Proposal Title

Millersville University Content Repository for Boundary Layer, Ocean Science, and Cyber-education Initiatives

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Requested Amount: $17,142

Project Summary

This project will upgrade the LDM server and establish THREDDS, RAMADDA, and ADDE servers at Millersville University (MU) to benefit research and education across the Unidata community. We envision establishing a content repository for three primary thematic areas: 1) boundary layers and air quality; 2) coastal ocean and Chesapeake Bay studies; and 3) cyber-education initiatives, and we would actively engage a larger community of contributors and users involved in similar or related activities to participate in populating the repository with content in these areas. Such capability will allow ready access to observations/content collected or developed by MU researchers and educators, including those from activities at the Wallops Island Marine Science Consortium, as well as content in these and related thematic areas from other community contributors. The servers would make available to researchers and educators content from a variety of sources. Such content would include information packages containing observational data, imagery, model output, visualizations, scientific articles, and the like. Data and instructional resources such as the recent developments at MU in 3-D immersion world applications (e.g. Geopod) and geophysical fluid rotating tank experiments (e.g. Weather in a tank), and other cyber-education initiatives contributed from the community would also reside on the servers. With the plethora of new data and products soon to come online from next-generation satellite systems, profiling networks, dual-polarization radar, NOAA climate services and the Ocean Observing Initiative to name a few, these servers can help address the greater demands for throughput, archiving, and dissemination to the broader user community.

Project Description

Millersville University (MU) proposes the establishment of a THREDDS/RAMADDA server to function as a content repository for three major trans-disciplinary areas in which we have a high level of expertise and involvement: 1) boundary layers and air quality; 2) coastal ocean and Chesapeake Bay studies; and 3) cyber-education initiatives. There is a paucity of contributions in the current RAMADDA collection in these areas, and we believe that these can be significantly expanded and extended by leveraging our own efforts and facilities to populate the repository, and thereby stimulate contributions in similar and related thematic areas from across the community. Using MU's significant boundary layer/air quality observational facilities, in-situ measurements of the coastal ocean and Chesapeake Bay, 3-D immersion world virtual application (Geopod) currently in development, and geophysical fluid experiments will allow the creation of a broad range of transdisciplinary resources that will be accessible by the community via the requested THREDDS/RAMADDA server. We envision a deep, rich, and full content repository that will be readily available to all users, and serve as the focal point for educators and researchers in these thematic areas.

The RAMADDA content repository currently lacks case studies that incorporate measurements of the atmospheric boundary layer and surface chemistry. Millersville has been employing surface, balloon-borne, and remote sensing instruments to measure

boundary layer thermodynamic and kinematic properties for many years. Surface fluxes and wind and virtual temperature profiles are obtained continuously from our flux tower and acoustic sodar with RASS (radio acoustic sounding system), while tethered balloon, trace gas, and recently added Rawinsonde measurements complement these measurements during specific intensive operational periods. These measurements are integrated with data and model output distributed via the LDM/IDD, and the output from our in-house WRF and WRF-CHEM models, to construct comprehensive case studies of atmospheric phenomena. We believe these case studies could serve as a valuable educational resource for faculty and students studying the boundary layer, air quality, and their complex relationships. We have well-established partnerships with regional facilities whose data can be integrated into case studies. The data would be available to any researcher interested in boundary layer phenomena.

Millersville is also involved in an NSF-funded project (NSF-IIS) to develop a 3-D immersion virtual world environment that can be used as an open source plug-in with IDV (Geopod). We believe that instantiations of this effort could be readily available to a large community of potential users through the IDV Community Resources link on a RAMADDA server. The Geopod team is working toward the goal of providing self-guided missions on topics of interest to geosciences educators (e.g. exploring fronts, jet streams, air masses, etc). These missions, which can be envisioned as interactive, self-navigated, virtual excursions inside a data volume rendered in IDV, would be freely available on the RAMADDA server and downloadable into IDV. Moreover, each mission will include built-in instructional methodologies that have undergone formative and summative assessment. The Geopod project will allow multiple simultaneous users to navigate through a 3-D visualization of model fields rendered in IDV and actuate virtual devices (e.g. virtual dropsonde, virtual particle imager) while being guided by a mission that contains targeted goals and learning outcomes.

In addition to virtual applications, we routinely use our two rotating tanks to demonstrate 3-D geophysical fluid circulations as part of laboratory exercises in meteorology and ocean science course (http://www-paoc.mit.edu/labguide/index.html). These experiments, including particle tracking, can be saved in digital format and uploaded to the RAMADDA server for access by the community as course supplements. We have found these to be great instructional aids in dealing with complex topics, and we already have an interested, albeit small, community of adopters (e.g. SUNY Oswego synoptic students visited MU for a day of “Weather in a Tank” experiments).

Finally, Millersville is an affiliate partner in the Ocean Observing Initiative and a senior stakeholder in the Marine Science Consortium (MSC) at Wallops Island. Using our research vessel outfitted with a CTD profiler and numerous other instruments, we can populate the RAMADDA server with content focusing on the coastal ocean and the Chesapeake Bay. There is an important climate connection to the studies conducted at the MSC. The coastal ocean in the mid-Atlantic region is extremely vulnerable to sea level rise. Millersville is about to begin a project funded through NASA to survey the coastline as ground-truth for NASA airborne Lidar measurements. These collections of

data, metadata, imagery, and GIS files can be available to the community via the THREDDS/RAMADDA server.

Proposed Equipment

The equipment requested is as follows:

- Dell PowerEdge R510 server with dual Intel Xeon E5520 2.26GHz processors
- 24GB RAM
- Ten 1 TByte hard drives
- Single 12 TByte network area storage device

The requested equipment will allow the establishment of a THREDDS and RAMADDA server as a content repository at Millersville University in thematic areas, and significantly upgrade the LDM server. This proposal uses existing Unidata software applications (THREDDS, RAMADDA, and IDV), and will benefit a broad range of users from research, education, and operational meteorology communities in the manner described below.

A new LDM will increase our capacity and allow for the storage of larger quantities of data that can then be used for case studies and other research endeavors, as well as for educational and operational uses. The locally generated data, products, and instructional supplements from Millersville University would be leveraged to build content for the repository, and serve as stimulus for engaging the community to contribute additional resources. These include, but are not limited to:

1) Millersville University's locally generated operational, regional WRF model output. This model is run twice a day over a domain encompassing the Eastern two-thirds of the continental United States. The model currently runs 72-hour operational simulations at a grid spacing of 25 km, and 4 km simulations for research. The model output is currently made available to users via a web page providing graphical fields that are created in-house and then published on the web (http://www.atmos.millersville.edu/~wrf/). The WRF model is used by numerous individuals and organizations outside the university, including the Pennsylvania Department of Transportation; the local hot-air ballooning community; television station WVVA in Bluefield, West Virginia; and Weather Trends International, Inc. If a THREDDS and RAMADDA server is established at MU then in addition to autogenerated products, the gridded fields could be made available to others in netCDF format for more in-depth analysis and use in research, operations, and education. Users could then create their own, tailor-made graphics from the gridded data fields. This model output would play a central role in developing case studies using the boundary layer observations taken at MU.

2) Millersville University has recently acquired a Vaisala Rawinsonde MW31 system that is being used for research and educational purposes. The Rawinsonde

profiles are being used as a supplement for classroom instruction, as well as to build case studies during interesting weather events. These data will be made available to the user community via the THREDDS and RAMADDA server.

3) An acoustic sodar with RASS extension is installed at a local off-campus site and is providing real-time boundary layer wind and virtual temperature profiles to 500 meters on a continual basis. The measurements from this instrument will be made available via the new servers.

4) Data from MU's weather station instrumentation and flux tower may also be useful to users outside of the University, and would be made available via the servers.

In addition to the locally-generated data listed above, MU will increase the data products made available to other, downstream IDD nodes.

Complementing atmospheric observations, Millersville has an active Ocean Sciences and Coastal Studies program and is a senior partner in the Marine Science Consortium (MSC) at Wallops Island (MU President McNairy serves as Chair of the Board of Directors of the MSC). Faculty and students at MU have ongoing research programs at the MSC with an emphasis on coastal studies – shore to continental shelf, and the environmentally sensitive Chesapeake Bay region. Our involvement in the MSC ranges from education – teaching Field Methods in Oceanography, Biogeochemical Oceanography, and Coastal Environmental Oceanography, to research such as mapping the coastal zone, cross-sectioning the ocean surface layer using CTD profilers onboard our research vessel, R. V. Parker, and remote sensing studies with scientists at the NASA Wallops Island Flight Facility.

Millersville will also leverage the efforts from two NSF grants, GeoPOD: Geosciences Probe of Discovery and WEATHER IN A TANK: Exploiting Laboratory Experiments in the Teaching of Meteorology, Oceanography and Climate[1]. Both projects focus on unique approaches to learning: Geopod by using a 3-D virtual environment immersed in IDV-rendered numerical model fields, and Weather in a Tank through the use of a rotating tank to simulate geophysical fluid circulations. Capabilities stemming from these efforts will add a new a different dimension to the RAMADDA content repository over that which currently exists.

Personnel

PI DeCaria brings expertise in project management, numerical modeling, and has training that bridges the disciplines of meteorology and ocean sciences. He will be responsible for meeting the benchmarks in the timeline, engaging the community and building participation, and reporting. The co-PI Fitzgerald brings a high level of technical expertise to the project, not only in his role as a distributed systems specialist, but through his direct involvement in Linked Environments for Atmospheric Discovery

(LEAD), WRF, IDV, and as a contributing member of the Unidata community. In addition, both the project PI and co-PI are experienced with set up and use of WRF, having both contributed to the installation and implementation of the WRF at Millersville University.

Millersville University has a long history of active participation in Unidata's community-based support efforts. The faculty and staff of the Department of Earth Sciences are active users and promoters of Unidata technology and capabilities. Faculty have served the community as members of the Users and Policy Committees, IDV Steering Committee, and have participated and presented at Unidata workshops and offered a regional IDV workshop. Hosting a THREDDS/OpenDAP server will only enhance that participation, as well as expand upon Millersville University's ability to contribute to the community via the IDD and the RAMADDA repository.

The equipment requested in this proposal will also enhance the educational opportunities for our undergraduate students. There are currently three research projects ongoing at MU that make extensive use of data from the local WRF as well as data from the LDM feed. Establishment of a THREDDS and RAMADDA server at MU would allow easier access to these data by both the undergraduate student researchers at MU, but by researchers and operational users elsewhere.

Budget

An itemized list of the equipment that will be purchased through this Unidata grant follows below. The cost estimates are directly from the vendor and include the educational discount.

Equipment for THREDDS/RAMADDA/OpenDAP server.

- Dell PowerEdge R510 server with dual Intel Xeon E5520 2.26GHz processors
  - 24GB RAM
  - Ten 1 TByte hard drives
  - Redundant Power Supply

- Dell PowerVault NX3000 with Intel Xeon L5520 processor
  - Six 2 TByte hard drives in a Raid-5 configuration.
  - Redundant Power Suppley

Total cost: $17, 142

Project Milestones

We expect to purchase the equipment within one month of award. A specific Plan of Action and Milestones is:

- May 2010 – Notification of award.
- June 2010 – Acquire and install equipment.
- July 2010 – Set up and configure THREDDS, RAMADDA, LDM server.
- August 2010 – Server online and operational.
- August 2010 – Begin to populate the server with content generated at MU in the three thematic areas.
- September 2010 – Initiate community-building process by soliciting participation from the community in thematic and related areas.

[1] *Bulletin of the American Meteorological Society, Nov 2009 by Illari, L, Marshall, J, Bannon, P, Botella, J, Clark, R, Haine, T, Kumar, A, Lee, S, Mackin, K J, McKinley, G A, Morgan, M, Najjar, R, Sikora, T, Tandon, A*