3 October 2011

MEMORANDUM: UCAR Board of Trustees
UCAR Member Representatives
UCAR University Relations Committee Members
UCAR Academic Affiliates

FROM: Jack D. Fellows, Director, UCAR Community Programs
SUBJECT: 2011 UCAR Community Programs Report

The purpose of this report is to summarize UCP activities over the past year. Please read the full report below, but the following are brief highlights of a few of the many exciting UCP activities:

1. **Cooperative Program for Operational Meteorology, Education and Training (COMET Director Tim Spangler, [www.comet.ucar.edu](http://www.comet.ucar.edu)).** COMET supports the communication and application of atmospheric and related sciences scientific knowledge for the operational and educational communities. COMET extensive library of over 600 hours of educational material is available at no cost via its MetEd website, and now includes a MyMetEd section where users can add modules to a personal queue and more easily track and share quiz results. COMET online materials and modules serve over 204,000 users in 200 countries and over 1,300 US universities. This past year saw new releases in climate, fire weather, satellite meteorology, tropical meteorology, tsunami training, numerical weather prediction, and volcanoes. COMET’s Outreach program has provided over $10 million to support cooperative research projects between 96 universities and over 120 National Weather Service and other agency offices.

2. **Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC Director Bill Kuo, [www.cosmic.ucar.edu](http://www.cosmic.ucar.edu)).** COSMIC satellites continue to provide 1,000-1,800 GPS radio occultation (RO) soundings each day to support the operational and research communities and is processing RO data from additional missions (Argentinean SAC-C and US Air Force CNOFS). To date, COSMIC has provided over 3 million neutral atmosphere sounding profiles and over 3 million ionospheric profiles. Roughly 90% of these have been delivered to operational weather prediction centers around the world within three hours. At NCEP, assimilation of COSMIC data is showing remarkable improvement in forecast skill of up to eight hours at day four and up to 15 hours at day seven. The ECMWF has concluded that GPS RO (COSMIC, METOP/GRAS) is the fifth largest contributor to forecast error reduction for short-range (24-h) forecasts, although it contributed only ~3% of the assimilated observations. COSMIC is now supporting more than 1,697 registered data users from 61 countries, and providing RO data in a real time to the university community via the Unidata Local Data Manager system. The COSMIC team is working with NOAA, the US Air Force, and Taiwan’s National Space Program Organization on a follow on mission, known as COSMIC-2 (C-2). C-2 will produce over 8,000 radio occultation soundings/day, with six satellites at 72 degrees inclination and six at 24 degrees inclination for increased sampling density in the tropics. The C-2 mission is scheduled for launch in mid-2015, but is dependent on FY12 funding appropriations for NOAA. The COSMIC team is now finishing the first year of the COCONet project to infuse state of the art GNSS infrastructure into the Caribbean. A collaborative team from COSMIC, UNAVCO, Purdue University, the University of Puerto Rico Mayaguez, and the University of Texas at Arlington are leading this effort.
3. **Unidata (Director Mohan Ramamurthy, www.unidata.ucar.edu).** After 27 years of growth and change, the Unidata program remains committed to its core mission of providing data services, tools, and cyberinfrastructure leadership for the Earth system science community. 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. 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. Unidata began providing WSI Corporation global lightening data available in 2011 and enhancements to most of the Unidata software products, including GEMPACK, IDV, LDB, NetCDF, RAMADDA, THREDDS, and UDUNITS and workshop on how to use these packages. Unidata is also supporting the transition from GEMPACK to AWIPS II and the adoption of CF-NetCDF as an Open Geospatial Consortium standard. Unidata continues to provide community equipment awards. Since 2003, Unidata has provided awards to 60 universities, with eight of the nine 2011 proposals funded. Unidata has update its website and begun a weblog (News@Unidata) and begun creating a new strategic plan that will guide Unidata over the next five years.

4. **National Science Digital Library Core Integration Group (NSDL Director Kaye Howe, www.nsdl.org).** In February 2011, NSF announced that it would not continue to fund NSDL beyond 30 September 2011, but invited NSDL to submit a one-time proposal supporting a transition to long-term sustainability for NSDL (submitted June 2011). This proposal includes transitioning the NSDL technical infrastructure, collections, and networks. It is hoped that this transition will have minimal impact on NSDL users. NSDL continued to work on the STEM Exchange (an information system that can automatically capture and display aggregated real-time user interaction data as resources are annotated, reviewed, downloaded, embedded, shared, accreted, modified) and Learning Registry (a “messaging” system to support the exchange of learning resources, and their metadata and paradata).

5. **Digital Learning Sciences (DLS Director Mary Marlino, http://dlsciences.org/).** DLS supports the development of systems and services that enable science and educational organizations (i.e., school districts, universities, libraries, and publishers) to organize, manage, comprehend, and enrich online resources to improve learning outcomes and learner engagement. DLS continues to develop its Curriculum Customization Service (now called “Inquiry Hub”) tools to help personalize learning and it is being tested in six school districts in Colorado, Utah, and Nevada. The DLS is also a major contributor to UCAR’s OpenSky system that provides broad community access to UCAR scholarship. DLS partners with a broad range of UCAR member universities on community projects, including DataNet, data referencing, and data curation.

6. **Visiting Science Program (VSP Director Meg Austin, www.vsp.ucar.edu).** VSP helps prepare the next generation of weather and climate scientific leaders and workforce by supporting effective and collaborative fellowship, visitor, and workshop programs that meet emerging training and research needs. VSP just received a new 5-year Cooperative Agreement from NOAA to continue its collaborative partnership in research and training programs. In 2011, 15 UCAR member universities and several national labs benefitted from VSP’s competitive visiting scientists appointments. VSP continued to support its prestigious fellowship and postdoc programs. The next round of applications for these programs are due in January 2012. In April, VSP and NOAA celebrated the 20th
anniversary of the Climate and Global Change Postdoctoral Fellowship Program with a two-day symposium in Washington DC, including a reception on Capitol Hill. VSP also supported ten major community workshops this past year.

7. Joint Office for Science Support (JOSS Interim Director Karyn Sawyer, [www.joss.ucar.edu](http://www.joss.ucar.edu)). On 3 August 2011, JOSS Director Gene Martin died after a brief illness. Gene spent most of his career traveling the globe laying the groundwork for atmospheric field projects. Gene came to NCAR in 1978 and was a key member of JOSS’s staff for many years until becoming its Director in 2005. Gene was a great colleague and will be greatly missed. JOSS welcomes back Karyn Sawyer as the interim JOSS Director. For almost 30 years, JOSS has been a team of professional and skilled technical and administrative specialists whose mission is to help the scientific community with project staffing, financial planning, meeting support, documents, and promoting education for scientists. In 2011, JOSS arranged travel for over 1,400 community members and supported over 400 scientific events. JOSS has continued to support the Intergovernmental Panel on Climate Change effort, including supporting the over 800 authors involved in IPCC reports. NOAA just awarded JOSS a new 5-year Cooperative Agreement to continue these activities.

8. Global Learning and Observations to Benefit the Environment (GLOBE Director Andy Tasker, [www.globe.gov](http://www.globe.gov)). GLOBE continues to build a worldwide community of students, teachers, scientists, and citizens working together to better understand, sustain, and improve Earth’s environment at local, regional, and global scales. Andy Tasker began work as the new GLOBE Director in June 2011 after former director Ed Geary took a position at NSF. Andy’s background includes running both and environmental NGO and commercial biodiversity consultancy, as well as being GLOBE UK Country Coordinator since 1997. In July, GLOBE had a successful International Meeting in Washington DC, attracting 180 participants from 46 countries and 26 U.S. States. The meeting focused on new directions for GLOBE, discussing a new five-year Development Strategy for the international partnership that had been prepared for the meeting. The GLOBE Student Climate Research Campaign was launched in September 2011 for existing GLOBE schools, with an updated series of activities to be launched in November 2011 for a global audience. Thanks to additional NASA support, a new GLOBE website and infrastructure has been developed that will allow interactive participation between teachers, students and scientists, as well as continuing to promote the collection and analysis of data. The first phase of this website comes on line in November 2011 and new data visualizations incorporated by April 2012.

End of UCP Report Highlights
The COMET® Program
Program Director: Dr. Tim Spangler
www.meted.ucar.edu

COMET supports, enhances, and stimulates the communication and application of scientific knowledge of the atmospheric and related sciences for the operational and educational communities. COMET uses innovative instructional methods to engage both scientific professionals and the public by producing and delivering online modules and courses, both locally and at a distance, that serve as resources for a wide variety of users, including operational meteorologists, decision makers, emergency managers, broadcast meteorologists, and university faculty as well as K-12 teachers and students.

COMET promotes improved education through support for collaborative applied research activities through its Outreach Program. By fostering professional interactions between environmental forecasters and university faculty and students, the Outreach Program serves a diverse group of users. Given the collaborative nature of the Outreach Program, project benefits extend to both parties. Forecasters gain access to the expertise of leading researchers, while the academic partners receive modest financial support and work on projects to address some of the most pressing challenges that forecasters face.

MetEd Website (www.meted.ucar.edu)
COMET’s primary website, MetEd, was updated this past year to provide easier access to our extensive library of modules and with new features for managing user accounts. The redesigned site includes a new MyMetEd section where users can add modules to a personal queue and more easily track and share quiz results. Also added is an enrollment feature to distance learning courses (collections of modules grouped into topic areas) with progress tracking available on the distance learning course pages and on MyMetEd.

The COMET Program provides all of its distance learning educational materials at no cost through its MetEd Website (www.meted.ucar.edu). COMET online materials and modules serve over 204,000 users in 200 countries (approximately 1/3 of the users are international) and represents over 1,300 US Universities. The MetEd Website is also available as a parallel site in Spanish, and a portion of the online library is available in Spanish, French, Russian, Portuguese, and Indonesian.

COMET’s extensive library (over 600 hours of educational material) has won numerous awards, including the Brandon Hall Excellence in Learning Gold Medal Award (2004) the American Geophysical Union Award for Excellence in Geophysical Education (2006), the National Weather Association Public Education Award (2009) and recognized with the Chief Learning Officer Learning in Practice Certificate of Merit for “Excellence in Content” (2010).
COMET Distance Learning Highlights:

Climate
In FY11, COMET held one Climate Variability and Change Virtual Course and began development of an Advanced Climate Variability and Change course, which will be held in early FY12. COMET published Coastal Climate Change, a 3-hour distance learning module on the impact of a changing climate on coastal regions. The Program also supported a workshop for the Climate Change and Western Water Group (CCAWG) in partnership with the Bureau of Reclamation and NOAA. Finally, COMET, with support from UCAR, began work on a module on climate models which will be published in FY12.

Fire Weather
The Intermediate Wildland Fire Behavior (S-290) online training classroom course held last year was officially certified and as of 9/12/11 has 2,148 course completions.

Satellite Meteorology
In partnership with the National Environmental Satellite, Data, and Information Service (NESDIS), Geostationary Operational Environmental Satellite – R Series (GOES-R), the Joint Polar Satellite System (JPSS) Programs and European Organization for the Exploitation of Meteorological Satellites (EUMETSAT); COMET continues the expansion of satellite-related training materials. In FY11 COMET published a significant update to its most popular satellite-specific training modules GOES Channel Selection, Version 2. The revised module now contains information on GOES-13, 14, and 15. COMET also infused state of the science satellite information into many modules on other topics including Dust Forecasting and Volcanic Impacts.

Throughout the year COMET also continued to support and populate the Environmental Satellite Resource Center (ESRC). The ESRC serves as a repository that provides easy access to a wide range of useful information and education and training about low-earth orbit and geostationary satellites. The site has been adopted as an official repository for the World Meteorological Organization (WMO) Virtual Laboratory. Finally, with one time funding, COMET held a week long residence course for 24 faculty to upgrade their knowledge regarding advances in environmental monitoring from satellites and how to integrate new data, products, and tools into their courses.
Tropical Meteorology

Throughout 2011 COMET worked to republish the online Introduction to Tropical Meteorology textbook in an updated format that is more user friendly and easier to maintain. This free textbook is targeted at the undergraduate and first year graduate levels. As part of this effort COMET also published a new chapter on Global Circulation. Each chapter of the book offers many features including quizzes, links to additional information, animations, and robust print versions. A majority of the textbook has also been translated into Spanish.

Tsunami Education and Training

Saving lives in tsunami events requires a complex system of trained professionals, observational networks, data processing and communication systems, standardized products, and local response protocols. During the past year COMET has worked on several different products that communicate and demonstrate appropriate outreach and warning procedures for Watch Coordination Meteorologists and Emergency Managers; teach the basics of tsunami science; develop awareness of the contribution of each component in the tsunami warning system; teach school children about the science and safety of tsunami events; and help all those involved in the public tsunami warning system to become better consumers and communicators of tsunami warning information. In FY11, COMET published the following modules:

- **Tsunamis** (an introduction to the Science of Tsunamis)
- **Tsunami Warning Systems** (a description of processes implemented at NOAA's Tsunami Warning Centers to anticipate, detect, and warn for a tsunami)
- **Community Tsunami Preparedness: Version 1** (a module intended primarily for emergency managers to help prepare their communities to be tsunami-ready)
- **Tsunami Strike! Pacific Edition** (the science and safety of tsunami events taught in a scenario-based learning format for middle school and high school children)
- **Tsunami Strike! Caribbean Edition** (another module intended for middle school and high school children—this time with a scenario in which the learner assumes the role of a reporter investigating Caribbean tsunami threats)

In FY11 COMET also received funds from the Maryland Emergency Management Agency to augment the recently issued Community Tsunami Preparedness module with additional information about tsunami risks on the East Coast and other topics, as well as material resulting from the March 2011 Japan tsunami and its effects on the US West Coast. Version 2 will be published in early FY12.
Numerical Weather Prediction (NWP)

COMET has been developing web-based distance learning courses as part of a new NWP training series entitled *Effective Use of NWP in the Forecast Process*. The first course, *NWP Basics and Background*, was completed in November, 2010. This 12-hour course includes updated versions of modules from an older, web-based course, plus new modules that place greater emphasis on operational applications of NWP. The second course, *Using and Adding Value to NWP in the Forecast Process*, was completed in August, 2011. This 6-hour course highlights effective application of NWP in the forecast process. Development of a third course, *NWP in the Era of Digital Forecast Preparation*, is underway.

Volcanoes

The COMET Program has a long history of providing distance learning in the area of aviation weather. With the disruptions to the aviation industry brought about by recent volcanic eruptions, a change in training priorities lead to COMET developing a distance learning course on Volcanic Ash for operational forecasters in FY11, consisting of four modules:

- **Volcanic Ash: Introduction** provides a concise introduction to volcanic ash through the examples of the Mt. Pinatubo and Eyjafjallajökull eruptions. This module introduces the 4-part series on Volcanic Ash.
- **Volcanic Ash: Volcanism** provides information on the geological, and geophysical processes related to volcanic activity and volcanic ash in the atmosphere and on the ground.
- **Volcanic Ash: Observation Tools and Dispersion Models** provides information on the tools; remote sensors and dispersion models used to monitor volcanic activity and eruptions; and to forecast the spread of volcanic ash.
- **Volcanic Ash: Impacts to Aviation, Climate, Maritime Operations, and Society** provides information related to the impact of volcanic ash on aviation (aircraft and air travel), climate (short and long term), society (personal health, structures, and agriculture), and water (inland and coastal).

The Volcanic Ash distance learning course will be completed by 30 September 2011.

International Activities

COMET continues to work closely with the National Weather Service International Activities Office (IAO), the World Meteorological Organization, EUMETSAT, and other organizations and national meteorological services to provide education and training for the international community. Projects include new and adapted distance learning modules, workshops and workshop support, and a significant effort to provide Spanish translations of COMET modules and courses.

COMET has translated 14 complete modules into Spanish in the last 12 months, and is nearly done developing a Spanish-language
version of the *Introduction to Tropical Meteorology* online textbook. COMET is also supervising additional translations being accomplished by other agencies in Spanish as well as other languages. Over 20,000 Spanish-speaking users have registered on the MetEd Website worldwide. In addition to translations, COMET has worked with WMO and NWS IAO and the Caribbean Institute of Meteorology and Hydrology (CIMH) to support the development of a Continuing Professional Development course for Caribbean aviation forecasters. The course materials, which consist primarily of COMET modules, will also be made available internationally for use by other organizations.

COMET is also working with CIMH to develop a university-level Synoptic Meteorology online course appropriate for forecasters working in tropical regions. The final course package will be made available freely to any institution to use as a basis for developing new courses.

COMET does ongoing project work for the Meteorological Service of Canada (MSC), including current module efforts on satellite feature identification of atmospheric rivers and jet streaks. COMET also offers a 2-week residence course on winter weather for MSC, and completed another project on radar interpretation for the Australian Bureau of Meteorology.

With funding from EUMETSAT, COMET is creating modules on Atmospheric Dust and Climate Monitoring, as well as continuing its work on the ASMET project, which focuses on training in satellite meteorology for African forecasters. In addition, COMET has created an international edition of its Basic Hydrologic Sciences Distance Learning Course, offered three online courses in hydrology for international audiences, is developing a module on implementing quality management systems for national meteorological and hydrologic services, and preparing to conduct a train the trainer course about online learning for faculty at WMO regional training centers.

**Outreach Program**
The Outreach Program provides funding for applied research projects that involve university faculty and students working collaboratively with operational weather forecasters. Since its inception, the Outreach Program has worked with the NWS to provide a total of over $10 million to support almost 350 research projects, including 106 Cooperative Projects and over 240 Partner Projects. These projects have paired 96 different universities with over 120 NWS, Department of Transportation (DOT), Navy and AFWA offices. The GOES-R Program provided funding for targeted Partners and Cooperative Proposals that would conduct pre-operational research and demonstrations of selected capabilities anticipated from this next generation of satellite systems. The objective is to ensure that users of the GOES-R system can immediately take advantage of these capabilities as soon as the system is operational, resulting in an effective transition of GOES-R research products to the operational weather community.
COSMIC Mission Status
Since the launch of the six-satellite constellation in April 2006, COSMIC has provided GPS radio occultation (RO) data to support research and operations. To date, COSMIC has provided ~ 3 million neutral atmospheric sounding profiles, and ~ 2.9 million ionospheric profiles and absolute total electron content data arcs. Figure 1 shows the number of neutral atmospheric profiles generated per day throughout the mission. Currently, COSMIC is producing 1,000 to 1,800 GPS RO soundings per day. Five of six satellites are operating and providing data - FM3 has been out of ground contact since Aug 1, 2010 and is not expected to return. Additionally some degradation of the spacecraft buses (i.e. battery aging) and GPS RO payloads is reducing the quantity of data collected. All five operating spacecraft have some power limitations due to battery aging, which results in payload duty cycles < 100 % depending on solar beta angle variations. All GPS payloads have experienced infrequent (<15%) reduced GPS signal-to-noise ratio on the navigation antennas and some occultation antennas, which is under investigation. The reduction of soundings due to these factors is largely compensated by improved spacecraft operations and GPS RO firmware, and therefore the number of soundings remains reasonably stable. With a 5-year spacecraft design life, it is reasonable to expect continued COSMIC operation at a high level past 2011.

![Figure 1: Daily COSMIC profile count throughout the mission. The red color shows the soundings from real-time processing. The green color shows the soundings from post-processing, which often is able to generate more sounding profiles but lags 1-2 months behind the real-time products.](image-url)
Ninety percent of COSMIC profiles are processed and delivered to operational centers within 3 hrs; the remaining ten percent have latency greater than 3 hours due to inability of the constellation to dump every orbit (~100 minutes). Major global weather prediction centers, including ECMWF, NCEP, UK Met Office, Meteo France, Air Force Weather Agency, and Environment Canada, are relying on the COSMIC data for their operations. They all have reported significant positive impacts on their forecasts. The NSF/NASA McMurdo ground station has now returned to service from a maintenance upgrade and is used operationally (in addition to the NOAA operated Fairbanks and Norway stations) for up to 6 passes/day.

The UCAR COSMIC Program and JPL continue to work with Taiwan’s National Space Organization (NSPO) to improve and upgrade the COSMIC GPS RO firmware. In the last year two firmware upgrades have been uploaded, tested and evaluated, one in Oct 2010 and one in Mar 2011. The purpose of these upgrades was to either improve the number and quality of tracked occultations or to collect additional data for science investigations. Firmware changes to collect additional data for science investigations included tracking of deep occultation signals down to -350 km height of straight line (HSL), and collecting 50 Hz L1 C/A amplitude data on reference satellites for F-region scintillation studies. Both of these changes produced useful test data. Investigation of the deep signals at UCAR has verified useful RO signals below -300 km HSL, which shows the necessity of tracking RO signals to this depth to fully reconstruct lower tropospheric profiles.

**RO Data from Missions of Opportunity**

In an effort to increase the number of RO soundings available to the research and operations community, the COSMIC Program has initiated acquisition and processing of data from additional missions. RO data from the SAC-C (Satélite de Aplicaciones Científicas – C) and the USAF C/NOFS-CORISS (Communication/Navigational Outage Forecast System - C/NOFS Occultation Receiver for Ionospheric Sensing and Specification) missions are now being provided in near real-time to NOAA and the global operational weather community via the Global Telecommunications System. SAC-C and C/NOFS have been providing about 200 and 150 occultations per day, respectively. Profiles from the METOP/GRAS (GNSS Receiver for Atmospheric Sounding) instrument derived with open-loop and closed-loop tracking data are also being provided in near real-time via the CDAAC website. The CDAAC has also recently intensified re-processing of data from all available missions (COSMIC, GPS/MET, CHAMP, SAC-C, GRACE, METOP, TerraSAR-X, and C/NOFS) and now makes available over 4.7 million profiles. The UCAR COSMIC Program is actively pursuing additional data from several current and upcoming RO missions (India’s ROSA instrument on OCEANSAT-2, India’s Megha-Tropiques/ROSA, Argentina’s SAC-D/ROSA, Korea’s KOMPSAT-5, Spanish PAZ, and Brazilian EQUARS) for processing and distribution to the research and operations community. Currently, UCAR has signed an MOU with Korea’s Astronomy and Space Science Institute (KASI) for RO data processing for KOMPSAT-5 that is due to launch soon in Sept 2011. A draft MOU has also been sent to the Institute for Space Studies of Catalunya (IEEC) to process RO data from the Spanish PAZ mission set to launch in 2012. Efforts to obtain RO data from the Italian ROSA (i.e. OCEANSAT-2 and SAC-D) instrument have been unsuccessful to date.

**COSMIC Science Highlights**

While the main task of the UCAR COSMIC team is to provide data products to the community, we are also effectively advancing RO science, as evidenced by 68 of our peer-reviewed publications from 1993 to 2010 that were cited ~2,239 times (computed from ISI Web of Science in February 2010). The COSMIC team C/N ratio (number of citations divided by number of publications) of ~33 compares favorably with all of NCAR/UCAR which ranks first in the world with a rating of ~22 (ISI Web of Science Essential Science Indicators).
Investigation of systematic errors in lower tropospheric inversions

In the last year UCAR has continued to investigate and publish studies on systematic inversion errors in the moist lower troposphere (LT) (Sokolovskiy et al., JGR Atmospheres, 2010). Inversion biases in the LT are the main challenge of GPS radio occultation (RO), and they are still not fully understood. They depend on: (i) signal tracking by receiver; (ii) inversion algorithms; (iii) the structure of the refractivity (moisture) in LT. UCAR evaluated the uncertainty of the retrieved refractivity in LT related to different signal-to-noise ratios (SNR) and different lengths of the recorded RO signal (tracking depth). Knowing the magnitude of this uncertainty, which can be up to ~1% in the lowest few kilometers, is very important for climate studies.

Retrieval of Electron Density Profiles via Data Assimilation

The UCAR COSMIC program has developed a new data assimilation (DA) technique to improve radio occultation retrievals of electron density in the ionosphere (Yue et al., JGR Space Physics, 2010). This work is significant for ionospheric applications and scientific research using RO-derived electron density, especially in low altitude and latitude regions.

The standard Abel retrieval assumes spherical symmetry in the ionosphere, which results in large retrievals errors below the F layer in the presence of horizontal gradients. This new DA approach uses a Kalman filter to retrieve the electron density profile along the tangent points by assimilating the occultation side slant total electron content (TEC) data into an empirical background model. This DA approach was validated with COSMIC satellite radio occultation (RO) data from 2009.266 via simulation and real data retrieval. The results show that the data assimilation can improve the electron density retrieval especially below 600 km. The left panel of Figure 2 shows a comparison of an actual standard COSMIC Abel retrieval and data assimilation retrieval with ground-based ionosonde data (Lat ~50N, 2009.266). The DA retrieval agrees much better with nearby ionosonde data, because it is less influenced than the Abel method by ionospheric inhomogeneity. The plot on the right in Figure 2 shows simulation results of the Abel and DA retrievals. Some pseudo features made by the Abel retrieval such as the plasma cave underneath the EIA region and the three peaks along the latitude direction in E layer disappear in the data assimilation retrieval. Independent validation by ground based ionosonde observations confirms the improvement of data assimilation retrievals below F2 peak (Yue et al., 2010).

Detection of Sporadic Es Clouds by GPS RO

The UCAR COSMIC Program has developed an approach to detect sporadic Es clouds with GPS RO data (Zeng and Sokolovskiy, GRL, 2010). This approach provides a tool for detecting Es clouds and enables the investigation of their morphology.

When sporadic Es clouds are aligned with the propagation direction they result in specific U-shaped structures that have been simulated with a multiple phase screen method and observed in actual COSMIC GPS RO signals. The left panel in Figure 3 shows these U-shaped structures present in L1 C/A signal-to-noise ratios (SNR) for five example COSMIC occultations. The right panel of Figure 3 shows distributions of the Es events in latitude and h (Figure 3a) and in latitude and local time (Figure 3b) in July 2009. Both distributions show a higher occurrence in mid-latitude summer and agree well with results of previous studies. The right panel of Figure 3 shows distribution of the Es events in height (Figure 3c) and in thickness (Figure 3d). The Es events observed at h < 90–120 km are due to Es clouds tilted with respect to local horizon by up to 10 degrees since they must be aligned with the propagation direction.
Figure 2: Left: Comparison of actual COSMIC Abel and data assimilation retrievals with co-located ionosonde. Right: Simulation of magnetic latitude and altitude variations of true electron density (a), Abel retrieved electron density (b), electron density retrieved via data assimilation (DA2) approach (c), absolute Abel deviations from truth (d), absolute DA2 deviations from truth (e).
COCONet: The Continuously Operating Caribbean Observational Network

UCAR/COSMIC is now finishing the first year of the COCONet project. It is a five-year NSF funded project to infuse state of the art GNSS infrastructure into the Caribbean. A collaborative team from UCAR/COSMIC, UNAVCO, Purdue University, the University of Puerto Rico Mayaguez, and the University of Texas at Arlington is leading this effort. COCONet will form an observational backbone for a broad range of geoscience investigations and enable research on natural hazards in the region. Atmospheric applications of COCONet include data assimilation, model and satellite validation, while also providing critical observations necessary to understand atmospheric processes that influence the Caribbean.

The figure below shows the network of stations that will comprise COCONet. There will be 50 new continuous GNSS (cGNSS) and meteorology stations in the Caribbean and Central America (yellow circles), 15 refurbished sites (green diamonds), as well as incorporate data from another 50 existing cGNSS sites (blue squares) into the overall data stream. COCONet will provide free, high-quality, low-latency, open data and data products for researchers, educators, and students. Data products will include raw data, surface meteorology measurements, total column water vapor estimates, as well as time-series of daily station positions. The UCAR/COSMIC program encourages member institutions to access the data for research.

Figure 3: Left Panel: The amplitudes of COSMIC RO signals versus height showing U-shape structures. Right panel: (a–d) Distributions of the Es cloud events in COSMIC data from July 2009.
Suominet: Continuous integrated water vapor from GPS

The COSMIC program provides estimates of total column precipitable water vapor (PW) from more than 400 stations in the North America/Central America/Caribbean region, plus an additional 100 continuously operating GPS stations worldwide. These results are computed at 30-minute time resolution. Estimates of PW from North American stations are computed in both near real-time as well as in a daily post-processing scheme. The global network is processed on a daily basis. PW estimates from cGPS stations are useful for water cycle research, severe precipitation studies, model initialization, and long-term evaluation of water vapor. Data are distributed through the Unidata LDM tool, and through the Suominet web page (www.suominet.ucar.edu). Contact John Braun (braunj@ucar.edu) for more information.

The image below shows the Suominet PW estimates on Sept 2, 2011 at 2145UTC displayed over a GOES-IR4 satellite image of the United States. Tropical storm Lee can be seen on the Gulf Coast, while a moisture surge associated with the North American Monsoon is visible in southwest Arizona.
**GPS Interferometric Reflectometry**

The COSMIC program continues the collaborative (along with the University of Colorado) development of GPS-Interferometric Reflectometry (GPS-IR) methods to retrieve estimates of soil moisture, snow depth, and vegetation indices over medium range spatial scales (1000m³). These observations are potentially useful for satellite validation, numerical model initialization, and regional hydrology studies. The research team has established 10 experimental sites for algorithm refinement and validation purposes. It has also begun to evaluate the potential of using the 1000-station Plate Boundary Observatory (PBO) to provide consistent measurement of soil moisture, snow depth, and vegetation over the western United States.

The photograph above show GPS instruments installed at the Marena Oklahoma in Situe Sensor Testbed (MOISST) near Stillwater, OK. The MOISST testbed is being used to evaluate in situ soil moisture sensors to be used for calibration and validation of future satellite missions, including the Soil Moisture Active Passive (SMAP) satellite scheduled for launch in 2014. The time series on the right shows variations in GPS-IR effective reflector depths GPS-IR as well as time domain reflectometer data at 2.5 cm (black) and 7.5 cm (red) depths. Changes in GPS-IR effective reflector heights are clearly correlated with changes in near surface soil moisture. The Google earth image shows the sampling station locations and sampling area from the GPS instruments installed at the MOISST site.

**Community Development and Educational Efforts**

The high resolution, globally distributed RO data sets from COSMIC and other missions are being used by approximately 1,697 registered users from 61 countries to advance Earth system science, not only representing the leading operational weather centers, but also major U.S. and international universities, research laboratories, and several private companies. In collaboration with UNIDATA, COSMIC soundings are now provided in a real time data stream with the LDM (Local Data Manager) software to support the university community.

The COSMIC Program continues to support development and educational efforts in RO science and technology within the university community. In April 2011, the COSMIC Program supported the “Fifth FORMOSAT-3/COSMIC Data Users Workshop” in Taipei, Taiwan with over 477 hours of administrative time contributed for planning and executing the student trip (NSF Award OISE-1043065), and with salary
and travel funds for staff travel to Taiwan. Information on the student program and presentations can be found at http://www.nspo.org.tw/5th_FS3WS/program_plan.html.

UCAR/COSMIC is also providing universities with data user support, mentoring of under-graduate and graduate students and post-docs, and dissemination of CDAAC software. COSMIC assisted Jennifer Haase (Purdue Univ.) by generating ECMWF profiles for comparison with three GISMOS airborne profiles and also generated a GISMOS database within the CDAAC system to manage future GISMOS data. COSMIC has also provided science and computer mentoring to culturally diverse under-graduate students in the UCAR/SOARS (Significant Opportunities in Atmospheric Research and Science) each year from 2003-2011. UCAR and the University of Colorado (CU) are also planning to jointly advise a CU graduate student on a PhD thesis to study and improve ionospheric inversions and data assimilation methods with RO data. Additionally, COSMIC/CDAAC has distributed its neutral atmospheric inversion software and is providing user support to CU in Boulder, University of Kyoto Japan, and recently to two new universities: University of Hawaii, Prof. James Foster, and Universidade Estadual Paulista (UNESP) of Brazil, Prof Galera Monico.

UNIDATA
Program Director: Dr. Mohan Ramamurthy
http://www.unidata.ucar.edu

Introduction
After 27 years of growth and change, the Unidata program remains committed to its core mission of providing data services, tools, and cyberinfrastructure leadership for the Earth system science community. Guided by the concepts laid out in its most recent five year core funding proposal, Unidata has been proactive in finding and distributing new types of data, efficient in managing the distribution of ever-greater volumes of data, and productive in enhancing and supporting its software tools, all while bringing new institutions into a broadening user community.

This report highlights Unidata’s activities and accomplishments during the last year.

Unidata’s Mission:
To provide the data services, tools, and cyberinfrastructure leadership that advance Earth system science, enhance educational opportunities, and broaden participation.

Unidata’s Strategic Vision:
Unidata’s vision for the next five years calls for providing comprehensive, well-integrated, end-to-end data services. These include an array of functions for collecting, finding, and accessing data; data/content management tools for generating, cataloging, and exchanging metadata; and submitting/publishing, sharing, analyzing, visualizing, and integrating data.
To fulfill our mission and serve our broad community, the Unidata Program Center (UPC):

- Acquires and distributes real-time meteorological data for education, research, and outreach
- Develops software for accessing, managing, analyzing, visualizing, and effectively using geosciences data
- Provides comprehensive training and support to users of its products and services
- Facilitates advancement of standards, conventions, and interoperability
- Provides leadership in cyberinfrastructure and fosters adoption of new technologies
- Assesses and responds to community needs, fostering community interaction and engagement to promote sharing of data, tools, and ideas
- Advocates on behalf of the university community on data issues and negotiates data agreements
- Grants equipment awards to universities to enable and enhance participation in Unidata

**Data Services**

**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.

**New Data Stream: Global Lightning Data**

The academic community has been requesting for some time that global lightning data be made available via Unidata data distribution systems for research and education use. To respond to that community need, WSI Corporation and Unidata began making global lightning data available to members of the Unidata community at the beginning of 2011.

WSI Corp.’s Global Lightning Network (GLN) provides high quality real-time and archive lightning stroke data to clients throughout the world. Lightning sensors are located at more than 150 international hosting partner sites in addition to the
detectors that make up the North American Precision Lightning Network.

Kim Rauenzahn, Lightning Product Manager for WSI Corp., says that “WSI appreciates the opportunity to expand our provision of lightning data to the Unidata community. Serving the educational and research institutions is very important to WSI with, we feel, mutual benefits for all involved. We look forward to working with organizations interested in global lightning research.”

Software Tools and Support

Enhancements to Existing Products

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

- GEMPAK: Version 6.2.0
- IDV: Versions 2.9u1, 2.9u2, 2.9u3, and 3.0
- LDM: Versions 6.8.1 through 6.9.8
- NetCDF: Versions 4.1.2beta and 4.1.3
- NetCDF-Java: Versions 4.2.5 through 4.2.26
- RAMADDA: Became an Open Source project in December 2010
- THREDDS Data Server: Versions 4.2.0 through 4.2.8
- UDUNITs: Version 2.1.20

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.

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. When completed in FY 2012, AWIPS II will integrate the functionality of existing N-AWIPS software (also known as GEMPAK). As a result, the NWS has announced its termination of development and support for GEMPAK.

Because many Unidata member universities rely heavily on GEMPAK, the UPC is 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. In the near term (the next 2-3 years), the UPC will continue to support university users of GEMPAK. In the longer term, the UPC will announce a transition away from GEMPAK, while providing support for the final NCEP GEMPAK release until a suitable replacement is available for the university community. GEMPAK users will be encouraged to transition to the IDV by enhanced user training and the addition of GEMPAK-like capabilities. Simultaneously, the UPC will work with NCEP to make the AWIPS-II package available to the university community and provide support for it. Given its expected capabilities, AWIPS II will likely be of interest to the academic community for education and research.

The UPC received its first unrestricted copy of the AWIPS II source code in late July 2011. Program Center staff are evaluating the code and determining what steps will be necessary to create a package suitable for use by community members. Additional information, including previous announcements and FAQ on GEMPAK migration, is available at:

http://www.unidata.ucar.edu/software/gempak/nawipsmigration/
Software Training Workshops
Each year, the Unidata Program Center organizes training workshops, conducted by UPC software developers, on its software and data systems. These 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.
This year's training workshops, which were a tremendous success, were attended by 69 participants from 6 countries: United States, Canada, Mexico, Costa Rica, Spain, and Germany. The attendees represented a wide range of organizations, including universities, government agencies, research organizations, and the private sector.

Cyberinfrastructure Standards

Adoption of CF-NetCDF as an OGC Standard
In April 2011, the Open Geospatial Consortium (OGC) membership approved the Network Common Data Form (netCDF) Core Encoding Standard, and netCDF Binary Encoding Extension Standard - netCDF Classic and 64-bit Offset Format as official OGC standards.

Unidata and other OGC members 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 worked with the OGC to provide the formal specifications necessary for netCDF's adoption as an OGC standard.
Building Community

2011 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 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 2011 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, when AWIPS II is made available in the Fall 2011 time frame, to share data relevant to furthering Unidata’s mission with the community at-large.

We received a total of nine responses to the 2011 RFP and funded eight of them, partially or fully. The high success rate for award proposals should encourage others who may have hesitated to apply in the past.

<table>
<thead>
<tr>
<th>University</th>
<th>Project</th>
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<tr>
<td>New Mexico State University</td>
<td>Portal for Community Access to Meteorological, Satellite, and Model Archives</td>
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<tr>
<td>PI: David DuBois</td>
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<tr>
<td>Pennsylvania State University</td>
<td>IDD Ingest Relay Replacement in Support of the THREDDS/RAMADDA Server System</td>
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<tr>
<td>PI: Charles Pavloski</td>
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<tr>
<td>Rutgers University</td>
<td>Upgrade of Existing Computer Hardware to Facilitate Processing and Distribution of Large Oceanographic Environmental Datasets from the Rutgers University Coastal Ocean Observation Laboratory</td>
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<td>PI: John Kerfoot</td>
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<tr>
<td>San Jose State University</td>
<td>Server Upgrade and Electronic Map Wall at San Jose State University</td>
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<tr>
<td>PI: Alison Bridger and Marty Leach</td>
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Texas A&M University  
PI: Gerald J. Creager  
Upgrading LDM Server and Archive Systems to support Atmospheric Sciences at Texas A&M University and in the Broader Community

University of Colorado/CIRES  
PI: Catherine A. Smith  
Improving Access to a Climate Data Repository using Unidata Tools

University of South Florida  
PI: Jennifer M. Collins  
Upgrading Meteorological Analysis and Visualization Capability

University of Salento & CMCC, Italy  
PI: G. Aloisio, S. Siore, O. Marra  
Establishment of a Multiplexed THREDDS Installation and a RAMADDA Collaboration Environment for Community Access to Climate Change Data

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/

2011 American Meteorological Society Meeting

Several Unidata Program Center staff members attended the 91st annual meeting of the American Meteorological Society in Seattle, WA in January 2011. The conference theme — Communicating Weather and Climate — brought many opportunities for discussion of how Unidata technologies can facilitate the analysis and communication of observational and model weather and climate data.

The Tenth Annual AMS Student Conference and Career Fair, “Communicating Weather and Climate - The Role of a Young Scientist,” occurred over two days before the main conference sessions began. 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. Student interest was strong, with career fair attendees lining up to discuss Unidata’s offerings and opportunities.
Unidata’s booth in the main AMS Exhibition hall was also well attended. Program Center staff members were on hand to provide demonstrations of the Integrated Data Viewer and the current prototype of the AWIPS II National Centers perspective, and to meet with members of the Unidata community.

Results of the Community Survey
The community’s input is always a vital part of understanding community needs as well as defining and shaping the future of Unidata, and providing supporting metrics for the National Science Foundation, Unidata’s primary sponsor.

As noted in last year’s annual report, in late 2010, the Unidata Users Committee conducted a survey, posing 31 questions to the Unidata community to gather information about the users, understand their needs and assessment of the products and services from Unidata and the overall state of the program. The answers painted a picture of the evolving community and how it uses the data and tools Unidata provides, and how Unidata can better serve the academic community.

240 members of the Unidata community from 36 countries replied to the survey. Some of the other statistical highlights include:

Nearly half of the respondents identified themselves as researchers, indicating that adoption of Unidata products within the research community has increased.

A large majority (nearly 75%) identified themselves as specializing in Meteorology or Atmospheric Science. Respondents who listed the fields of Oceanography, Earth System Science, Environmental Science, Climate Science, and Computer Science as specialties also made up significant sub-groups.

Nearly half of the respondents report using Unidata tools and data more than five hours per week. About 97% of the users were either satisfied or highly satisfied with the Unidata program.

Program center staff have worked to address issues raised in the survey, including:

- Making it easier to use NetCDF libraries under the Windows operating system
- Enhancing ease-of-use of the Local Data Manager (LDM)
- Providing additional display features and control over use of system memory for the Integrated Data Viewer (IDV)
- Keeping GEMPAK users better informed about AWIPS II development

Featured Community Site: The University at Albany
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.
In the spring of 2010, the Department of Atmospheric and Environmental Sciences (DAES) at the University at Albany, State University of New York received funds from Unidata’s annual Community Equipment Awards program to renovate the department’s electronic map room. As a result, during the summer of 2010 our department purchased eight Dell Optiplex 780 desktop computers with dual-quad core CPUs (thus eight CPUs are available per unit) and eight GB of RAM. Seven of the systems sit in the DAES electronic maproom, while the eighth resides in the Principal Investigator’s office, for use as a development machine as well as an emergency hot spare.

The new machines have been a boon to the maproom’s users, as the computers they replaced (2006-vintage PCs) each had only a single CPU. In addition to the performance improvement attributable to the additional processing power, the fact that we are now able to use 64-bit CentOS 5 and Windows 7 operating systems allow users to allocate more than the previous limit of 1.5GB of RAM to Java-based programs, such as Unidata’s Integrated Data Viewer.

Maproom Software
Although the maproom is used by faculty, staff, and students, junior and senior level undergraduates are the heaviest users of the new machines. The students put a variety of tools to excellent use in local and national forecast contests, synoptic lab presentations and discussions, and class projects. Historically, Unidata’s GEMPAK/N-AWIPS software has been the most widely used meteorological display and analysis package in our department. Students are also exposed to Unidata’s Integrated Data Viewer (IDV) during the spring semester when they take the P.I.’s computer applications class.

The maproom also hosts two quasi-weekly research discussions, one led by Dr. Paul Roundy centering on tropical-extratropical interactions, and another hosted by Dr. Lance Bosart where recent interesting weather events are explored from a variety of temporal and spatial scales. Discussion participants use the maproom’s Crestron audio-visual system to display graphics from a variety of sources on the new workstations, from external websites to locally-installed packages such as MATLAB and NCAR Graphics in addition to Unidata software.
RAMADDA in the Maproom
Another key goal of the DAES equipment proposal was to enable sharing of data locally and externally via Unidata’s RAMADDA server. The department’s RAMADDA server was established prior to the funding of this proposal, and users can upload content easily with the IDV’s Publisher plugin as well as view content stored on RAMADDA. Currently, output from the DAES’ regional Weather Research and Forecasting (WRF) Model run is updated four times a day and served via RAMADDA. Users are also encouraged to use RAMADDA to house their IDV bundles of interest.

Organizational Advances

Development of Unidata’s 2011 Strategic Plan
In mid-2011, UPC Staff began work on creating a new Unidata strategic plan to guide activities for the development and implementation of our next five-year NSF grant proposal. While the plan is still in its formative stage, UPC staff and our governing committees have worked to elucidate a vision for how Unidata can better serve its core constituency of atmospheric science researchers and educators while reaching out to other geoscience communities. We encourage input from the UCAR community on the strategic directions and goals for the program going forward and how best Unidata can meet the evolving needs of educators and researchers in the atmospheric and related sciences. We anticipate that the development of the new strategic plan will be completed in early 2012 and the plan will be disseminated to the community for feedback.

Updated Unidata Web Site
Earlier this year, the UPC redesigned its web site to make it easier for users to find the information they are looking for and use. The visually more appealing, revamped site features new navigation features and reorganized menus.

Unidata is also replacing the monthly Unidata Community E-Letter with the News@Unidata weblog. Switching from the newsletter-on-a-webpage format to a blog will give the UPC the opportunity to communicate with its community more frequently — and make it easier for users to add your insights to the conversation via blog comments or social media.

As often happens with home-improvement projects, working on the big changes to the web site remains a work in progress and it has reminded us of other, smaller projects we want to tackle. But it is worth adding that the response to the redesigned web site from the community has been highly positive.

NSDL Program
National Science Digital Library
Program Director: Dr. Kaye Howe
http://nsdl.org

NSDL Network
2011 has been a year of transition for the National Science Digital Library (NSDL). In February 2011, the National Science Foundation announced that it will not continue to fund the National STEM Distributed Learning (NSDL) grant-making program within the Division of Undergraduate Education of the Education and Human Resources Directorate, as of September 30, 2011.
This change for the NSDL community was counterbalanced by NSF’s invitation to the Resource Center to submit a one-time proposal supporting a transition to long-term sustainability for NSDL, submitted to NSF in June 2011.

The NSDL network of collaborative partners (themselves networks of networks, assembled as NSDL portals on behalf of disciplines or audiences, and funded via the NSDL program in the National Science Foundation), and its coherent, shared history, with evolving, open relationships and resources—this network of interactive partners is, in fact, the platform of NSDL. The result has been continuous learning and adaptation as each of the partners learned both from its own immediate context, and relationships to others, then passed that learning on to the network.

This collaborative network is the foundation enabling NSDL to leverage its decade of experience in provision of digital teaching and learning, bring recent pilot projects to scale and to integrate new partnerships and new capacities into NSDL’s baseline value propositions as a nexus for STEM education reform.

- **Transitioning technical infrastructure** - NSDL is moving essential operational technical infrastructure from Cornell University to a combination of Cloud services and UCAR-based hosting services. These changes position the library for a sustainable future; streamline technical operations for efficiency. Completion is scheduled for late fall, 2011, with minimal impact on users.

- **Transitioning library collections** – a three-pronged approach to strengthen policies and processes around quality metadata, enhance the pedagogic utility of resources, and ready collections for the evolving ways that teachers want to find and use digital content:
  - **Learning Application Readiness** (LAR) - a framework for assessing how well educational resources, collections, and related metadata are aligned to educational goals, curriculum, or professional development needs of teachers and learners; and how readily curated resources and collections can be programmatically embedded in tools and services that educators and students use. LAR workshops conducted May and September 2011 to refine framework and guidelines.
  - **Alignment of NSDL resources to educational standards** addresses urgent national need for quality resources correlated to Common Core Math standards and (ultimately) Next Generation Science standards. NSDL is working with network partners to identify sets of their resources suitable for Common Core and Next Gen collection building.
  - Development of open **paradata** exchange with online communities of practice to unlock a flow of user activity data enabling observation of patterns of teachers’ digital content habits and to infer resource utility from actions of users themselves. Working with partners to collect and implement their user portal paradata into NSDL user interface, and to pass paradata elements along to interested partners for their use.

- **Redefining NSDL Network Effects**
  - **The STEM Exchange** - Initiated with cooperation of NSF and the White House Office of Science and Technology Policy, NSDL STEM Exchange is a new information system
around digital resources that can automatically capture and display aggregated real-time user interaction data as resources are annotated, reviewed, downloaded, embedded, shared, accreted, modified, and updated by user-practitioners through their professional online communities, social media spaces, and state and districts resource portals.

- Online practitioner communities within STEM Exchange use this network to disseminate NSDL LAR and Common Core resource collections. Activity throughout the Exchange in turn generates paradata that is fed back to NSDL core data repository and made visible alongside traditional resource metadata.
- Partnering with Butte County (CA) Dept of Education (Brokers of Expertise and CTEOnline), iCPALMS Pathway (Florida State Univ), and Intel.

  - **The Learning Registry** Learning Registry is an inter-agency initiative led by the Office of Educational Technology at the U.S. Department of Education and the Advanced Distributed Learning Lab at the Department of Defense that is building a deeply back-end, but lightweight, “messaging” system infrastructure to support the exchange of learning resources, and their metadata and paradata (US Dept. of Education 2011a).
    - NSDL sits on the Registry’s Technical Working Group and is a core development partner since the project’s inception. A beta launch is targeted for Fall 2011.
    - STEM Exchange is the primary proof-of-concept project for the Learning Registry technical platform.
    - **Paradata** is a central construct for the project, and the NSDL CommPara framework is being adopted as the default framework for the launch of the Learning Registry.
    - NSDL continues its leadership in refining the construct of paradata, as use cases throughout the Registry community rapidly expand.
    - NSDL hosting the second LR PlugFest in December 2011, an event that encourages anyone in the open community to rapid test the codebase and develop new functionalities

NSDL leadership on defining paradata practices and working group participation in the Learning Registry aids NSDL positioning among the federal agencies and other stakeholders who are convening and funding education reforms and innovations. These activities provide us with opportunities to bring the capabilities of NSDL to the table; and to demonstrate the value of our community knowledge and lessons learned, our corpus of learning content, and our unparalleled network of STEM education partners. Through this work we are positioning NSDL at the front of the conversation around the next generation of digital content.

- **Additional partnership collaboration**
  - NSDL is partnering with the **Consortium for School Networking (CoSN)** in the construction of a professional certification program for K12 school Chief Technology Officers (CTOs) that elevates their expertise, provides professional development, and promotes their educational leadership.
  - **Southern Regional Education Board (SREB)** – working with them to build a consortium of state-level learning object repositories, and a student-centered learning portal.
Integrated Information Services (IIS) integrates library and information research, development, and operations of the NCAR Library with the Digital Learning Sciences (DLS) program in UCP. IIS supports UCAR efforts to manage, preserve, and provide access to its scholarship and other intellectual assets for the broad research and education community.

IIS provides an organizational structure that
- Allows the Library to better respond to the current and future information needs of NCAR, UCP, and the larger UCAR community
- Leverages the expertise of Library and DLS staff, bringing technical expertise to Library projects and a community of users and operational environment for DLS technologies
- Integrates staff and resources of DLS and the NCAR Library

Digital Learning Sciences (DLS) remains a program in UCP and is a collaboration between UCAR and the Institute of Cognitive Science at the University of Colorado at Boulder. Its mission is to support the development of systems and services that enable science and educational organizations—school districts, universities, libraries, and publishers—to organize, manage, comprehend, and enrich online resources to improve learning outcomes and learner engagement. With its partners, DLS develops advanced learning tools and infrastructure and services to manage digital objects. It also investigates how cognitive tools, computational algorithms, and user-centered interfaces can improve learning and engagement.

**UCAR Data Reference & Citation**

IIS recently hired Matthew Mayernik to work with UCAR/NCAR data managers to develop a coherent strategy and organization-wide policy on data citation across UCAR/NCAR data centers. Matt joined UCAR after completing his Ph.D. in Information Studies (2011) from the UCLA Department of Information Studies. His work within the NCAR library is focused on developing research data services; his research interests also include metadata practices and standards, cyberinfrastructure development, and social aspects of research data. IIS will utilize its expertise in information science, discovery, curation, and research to the requests for transparency and replicability of science through formal mechanisms for data citation.

**Data Curation and Education in Research Centers (DCERC)**

DCERC, a project funded by the Institute of Museum and Library Services, is a partnership between the NCAR Library, the University of Illinois Graduate School of Library and Information Sciences, and the University of Tennessee School of Information Sciences. DCERC will develop a model for educating Library and Information Science masters and doctoral students in data curation through field experiences in research and data centers.
NCAR will provide summer research experiences for three masters students in 2012 and 2013; three doctoral students will spend two semesters at NCAR in 2013-14. The goal is to provide research and practice-oriented opportunities for students to engage with a variety of observation, model, and simulation data. While at NCAR, students will participate in data rich activities related to field campaigns or other scientific research projects. They will be paired with science and data mentors based on their areas of interest and technical skill levels. Particular attention will focus on aligning the research or practice-oriented interests of students to a particular research or data environment at NCAR. NCAR labs with the opportunity to host/mentor these students include EOL/CDS, CISL/RDA, and NESL/CCRS.

“Inquiry Hub”

Inquiry Hub builds on the DLS Curriculum Customization Service (CCS) work with Denver Public Schools, formalizing partnerships with districts and publishers. DLS continues to focus on developing and creating environments to support educators to customize instruction and personalize learning. The aim is to improve learning outcomes and learner engagement through scalable, cost-effective software tools supporting personalized learning, informed by cutting edge learning science research on human cognition and language processing.

The data we gathered during the 2009-2010 DPS field trial indicate that teachers integrated digital resources more frequently and more efficiently into their instructional practices. While the CCS was designed to most directly impact planning and professional development, we also discovered that classroom teaching also was impacted when many educators incorporated the CCS directly into their day-to-day in-class routine by projecting instructional artifacts such as lab activities and animations onto a screen during class, and by making supplementary instructional materials directly available to students via their own teacher websites and wikis. A multi-district study is now underway to further evaluate impact on teacher practice and student learning in Earth and physical science in six school districts in Colorado, Utah, and Nevada.

With NSF funding, a new 4-year award will support addition of new science and mathematics curriculum developed by key publishing partners, It’s About Time, Kendall/Hunt, and Key Curriculum Press. This effort is poised to provide the key tools and services needed to dramatically scale learner-centered STEM teaching and to sustain its implementation in mainstream classroom settings.

OpenSky

Launched in the fall of 2010, OpenSky, the institutional repository serving UCAR, NCAR, and UCP, has entered into an operational phase in its development. Its initial purpose was to provide broad community access to UCAR’s scholarship and other intellectual assets while serving to generate metrics on the institution’s publishing productivity. We recently updated the OpenSky submission form in response to user comments and requests to streamline processes and provided training to support the accelerated 2011 NCAR Annual Report deadlines. We are now engaged in a more comprehensive focus on metrics, understanding measures of impact and incentivizing preservation and dissemination activities, and this will drive the next phase of OpenSky’s development.
In February, NSF announced plans to discontinue funding of the NSDL program as of September 30, 2011. Current awardees received their last year of funding and will continue their work to end of their grants; this includes both DLS and the NSDL Resource Center. In addition, at NSF’s request, the NSDL Resource Center led the submission of a proposal to support repositioning NSDL for the next generation of digital learning. NSF will provide funding for this work, which is also intended to plan for the sustainability of NSDL. In this new configuration, IIS will continue to provide support for the technical infrastructure and curation of collections of resources that underpin the NSDL.

Data Conservancy
For the past 2 years, UCAR has been partnering with Johns Hopkins University on this DataNet project. NSF funding for the forthcoming year of the Data Conservancy (DC) was cut from $5 million to $2 million, and the NSF has determined that this will be the final year of funding for the DC. With the re-focusing of the project’s direction, UCAR’s funding from DC has been reduced to support a portion of a post graduate scientist, working with Patricia Romero-Lankao on a meta-analysis of societal impacts of climate change, and a portion of a research data services specialist (Matt Mayernik) to focus on Broader Impacts. Matt will continue to work on broader impacts and in support of data management planning.
Visiting Scientist Programs
Program director: Meg Austin
http://www.vsp.ucar.edu/ and http://www.vsp.ucar.edu/Heliophysics/

VSP helps prepare the next generation of weather and climate scientific leaders and workforce by supporting effective and collaborative fellowship, visitor, and workshop programs that meet emerging training and research needs.

NOAA awarded a new 5-year Cooperative Agreement to VSP to continue its collaborative relationship in research and training programs. VSP also receives funds from NASA and the Department of Defense for similar programs and workshops.

Annual Postdoctoral Fellowship Program Deadlines:

- Postdocs Applying Climate Expertise (PACE)
  - 4 January 2012

- Jack Eddy Postdoctoral Fellowships
  - 11 January 2012

- NOAA Climate & Global Change Postdoctoral Fellowships
  - 18 January 2012

In 2011, the following universities and labs benefitted from new VSP appointments:

- University of California, Irvine
- Princeton University
- Massachusetts Institute of Technology
- Harvard University
- Lamont Doherty Earth Observatory
- Woods Hole Oceanographic Institute
- University of Washington
- California Institute of Technology
- University of Minnesota
- University of Colorado, CIRES
- Scripps Institution of Oceanography
- University of California, Davis
- University of Texas
- University of Illinois
- Harvard Smithsonian Center for Astrophysics
- Naval Research Laboratory
- NOAA labs
- Air Force Weather Agency
In April, VSP and NOAA celebrated the 20th anniversary of the Climate and Global Change Postdoctoral Fellowship Program with a two-day symposium in Washington DC, including a reception on Capitol Hill. Alumni, hosting scientists, and NOAA sponsors gathered for this noteworthy event.

**UCAR Community Reviews of Federal Agencies**
VSP organizes and supports the UCAR Community Advisory Committee to NCEP. A panel of experts reviews each Center and written reports are submitted to UCAR’s president for discussion with NCEP leadership.

VSP is currently working with the NOAA Office of Hydrology to establish a similar review process.

**Workshops**
VSP organizes and administers workshops, summer schools, and meetings that foster collaboration and relationship building among scientists in the community.

**2011 Workshops and Meetings**

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<tr>
<th>Date</th>
<th>Event Description</th>
<th>Location</th>
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<tr>
<td>January 25, 2011</td>
<td>NCEP Review Update at AMS – Seattle, WA</td>
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<td>March 22-23, 2011</td>
<td>C&amp;GC Steering Committee Mtg. – Miami, FL</td>
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<td>April 14-15, 2011</td>
<td>C&amp;GC 20th Anniversary Symposium &amp; Celebration, Silver Spring, MD</td>
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<td>April 25-29, 2011</td>
<td>Space Weather Workshop – Boulder, CO</td>
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<td>June 26 - July 1, 2011</td>
<td>CEDAR GEM Joint Workshop – Santa Fe, NM</td>
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<td>July 29 - August 3, 2011</td>
<td>Heliophysics Summer School – Boulder, CO</td>
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<tr>
<td>October 11-13, 2011</td>
<td>US/UK Joint Space Weather Workshop – Boulder, CO</td>
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<td>October 12-14, 2011</td>
<td>UCACN Kick-off/NCEP Strategic Plan Meeting – Columbia, MD</td>
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<td>December 6, 2011</td>
<td>C&amp;GC Postdoctoral Fellowship Lunch Meeting at AGU – San Francisco, CA</td>
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Gene Martin
On August 3, 2011, Gene Martin, director of JOSS, died after a brief illness. He was a UCAR leader who traveled the globe for decades, laying the groundwork for atmospheric field projects. Gene came to NCAR in 1978 and was a key member of JOSS’s staff for many years.

Gene began his career as an administrative assistant to Walter Orr Roberts, NCAR’s first director. In 1982, Karyn Sawyer hired him to work in the International Program Office, the precursor to JOSS and one of UCP’s first programs. Together they built the office that became JOSS. Gene was known for his ability to improvise and get difficult tasks accomplished, often in foreign destinations.

Gene became JOSS deputy director and, when Karyn moved to EOL in 2005, assumed the director role. He was known among his staff and colleagues for being outgoing, straightforward, and funny. He had high expectations, was very passionate and cared a lot about his staff. He will be greatly missed.

In the meantime, JOSS welcomes back Karyn Sawyer as its Director for an extended period of time as it moves into the future.

Here’s what JOSS does:
For almost 30 years, JOSS has been a team of professional and skilled technical and administrative specialists whose mission is to collaborate with the scientific community. JOSS works closely with scientists and research managers to plan, organize and conduct scientific programs in the most productive, efficient and cost-effective ways.

- **Staffing**: Assembles and manages special project staff, and provides a broad range of administrative program support activities effective for accomplishing limited-term programmatic functions within community organizations. JOSS currently has 14 on-site and 38 off-site staff.
- **Financial Planning**: Works with research Principal Investigators and Federal program managers to provide financial planning for programs/projects based on historical data, expenditure projections, and financial trends.
- **Meetings**: Plans and implements scientific meetings and workshops, utilizing expert event-planning staff, effective multi-media tools, and remote conferencing technologies. This allows scientists and research managers to focus on meeting content, rather than logistics.
- **Documentation**: Facilitates the preparation and dissemination of reports in hardcopy and electronic formats; builds and maintains programmatic websites. In addition, JOSS collaborates with federal program managers and designated science directors of other scientific programs.
- **Education**: Promotes education for early career scientists, improves the interactions of educators and students with scientists, and facilitates the distribution of significant scientific media.
Examples of FY 11 activities:
In the past year, JOSS arranged travel for over 1400 scientists and non-federal stakeholders to events around the world.

400 scientific events were supported with a variety of services; 25 of these received on-site support from JOSS staff.

JOSS continues to support The Intergovernmental Panel on Climate Change (IPCC) on the Fifth Assessment Report (AR5). It will consist of three Working Group (WG) Reports and a Synthesis Report, to be completed in 2013/2014. JOSS is specifically supporting WG II: Impacts, Adaptation and Vulnerability – due mid March 2014.

More than 800 authors, are involved in writing the reports. First Lead Authors meetings have been held along with a number of workshops and expert meetings in support of the assessment process.

JOSS has been involved with these series of reports since 1997.

WCRP
JOSS has been chosen to provide organizational and logistical support to The World Climate Research Programme’s International Open Science Conference (OSC) on 24-28 October 2011 in Denver, Colorado. WCRP is sponsored by the World Meteorological Organization (WMO), the International Council for Science (ICSU) and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO).

A better understanding of the behavior of the climate system and its interactions with other Earth system components is critical to predict its future evolution, reduce vulnerability to high impact weather and climate events, and sustain life. To prepare for meeting these challenges, the WCRP Open Science Conference provides a unique opportunity to bring together major disciplines and leaders of the Earth system research community to help identify opportunities to advance further understanding and prediction of variability and change in the Earth’s climate system from seasons to centuries, and from regions to the entire globe. This need is perhaps greater than ever before given that humans have emerged as the dominant agent of future change. To advance on such challenges, the WCRP will assemble for the first time ever its entire research community, and engage other key international research programs, in a major Open Science Conference (OSC) in October 2011. The OSC will facilitate cross-fertilization across the diverse research communities within the WCRP, as well as with other international research programs, including the International Geosphere-Biosphere Programme (IGBP), the World Weather Research Programme (WWRP) and the Earth System Science Partnership (ESSP).

The OSC will appraise the current state of climate science, thereby making a measurable contribution on the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). It will identify key opportunities and challenges in observations, modeling, analysis and process research required to understand and predict responses of the Earth as a system.

In addition, by entraining as many young scientists and students as possible from across the world, including less-developed and developing countries, the OSC will facilitate growth of the diverse future workforce needed to meet the increasingly complex scientific challenges of the future.
FUNDING
JOSS's new 5-year Cooperative Agreement with NOAA totals $53M. This new agreement is for JOSS to assist Earth system science by providing infrastructure and community support to the applied research activities.

JOSS has also been notified that NSF will extend the Cooperative Agreement for Climate Change Collaboration Activities through FY12 with funding totaling about $5M. These activities include the USGCRP National Climate Office and the IPCC TSU Working Group 2 and Participant Travel.

These awards are necessary to JOSS in order to continue a long history of service to our community. They represent a continuing vote of confidence from our community.

GLOBE Program
Global Learning and Observations to Benefit the Environment
Program Director: Dr. Andy Tasker
http://www.globe.gov

Andy Tasker began work as the new Director of the GLOBE Program Office in June 2011. His background includes running both an environmental NGO and commercial biodiversity consultancy, as well as being GLOBE UK Country Coordinator since 1997.

In July, GLOBE had a successful International Meeting in Washington DC, attracting 180 participants from 46 countries and 26 U.S. States. NASA's Chief Scientist, Dr Waleed Abdalati gave an inspiring introduction, with papers and posters from the GLOBE Community world-wide. The meeting focused on new directions for GLOBE, discussing a new five-year Development Strategy for the international partnership that had been prepared for the meeting. An Annual Review for 2010 was also circulated to delegates, then mailed to the remainder of the 110 countries and 46 states that make up GLOBE.

A Board for the GLOBE Program Office (GPO) has been formed, comprising representatives of GLOBE’s key funders (NASA, NOAA & NSF) and UCAR. Having been actively involved in the day-to-day management of the GPO in the first half of 2011, the Board is now moving to a more strategic role, advising on direction rather than on the details of running the office.

The GLOBE Student Climate Research Campaign was launched on 12 September, with an internal focus on engaging existing GLOBE schools in the first phase. In November an updated series of activities will be launched to a global audience. The $1.2 million NSF-funded ITEST project is now back on track, with a new Coordinator to support the teacher network and develop innovative new technologies for learning and for teacher-scientists collaborations.

Thanks to additional support from NASA, a new website is being developed for GLOBE that will allow interactive participation between teachers, students and scientists, as well as continuing to promote the collection and analysis of data. The first phase of this website comes on line in November, operating on new hardware that NASA is also providing. New data visualizations will be developed from then until April 2012 when the project concludes.
The concept of GLOBE e-Teachers is being reviewed, with the aim of getting this new process approved and operational before launching the new website. This should ensure that teachers attracted by the website can then get involved with GLOBE straightaway through an on-line training process. They can then sign up for the traditional hands-on training at a later date.

There have been continuing changes in staffing, as we re-shape to provide a more focused delivery of our plans, with a new Technology Manager and a Communications Manager both starting before the end of September. In addition new internal management systems are being developed to ensure that GPO delivers its agreed targets.

Internationally, the GLOBE Regional Offices in Africa (South Africa), Asia-Pacific (India), Europe (The Netherlands), Latin America (Argentina), the Near East (Jordan) and North America (Texas) are developing well. In addition to providing a more local focus to GLOBE’s work, they have also helped re-energize countries where activity had been reduced, and also attracted significant regional funding.

Finally, a start has been made on registering the GLOBE Center as a 501(c)(3) not-for-profit organization to carry out future fundraising work in the areas of charities, foundations and commercial sponsors. These sources would enable GLOBE to fund international projects as well as providing resources for US teachers and science education centers.