

## **Interim Report for FY2004 (October - December) EAR-0321760, Support of UNAVCO Community and Facility Activities**

The Fall 2004 AGU meeting in San Francisco capped an exciting year of Facility support to the GPS community. The scope of Facility work is well represented by the numerous AGU talks and posters with staff participation (see references listed below). The focus of these presentations included expanding data archival requirements associated with the PBO; support of the U.S. Existing Networks project and other individual investigator field projects; the new PBO campaign equipment package (also exhibited at the UNAVCO booth, see photo below); a number of new and ongoing Education and Outreach resources; and visualization and information technology developments that are part of UNAVCO's involvement in the GEON ITR NSF project. A revamped UNAVCO booth also made its first appearance at the AGU since the formation of UNAVCO, Inc. and had a nearly continual stream of visitors interested in Facility and PBO activities, discussing future projects, and the latest in GPS technology available from UNAVCO.

Also meeting at the AGU was the newly formed Facility Standing Committee. This committee, with Prof. Tim Dixon as Chair, joins the PBO Standing Committee and the Education and Outreach Committee as one of the key advisory groups for UNAVCO. The Facility Standing Committee reviews the policies and effectiveness of the UNAVCO Boulder Facility in meeting its commitments to its user community and in achieving the goals of the UNAVCO Strategic Plan. The Committee is appointed by and reports to the UNAVCO Board of Directors and will look at technology developments, equipment and engineering resources, archiving guidelines and new initiatives to enhance the effectiveness of the Boulder Facility, as well as advising the Facility Manager and the UNAVCO President on program planning, yearly budgets, and resource allocation.

In addition to rapidly growing raw GPS data collections in the UNAVCO Archives, the Facility is also supporting development of GPS product collections, including velocity and strain solutions. The most comprehensive effort, the "Global Strain Rate Map" project (Kreemer, and others, 2003) combines the velocities from many UNAVCO-supported projects into a simultaneous plate motion and plate boundary deformation solution. Version 2.0 of the GSRM was released earlier this year and results can be explored in an interactive fashion at the GSRM website. GSRM results are also the basis of several of UNAVCO's Education and Outreach tools, where plate motions, strain rate, and deformation style can be viewed along with comparative geophysical map information.

We present below some highlights of Facility activities for the quarter, the Global Strain Rate Map as the Featured Project, and monthly Facility reports (Oct-Dec 2004).

## Facility Presentations and Activities at the 2004 Fall AGU Meeting in San Francisco



The UNAVCO booth at the Fall AGU meeting.

Anderson, G., K. Feaux, M. Jackson, W. Prescott, C. Stolte, and J. Wright (2004), **The Plate Boundary Observatory: Operational Status and Data Plans**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract G21A-0130.

Bensen, G.D., C.M. Meertens, and A.F. Sheehan (2004) **Information Technology Developments for Geodynamics**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract SF41A-0760.

Blume, F., G. Anderson, J.T. Freymueller, T.A. Herring, T.I. Melbourne, M.H. Murray, W.H. Prescott, R.B. Smith, and B. Wernicke (2004), **The PBO Nucleus: Integration of the Existing Continuous GPS Networks in the Western U.S.**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract G21A-0133.

Estey, L., P. Pappalardo, and C. Meertens (2004) **Jules Verne Voyager: A Web Interactive Tool for Comparative Planetology**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract ED13C-0732.

Eriksson, S.C., C.M. Meertens, L. Estey, M. Weingroff, M.W. Hamburger, W.E. Holt, and G.A. Richard (2004), **Voyager Interactive Web Interface to EarthScope**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract ED13E-0750.

Hamburger, M.W., G. Galgana, E. Corpuz, and B. Bartel (2004), **Volcano-Tectonic Deformation at Taal Volcano, Philippines**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract G43C-05.

Meertens, C.M., D. Seber, and M. Hamburger (2004), **Seismic Sensors to Supercomputers: Internet Mapping and Computational Tools for Teaching and Learning about Earthquakes and the Structure of the Earth from Seismology**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract ED32A-03.

Meertens, C.M., D. Murray, and J. McWhirter (2004), **Collaborative Visualization and Analysis of Multi-dimensional, Time-dependent and Distributed Data in the Geosciences Using the Unidata Integrated Data Viewer**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract SF13A-0710.

Phillips, D.A., J. Greenberg, J. Sklar, C.M. Meertens, V. Andreatta, and K. Feaux (2004), **The Campaign GPS Component of the Plate Boundary Observatory (PBO): New Tools, New Strategies and New Opportunities to Support EarthScope Investigations**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract G51B-0082.

## 1.1 Facility Highlights

### NSF/EAR Program Support

#### *University PI Project Support*

Twelve different projects funded by NSF/EAR programs were provided engineering and equipment support during the quarter (Table 1). The project mix included six permanent networks involving installation, operation and ongoing maintenance; five campaign or mixed mode projects involving episodic deployment or personnel and equipment; and one long-term receiver test. Proposal planning and budget development support was provided for six new projects proposed under NSF programs on the December deadline.

| <b>Project Name</b>           | <b>PI</b> | <b>Mode</b>       | <b>Support Provided</b>   |
|-------------------------------|-----------|-------------------|---|
| Parkfield Earthquake Response | DeMets    | Campaign          | Equipment and technical support to two surveys since September Earthquake.  |
| BARGEN                        | Wernicke  | Permanent Network | Extensive operations support to regional scale network. Planned and ordered equipment for 18 station network expansion. |
| Bhutan                        | Billham   | Mixed Mode        | Remote technical support and troubleshooting.   |
| Colombia Earthquake Response  | Mora      | Campaign          | Helped PI access available equipment for earthquake response deployment.  |
| Cotopaxi Volcano              | Dixon     | Permanent Network | Remote technical support and troubleshooting. Planning for new installations in 2005.                                   |
| Eastern Mediterranean         | Reilinger | Mixed Mode        | Equipment integration and remote technical support for multiple stations.   |
| Mauna Loa                     | Brooks    | Permanent Network | Planned installation of 12 station network in 2005.   |
| Philippines Volcanoes         | Hamburger | Permanent Network | Remote technical support and troubleshooting.   |
| Pseudorange Bias Testing      | Larson    | Testing           | Purchased environmental test chamber and began assembling laboratory equipment.   |
| RETREAT/Italy and Croatia     | Bennett   | Mixed Mode        | Equipment and field support.  |
| Suominet                      | Multiple  | Permanent Network | Support to one new station installation and technical support to another existing station.                              |
| UNR/Las Vegas                 | Blewitt   | Permanent Network | Remote technical support and troubleshooting.   |
| Block Kinematic               | McCaffrey | Campaign          | Equipment   |

**Table 1. NSF EAR Funded Projects Supported During Quarter**

*Western US Existing Networks Project Support.* Work on upgrades continued during the quarter, with seven more existing stations now meeting PBO standards. Plans for further upgrades in California in the near future are in place. Excellent data flow was maintained for all stations through coordinated troubleshooting when necessary - network operators as well as UNAVCO employees made several onsite repairs. Project personnel also took the lead in diagnosing and solving technical issues that arose with the PBO-standard CDMA

communications hardware, and are helping to coordinate testing of the latest Trimble NetRS firmware release with PBO. A poster summarizing the current operational status and scientific results of the project was presented at the AGU Fall Meeting in December.

*Plate Boundary Observatory Project Support.* Firmware version and accessory software testing was conducted by the Engineering Group for both NetRS and GB-1000 receivers to evaluate new functionality implemented by vendors for the PBO project. Campaign engineering support for EarthScope science projects was planned within the Engineering Group and staffing assignments were made. Campaign accessory equipment and packaging was designed and approved by PBO management and a budget was established to support necessary procurements. Planning to beta test the new GB-1000 receivers on the MAGNET network in California and Nevada was initiated in conjunction with UNR and PBO staff. Planning for the PBO permanent stations at collocated US Array stations continued with USGS/ASL, with a budget being established and GPS receivers and accessories ordered. Technical coordination with ASL on site reconnaissance was initiated.

*PBO/Warehouse Activity.* The warehouse has been configured with additional shelving and lab and assembly areas. The Facility hired a PBO Depot Technician who will assume the equipment ordering, testing, and kitting responsibilities for PBO. The Inventory Database development is complete and a physical inventory and Government Property check will be completed by the end of the year at the Facility and at all PBO Regions. Fiscal year forecasts are being added to aid in earned value reporting for PBO.

**NASA/SENH Program Support.** The UNAVCO Facility responded to approximately 350 individual trouble and maintenance issues during this fiscal quarter, including major equipment and communications upgrades at a dozen of the GGN sites. Poor tracking performance at several stations led to discovery of several defective GPS receivers, which are being repaired by the manufacturer at no cost, though with significant effort and cost to retrieve and replace at installed locations around the world. Continued improvements to network and site operating systems have been systematically adopted and distributed to the remote stations. Building upon successful transition of primary network monitoring, operation and maintenance responsibilities as reported in the April-June quarterly report, the UNAVCO Facility's role in supporting the GGN and IGS activities continues to positively evolve. The FY2005 NASA statement of work was developed in conjunction the relevant JPL staff members. New tasks will include planning for enhancements to IGS reference frame stations to improve the stability of time series observations at core locations, performance and functional evaluation of GPS receivers that could be adopted within the GGN in the future, establishment of operating agreements at new station locations and increased business operations support to the IGS Central Bureau.

**NSF/Office of Polar Programs Support.** The Antarctic field season is currently underway with projects supported on Mt. Erebus, the McMurdo Dry Valleys, the Trans Antarctic Mountains, the West Antarctic Ice Sheet, the Amery Ice Shelf, and the Polar Plateau. A record 80 receivers were deployed for this effort, and field engineering support is provided from McMurdo Station from mid-October through January. Recent highlights include the installation of a year-round repeater on Mt. Erebus to enable Ethernet communication with

continuous GPS installations in the Trans Antarctic Mountains, and upgrading two sites with the new Ethernet enabled Trimble NetRS receiver. Iridium satellite data modems have been integrated and tested with the Trimble NetRS receiver, and a prototype deployment is planned for next month at a remote, autonomous Antarctic site. This system provides a low power, global communication option for GPS data retrieval, and applications are anticipated in both the Arctic and Antarctic. A “Remote Station Engineering” section was added to the Polar web section ([http://www.unavco.org/facility/project\\_support/polar/polar.html](http://www.unavco.org/facility/project_support/polar/polar.html)) to serve as a repository of relevant information as remote permanent station systems evolve. The recently completed 2004 annual Arctic report is also available on this page.

**General Support and Infrastructure Development.** The Engineering Group announced a new Community group buy of Trimble and Topcon GPS receivers. Details can be found on the UNAVCO web site ([http://unavco.org/facility/project\\_support/campaign/equipment/purchase/feb\\_04\\_mass\\_buy/feb\\_04\\_announcement.html](http://unavco.org/facility/project_support/campaign/equipment/purchase/feb_04_mass_buy/feb_04_announcement.html)). Testing and various user documentation was developed for equipment, including Iridium satellite transceivers, IP radio modems, CDMA modems, Zephyr antenna mixing, and a low power PC by the Engineering Group during the quarter. Several sections of the Facility web site were updated with new information.

To support PBO and the Existing Networks project, Data Group personnel have worked with receiver manufacturers to assist them in providing data in BINEX format from the receiver. The GPS handling software toolkit “TEQC” has been enhanced in its BINEX handling capability.

Both the PBO and International Health and Safety Plans were finalized. John Owen was officially designated as the UNAVCO Health and Safety Manager. First aid training was provided to PBO staff in Riverside and a successful Emergency Response Team drill was conducted

## **Archiving and Data Management**

*Permanent Stations.* Data and metadata from forty new PBO sites, for a total of sixty-four PBO sites are being archived at UNAVCO. In addition to the forty new PBO sites, twenty-one new sites from Antarctica, New Zealand, Iran, Mexico, Alaska, Hawaii, and the continental United States were added for data management and archiving this quarter. This brings the total active global permanent stations archived at UNAVCO to 433.

*Campaigns.* Archiving was completed this quarter for twenty campaigns: Antarctica Support 2003/2004, Bench Glacier 2003, Columbia Glacier 2004, India Shillong 2004, Jamaica 2004, Kuparuk 2003, Lebanon 2002, Longs Peak 2004, Mississippi Delta 2003, Mississippi Delta 2004, Nepal 2001 revisited, Nepal 2004, Nepal Khumbu 2004, Oregon/Washington 2004, Poas Volcano Gravity/RTK 2002, Philippine Sea Plate 1991, SILVVER 2003, Taku Glacier 2003, Toolik 2003.

Data pickup from the Archives ftp pickup area now averages 2 Gb per day, compared to 500 Mb per day one year ago. To support the rapidly growing archive and data management data

volumes and reliability requirements, significant investments were made in archive computing and disk storage hardware.

**Education and Outreach.** (Susan Eriksson, UNAVCO E&O coordinator)

*Increasing Diversity.* UNAVCO submitted a proposal to the Opportunities for Enhancing Diversity in the Geosciences on October 18, 2004. RESESS (Research and Education in Solid Earth Science for Students) is a multidimensional program, combining structured mentoring, ongoing research internships, and a supported learning community for undergraduate and graduate students from underrepresented groups in order to increase the diversity within solid earth sciences. UNAVCO is the lead organization with NCAR, IRIS, USGS (Golden), University of Colorado, University of Central Washington, and Highline Community College (Seattle) participating. We requested \$1.6 M for a five-year program. The goal of the program is to increase the number of individuals from underrepresented populations who complete Masters' and PhD degrees in solid earth geosciences.

Facility staff will act as mentors for research projects, written and verbal communication, and community. This proposed project will also help build our student base in geodetic research which will contribute to a robust UNAVCO community in the long term.

*Jules Verne Voyager Tools.* Two groups of students completed their semester-long study of the design for Voyager Sr. and EarthScope Voyager Jr. This is part of the Facility's participation in the EarthScope-funded project of PI's Michael Hamburger and Bill Holt, *Collaborative Mapping Tools.* Facility staff member Lou Estey is currently adding new data sets to Jules Verne Voyager Sr. including magnetics (North America and global), heat flow (North America), global tomographic models, gravity (Bouguer and free-air anomaly maps), continually updated earthquake locations, active faults, crustal thickness and mantle velocity data base, and updates to EarthScope (e.g., site installation status). Susan Eriksson of UNAVCO and Marianne Weingroff of the DLESE Program Center are working with Hamburger on curricular material, redesign of the interface, and evaluation of the EarthScope Jr. Project participants met at the Fall AGU meeting to review project progress and plan 2005 activities.



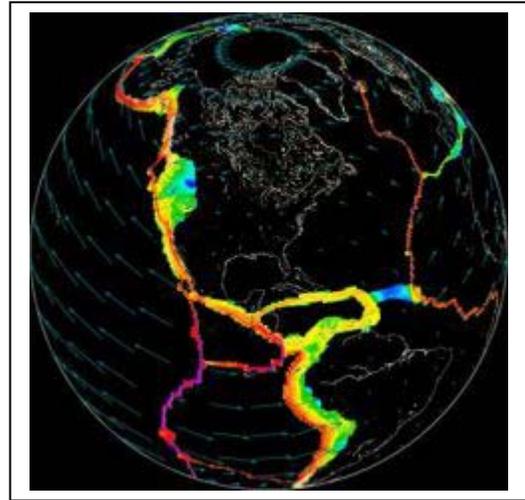
Emily Elliott, Camille Dodson, Joe Kahim, Anh Dang (above), University of Colorado undergraduate students in a *Technology for Community* course have worked with other undergraduates taking a geology course to test and design a new prototype for the EarthScope Voyager Jr.

## 1.2 Quarterly Featured Project

|                                |   |
|--------------------------------|---|
| <b>Project:</b>                | Global Strain Rate Map Project                            |
| <b>PIs:</b>                    | Bill Holt (SUNY Stonybrook) and Corne Kreemer (U.N. Reno) |
| <b>Funding Agency/Program:</b> | NSF EAR   |
| <b>Dates:</b>                  | On-going  |
| <b>UNAVCO Staff:</b>           | Lou Estey and Chuck Meertens                              |

### Summary:

The Global Strain Rate Map (GSRM) quantifies the complete present-day surface motions for the Earth's tectonic plates and the boundary zones between plates through a globally self-consistent model. Plate boundary zones, where plates are created and destroyed, generate the vast majority of damaging earthquakes and volcanic activity in the world.



This project is part of the International Lithosphere Program and is supported by the National Science Foundation through grants to the Principal Investigators, Bill Holt and Corne Kreemer (EAR-0310193), and to UNAVCO (EAR 0321760). The elucidation of tectonic motions at plate boundary zones, such as the San Andreas Fault in the western U.S., is one

unique, fundamental result of the GSRM. EarthScope's Plate Boundary Observatory, supported by UNAVCO, will contain 875 new continuous GPS sites to gather more data over the next 15 years and, together with extensive seismic imaging and deep drilling in the San Andreas Fault, will provide an unprecedented view of plate boundary processes.

UNAVCO has supported the creation and utilization of the GSRM at multiple levels and hosts the project website (<http://www.world-strain-map.org>). The model includes thousands of GPS measurements spanning two decades of effort and 86 different published studies, the majority of which received support from UNAVCO through equipment, engineering, or archiving. One key to the production of the GSRM is the availability of data, velocity solutions, and crustal strain models from the UNAVCO Archive. The long-term availability of GPS data and products from the Archive is crucial to the completeness and ultimate value of scientific projects such as the GSRM. The model investigators have collaborated extensively with UNAVCO to incorporate the GSRM into UNAVCO's Voyager interactive research and teaching visualization website ([http://www.unavco.org/edu\\_outreach/edu\\_outreach.html](http://www.unavco.org/edu_outreach/edu_outreach.html)).

### Notable Aspects of this Work:

- Scientists and engineers have an unprecedented tool to foster the understanding of geodynamic processes with the intricately detailed view of global surface motions

available from the model and viewable through UNAVCO's Voyager Web mapserver. This understanding will lead to better forecasting and mitigation of earthquake and volcano hazards.

- The model integrates the work of hundreds of investigators around the world.
- The model leverages GPS data and products available to all through the UNAVCO Archive.
- The GSRM is a simultaneous solution of GPS-derived site motions, seismic moment tensor solutions, and geologic fault slip data. This multi-disciplinary combination ensures a comprehensive global view of plate boundary strain rate.

Kremer, C, A.J. Haines, W.E. Holt, G. Blewitt, and D. Lavalée, On the determination of a global strain rate model, *Earth Planets Space*, 52, 765-770, 2000.

Kremer, C., W.E. Holt, and A.J. Haines, An integrated global model of present-day plate motions and plate boundary deformation, *Geophys. J. Int.*, 154, 8-34, 2003.

**Interactive Web Interface to the Global Strain Rate Map Project**  
<http://www.world-strain-map.org>

**Abstract**  
 An interactive web interface allows users to explore the results of a global strain rate and velocity model and to compare them to other geoscientific observations. The model is based on a global system of plates and is derived from a global grid of plates. The model is based on a global system of plates and is derived from a global grid of plates. The model is based on a global system of plates and is derived from a global grid of plates.

**Sample Map Views of the GSRM from the UNAVCO Jules Verne Voyager**  
 Finite Element Model Grid on plate boundary | Observed GPS Velocities | Principal Axes of Strain Rate and Second Moment of the Strain Rate Tensor: Red = High strain rate | Data Focal Mechanisms (blue) Model Focal Mechanisms (pink)  
 Observation Locations | Model GPS Velocities | Vertical Strain Rate (Ezz) | Strain Style: Green-Shear | Blue-Compression | Red-Tension

**Global Strain Rate Map Project Website**  
<http://www.world-strain-map.org>  
 Model Introduction | Data Sources: GPS, Geodetic, Geologic, and Seismic | Model Results | GSRM References

**Other Applications using the GSRM**  
 UNAVCO and Outreach Activities using the GSRM | Educational materials using GSRM maps to teach plate tectonics | On-line Plate Motion Calculator: included GSRM and other plate motion information | Related Citations and References

Meertens, C.M., L. Estey, C. Kremer, and W. Holt (2004) Interactive Web Interface to the Global Strain Rate Map Project, *Eos Trans. AGU*, 85(17), Jt. Assem. Suppl., Abstract G21B-02.

## **2.0 UNAVCO Monthly Reports**

### **2.1 October 2004**

#### **Highlights**

- Board of Directors met in Washington, DC on 28 and 29 October. Guest attendees included NSF Program Managers (Shedlock, Whitcomb, Lambert) and USGS NEHRP Coordinator (Applegate)
- We submitted RESESS proposal for a multi-year mentoring program for students
- Two Engineers deployed to McMurdo Stations for Antarctic summer field season. One will spend the entire summer there
- Parkfield and Mt. St. Helens events precipitated extensive activity on the part of UNAVCO staff and UNAVCO advisory committees.

#### **Facility (Chuck Meertens)**

##### **Facility Data Group (Fran Boler)**

##### **NSF/EAR Data Support**

- Routine archiving of permanent stations proceeded with 27 Gb archived.
- One new permanent station (Wasatch: HWUT) was added for ongoing data management and archiving.
- Archiving was completed for five campaigns this month. New data and documentation for ten campaigns was received.
- 75,000 files and 19 Gb of data were picked up from the ftp area during the previous month.

##### **NSF/EAR Plate Boundary Observatory Data Support**

- Added 18 sites (P171, AC27, AC59, AV01, AV03, AV04, AV05, P271, P295, P693, P695, P696, AC63, AC62, AC64, AC65, AB37) for interim data management and archiving.
- Data handling software was modified to accommodate a new PBO requirement to accept hourly files, providing hourly RINEX on the ftp pickup area.

##### **Infrastructure**

- The production Archive database was migrated to new server running Oracle 9i.
- New data pulling hardware systems were brought online to replace aging systems.
- An authentication system was installed for project and permanent station web forms.

##### **Software Development**

- Permanent station data handling software was modified to make the calling process more flexible.
- Permanent station data pulling software was upgraded to be able to pull from NetRS receivers using HTTP and FTP, and to handle pulling from ftp sites using YYYY/DOY and YYYY/YYYY.DOY directory structures.
- The equipment database was modified to incorporate Government property designation; reporting tools based on this information were designed.
- Archive database scripts, web access and database-database connections were updated to reflect new database location.
- Schema generation scripts for the Oracle 9i instance of the Archive database were developed and tested.

## **Education and Outreach**

- The Voyager Jr. image generation functionality was enhanced.

## **Engineering Group (Steve Fisher)**

### **NSF/EAR Program Support**

#### *University PI Project Support*

- Provided equipment for Parkfield emergency response to PI Chuck DeMets.
- Deployed and provided field support for RETREAT project in Italy and Croatia for PI Rick Bennett.
- Took delivery of 20 NetRS receivers and accessories for Yucca Mountain Expansion Project. Began preparing to integrate station equipment for site installations.
- Helped plan and develop proposal budget for Mississippi Delta 2006-2007 project.
- Continued preparations for Cayuga College monument installation.
- Longs Peaks Boulderfield monitoring "community" survey project completed.

#### *Western US Networks Project Support*

- Coordinated permit renewals at PANGA stations with US Coast Guard, PBO, & Andrew Miner.
- Prepared and shipped upgrade hardware to PANGA and SCIGN.
- Procured loan of Trimble 4000 from CU and/or UAF for Wyoming Atmospheric project.
- Assisted Kurnik in preparation of NSF Equipment report, updating Equipment database.
- Extensive troubleshooting (PANGA, BARGEN, EBRY).

#### *Plate Boundary Observatory Project Support*

- Conducted firmware version testing of campaign receivers for PBO. Worked out process for initiating and reporting continues equipment tests for PBO.
- Finalized prototype packaging and cost estimate for Topcon PBO campaign receivers.
- Began discussing strategy for filling PBO campaign engineering responsibilities with interested parties.
- Trained PNW crews on short-braced monument installations.

### **NASA/SENH Program Support**

- Meeting with PEM at UNAVCO: discussed site responsibilities, computer/rx upgrades, upcoming FY SOW. Also, the installation of a test-site/bed at Marshall.
- Helped review documents for IGSCB.
- New 4-port serial cards picked for LINUX computers.
- Eight new rack mount computers arrived.
- Ordered more computer aux. equipment.
- PC-104 prototype for Uganda (MBAR) testing ongoing
- Station Support:
  - ISPA VSAT network upgrade work at PTWC (Hawaii), connection somewhat improved.
  - MSKU VSAT connection restored. New computer/BootBar installed. Site operational with soc files. Real-time stream still not up due to problems with either bandwidth or permissions after a DoS attack locally. Updated log submitted.
  - PIMO Computer/power outage problems. Will swap in "new" computer from last year.
  - QUIN New system UPS to site to replace old BEST unit.
  - SEY1 No connection to IS, might be related to DNS change. Working w/ Patrick to restore.

- SHAO Station operations restored. Data public. Updated log submitted.
- ZAMB Computer connections back up. Data recovered back to DOY 2004.169.
- CRAO Site now included in the IGS w/ new log, etc.
- CORD Jay is progressing with plan for site visit in December.
- DYR2 Jay is configuring new computer and TR for new site installation.
- Approximately 100 individual NASA trouble or maintenance issues were handled during this month.

### **NSF/Office of Polar Programs Support**

- Extreme environment test facility established at Niwot Ridge.
- Antarctic field season begun with two field engineers deployed to McMurdo Station.
- Permanent station CONZ on Mt. Erebus upgraded to NetRS receiver.
- Iridium satellite system testing in progress for downloading remote GPS receivers.
- Antarctic program 2005 proposals reviewed for GPS requirements and supportability.

### **General Support and Infrastructure Development**

- Continued testing of Trimble Zephyr Geodetic antenna with 4000 series receivers.
- Contributed to UNAVCO Board of Directors Meeting presentations.
- Helped conduct Facility tours for Earthscope project personnel and NSF program manager.
- Assisted with final preparations, rewriting, and editing "RISES" E&O NSF proposal.

### **Equipment Group (Chuck Kurnik)**

#### **Equipment Support**

- October is typically a slow month. A second Antarctic shipment was sent, and no NASA projects.
- The yearly NSF Government Equipment report was submitted to NSF on 15 Oct.

#### **PBO/Warehouse Activity**

- The Equipment Group would like to welcome the newest staff member, John Symank, as PBO Depot Technician. John comes to UNAVCO with years of technical experience.
- A *Costed Bill of Materials* was developed for PBO Year 2. This will be used to track plan vs. actual expenditures on PBO permanent GPS station equipment, as well as earned value.

### **Education and Outreach Department (Headquarters, Susan Eriksson)**

#### *Building Program Capacity*

- A proposal was submitted to *the Opportunities for Enhancing Diversity in the Geosciences* on October 18, 2004. RESESS (Research and Education in Solid Earth Science for Students) is a multidimensional program, combining structured mentoring, ongoing research internships, and a supported learning community for undergraduate and graduate students from underrepresented groups in order to increase the diversity within solid earth sciences.

**Goal:** Increase the number of individuals from underrepresented populations who complete Masters' and PhD degrees in solid earth geosciences.

#### **Objectives:**

1. Build a robust, independent program of research experiences and mentoring of individuals from underrepresented populations.

2. Educate faculty and other researchers in solid earth geosciences about mentoring, the value of undergraduate research in successful graduate careers, and the culture of science and how it relates to recruitment and retention of individuals from underrepresented populations.
  3. Build a sustainable program that can endure past the time period of this proposed grant.
  4. UNAVCO is the lead organization with NCAR, IRIS, USGS (Golden), University of Colorado, University of Central Washington, and Highline Community College (Seattle) participating. We requested \$1.6 m for a five-year program.
- Attended the INSAR Workshop in Oxnard, California on October 20-22 and worked with other geosciences educators to develop a preliminary statement regarding E and O in future INSAR programs.
  - Participated as an E and O representative in the EarthScope portal meeting, October 27.
  - Attended the UNAVCO Board Meeting with an E&O report; an E&O Standing Committee was established.
  - Ongoing work on AGU booth, acquisition of high-resolution cameras and pictures for various UNAVCO purposes.

#### *Dissemination*

- UNAVCO had a table at the Open House for Earth Science Teachers at the annual meeting of the Society of Exploration Geophysicists, October 10, Denver. Approximately 10 teachers visited the event. Four teachers have agreed to give input for the Voyager products.

#### *Professional Service*

- Convened a DLESE Task Force on Diversity to establish a diversity plan for DLESE. Eriksson is co-chair.

## **2.2 November 2004**

### **Highlights**

- Provided proposal budget/technology support for five new NSF EAR proposals.
- Provided campaign equipment to Parkfield earthquake response project (DeMets).

### **Facility (Chuck Meertens)**

#### **Facility Data Group (Fran Boler)**

##### **NSF/EAR Data Support**

- Routine archiving of permanent stations proceeded with 31 Gb archived.
- Five new permanent stations (INEEL: BCYI; IGS/GGN-UNAVCO: TEHN; Antarctica-Transantarctic Mountains: FLM2; Northern Mexico: USMX, YESX) were added for ongoing data management and archiving.
- Archiving was completed for nine campaigns this month. New data and documentation for four campaigns was received.
- 108,000 files (36 Gb) of data were picked up from the ftp area during the previous month NSF/EAR Plate Boundary Observatory Data Support

##### **NSF/EAR NUCLEUS Data Support**

- TEQC translator for NUCLEUS receiver formats to NetRS-like BINEX and mechanism for data file handoff to PBO is complete; this functionality is needed for transition to PBO handling of non-NetRS NUCLEUS data.

##### **NSF/EAR Plate Boundary Observatory Data Support**

- Added 12 sites (P040, P042, P044, P089, P105, P281, P282, P283, P376, P687, P698, P702) for interim data management and archiving.
- Budget for PBO Archive clone at IRIS finalized. Planning for implementation of the clone is underway.
- Reporting tools designed/tested to check Archive data holdings for accuracy and consistency with what has been transmitted by PBO.
- Design for ftp pickup reports for PBO data initiated.
- Design for streamlining of the schema for archiving PBO BINEX data is underway.

##### **Infrastructure**

- Recovered from system failure in Jules Verne Voyager mapserver cluster.
- New server configured and fibre storage device implemented for long term Archive storage.

##### **Software Development**

- Equipment database query tools for Government property reports were refined.
- Began work on handling Vaisala metpack meteorological data, which includes wind speed, rainfall, and other variables in addition to "standard" met observables.

##### **Education and Outreach**

- Generated new images (GSRM 1.2 and faults) for VoyagerJr Earth and EarthScope for Michael Hamburger (in association with his EarthScope E&O NSF grant) .

- With the E&O coordinator, provided content for one-page handouts content and UNAVCO booth poster.

## **Engineering Group (Steve Fisher)**

### **NSF/EAR Program Support**

#### *University PI Project Support*

- Provided planning and budgeting support to PIs for 5 new proposals being submitted under the December 1 EAR deadline.
- Parkfield Earthquake Response (C. DeMets): Provided equipment and technical support to resurvey of Parkfield, CA area stations in response to September 2004 earthquake. Second survey since earthquake.
- Eastern Mediterranean Project (R. Reilinger): troubleshooting Saudi Arabia computer and communications (with GGN), prepared field computer for Diyarbarkir (also GGN).
- BARGEN (B. Wernicke, J. Davis): Multiple ongoing technical support issues were handled in cooperation with CfA, Caltech and UNR staff and contractors effecting multiple stations. Yucca Mountain expansion budget was allocated, internal account set up and purchase requisitions were filed for new GPS receivers and other equipment. Five stations were upgraded with NetRS/IP telemetry in cooperation with ExNets project. Custom script was developed for hypertext protocol station communications and data retrieval.
- Bhutan Project (R. Billham): Provided technical support to new permanent stations.
- Philippines Volcanoes (M. Hamburger): Telemetry problems were evaluated and resolved in conjunction with local contacts to restore communications at permanent stations.
- Colombia Earthquake Response (J. Kellogg, H. Mora): Helped PI access available equipment for use in resurveying existing CASA project stations in area.
- Cotopaxi Volcano (T. Dixon): Telemetry problems were evaluated and resolved in conjunction with local contacts to restore communications at permanent stations.

#### *Western US Networks Project Support (ExNets/NUCLEUS)*

- Extensive investigation/troubleshooting of sudden communication loss with three CDMA equipped ExNet stations in Yellowstone Park. Coordination with Verizon, Proxicast, and PBO personnel resulted in diagnosis (changes to Verizon's method of handling data compression in the region) and complete solution to be applied to all ExNet and PBO CDMA stations.
- Coordinated NetRS upgrade of PANGA station LCKP to CDMA/NetRS, including extensive post-installation CDMA troubleshooting.
- Coordinated NetRS upgrades of BARGEN stations BAMO, LEWI, and MINE served through a single CDMA router at LEWI, served by Ethernet radios.
- Coordinated NetRS upgrades of BARGEN stations ELKO and COON to CDMA comm.
- Identified and diagnosed separate CDMA issue at ELKO and BARGEN station SLID. Solution identified by Proxicast, and firmware upgrades will be applied as soon as possible.
- Planned repairs at BARGEN station SLID with UNR staff. SLID had ceased tracking satellites due to 4000 receiver failure.
- Planned first round of SCIGN NetRS upgrades with network coordinator and technical staff, including training on NetRS and CDMA equipment.
- Developed together with PBO staff comprehensive CDMA installation, diagnostic, and troubleshooting procedures. Report to be produced in Dec.

#### *Plate Boundary Observatory Project Support*

- Equipment Testing: Continued firmware version and accessory software testing for NetRS and GB-1000 receivers. Helped evaluate Trimble choke ring antennas for potential manufacturing defect.

- PBO Campaigns: Ordered equipment and assembled prototype field package for Topcon PBO campaign receivers. Assigned PBO campaign engineering function within group. Began coordinating project to test and evaluate real world performance and operation of the Topcon GB-1000s on MAGNET network in California and Nevada with G. Blewitt and others at UNR.
- Eastern US Seismic Array: Finalized project budget for 16 co-located stations with USGS/ASL and submitted to contracts and grants personnel to finalize purchase order. Began coordinating station reconnaissance.

### **NASA/SENH Program Support**

- Revised FY2005 work statement and budget based on meeting with JPL PEM. Evaluating 2005 NASA budget and resource allocation.
- Helped review documents for IGSCB.
- Evaluated tracking problems with Thales uZ receivers and worked with JPL and vendor to coordinate plan to repair affected receivers.
- Began detailed planning and budgeting for prototype station configuration for deployment at "IGS reference frame sites" that allows evaluation of site effects on the time series. Prototype station will be deployed at Marshall, Colorado during 2005.
- Implemented new "yum" kickstart Redhat Linux installation from JPL on remote computers.
- Station Support:
  - CORD: Re-prepared field computers for Cordoba with latest supported configuration and re-established contact with collaborators to finalize shipment for system upgrade. Expedited uZ in to Thales for repair prior to deployment. Collaborators notified us customs preparations have finally been made. Possible trip in January will be scheduled after equipment arrives.
  - CHPI: Started importation procedures for new uZ w/ INPE.
  - FAIR: Site upgraded with new uZ and rack mount computer. Updated IGS log submitted.
  - MCM4/Z: Site upgraded with new rack mount computer.
  - SEY1: Internet connection was reestablished, troubleshooting login problems.
  - MDO1: Replaced and repaired faulty receiver.
  - AREQ: Gilat VSAT routing reconfigured (after service restored) to accommodate RTNT stream.
  - Approximately 160 individual trouble or maintenance issues were handled during this month on the GGN.

### **NSF/Office of Polar Programs Support**

- Antarctic Projects:
  - Mt. Erebus repeater installed, making LOS ethernet links feasible for a large sector of the Transantarctic Mountains with considerable GPS activity.
  - TAMDEF (T. Wilson): Established site FLM2 (Mt. Fleming) in the Transantarctic Mountains. NetRS with Intuicom ethernet bridge radio, 164km link to Mt. Erebus repeater, 36km from repeater to McMurdo Internet.
  - Power system installed at remote Antarctic site Fish Tail Point (T. Wilson) to accommodate Iridium satellite communications in January 2005.
    - Antarctic inventory form draft completed for annual inventory control.
- Arctic Projects:
  - 2004 Arctic Report completed, on-line, and sent to NSF.
- Polar Services web page updated to add "Remote Station Engineering" section highlighting UNAVCO efforts, and DGPS Stations section re-organized for better scalability to accommodate new stations.

## **General Support and Infrastructure Development**

- Helped prepare booth and display materials for AGU meeting.
- Completed new monumentation web page.
- Design and built laser jig to aid installation of short-drilled brace monuments.
- Developed configuration documentation for IP radio modems.
- Configured Iridium satellite communication with NetRS receiver and started operations testing to develop supported configuration for multiple project use.
- Long term testing and troubleshooting very low power PC104 based permanent station computer continues.
- Set-up new mail list to aid internal communications between Facility and PBO personnel.
- Created new position description for project managers and reclassified one employee.

## **Equipment Group (Chuck Kurnik)**

### **Equipment Support**

- Most of UNAVCO's Equipment Pool is in Antarctica.
- One NSF and three NASA projects were shipped in November.

### **PBO/Warehouse Activity**

- Inventory database development is well underway. The schema and several entry screens have been developed.
- A quarterly shipping plan for year 2 has been developed. The Equipment Group is working with PBO Regions and Purchasing department to determine exact quantities and schedules.
- Four PBO GPS sites were shipped to the Northern California Region, and two to Southern California in November.

## **Education and Outreach Department (Headquarters, Susan Eriksson)**

### *Building Program Capacity*

- Worked with EarthScope Portal Committee on Education and Outreach needs.
- Wrote an E&O Summary for the Portal O&M proposal.

### *Dissemination*

- November was the main month for revising the UNAVCO booth. New pictures were shot, solicited, and selected for the backlit portion of the booth, 8 one-page handouts were written, and three posters completely revised. Jim Riley redesigned the headers for the booth and worked with Eriksson on other marketing related materials. Rose Blas worked on coordination of booth staff and AGU logistics, and several other staff members have been active in preparing materials for AGU.
- Represented UNAVCO at Geoscience Educators Reception at Geological Society of America Annual Meeting and other events and meetings at GSA, November 6-9, Denver.
- Met with EarthScope and IRIS E and O staff concerning Outreach flow of work, November 8.
- Wrote a short summary on UNAVCO to be printed on the back page of the reprints of Kyle Bohnenstiehl 's Professional Surveyor's article on PBO.

### *Professional Service*

- Lou Estey is serving on the 2005 DLESE annual meeting planning committee.

## **2.3 December 2004**

### **Highlights**

- Facility staff participated in nine presentations at the Fall AGU meeting.
- Facility Standing Committee formed.
- Mauna Loa EAR project initiated, B. Brooks, U. Hawaii.

### **Facility (Chuck Meertens)**

#### **Facility Data Group (Fran Boler)**

##### **NSF/EAR Data Support**

- Routine archiving of permanent stations proceeded with 17 Gb archived.
- One new permanent station (CORS: AST1) was added for ongoing data management and archiving.
- Backlogged data for six sites were archived and RINEXed.
- Investigated corrupted data from HWUT.
- Archiving was completed for one campaign this month. New data and documentation for three campaigns was received.
- 160,000 files (62 Gb) of data were picked up from the ftp area during the previous month.

##### **NSF/EAR NUCLEUS Data Support**

- Manually pulled and archived data from MPUT, LTUT, TSWY, and CORV.

##### **NSF/EAR Plate Boundary Observatory Data Support**

- Added one site (P281) for interim data management and archiving.
- To initiate the replication of public PBO metadata task of the Archive Statement of Work, initial discussions with PBO personnel were held.

##### **NASA/SENH Data Support**

- Configured new data pulling systems for soc2rinex capability.

##### **Infrastructure**

- Hardware to support implementation of a storage area network (SAN) built on recently acquired high-end storage device was specified and ordered. This system will serve all UNAVCO divisions.

##### **Software Development**

- System for tracking equipment items that are deployed to the field was implemented.
- A site log archiving and tracking system was developed and implemented.

##### **Education and Outreach**

- Data Group staff presented two posters at the AGU Fall Meeting in San Francisco.

### **Engineering Group (Steve Fisher)**

## **NSF/EAR Program Support**

### *University PI Project Support*

- Pseudorange Bias Testing (K. Larson): Purchased environmental test chamber and began assembling laboratory and equipment.
- BARGEN (B. Wernicke, J. Davis): Major ongoing technical support was provided to re transfer some responsibilities for network O&M back to CfA and Caltech, now that new staff and contractors are assigned to project. Site fixes: MPUT, SPIC, NEWS, UPSA, TOIY remotely, FERN consulted CfA, Qwest and Jeff Behr, SLID with UNR (with ExNets). More equipment was ordered for Yucca Mountain network expansion. Technical support to project staff.
- Mauna Loa (B. Brooks): Developed plan and budget for UNAVCO to participate in supporting project. Officially received and accepted support request for spring installation of 12 GPS stations on Mauna Loa Volcano.
- Cotopaxi Volcano (T. Dixon): Provided technical support to planning installation of two new stations and reconfiguration of existing wireless telemetry network to accommodate the additional stations.
- SuomiNet-C GPS Network (A. Newman): assisted investigator with equipment/processing issue.
- E. Mediterranean (R. Reilinger): Ongoing site issues at IFRN were addressed.
- UNR/Las Vegas (G. Blewitt): Communications with both sites went down and was repaired
- Bhutan (R. Billham): NetRS receiver purchase submitted.

### *Western US Networks Project Support (ExNets/NUCLEUS)*

- Repaired/reconfigured BARGEN station SLID, coordinated fieldwork with UNR staff.
- Coordinated Trimble NetRS firmware testing (1.1-1 binex) with PBO and SCIGN.
- Extensive troubleshooting in EBRY and PANGA (non-upgraded) sites.
- Continued evaluation of new Proxicast LAN-Cell firmware.
- Coordinated testing of ExNet Choke rings with PBO and Development and Test Engineer.
- Planned early 2005 Equipment purchases for Existing Networks upgrades.

### *Plate Boundary Observatory Project Support*

- Equipment Testing: Continued firmware version and accessory software testing for NetRS and GB-1000 receivers. Continued to evaluate Trimble choke ring antennas for potential manufacturing defect (rotation tests). Acquired new computer and OS for D&T lab. Worked with Topcon on solution for automatically duplicating data on CFC. Coordinating Topcon site visit in January for training and technical interaction.
- PBO Campaigns: Began detailed planning and coordination of MAGNET GB-1000 deployment with UNR. Started testing receivers in lab and assembling necessary equipment.
- Eastern US Seismic Array: Continued coordinating station reconnaissance.

## **NASA/SENH Program Support**

- Evaluating 2005 NASA budget and discussing relevant changes to Facility resource allocation.
- Planning response to special heightened awareness for network issues at JPL during Jan. 05 Cassini Saturn encounter.
- Helped interface with multiple parties on organizational issue for IGSCB.
- Began swapping Thales uZ receivers from GGN stations for warranty recall repairs – five receivers swapped at GGN stations this month.

- Began designing prototype station configuration for deployment at “IGS reference frame sites.”
- Station Support:
  - MBAR: Discovered bad eeprom chip on PC-104, had board repaired. Trying to load Redhat 9.0.
  - CORD: Receiver shipped to Thales for repair, and returned to facility. Checked Cordoba pc, customs is ready for shipment; equipment packed up and shipped out.
  - CRO1: Investigated clock problem at CRO1, solicited input from Thales who is helping with the problem.
  - CHPI: Customs in Brazil has cleared us to ship the new uZ down which will replace the old faulty one. Waiting on signed importation letters then shipping of equipment will begin.
  - SHAO: Working with locals in China to figure out why receiver reverted back to it's old firmware, trying to coordinate a time when Liyan can re-load the firmware for us.
  - Zambia: Shipping new flashcard and lightning protector.
  - FAIR: New antenna will be installed, IGS log will be submitted
  - KOKB: New uZ receiver shipped to replace faulty one.
  - CRO1: Updated PC configuration.
  - Approximately 100 individual trouble or maintenance issues were handled during this month on the GGN.

#### **NSF/Office of Polar Programs Support**

- Antarctic Projects:
  - Mt. Field season continues, with recent engineering support to several projects in the McMurdo Dry Valleys region including Beacon Valley (D. Marchant), Lake Hoare (P. Doran), Lake Fryxell (B. Lyons), and Victorialand Coast (M. Uhle).
  - Completed initial phase of Iridium modem integration and testing for GPS data downloads - ready for Antarctic field deployment in January.
  - Participated in Antarctic remote geophysical observatory planning meeting.
- Arctic Projects:
  - Attended Toolik Field Station Science Vision & Steering Committee Meeting.
  - Initial planning for 2005 Alaska north slope activities, including DGPS maintenance visits, PI projects, and a community GPS/GIS training course.
- Bench testing met pack/anemometer for polar applications.

#### **General Support and Infrastructure Development**

- Coordinated and announced community GPS receiver purchase for Members and Associate Members on a Feb. 28 order deadline. Trimble NetRS, R7 and Topcon GB-1000 GPS receivers are included.
- Began negotiating new purchase arrangement and pricing for Trimble R7 receivers for community receiver pool.
- Hosted visit by Leica Geosystems staff to review results of preliminary evaluation of new Leica receiver. Discussed Leica non-profit pricing program.
- Four staff members attended the AGU meeting to present posters and to help staff the booth.
- Continued operations testing of Iridium satellite transceiver to develop supported configuration for multiple project use.

- Long term testing and troubleshooting very low power PC104 based permanent station computer continues.
- Renewed arrangement for telemetry test site near Jamestown, CO.
- Revised and updated development and testing and permanent station equipment areas of Facility web site.

## **Equipment Group (Chuck Kurnik)**

**Equipment Support:** Continuing our slow season while most of UNAVCO's Equipment Pool is in Antarctica, one NSF and one NASA projects were shipped in December.

PI's with funded NSF projects request support from UNAVCO thru the on-line "Project Support Request" system. UNAVCO's internal process for addressing these requests is being documented this month.

**PBO/Warehouse Activity:** An NSF "Government Property" audit is being performed at the Boulder Facility and each of the PBO Regions. This is to ensure the accuracy of the Equipment Database, UNAVCO's property tracking system.

In preparation for the release of the Inventory Database, physical inventories (counts) are being done at the PBO Boulder Warehouse and each of the PBO Regional warehouses. These counts will be loaded into the system in January, and inventory levels at all PBO warehouses will be tracked centrally in Boulder.

Many of the items used in PBO GPS sites are received and kitted at the Boulder Warehouse before being shipped to PBO regions. In year 1, equipment was shipped on a site-by-site basis. This year, a new shipping methodology is being implemented. A yearly forecast of mix (monument type, power, communication strategy) has been developed, and equipment will be shipped quarterly based on the forecast and actual quantities used. Two large shipments of 10+ sites each are going to Northern CA and Southern CA PBO regions this month.

The Boulder warehouse continues to be outfitted. More inventory racks have been purchased, including a large rack, three bays wide by three levels high. A quote for a mezzanine to cover a 20' x 30' area has been received as well.

## **Education and Outreach Department (Headquarters, Susan Eriksson)**

*Jules Verne Voyager Tools.* Two groups of students completed their semester-long study of the design for Voyager Sr and EarthScope Voyager Jr. This is part of the Facility's participation in the EarthScope-funded project of PI's Michael Hamburger and Bill Holt, *Collaborative Mapping Tools.* Facility staff member Lou Estey is currently adding new data sets to Jules Verne Voyager Senior including Magnetics (N.A. and global), Heat Flow (North America), Global tomographic models, Gravity (Bouguer and Free-air anomaly maps), continually updated Earthquakes, Active faults, Crustal thickness and mantle velocity data base, and updates to EarthScope (e.g., site installation status). Susan Eriksson of UNAVCO and Marianne Weingroff of the DLESE Program Center are working with Hamburger on curricular material, redesign of the interface, and evaluation of the EarthScope Jr. The project participants met at the Fall AGU meeting to review project progress and plan 2005 activities.