2006 Unidata Community Equipment Award
Final Report

WAHTER: Integrating meteorology data in hydrology research and education and expanding the University of Nebraska's IDD capabilities

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1. INTRODUCTION

The University of Nebraska-Lincoln (UNL) recently embarked on a campus-wide effort to enhance water-related research and education. The Water Resources Research Initiative (WRRI) involves more than 75 faculty in a wide range of fields and aims to "promote greater collaboration among research faculty in UNL water science disciplines of great strength such as groundwater hydrology, water quality, climate change, irrigation, remote sensing and geographical information systems". Owing to the obvious and reciprocal importance of hydrology in meteorology and geology, the Geosciences department has assumed an active role in the WRRI. Three new faculty with expertise in hydrology have recently been added to the Department of Geosciences as part of WRRI (including one of the co-PIs, E. Istanbulluoglu). Their use of meteorological data in hydrological research (especially hydrological modeling) means that they are positioned to take advantage of Unidata resources and to contribute to the Unidata community.

The Meteorology-Climatology Program within the Department of Geosciences at UNL has been involved with Unidata almost since its inception. The program is a Tier-2 IDD relay site, has maintained an ADDE server for McIDAS data, and one of the co-PIs (C. Rowe) has served on the Unidata User's committee. Prior to receiving the Unidata Community Equipment Award, data ingest was controlled by a 10-year old Sun Enterprise 450 that, along with its duties as an IDD relay, also acted as a real-time weather chart and image processor, departmental file server, and web server. To serve the research and pedagogical requirements for hydrology and meteorology faculty and students, this system needed to be upgraded.

2. PROJECT OBJECTIVES

To enable the integration of meteorology data in research and education and the expansion of the UNL's IDD capabilities we proposed WAHTER (**W**eather **a**nd **H**ydrology **T**raining **E**ducation and **R**esearch). The primary objective of WAHTER was to facilitate the use of meteorological data in distributed hydrology models used for research, engineering, and education. Processed and value-added meteorological data could then be injected into the IDD stream for access by member institutions.

The second objective of WAHTER was to develop a two-tiered archive of meteorological data for research and pedagogical applications at UNL and elsewhere within the Unidata community. The first archive level (tier-1) would be a 30-day archive of the full data suite within the IDD stream. The second tier of the WAHTER archive would be composed of meteorologically and/or hydrologically important cases pulled from the tier-1 archive and stored on removable media.

3. EQUIPMENT PURCHASED

a. Supplemental funding

The Department of Geosciences contributed $2,675 to supplement the equipment award. This money was earmarked for a Linux-based workstation that would house the removable media drive and act as a portal to the tier-I archive for purposes of building the tier-II archive. The Water Resources Research Initiative contributed $5,000 to enable the piggy-backing of more disk space onto the servers purchased with the award.

b. Equipment and implementation

Two Dell PowerEdge 2950 servers were purchased. Both have been configured with Linux OS (Fedora Core 6). The first, designated "IDD", has been tasked with LDM duties. IDD is driven by 2-3.73 GHz dual-core processors and has 16 GB of dual-ranked memory and 2-36GB 15K RPM hard drives (four hard drive slots remain open on this machine, allowing for modest growth). The two hard drives are configured with software RAID-1 (mirroring) for fault tolerance. The second server, designated "Meteo" has been tasked with file and web serving. It is driven by 2-3.2 GHz dual-core processors and contains 4 GB of dual-ranked memory and 6-300 GB 10K RPM hard drives. The OS hard drive is mirrored with RAID-1 while the four remaining hard drive are configured with RAID-5 (striped with distributed parity; allows for a single disk failure before data are lost). These 4 drives will house the home directories of all departmental users along with all web page files and databases.

Along with the two servers, two Dell PowerVault disk arrays were purchased. Each disk array contains 15-500 GB drives configured with software RAID-6 (striped with dual distributed parity; two concurrent disk failures must occur before data are lost).

One of these arrays is reserved for departmental research data. The other is reserved for the two-tiered archives. At ~6 Tb each (maximum disk space is reduced due to RAIDing), these disk arrays will be more than sufficient to meet the research and pedagogical objectives of our proposal as well as the near-term needs of the department.

The servers and disk arrays are housed at the Walter Scott Engineering Center computer room run by UNL Information Services. This is a climate controlled room with free rack space, uninterrupted power, and is staffed 24 hours, 7 days a week.

The Unidata Community Equipment Award and supplemental funding also enabled the purchase of a Dell Precision 690n workstation running Fedora Core 6 along with a Quantum DLT-V4 tape drive. This workstation was designed to act as a portal to the tier-I archive and with the tape drive enable the development of the tier-II archive (case studies on removable media). Each tape is capable of storing 320 GB of compressed data.

c. Lessons learned

We have found that some hardware errors on the servers are not easily diagnosed remotely. Recently, a memory chip failure showed up on the LED display of Meteo. However, since the equipment is housed across campus and since Dell's primary suite of diagnostic tools (OpenManage) is designed for Windows, it was nearly impossible to identify the errors remotely. The solution was the Dell Remote Access Controller 5 (DRAC-5). The DRAC-5 is a daughter card connected to the server motherboard but runs autonomously from the server and has its own network connection. Thus diagnostics can still be performed even after server failure, power outage, or loss of network connection. The DRAC-5 includes its own web-based GUI for monitoring the server and does not rely on OpenManage.

4. SERVICES TO THE UNIDATA COMMUNITY

a. Real-time land surface model

Land surface states are required by distributed and physics-based hydrology models used for research and educational purposes as well as for real-time flood forecasting. Thus, a real-time land surface model (LSM) holds the potential to directly

benefit both research and education. Work is currently underway to implement a real-time LSM using the hardware purchased through the Unidata Community Equipment Award. This model will utilize hydrometeorological data within the IDD stream and will be supplemented by pseudo-real-time Normalized Difference Vegetation Index (NDVI) data collected by the Moderate Resolution Imaging Spectroradiometer (MODIS) on board the Aqua and Terra satellites. Output from this model will then be injected into the IDD stream for access by member institutions. A graduate student in the UNL Meteorology/Climatology program will be tasked with implementing and maintaining this model and we hope to have it operational by next summer.

b. Two-tiered archive

The hardware purchased through the Unidata Community Equipment Award has enabled the development of a 30-day archive of the complete suite of data within the IDD stream. This includes the CONDUIT and NEXRAD2 streams. Web-based access is now available at wxarchive.unl.edu. The interface to the data is currently a simple directory listing but a more user-friendly and versatile interface will be in place within the next ~6 months. This new interface will be developed collaboratively by an undergraduate computer engineering student currently employed by the UNL Research Computing Facility and the Department of Geosciences and a graduate student in the Meteorology/Climatology program. It will utilize PHP and the strategy for data delivery will resemble that used by the UCAR/JOSS Interactive Data Catalog. The hardware necessary to construct an archive of meteorologically and/or hydrologically important cases (the tier-II archive) is now in place.