Unidata 2013:
A Transformative Community Facility for the Atmospheric and Related Sciences

Annual Report for Award No. 0833450
for period 12/1/2011-11/30/2012

November 2012

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1   Introduction

The past year was another highly successful year for the Unidata Program. Unidata not only continues to fulfill its core mission to provide data, tools, and support for the atmospheric science and related communities, but also continues to develop and enhance its tools and capabilities and provide leadership in cyberinfrastructure to serve an ever-broadening community of users. The Unidata Program's rich portfolio includes:

- Acquiring and distributing real-time meteorological data for education, research, and outreach
- Developing software for accessing, managing, analyzing, visualizing, and effectively using geosciences data
- Providing comprehensive training and support to users of its products and services
- Facilitating advancement of standards, conventions, and interoperability
- Providing leadership in cyberinfrastructure and fosters adoption of new technologies
- Assessing and responding to community needs, fostering community interaction and engagement to promote sharing of data, tools, and ideas
- Advocating on behalf of the university community on data issues and negotiates data agreements
- Granting equipment awards to universities to enable and enhance participation in Unidata

During the past year, there were many notable activities and accomplishments that had a positive impact on the community across the breadth of the program, a few of which are highlighted in this report.

Development of a new strategic plan:

Guided by the evolving needs of the geosciences community and grounded by the program's core, the Unidata program developed a new strategic plan, "*Unidata 2020: Geoscience at the Speed of Thought*" in January 2012.

The new strategic plan outlines some of the broad issues faced by community members in their conduct of data-centered Earth System science, and lays out a flexible blueprint for action for the Unidata Program Center staff. The new plan was developed over several months in 2011 through meetings between Program Center staff and members of the Users and Policy committees. The following paragraphs, from the section titled "Our Vision for the Future," capture the core problem of ever expanding data volumes and "data friction," along with our approach to providing solutions:

Unidata's Strategic Plan was developed with the guidance of our governing committees.

> *Unidata and its community operate in an environment of rapid technological change and evolving scientific priorities. Sources of geoscience data are multiplying and data volumes are expanding, straining traditional data*

management techniques. Where in Unidata's early days our community was primarily concerned with university access to specific, well-defined weather-related data sets, today's Earth System scientists want the ability to expediently access and integrate any multidisciplinary data set — anywhere, at any time — that advances their scientific or educational goals.

Researchers and educators are looking to Unidata for help with all aspects of the scientific data lifecycle, from locating useful data to retrieving full or partial datasets, through the process of visualizing data locally or remotely, to managing and sharing their results. Working together with our community, we hope to create an environment in which scientists expend less effort locating, acquiring, and processing data and more time interpreting their data. Unidata envisions sustaining and enhancing a community that capitalizes on new technology and concepts to advance the understanding of the complexities of the Earth System and provide community leadership in advancing research and education in the geosciences.

The goal of enabling "*Geoscience at the Speed of Thought*" reflects the Unidata community's desire — and the Unidata Program Center staff's hope — to reduce the burden of acquiring and appropriately formatting geoscience data, leaving researchers and teachers more time and resources for analysis, interpretation, and education. To that end, the new plan presents the following mission and vision for Unidata's future, along with articulating goals in four thematic areas that included twenty sub-goals of detailed plans.

Unidata's Mission:

To transform the geosciences community, research, and education by providing innovative data services and tools.

Unidata's Strategic Vision:

Geoscience at the speed of thought through accelerated data discovery, access, analysis, and visualization

It is worth adding that the vision and goals outlined in Unidata's plan are congruent with the National Science Foundation's strategic plans and they also align well with the overarching goals of NSF's EarthCube initiative.

The strategic plan in its entirety is available at:
http://www.unidata.ucar.edu/publications/2012stratplan/Strategic_plan.pdf.

The Program Center staff is currently working to translate the goals set forth in the strategic plan into specific projects and actions.

2   Data Services

2.1   Real-Time Data Distribution

The bread and butter of Unidata's mission is helping researchers and educators acquire and use real-time meteorological data. Unidata is not a data archive center, but rather a facilitator; by participating in Unidata's Internet Data Distribution (IDD) system, educators and researchers can subscribe to one or more of the 30 streams of current data that interest them. The IDD system comprises over 500 machines at 250+ sites running Unidata's Local Data Manager (LDM) software to receive (and in many cases retransmit) real-time weather data.

On average, the IDD system ingests about 250,000 products (7 Gigabytes) each hour, with peak volumes approaching 15 Gigabytes per hour. Computers operated by the Unidata Program Center push in excess of 6 Terabytes of data to more than 650 downstream systems on an average day, making Unidata one of the largest users of both the UCAR/NCAR and Internet 2 networks.

(Note that there are several organizations and projects using the LDM to move substantial amounts of data without reporting statistics to Unidata.)
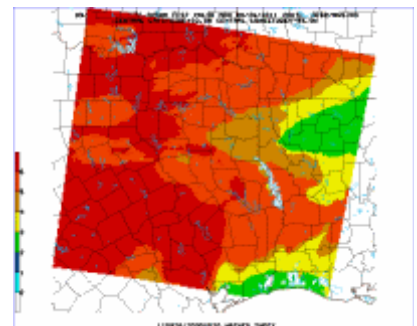
In addition to real-time data distribution, Unidata provides mechanisms for accessing some archived data sets and case studies. Some Unidata member sites also archive our data streams in raw, encoded form.

2.2   New Data Stream: Fire Weather Model Output in CONDUIT

The National Centers for Environmental Prediction have begun providing *Fire Weather* output from selected areas of the North American Mesoscale (NAM) model via Unidata's CONDUIT feed. The additional data were added into the CONDUIT feed on September 20, 2011.

Fire Weather Incident meteorologist Support (FWIS) model runs are high resolution innermost "nests" of NCEP's parallel NAM12 model. (*Nests* are relatively small geographic areas inside the model run area that are selected for higher-resolution modeling.) Nests located in the CONUS have a 1.33 km horizontal spacing and use a 375x375x60 grid. Nests located in Alaska have a 1.5 km horizontal spacing and use a 333x333x60 grid. The fire weather forecasts extend out for 36 hours.

NCEP's Fire Weather model data include calculation of the Haines index for the covered areas.

Rebecca Cosgrove, who represents the National Weather Service and NCEP on the Unidata Users Committee, noted that the fire weather data are currently experimental products, and "there is always the possibility that a cycle could be cancelled if there are other production issues." Fire weather model runs were fully integrated into the NAM output in October 2011.

As a result of the addition of the fire weather data, the volume of data moved through CONDUIT has increased by an average of 800 Mbytes/hour. As shown in the image at right, NCEP scheduled the insertion of the new data to occur during a time of relatively low data volume. No problems handling the additional data have been reported by IDD top-level relay sites.

3   Software Tools and Support

3.1   Enhancements to Existing Products

UPC developers are continually enhancing Unidata software packages. The following updates were released in the past year:

- GEMPAK: Versions 6.6.0 and 6.7.0

- IDV: Versions 3.0u1, 3.0u2, and 3.1

- LDM: Version 6.11.0

- NetCDF: Versions 4.2, 4.2.1, and 4.2.1.1

- NetCDF-Java: Version 4.2.32

- RAMADDA: Became an Open Source project in December 2010

- THREDDS Data Server: Version 4.2.10

- UDUNITS: No updates

Ongoing enhancements to Unidata software packages provide new functionalities and capabilities for accessing, analyzing and visualizing new types of data that the UPC routinely makes available for use by the education and research community.

3.2   Migration from GEMPAK to AWIPS II

As noted in previous reports, the National Weather Service's National Center for Environmental Prediction (NCEP) is developing the next generation Advanced Weather Interactive Processing System, AWIPS II. Scheduled for completion in FY 2013, AWIPS II will integrate the functionality of existing N-AWIPS software (also known as GEMPAK).

As development of AWIPS II has progressed, NCEP's ideas about the future of GEMPAK have evolved. In the early stages of the project, AWIPS II was thought of as a replacement for the older GEMPAK programs, and NCEP planned to discontinue development of GEMPAK entirely when AWIPS II was fully deployed. Current plans call for continued NCEP support of the GEMPAK command-line programs, with the AWIPS II Common AWIPS Visualization Environment (CAVE) eventually taking the place of the current graphical interfaces to the GEMPAK programs.

Because many Unidata member universities rely heavily on GEMPAK, the UPC has been working with the N-AWIPS and AWIPS II developers at NCEP and NWS on strategies to smooth the transition from GEMPAK to other software packages. The change in NCEP's

planning regarding continued support of GEMPAK gives Unidata community members the option to delay their transition to AWIPS II if they desire, as the UPC wil continue to support GEMPAK as well. Still, the UPC will continue working with the AWIPS II developers, with the goal of being able to provide the university community with an AWIPS II package suitable for non-operational environments soon after NWS and NCEP adoption of the package.

In the past year, UPC developers have taken several steps toward the goal of making the AWIPS II package available to the university community, including:
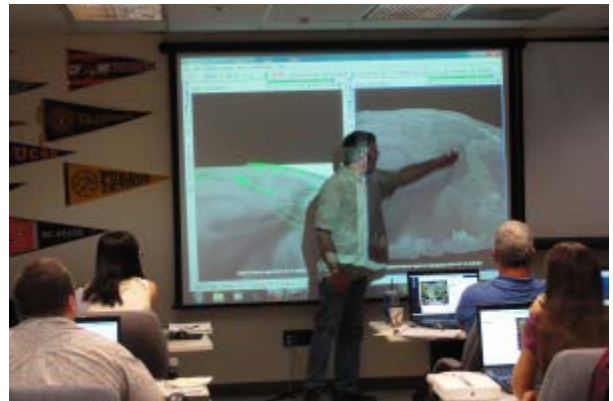
- Regular evaluation of AWIPS II code releases,

- Participation in development efforts,

- Introduction of a Unidata-sponsored beta-testing program for the AWIPS II Environmental Data Exchange (EDEX) at four university sites,

- Efforts to determine appropriate minimum hardware requirements for non-operational (that is, university) AWIPS II sites.

Additional information, including previous announcements and FAQ on GEMPAK migration, is available at: http://www.unidata.ucar.edu/software/awips2/

3.3 Software Training Workshops

Each year, the Unidata Program Center organizes training workshops, conducted by UPC software developers, on its software and data systems. The workshop topics include Unidata's display and analysis packages GEMPAK and the IDV, as well as data access and management tools, the Local Data Manager (LDM), the Network Common Data Form (netCDF), RAMADDA, and THREDDS software for cataloging, browsing, and accessing remote data and metadata.

Training workshops introduce participants to the wide range of Unidata software.

The 2012 training workshops, which were a tremendous success, were attended by 58 participants from 11 countries. The attendees represented a wide range of organizations, including universities, government agencies, research organizations, and the private sector.

4   Cyberinfrastructure Standards

4.1   OGC Adopts netCDF Enhanced Data Model Extension Standard

Following on the heels of the 2011 adoption by the Open Geospatial Consortium (OGC) membership of the Network Common Data Form (netCDF) Core Encoding and Binary Encoding Standards, in September 2012 the OGC has approved the Enhanced Data Model Extension to the netCDF Core Encoding Standard.

The netCDF enhanced data model was introduced as part of netCDF-4 in 2008. The enhanced data model added support for per-variable compression, multiple unlimited dimensions, more complex data types, and better performance by layering an enhanced netCDF access interface on top of the HDF5 format.

UCAR/Unidata and other OGC members originally introduced netCDF into the OGC as a candidate OGC standard to encourage broader international use and greater interoperability among clients and servers interchanging data in binary form. Among other benefits, this will make the large collections of environmental netCDF data more readily accessible and usable by non-experts. In addition to their ongoing development of netCDF itself, Unidata Program Center staff have been working with the OGC to provide the formal specifications necessary for netCDF's adoption as an OGC standard.

5 Building Community

5.1 2012 Users Workshop Brings Unidata Community Together

Every three years, the Unidata Users Committee works with the Unidata Program Center staff to organize a community workshop, supported by the NSF, with the goal of bringing the Unidata community together to share ideas about teaching and doing science. The 2012 Unidata Users Workshop took place July 9-13 at NCAR's Mesa Laboratory in Boulder, Colorado. The workshop's theme — Navigating Earth System Science Data — encompassed topics that drew speakers and participants from across the atmospheric and other geosciences communities.

2012 Unidata Users Workshop.

Twenty-six presenters from the Unidata community shared their insights on doing science in an environment of expanding data availability with the nearly 100 workshop attendees. The talks ranged from high-level descriptions of big initiatives like the National Science Foundation's Earth Cube, Global modeling at NOAA, and the joint NOAA-NASA GOES-R satellite program to hands-on demonstrations of data analysis tools including python, GrADS, Unidata's Integrated Data Viewer, and the still-in-development AWIPS-II system.
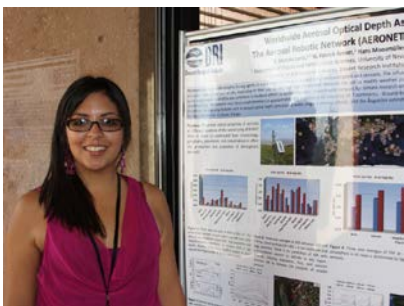
Student presenter Marcela Loria.

In addition to the daily talks, ten student attendees (along with one professor and several Unidata Program Center developers) made presentations during the workshop poster session. As one poster session attendee commented, "I really enjoyed hearing about different students' research and each student was great at explaining their project and answering questions."

5.2 2012 Community Equipment Awards

The Unidata Community Equipment Awards program funds new geoscience departments to join the Unidata community and to allow existing members to continue and enhance their participation. It is often regarded by the community as one of the best mechanisms for Unidata to promote diversity, as past awards tend to favor small institutions. Each year, the UPC sets aside $100K to fund the Unidata Community Equipment Awards program.

Since the UPC took over the program from NSF in 2003, this grants program has provided

A Unidata equipment award helped Penn State construct this weather wall.

funds for equipment purchases to 60 universities. Since this program has a large, positive impact on the university departments, it continues to receive very strong support from the NSF and the community.

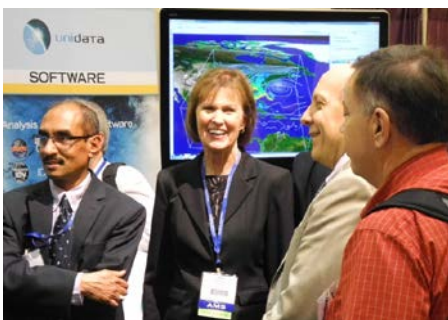For 2012 awards, special consideration was given to proposals that:

- Include installation of either the THREDDS Data Server or a RAMADDA server (or both) to share data relevant to furthering Unidata's mission with the community at-large

- Include installation of a prototype AWIPS II EDEX server, to share data relevant to furthering Unidata's mission with the community at-large.

We received a total of five responses to the 2012 RFP and funded three of them, partially or fully. The high success rate for award proposals should encourage others who may have hesitated to apply in the past.

University	Project
Iowa State University2 PI: Bill Gallus, Jr.	Installation of AWIPS II EDEX Servers for Sharing of Present Data and Future Distribution of Archived Data with Community
Valparaiso University PI: Kevin Goebbert	A Prototype AWIPS II EDEX Server System for the Department of Geography and Meteorology at Valparaiso University
University of Wisconsin at Milwaukee PI: Paul Roebber	Installation of RAMADDA, THREDDS and LDM at UWM

To see the wide range of previous recipient institutions and for more information on this year's awardees see: http://www.unidata.ucar.edu/community/equipaward/

5.3   2012 American Meteorological Society Meeting

NCEP Director Dr. Louis Uccellini visits the Unidata booth.

Several members of the Unidata Program Center staff attended the 92nd annual meeting of the American Meteorological Society in New Orleans, LA in January 2012. The conference theme — *Technology in Research and Operations: How We Got Here and Where We're Going* — provided ample opportunities to showcase Unidata technologies and discuss ways that Unidata can help community members analyze and visualize weather and climate data.

The Unidata booth in the AMS exhibition hall featured demonstrations of the current versions of the National Weather Service's AWIPS II software and Unidata's Integrated Data Viewer. UPC's Michael James was joined by NCEP colleagues David Plummer, Scott Jacobs, and Michelle Mainelli in demonstrating the AWIPS II functionality over the course of the conference. James says he was encouraged by the "wide-spread interest in, and enthusiastic response to, AWIPS II National Centers Perspective." Demonstrations of the IDV by UPC staff also drew enthusiastic responses: visitors new to the package were impressed by its 3D capabilities, while current users stopped by to learn about recently-added features such as support for ensemble grids, Hovmoller displays, and enhanced control of contour labeling.

Program center staff once again participated in the annual AMS Student Conference and Career Fair, which had a record 625 registered attendees. The large attendance is an indicator of the growth and vibrancy of the field. Unidata Users Committee Student Representative Stefan Cecelski was on hand to discuss Unidata with interested students at Unidata's table at the Career Fair, as were several Unidata Program Center staff members. "Comparing it to last year, there seemed to be more students coming up to the table who were already aware of some of our products and just wanted to know a little more," said UPC Staffer Tina Campbell. "We had a few that were surprised to find out all of our software is free to download."

Unidata's table at the AMS Student Conference career fair was well attended this year.

5.4   2012 National Weather Association Meeting

UPC Developer Yuan Ho with a community member at the 2012 NWA meeting.

Unidata Program Center staff also attended the National Weather Association meeting in Madison, WI. Staff members were on hand to talk with some 425 conference attendees about Unidata software products and data services, and to provide demonstrations of Unidata's Integrated Data Viewer (IDV) and a preview of the National Weather Service's next-generation AWIPS II package.

5.5 Featured Community Site: University of Salento, Italy

The following article (a longer version was originally published in the News@Unidata blog) highlights one university's use of Unidata technology and equipment funding.

Students in the University of Salento's Advanced Data Management course

By Prof. Giovanni Aloisio, Dr. Sandro Fiore, and Dr. Osvaldo Marra
Department of Innovation Engineering
University of Salento, Italy
and
Euro-Mediterranean Center on Climate Change, Italy

In 2011, the University of Salento in southern Italy became the first European institution to receive a Unidata Community Equipment Award. The award allowed the University to establish a data management platform for climate change data related to the Mediterranean area at the High Performance Computing Laboratory at the University of Salento, in Lecce, Italy. The project has been carried out in close collaboration with the Euro-Mediterranean Centre on Climate Change (CMCC).

Students attending the University's 2010-2011 "Advanced Data Management" course at participated in a series of seminars titled "Science data management," about the Common Data Model and the NetCDF Java and C libraries, as well as the ISO19115 and the ISO19139 standards. Thanks to the equipment grant, students have been able to test and learn more about Unidata software like THREDDS, RAMADDA, IDV, and the NetCDF libraries in an IT laboratory setting. In particular, the students:

- Worked on a real environment, starting from the setup of the hardware to the configuration of the services and the implementation and testing of the code.

- Learned a lot about tuning a VM-based environment with multiple machines, cores, services, and data.

- Deployed and managed a multiplexed configuration for the THREDDS installation.

- Designed and implemented some simple software applications running on climate change datasets, exploiting the C and Java NetCDF libraries.

Professor Giovanni Aloisio

- Worked on real data, understanding in a concrete way the nature of these multidimensional datasets, as well as the concepts of variable, dimensions, metadata, etc.

Future Directions

The hardware purchased with the Unidata equipment grant -- an IBM x3630 M3 system equipped with a large amount of RAM, fast disk storage, and good processing power – continues to contribute to the program. Starting in 2012, coursework features a stronger

focus on the NetCDF C library and parallel data mining applications exploiting MPI and OpenMP. Students are now focusing their attention much more on (i) designing and developing data-mining applications which analyze NetCDF files and (ii) understanding the NetCDF storage structure, format and libraries (C and Java).

5.6   GeoPod Adds Teaching Tools to IDV

Professors and students from the departments of Computer Science and Earth Sciences at Millersville University are using Unidata's Integrated Data Viewer (IDV) as the platform for an application to let students explore meteorological data in three dimensions.
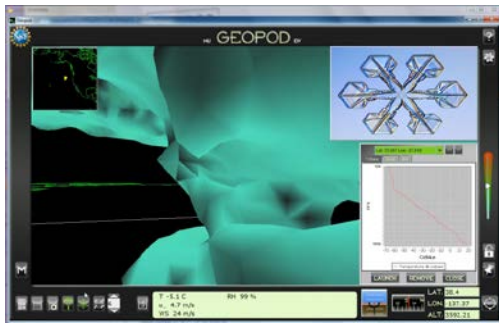
The Geopod interface is geared toward data exploration and teaching.

The application, known as the Geosciences Probe Of Discovery, or *Geopod*, uses the IDV's "Flythrough" facility to give the experience of navigating through 3D meteorological data sets as if in an airplane. Users fly through the data as if playing a video game, using mouse and keyboard to control position or allowing an autopilot to follow a preselected trajectory. The Geopod developers used the IDV's extensibility features to create custom displays of meteorological data on the screen, allowing users to quickly note parameters of interest. A particle imaging display lets users view ice crystal formations, and a virtual dropsonde device lets them create a vertical profile at any location.

Teaching features are tightly integrated into the Geopod application. Teachers can create "missions" for students to undertake, exploring a dataset to learn about specific features. Missions can include background material and multiple objectives, as well as an assessment or 'quiz' for students to take after completing the mission. Students can create notes within the application, and mark specific locations of interest.

6   Organizational Advances

6.1   New Committee Members

The Unidata Program Center is pleased to welcome six new members to our governing committees. Committee members normally serve three-year terms; these terms are finishing up for three members of the Users committee and three members of the Policy committee. New members and those finishing their terms will overlap for one meeting, which took place in mid-September, 2012.

The UPC staff looks forward to working with our new committee members, and to having all the current members of both committees at the Program Center in Boulder, Colorado for the October meeting.

The following provides a brief introduction to the scientists joining Unidata's committees. You can additional information about the governing committees, including contact information for committee members, on the Governing Committees page.

Lynn McMurdie, Policy Committee

Dr. Lynn McMurdie is a Senior Lecturer and Research Meteorologist in the Department of Atmospheric Sciences at the University of Washington. She teaches several courses in Synoptic Meteorology, Weather Analysis and Forecasting, and Dynamics, and received the Department Teaching Award in 1999, 2004 and 2011. Her current research interests include predictability of synoptic scale weather systems over oceanic and coastal regions, winter-time lightning in cold air outbreaks, orographic precipitation and remote sensing of water vapor and liquid and frozen precipitation.

Michael Baldwin, Users Committee

Dr. Michael Baldwin is an associate professor in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue University, where he teaches weather analysis and forecasting. His research interests include numerical weather prediction, forecast verification, data assimilation, and data mining.

Michael Piasecki, Policy Committee

Dr. Michael Piasecki holds degrees in civil engineering from the University of Hanover, Germany (Diplom, 1991), and the University of Michigan (Ph.D., 1994) with a focus on water resources engineering. He is currently an associate professor in the Department of Civil Engineering at City College of New York in New York City.

Robert Fovell, Policy Committee

Dr. Robert Fovell is a professor of atmospheric and oceanic sciences at UCLA, where he teaches courses in numerical modeling, advanced dynamic and synoptic meteorology, Earth systems, and general meteorology. His research focuses on mesoscale meteorology, primarily using high-resolution numerical models. He is an internationally recognized modeler whose learning materials include visualizations of gravity waves, downslope winds, thunderstorms, and other phenomena.

Russ Schumacher, Users Committee

Dr. Russ Schumacher is assistant professor in the Department of Atmospheric Science at Colorado State University, where he has been since 2011. Prior to that, he held the same position at Texas A&M University. At both universities, he has been a regular user of Unidata software and data in research and teaching, including GEMPAK, LDM, and IDV. His research interests are primarily in mesoscale meteorology, including mesoscale convective systems, heavy precipitation, and numerical prediction, and he teaches courses in synoptic and mesoscale meteorology. As a member of the Users committee, he hopes to learn more about the new products and services that Unidata provides, as well as to help guide the future advances to make them even more useful in research and education.

Sam Ng, Users Committee

Dr. Sam Ng is an associate professor of Synoptic and Mesoscale Meteorology at Metropolitan State University of Denver, where he has taught courses in synoptic meteorology, weather analysis, forecasting, and mesoscale meteorology since 2006. He also serves as the faculty advisor for the Metropolitan State student chapter of the American Meteorological Society.

6.2   EarthCube Participation

Staff from the Unidata Program Center continue to be involved in the EarthCube initiative in various ways:

- We are involved in four of the projects currently underway: the Brokering concept award, the Interoperability concept award, the Earth System Modeling concept award, and the Governance community group.

- Two staff members participated in the second EarthCube Charrette, held in June 2012.

- At NSF's request, we are organizing a workshop of the mesoscale modeling, data assimilation, and ensemble prediction community to help shape EarthCube's plans. The workshop will be held in December 2012.

6.3   UPC Staffing

As a result of staff departures and new project-specific funding, the Unidata Program Center has in the past two years been staffed at less than full capacity. In 2012, the UPC returned to full staffing, hiring three software engineers and one system administrator to fill open positions. With the recent hiring, there are now 25 staff members working at the Program Center. Several of the new hires have two-year term appointments.

6.4 Growth of Unidata's Global Community

According to metrics collected by the Unidata Program Center in the spring of 2012, the Unidata Program serves more than 40,000 educators, students, and researchers at more than 2900 sites in 117 countries around the world.

While the vast majority of sites availing themselves of Unidata services are universities in the United States, use of Unidata software and data streams has expanded in Asia recently, with growth in China leading the way. One indicator of this growing interest is provided by the Chinese Meteorological Agency (CMA), which invited two Unidata Program Center staff members to travel to Chengdu, China in June 2012 as their guests. The two UPC staffers trained CMA personnel in the use of Unidata's Local Data Manager (LDM), Integrated Data Viewer (IDV), and RAMADDA software.
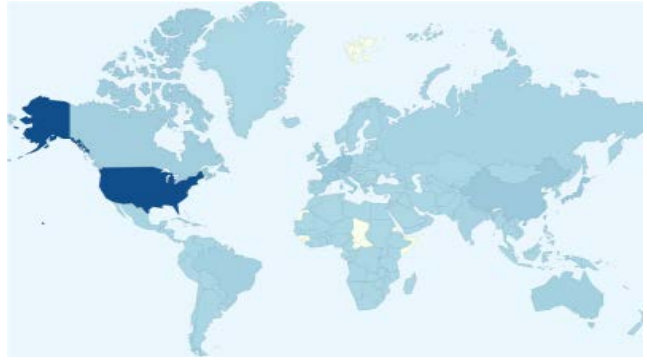
View an interactive map of at http://bit.ly/TDGFE6
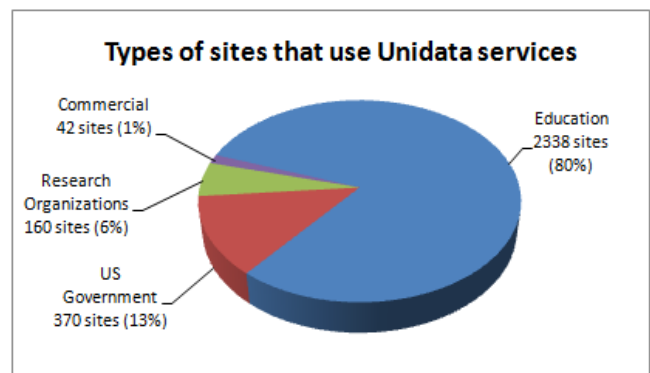
6.5 Software Engineering Processes

We are continually look for ways to improve our software engineering processes through:

- Using agile software development techniques

- Leveraging open source software repositories such as Github

- Doing automated code testing and using static analysis tools

- Using Project and issue tracking software like Jira and Redmine

- Generating documentation with software like Doxygen

- Increasing communication overall through regular technical staff meetings and project-centered group meetings.

- Hiring smart programmers

6.6 WRF Collaborations

Unidata Program Center staff began a closer collaboration with the Weather Research & Forecasting (WRF) model team NCAR's Mesoscale and Microscale Meteorology group

(MMM) in the summer of 2012. As an outcome of our meetings with the WRF team, we are now working with NCAR/MMM WRF group to improve the compliance of WRF netCDF output with the Climate and Forecast (CF) conventions. Other related projects include the creation of tools to allow WRF to read input from netCDF files, progress on a THREDDS Data Server (TDS) download subset server to return WRF required fields on a specified space/time subset, and improved support for staggered grids and time-dependent coordinates.

Additionally, the UPC's IDV development team made presentations at the June WRF Workshop held in Boulder, Colorado.

6.7 Google Africa Initiative Meningitis Project

Unidata, in collaboration with sister UCAR entities and a few external institutions, is involved in a project called the Google Africa Initiative Meningitis Project. Specifically, Unidata is involved in UCAR Africa Initiative (AI) which will soon enter its second (and final) no-cost extension of is Google.org award. Unidata's role in this initiative is to employ Unidata technologies in the collection and dissemination of data relevant to the project. Packages being used actively are: LDM, IDV, RAMADDA, THREDDS, and McIDAS ADDE.

The following are some highlights:

- The IDV is being used to generate displays of forecast relative humidity using TIGGE ensemble data from ECMWF (via the NCAR/CISL TIGGE repository).

- Work is being done to automate the generation of displays upon receipt of a new forecast.

- The next step in the effort will be to transfer the technologies used to the African Centre of Meteorological Application for Development (ACMAD) which is located in Niamey, Niger.

At some point in early 2013, a small number of the UCAR AI participants will need to travel to ACMAD to review their current computing and network capabilities and begin setting up needed systems.