A Proposal to the

Unidata Program Center's Equipment Awards Program

For Support of

Expanding use of real-time and archived weather and climate data and Unidata tools at Colorado State University

Name and address of institution:	Colorado State University Office of Sponsored Programs 2002 Campus Delivery Fort Collins, CO 80523-2002 Phone: 970.491.6355 Fax: 970.491.6147
Institutional Identifiers:	DUNS: 78-597-9618 Cage Code: 4B575 TIN: 846000545
Desired Starting Date:	May 1, 2013
Proposed Duration:	1 year
Amount Requested:	$ 8,862
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Project Summary:

The Colorado State University (CSU) Department of Atmospheric Science currently operates a server that runs the Local Data Manager (LDM), which collects real-time weather observational and forecast data and archives it for a few days. However, the datasets currently obtained by CSU are limited because the current LDM server is relatively old and lacks sufficient disk storage. The current datasets are of limited utility to many in the department due to the department's wide range of research interests and the limited ability of the system to store datasets commonly used. This proposal represents a student-initiated effort to enhance the availability and use of both real-time and archived weather and climate datasets.

The Department of Atmospheric Science recently constructed a new weather lab used in graduate student classes and weekly public weather discussions. This weather lab was largely funded by student fees and completed in the summer of 2012, and currently draws real-time data from the LDM. Replacement of the LDM system, combined with a greater capacity for storing archived data, will facilitate students, faculty, and research staff from both CIRA (Cooperative Institute for Research in the Atmosphere) and CMMAP (Center for Multiscale Modeling of Atmospheric Processes) in research and academic settings, democratizing the access to quintessential resources.

A centrally located and easily accessible repository of essential datasets, from both real-time and archival sources, would benefit the entire department in research and classroom settings alike. Implementation of the Unidata software packages RAMADDA and THREDDS with the new LDM will facilitate broader involvement of CSU in the Unidata community and provide more efficient data accessibility for studies in climate, forecasting, and remote sensing research.

Project Description:

The CSU Department of Atmospheric Science has a long history of research and education in all aspects of the atmospheric sciences. A wide variety of large datasets are used in these research and educational activities, but two issues have arisen in recent years that this new equipment will address. First, there is limited use of real-time weather data (such as that distributed over the IDD) in the department, because of the limited capabilities of the current LDM server. Second, commonly used datasets such as reanalyses (ERA-Interim, NCEP-NCAR, MERRA, JRA) are currently scattered on various research groups' own servers, difficult to locate, and stored in numerous formats and resolutions.

The new server will be configured such that its data storage can be easily mounted to any desktop machine in the department, and thus used as if it were a "local" hard drive. This will enable wider use of real-time data for everyone on the department's network (students, faculty, CMMAP and CIRA employees) and make collaboration between groups simpler. Furthermore, there are real-time datasets that are difficult to obtain after the fact because they are not archived by sources such as NOMADS; these datasets include the Short-Range Ensemble Forecast (SREF) system and the Real-Time Mesoscale Analysis (RTMA), which students and faculty in the department have stated that they would use in their research and classroom activities if they

were archived.

In addition to the expansion of the LDM capabilities with the proposed server, we will also install and begin to use a THREDDS server and the RAMADDA interface. The LDM, THREDDS, and RAMADDA will be configured so that the data stored at CSU can be used by the Unidata community. Furthermore, we will incorporate the output from the CSU local real-time WRF model forecast ensemble into the new server, so that the data can be used by all interested students, faculty, and staff in the department as well as CIRA and CMMAP researchers. The Integrated Data Viewer (IDV) and GEMPAK are installed on the computers in the renovated weather lab, and these will be among the tools used for visualizing and analyzing complex datasets.. The IDV is also gaining use in the classroom through Prof. Russ Schumacher's synoptic and mesoscale meteorology courses, and integrating the data stored locally with the IDV will enhance meteorological education.

The CSU Department of Atmospheric Science is now well-positioned to increase its use of large real-time datasets in classroom activities. The department weather lab was recently renovated to include 8 high-definition monitors and a high-end PC that delivers the content to these monitors. The PC runs Windows natively, but is also configured to run a Linux (Ubuntu) virtual machine whereby other scientific computation and visualization software can be run (e.g., GrADS, GEMPAK, Python, NCL, IDL, etc.) In several courses in the department, including the synoptic and mesoscale meteorology courses, student-led weather discussions are a key component of the course. These discussions encourage students to present to their fellow students and to connect the concepts taught in the classes to ongoing and past weather situations. However, the students currently use primarily web-based tools in these discussions, and are often not interrogating the observational and model forecast data as thoroughly as they could be with greater access to both the data itself and the tools to analyze it easily.

These new capabilities would allow for quick analysis and visualization of a wide variety of datasets that could be used in lab activities within the classes while also permitting more pertinent projects in other courses. Numerous courses emphasize statistical analysis techniques that would be enhanced by the use of real-world data, aiding to blend theory with modeled and observational data that is actually used in research applications. In the synoptic and mesoscale meteorology courses, many of the lab assignments require the students to analyze a particular dataset, primarily from static (hard copy) maps or graphics. Students frequently perform statistical data analysis, initialize models, and make use of various data sources to enforce key concepts in numerous courses. With ready access to the real-time datasets that could be read into any number of software packages, and a local server to conduct some of the data processing, the lab assignments could instead be done with larger, dynamic digital datasets. In all, this will enable more "hands-on" experience and experimentation with different types of data in the classroom.

Benefits to the Research and Academic Community at Colorado State University and Beyond:

The CSU Department of Atmospheric Science is a leading atmospheric science research institution, with 19 faculty and their students performing cutting-edge research in atmospheric chemistry, dynamics, and remote sensing on all scales. The department partners with both the

Cooperative Institute for Research in the Atmosphere (CIRA) and the Center for Multiscale Modeling of Atmospheric Processes (CMMAP), which combined hosts more than 100 research scientists, research associates, postdoctoral fellows, and visiting scientists.

The data server will be accessible by all members of this community and will enhance their ability to integrate multiple streams of data into their research, from satellite and reanalysis products to archived GFS output. A major obstacle to students and scientists beginning their career is downloading data from various agencies, which is both time-consuming and, in the case of high-resolution data sets, storage-prohibitive on personal computers. The server will centralize access to the most commonly used products and give researchers fast, local-network access to the largest data sets.

In particular, the LDM will maintain the most up-to-date real-time weather forecasts and analyses, making them available for use in forecasting courses and in the student-funded weather lab for department weather discussions. These discussions are particularly useful in building a community between the many different disciplines and research foci represented within the department. Further, the LDM will allow students to gain hands-on experience manipulating and processing real-time data with their own diagnostics and tools.

THREDDS and RAMADDA will both be used to provide a user-friendly interface to both internal department users and the broader scientific community and public at large. In converting all hosted reanalysis, satellite, and observational data to one standardized netCDF format, we will exploit RAMADDA's capability to display file metadata for netCDF files, which will streamline searching for and accessing products that would otherwise be stored across agencies in various formats and conventions. Internal department users will be able to upload general circulation and forecast model simulations, processed data, and gridded observational products to provide easy access via THREDDS and RAMADDA to classmates, collaborators, and members of the public.

Proposed equipment:

The equipment proposed here is a part of a suite of new equipment and capabilities that will be installed in the Department of Atmospheric Science in the coming months, using various sources of funds. Here, we propose to the Unidata equipment grant program to support a portion of the disk storage array that will be used to store the real-time and archived datasets mentioned above. Through consultation with Engineering Network Services (ENS) at CSU, we propose to purchase an iSCSI SAN dual disk controller, with 48TB of total storage space. This system has a 5-year hardware warranty. The total cost of this storage system is $17,724, and we are requesting half of that cost **($8,862)** from Unidata. The other half of the cost of the storage system will be supported by funds obtained from the Engineering Student Technology Committee at CSU, representing an effort led by the graduate students in the department. The data storage will be further complemented by a server that has recently been obtained with support from the department, the College of Engineering, and graduate student technology fees, thus forming a full suite of equipment capable of obtaining and archiving real-time data, storing

reanalysis datasets, and serving data to the larger Unidata community. The LDM, THREDDS, and RAMADDA capabilities will be installed on virtual machines on this server, and the entire system will be supported through the existing services provided by ENS at CSU.

Project Milestones:

The system will be purchased and installed early in the summer of 2013, such that it will be ready for use in classroom activities by the fall semester of 2013.

Personnel:

Prof. Russ Schumacher (PI) joined the faculty at CSU in 2011, and has extensive experience using large weather and climate datasets in research and education. He has spearheaded an effort to enhance the use of real-time weather data in educational and research activities, and this effort included a renovation of the department's weather center and the initiation of department-wide, student-led weather discussions in 2012. Dr. Schumacher began serving on the Unidata Users' Committee in 2012 and thus has knowledge of many of the capabilities of Unidata tools and services.

Nick Davis, David Duncan, and Adam Rydbeck are graduate student representatives in the department who have been the student leaders in the effort to enhance the use and availability of large, commonly used datasets. They will provide feedback and be involved in the process of evaluating and testing the new system to ensure that it meets the needs of the graduate student body.

CJ Keist, Systems Group Manager, CSU ENS, will lead the effort to purchase and install the new system using the diverse sources of funds mentioned above. He will work with Prof. Schumacher to enable the Unidata services on the system.

Budget:

$ 8,862 Total requested amount. This is one half of the cost of the quoted system.

The other half of the cost of the storage system will be supported by funds obtained from the Engineering Student Technology Committee at CSU.

No indirect costs are incurred in this budget. CSU calculates indirect costs on total costs minus tuition and equipment. Therefore, this proposal budget is exempt from indirect cost.

IoDynamix

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FEIN: 84-1337807
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Cybernetics iSAN-1216 Quote

Terms - Net/30

Quote #	CSU-iSAN1216
Date	3/13/2013
Sales Contact	Eileen McKaig
Phone	800-661-9650
E-mail	eileen@iodynamix.com

Customer

Colorado State University - College of Engineering
CJ Keist email:cj.keist@colostate.edu
Systems Group Manager
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Qty	Part#	Description	List	Ext. List Price	EDU Price	Ext. EDU Price
1	iSAN-1216	iSCSI SAN, dual hot-swappable controllers, 4GB cache per controller; four GbE ports (2 per controller); USB ports; dual hot-swappable power supplies, rack mount kit; SANDR mgmt suite: snapshots w/deduplication (256 per LUN), unlimited LUNs w/dynamic expansion, support for site-to-site replication, SNMP alerts, removable disk & tape backup features. 2 yr warranty w/Express Depot service. 16 3.5" Bays, 3U	$9,995.00	$2,995.00	$7,475.00	$7,475.00
16	RDI-SATA-3T	3TB SATA, 7.2K, 3.5" with Interposer board	$548.00	$5,990.00	$492.00	$7,872.00
3	Warranty	Annual warranty w/Express Depot service for years 3 - 5	$775.00	$2,325.00	$698.00	$2,094.00
1	Shipping	FedEx 2 Day Air Service to ZIP Code 80523	$283.00	$283.00	$283.00	$283.00
		Grand Total:		$18,983.00		**$17,724.00**