UNAVCO Report

Support of UNAVCO Community and Facility Activities

UNAVCO Facility Interim Report, March 2007
For period of performance December 2006 – February 2007

NSF Cooperative Agreement EAR-031760

Also includes the quarterly progress report for
UNAVCO Facility Support to NASA

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UNAVCO Facility March 2007 Interim Report
Period: December 2006 – February 2007
EAR-0321760: Support of UNAVCO Community and Facility Activities

1.0 Quarterly Summary

The UNAVCO Facility through this Cooperative Agreement provides engineering, equipment, data, and information technology support to NSF- and NASA-funded efforts. UNAVCO researchers use GPS and other high precision geodetic techniques to study earthquake processes, mantle properties, active magmatic systems, plate boundary zone deformation, intraplate deformation and glacial isostatic adjustment, global geodesy and plate tectonics, global change, and polar processes. In addition to supporting numerous individual EAR-funded PIs, the Facility also operates with JPL the NASA Global GPS Network (GGN), provides project management for the PBO Nucleus and GeoEarthScope (part of the EarthScope MREFC) projects, and provides support to the NSF Office of Polar programs-funded projects for individual PIs working in the Arctic and Antarctic regions with Facility funding coming from supplements to this Cooperative Agreement. The Facility is also part of a new UNAVCO/IRIS OPP MRI to develop robust power and communications systems for GPS and seismic operations in harsh polar environments. The Facility is organized into two primary groups, the Engineering Group and Data Group with additional project IT and administrative support from Facility Operations and Infrastructure staff. The Facility also contributes to UNAVCO Education and Outreach efforts. This quarterly report presents highlights and performance metrics for the period December 2006 - February 2007, including core support as well as summaries of major projects managed by the Facility.

UNAVCO Community Activities
Significant community activities that occurred during this quarter include:

- Two new associate member applications were approved for University of Durham and University of Western Ontario. Total UNAVCO membership now includes 65 full members and 32 associate members.
- Multiple papers and posters were presented by UNAVCO staff and community at the fall AGU meeting. A partial listing of these is included in the appendix.
- The annual member meeting was held at the fall AGU meeting. Reports from the PBO, E&O and Facility standing committees were presented by the committee chairs. The Chairman of the Board of Directors reported on corrective actions being taken in response to NSF's management review of UNAVCO.
- Succession of the UNAVCO president has begun, with C. Meertens appointed as interim president while a search is conducted for a permanent president.
- Resource and performance tracking is being implemented as follows:

- Work Breakdown Structure – we are in the process of setting up tracking of WBS elements that is required as part of the corrective response to the management review.
- Defined performance metrics already being tracked and compiled on a quarterly basis.
- We have automated the delivery of user feed back questionnaires and tabulation of results through the project request and management system.

1.1 Quarterly Featured Project

Project: Bangladesh
UNAVCO Facility Engineer: Nicole Feldl
Funding Source: NSF-EAR Tectonics
Principle Investigators: Leonardo Seeber and Michael Steckler (Lamont-Doherty Earth Observatory, Columbia University)
Project Location: Bangladesh

Figure 1. Map of new GPS stations installed in Bangladesh in February, 2007.

Participants from Lamont-Doherty Earth Observatory, Dhaka University, and the UNAVCO Facility installed 12 continuous GPS stations across eastern Bangladesh in February, 2007 (Figure 1). The project, aimed at understanding the deformation associated with the Burma Arc subduction system, includes deployment of the GPS systems for 4 years and a rotating network of seismometers. The Burma Arc setting is particularly unique due to the large amount of sediment from the Ganges-Brahmaputra

delta being incorporated into the subduction system, which produces a rapid broadening the accretionary prism and foldbelt. In addition, vertical velocities from the GPS data may allow for greater insight into possible subsidence of the delta.

Each GPS site is equipped with a Trimble NetRS receiver and Trimble Zephyr Geodetic antenna. The receivers are programmed to record observations at 15 second and 1 second sampling rates. Due to the scarcity of bedrock and good sky view in Bangladesh, all of the antennas were installed on reinforced concrete column buildings; monumentation consisted of a 5/8" diameter stainless steel all-thread rod cemented into a hole drilled into the roof (Figure 2). The height of the antenna above the roof ranged from 13-30 cm. Eleven of the stations were powered by AC power from the host building with a 100 Amp-hour battery back-up. The site at Barkhol, accessible only by boat across Kaptai Lake, utilized solar panels and a custom designed solar panel frame (Figure 3), with 118 Amp-hours of battery back-up.

The GPS network is focused mainly in the Sylhet Division of northeast Bangladesh and the remote Chittagong Hill Tracts of southeast Bangladesh. Data download will be conducted manually by colleagues in Bangladesh.

Figure 2. *(left)* UNAVCO Project Engineer Nicole Feldl aligns the antenna at JURI as Dhiman Mondal, a student of Dhaka University, watches. *(right)* Co-PI Michael Steckler of Lamont-Doherty Earth Observatory inspects the antenna mount. GPS station JURI is located at the Sagarnal Health Complex in the Sylhet Division of northeastern Bangladesh.

Figure 3. PI Leonardo Seeber of Lamont-Doherty Earth Observatory and Dhaka University student Dhiman Mondal construct the solar panel frame. GPS station BARK, the sole solar powered station in the network, is located at the Barkhol Upazilla (local government) officer's residence, on the east side of Lake Kaptai in the Chittagong Hill Tracts of southeast Bangladesh.

1.2 Facility Engineering

NSF/EAR Program Support

Facility EAR program support is categorized by task and related metrics in Table 1 below and is discussed in the following section.

Table 1. Engineering Performance Metrics – NSF CORE

WBS	Task	Performance Metrics	Numbers
1.1.1.2	Permanent Station Operations	# stations monitored (on O & M list), # station troubleshooting events	404 48
1.1.1.3	PI Project services	# projects	38
1.1.1.4.1	Engineering Technical Support	# tech support requests	48
1.1.1.4.2	Development and Testing	# D & T projects completed	1
1.1.1.4.3	Pool Equipment Maintenance (warehousing, repair, outfitting, tracking, reporting)	# receivers in pool # community/project receivers # receivers delivered to projects	381 1950 26
1.1.1.4.4	PI Equipment Repairs	# receivers repaired	34
1.1.1.4.5	PI Training Classes, Workshops, Meetings	# classes held or participated in	1

Permanent Station Operations. The facility provides operations and management (O&M) support to 404 continuously operating stations. During this quarter there were 48 troubleshooting incidents handled for stations monitored for EAR PIs. This included resolving communication and equipment issues, shipping replacement equipment and working with PIs and local contacts to resolve problems.

PI Project Services. In the last quarter 38 PI projects were supported by the UNAVCO facility, ranging from project design and budgets for proposals to full field deployments for new networks, network upgrades and campaign surveys. The Bangladesh 2006 project is an example of a project that received a full compliment of UNAVCO facility support. UNAVCO staff was involved in project planning, network design, Monumentation design, equipment preparation and shipping and installation of the equipment. A summary listing of PI project supported during the last quarter is included in Table 2.

Engineering Tech Support. During the last quarter the UNAVCO facility responded to 48 requests for support via our support mail alias (support@unavco.org), and by direct requests to staff via email and phone calls.

Table 2. UNAVCO Supported Individual PI Projects

Project Name or Location	PI	Support Involved
Africa Array - MRI	A. Nyblade	Technical planning & consultation, budgeting & letter of support
BARGEN Expansion O&M 2007-2012	B. Wernicke	Technical support, Station maintenance, archive, Field support
Central Iceland Geodynamics 2007-2009	R. Bennett	Technical planning & consultation, budgeting & letter of support
CfA antenna loan 2007	J. Davis	Pool equipment loan
Crete 2007-2009	R. Bennett	Technical support, Station maintenance, Station data retrieval & management, Data archive, Field support
Croatia GPS 2007-2009	R. Bennett	Pool equipment loan, Network or station reconnaissance
ELKO Expansion receiver loan	B. Wernicke	Pool equipment loan, technical support
ERITREA GEODYNAMICS 2007	R. Reilinger	Long term pool equipment loan, technical support
Ethiopia survey 2007	R. Reilinger	Pool equipment loan, technical support
Galileo-GPS low-multipath GPS antenna 2007	F. Scappuzzo	Pool equipment loan, technical and field support
GeoEarthScope Northern California ALSM (LiDAR)	D. Phillips	Pool equipment loan, project data retrieval & management, Technical planning & consultation, Field support, Training
Gravity Collection Eastern Oman 2007-2008	K. Mickus	Pool equipment loan, Technical planning & consultation, Training
Honduras Survey 2007	C. Roth	Pool equipment loan, technical support
Joshua Tree 2007 #1	R. Bennett	Pool equipment loan, technical support
KSA Saudi Arabia CGPS 2007-2011	R. Reilinger	Long term pool equipment loan, technical support
Kuril Earthquake: Evidence from GPS 2007-2008	M. Kogan	Long term pool equipment loan, technical support
MCC-Benin CORS Network 2007	G. Sella	Technical planning & consultation, budgeting & letter of support
MRI: UPRM Puerto Rico 2006	G. Wang	Technical planning & consultation, budgeting & letter of support
NGS Aerial Survey Support 2007	B. Baldwin	Station data retrieval & management
Nicoya Costa Rica 2007	Tim Dixon	Technical support, Station maintenance, Station data retrieval & management, Equipment purchase, Technical planning & consultation, Station installation, Field support,
Northeastern Caribbean Aseismic Slip 2007	Alberto López	Equipment purchase, Station installation, Equipment configuration/ integration
Plum Island LTER 2007	William Lee	Pool equipment loan, technical support
RES: Research Opportunities in Neotectonics 2007	Kevin Mickus	Pool equipment loan, technical support
Kuril earthquake: Evidence from GPS	Mikhail Kogan	Pool equipment loan, technical support
RETREAT V	Rick Bennett	Pool equipment loan, technical support
Riobamba Comms configuration 2007	Patty Mothes	Technical support, Data communications planning, Equipment configuration/ integration
Saudi Arabia 2007 Campaign	Rob Reilinger	Pool equipment loan, technical support
Sierra Negra volcano CGPS network 2007	Bill Chadwick	Technical planning &consultation, budgeting & letter of support
Skeidararjokull 2007	Rick Bennett	Pool equipment loan, technical support
South Tibetan Detachment System 2007-2012	Rick Bennett	Pool equipment loan, Technical planning & consultation
Southeast Alaska Archiving	J. Freymueller	Data archive
Southern San Andreas 2006	Rick Bennett	Pool equipment loan, technical support
Tajik-Kyrgyz Pamir and South Tien Shan 2007	R. Bendick	Equipment purchase, Data archive, Equipment configuration/ integration, Equipment testing
Trinidad/Tobago and Slovenia GPS 2006	John Weber	Pool equipment loan, technical support
U. Wisc. Madison Zephyr loan 2007-2010	Chuck Demets	Pool equipment loan, technical support

Development and Testing. The UNAVCO facility tested the Vaisala WXT510 metrological package for use with the NetRS receiver. The GPS receivers are capable of issuing query commands to the WXT510 and accept responses which are injected in to the data stream. The WTX510 is capable of recording temperature, relative humidity, pressures, wind speed and direction, rain and hail accumulation.

UNAVCO GPS Receiver Pool. The UNAVCO facility pool consists of 381 receivers of various types. The last quarter saw a continued high level of utilization of the UNAVCO receiver pool (Figures 3-6). Due to high demands on the pool and increased long term loans several PI request for equipment had to be turned down due to lack of equipment.

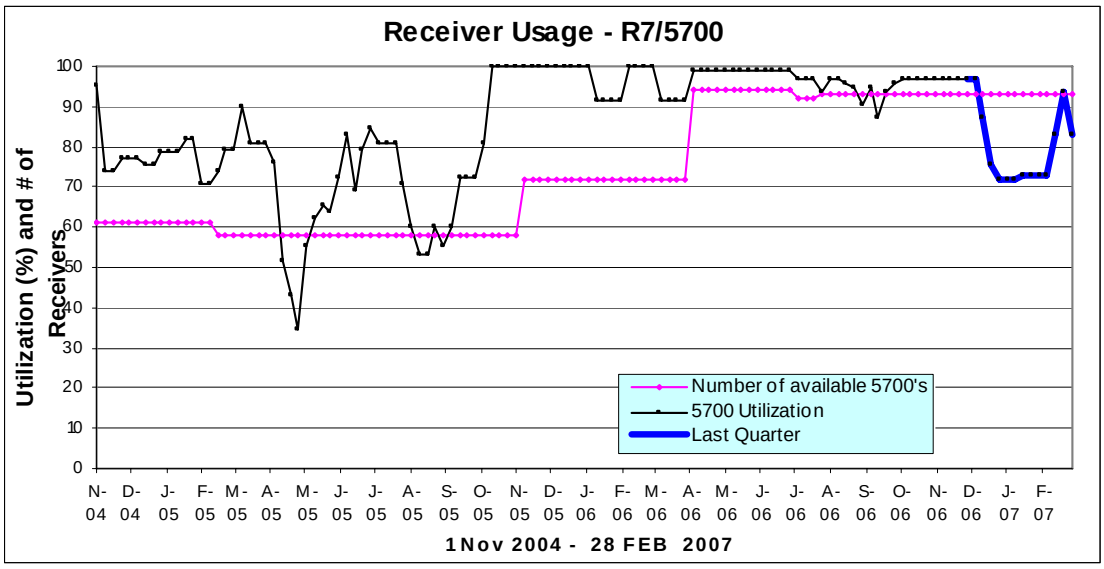

Figure 3. Trimble R7/5700 receiver usage over the last 2 1/2 years. Shown are the percentage utilization and the total number in the receiver pool.

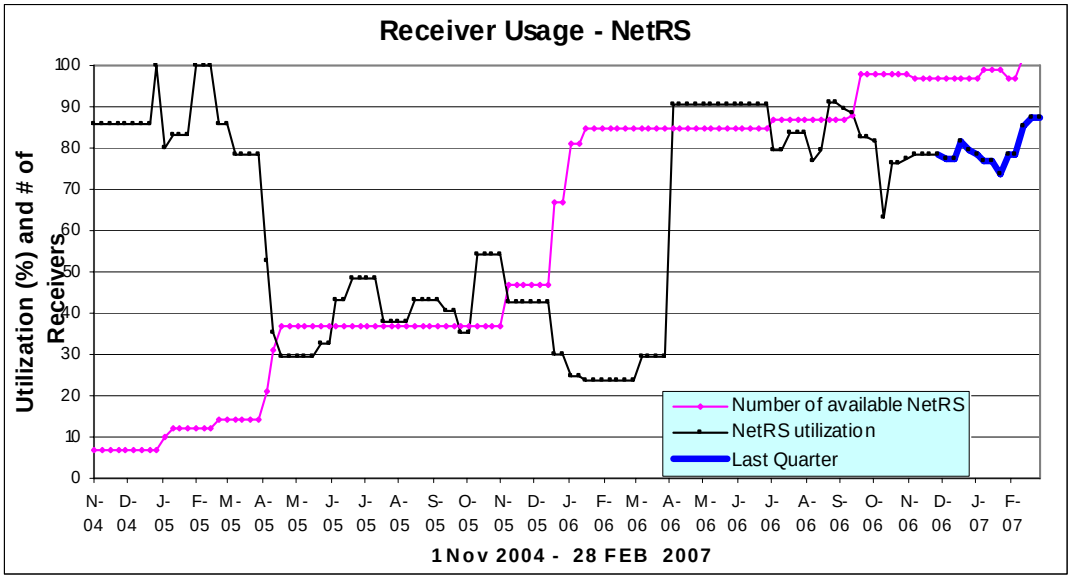

Figure 4. Trimble NetRS receiver usage over the past 2 1/2 years. This receiver package is intended for use in semi-permanent installations and campaigns. Shown are the percentage utilization and the total number in the receiver pool.

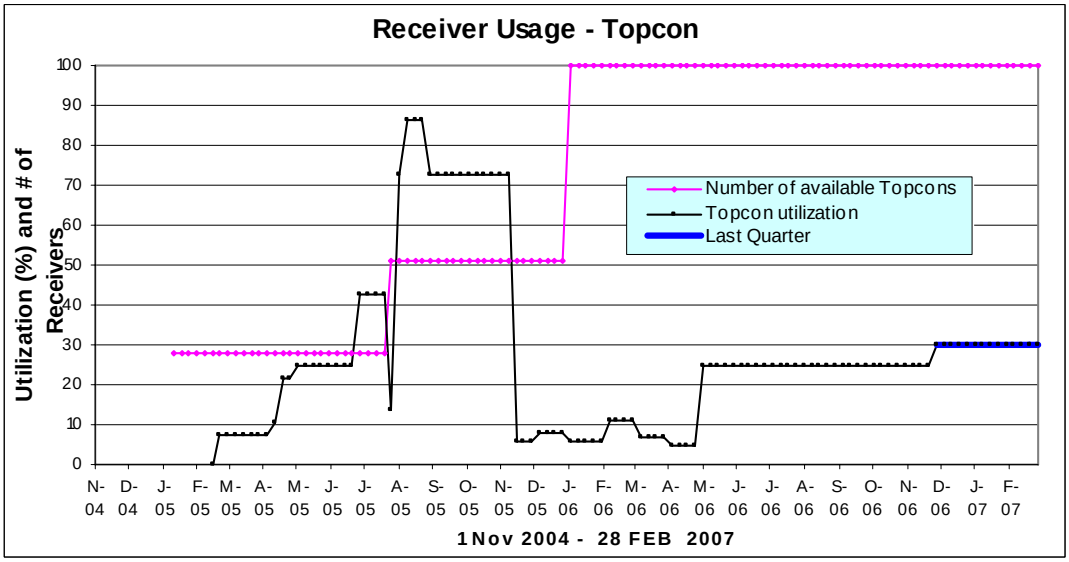

Figure 5. Earthscope/PBO Topcon receiver usage over the past 2 years. Shown are the percentage utilization and the total number in the receiver pool. Use of this pool is restricted to Earthscope or closely associated projects and subject to NSF approval.

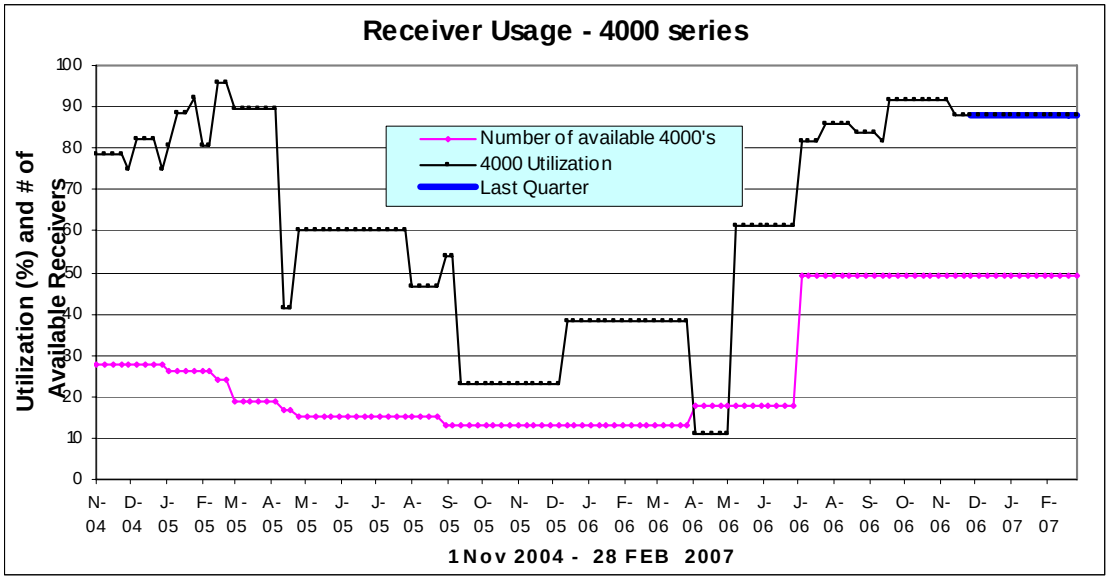

Figure 6. Trimble 4000 series receiver usage over the past 2 1/2 years. Shown are the percentage utilization and the total number in the receiver pool.

PI Equipment Repairs. During the last quarter the UNAVCO processed 22 receiver repairs. The repairs ranged from processing RMA with the manufacture to board level repairs in-house. In addition to the receiver repairs the facility repair depot handled 1 metrological instrument repairs.

NASA/SENH Program Support

UNAVCO with JPL provides support for the NASA GPS infrastructure through a network of 75 permanent GPS stations called the Global GPS Network (GGN) which represents approximately 20% of the stations that make up the IGS permanent station global network. Data from these stations are used to produce highly accurate products that are essential for Earth science research, multidisciplinary applications, and education.

Approximately 275 (through February 28th) individual trouble and maintenance issues were responded to by the UNAVCO Facility during the first fiscal quarter (Q1-2007), including GPS equipment, computer, and communications upgrades at several GGN stations.

As part of the ongoing computer upgrade of the GGN network, new Linux computers were installed and are now operational at the following stations in the GGN network; CIC1 (Mexico), IISC (India), and MDO1 (McDonald Observatory in Texas). The MDO1 computer is a specialized mini-pc with a custom Linux installation from JPL. It is very well suited for low power, and space restricted installations. New computer upgrades are being prepared for the following stations; CHPI (Brazil), AREQ (Peru), SANT (Chile), and YKRO (Ivory Coast).

A new Ashtech MicroZ receiver was installed at MDO1 (McDonald Observatory in Texas) upgrading this long standing reference frame station. By using a powered GPS signal splitter to drive the old AOA antenna, the GPS time series was preserved. Another two Ashtech MicroZ receivers and choke ring antennas were shipped to SEY1 (Seychelles) and HRAO (South Africa) to replace faulty equipment. One new Trimble NetRs receiver was also shipped to FAIC (Fairbanks, AK) to replace the unit at this important L2C station.

The site visit to the HARV (Harvest Oil Platform, CA) was successful. New VSAT communication equipment was installed, along with new LAN equipment. The station is now operational and two GPS receivers, one high rate, real-time, are delivering data again. The major upgrade work at PIE1 (New Mexico) with an antenna cable replacement, and an Ashtech choke ring antenna swap was concluded. This important reference station is now operational again and delivering good data. The reference clock (H-Maser) at the PIE1 station was also replaced by NRAO. The SHAO (Shanghai, PRC) Internet upgrade is moving towards completion this spring, and will greatly improve the data delivery and reliability from this station. Work is being done by the local personnel at the Shanghai Observatory. The MBAR (Mbarara, Uganda) station will need a new solar panel shortly to replace one that has been damaged. At HRAO (South Africa) a new MET-Pack is being installed and data is being integrated into the new Ashtech MicroZ data stream. The faulty Ashtech Z-XII3 receiver at the station delayed this instrument integration. Communications to the SOLA (Saudi Arabia) station has been restored with a phone modem dial-up to the receiver, but unfortunately the phone lines do not support data retrieval. A PI will visit the station this spring and work on communication solutions or alternatives for a timely data delivery. A newly configured computer hard drive (hot swap) has been shipped to RABT (Morocco) should it be needed, a replacement Ashtech receiver power supply was shipped to MSKU (Gabon), and several replacement UPS (Uninterruptible Power Supply) units were shipped to GGN stations this last quarter.

The new GGN station in Dar Es Salaam, Tanzania (TANZ) had its Trimble antenna replaced due to damage following soil settlements around the antenna cable. This station is not providing high-rate, real-time data currently due to unreliable station power and communications, but should be a valuable addition to the sparse African GPS coverage. NASA-JPL (through UNAVCO) provided a computer, GPS equipment and the wireless Ethernet radio equipment. The local collaborators provided equipment housing, power, monument, etc. with a UNAVCO engineer installing the equipment during project work in Tanzania in August 2006.

The new NASA equipment test station at Marshall Field outside Boulder for investigation of receiver and antenna performance, equipment mixing, and new GPS observables issues, has been completed. Two concrete monuments (with four antenna mounts) have been constructed, and equipment housing, communication equipment (wireless Internet and CDMA modems) has been installed. Currently one Trimble NetRs receiver is

running on the new monument at the site. The test installation is fully self-contained with a solar power system and battery backup.

The Facility has also taken delivery of five new Trimble NetRs receiver systems for the GGN and has conducted functionality, firmware, and quality tests on the new Trimble NetR5 receiver system. And lastly, the Facility is preparing a NASA-GGN poster for the upcoming Earthscope meeting in late March.

Table 3. Engineering Performance Metrics – NASA CORE

WBS	Task	Performance Metrics	Numbers
	Engineering and Equipment Services		
1.2.1.2 1.2.1.2	Permanent Station Operations	# stations monitored (on O&M list), # station troubleshoot events # new stations installed	75 275 0
1.2.1.3	Permanent Station Maintenance	# field trips or upgrades	7
1.2.1.4.1	Development and Testing	# D&T projects completed	2
1.2.1.4.2	Equipment Repairs	# receivers repaired	1
	Data and Data Product Services		
1.2.2.2	Archiving and data management	# permanent stations handled	66
1.2.2.4	Community Software	#TEQC downloads, #TEQC web information requests	Same as NSF 1.1.2.1.4 above

NSF Office of Polar Programs Support

The Antarctic field season was completed with 25 separate projects receiving equipment, training, and/or field support using 60 GPS receivers throughout the continent and offshore. A remote RTK base system was custom built and staged to provide drill rig positioning for the upcoming ANDRILL drilling on the Southern McMurdo Sound sea-ice to commence in September 2007 (Figure 5).The joint IRIS/UNAVCO MRI project deployed four staff for a late season effort to install Antarctic test-beds at McMurdo and South Pole Stations and a wind hardened field prototype at Minna Bluff (Figures 6 and 7). Unattended continuous data collection also continues for glaciology research on the Greenland Ice Sheet (T. Neumann, S. Das, G. Catania, I. Joughin PIs). Other highlights include attendance and presentation at AGU and POLENET meetings, the hiring of two new field engineers (one is a backfill for a vacancy left from the MRI staffing), preparations for the IPY GNET project to install several continuous stations on rock in Greenland next summer (M. Bevis PI). Performance Metrics are given in table 4.

Table 4. Engineering Performance Metrics - OPP

1.1.1.2	Permanent Station Ops	# stations monitored (on O&M list)	20
1.1.1.2		# station maintenance events	17
1.1.1.3	PI Project Services	# projects	27
1.1.1.4.1	Engineering Technical Support (email and phone support)	# tech support requests	not tracked
1.1.1.4.2	Development and Testing	#D&T projects completed	5
1.1.1.4.3	Pool Equipment	#receivers in pool	108
		#receivers on long term deployment	24
		#receivers delivered to projects	68
1.1.1.4.4	PI Equipment Repairs (RMAs)	# receivers repaired	included in EAR numbers
1.1.1.4.5	PI Training Classes, Workshops, Meetings	# classes/meetings held or participated in	26

Figure 7. Raytheon Research Associate Jason Bryenton and UNAVCO field engineer Thomas Nylen set up a remotely operated RTK base station in support of the ANDRILL project.

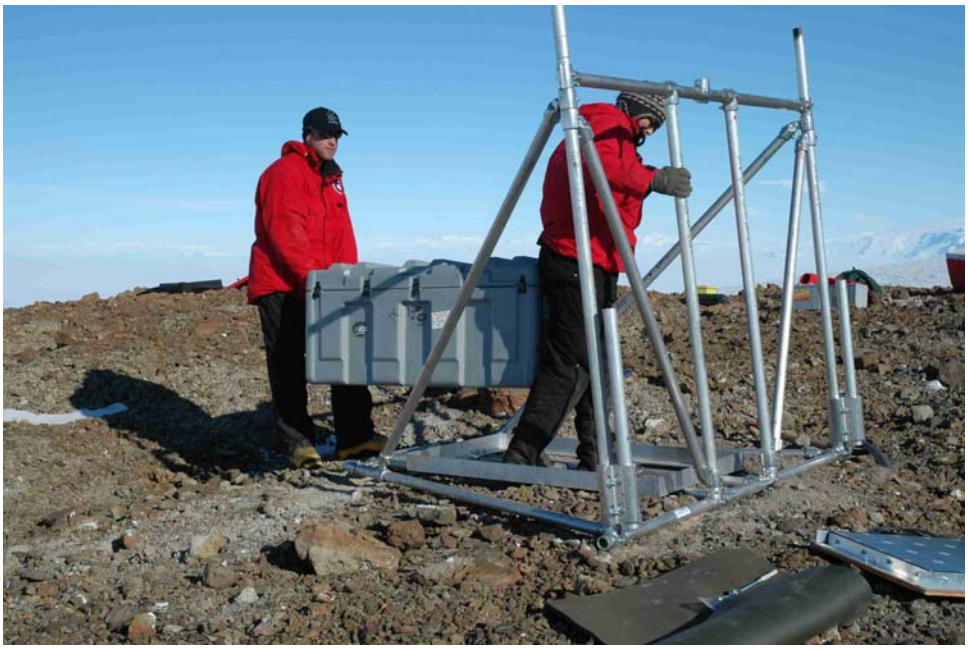

Figure 8. UNAVCO and PASSCAL MRI engineers Seth White and Tim Parker build the Minna Bluff extreme wind hardened GPS prototype at Minna Bluff, one of the windiest locations in Antarctica.

Figure 9. Bruce Beaudoin (PASSCAL), Jason Stauch (Raytheon), Seth White (UNAVCO), Tim Parker (UNAVCO) reflected in the South Pole during a break from installing extreme cold instrumentation for the IRIS-UNAVCO MRI project.

GeoEarthScope Support

GeoEarthScope is the component of NSF's EarthScope project that includes the acquisition of aerial and satellite imagery and geochronology.

LiDAR imagery acquisition for the Death Valley-Fish Lake Valley fault system (PI: James Dolan, USC) concluded in December 2006; the LiDAR data were collected and are currently being processed by the National Center for Airborne Laser Mapping (NCALM) at the University of Florida. The GeoES Northern California LiDAR project, the first project proposed by the GeoES LiDAR working group, was planned to commence this quarter but has been delayed until early next quarter by NCALM due to delivery issues with a new high resolution LiDAR scanner; UNAVCO has issued project subawards to NCALM and the Ohio State University to provide support for this project.

Significant progress was made regarding the geochronology component of GeoES this quarter. A Notice of Opportunity announcing plans for the geochronology provider request for proposals (RFP) was issued to the community at large in January. Approximately fifty geochronology labs submitted statements of interest in response to this announcement. The geochronology RFP was then sent to these labs in February. A total of 28 responses to the RFP were received by the end of this quarter and additional responses are expected. These responses will be evaluated by the GeoES geochronology working group during the next quarter.

Progress was also made regarding the InSAR imagery component of GeoES. UNAVCO is engaged in ongoing high level discussions with the European Space Agency (ESA) to facilitate the large data orders to support the Basin and Range InSAR project (PI: Falk Amelung, University of Miami) as well as additional upcoming GeoEarthScope InSAR projects. A subaward to the Alaska Satellite Facility (ASF) at the University of Alaska at Fairbanks to support InSAR data handling at UNAVCO was developed during this quarter and will be issued early in the next quarter.

The GeoES Project Manager participated in numerous community events during this quarter including: 2006 Fall AGU in December (GeoES was a featured topic at the EarthScope Town Hall meeting at AGU); interagency InSAR meeting at AGU; project planning meetings at AGU; USGS SoSAFE meeting in January. A new position was advertised this quarter to support GeoES activity: UNAVCO Data Engineer II (InSAR, LiDAR, Geochronology). In February this unfilled position was eliminated in favor of issuing the InSAR related subaward to ASF described above.

Performance metrics for GeoEarthScope are reported by the Plate Boundary Observatory. As presented at the EarthScope Facility management review meeting in November 2006, the current GeoES baseline does not accurately reflect the current activity and milestones and should be revised following completion of the GeoES review process in the next quarter. An example of a possible revised baseline is presented here.

PBO Nucleus Project Support

PBO Nucleus project station upgrades is now over three-quarters complete. 18 upgrades were completed during this quarter, bringing the total number to date of 163 of the 209 stations, 9 months ahead of schedule. The remainder of major equipment for the project was purchased at the end of February, 1 year earlier than planned, in order to keep pace with the fieldwork.

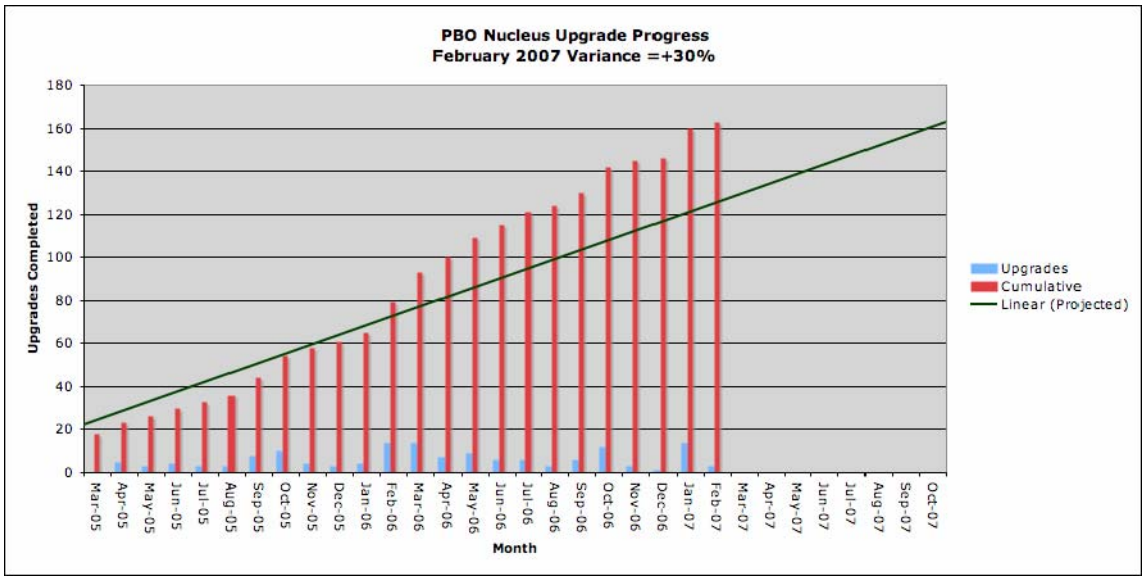

Figure 10. Progress timeline for upgrades of the PBO Nucleus network.

Renewals and transfers of station permits to UNAVCO have been ongoing throughout the project and was the subject of an audit this quarter to assess progress. The PBO Permitting Coordinator and assistants are funded by Nucleus to oversee this activity as coordinated by the Facility project manager and representatives from the original network operators. Approximately 55% of permit transfers (114) have been completed with another 30 in progress. Given that the priorities of both Nucleus and PBO staff have been on other aspects of their project this progress is far ahead of expectations.

Figure 11. (left) Station TOIY in central NV was upgraded in the winter by UNAVCO Staff using a snowmachine after the station failed. (right) Station EOUT, a former EBRY station near Ogden, UT, was upgraded in January by U. of Utah staff.

Collaboration with Plate Boundary Observatory field staff and management was further emphasized this quarter. Joint data communications networks were planned and installed in both the Basin and Range and Southern California regions by Nucleus and PBO staff. Planning for integration of Nucleus stations into the Operations and Management phase of the PBO began in earnest with recurring permit and data communications and estimated maintenance cost figures tabulated and presented, and potential problem issues and mitigation discussed. Nucleus staff made significant contributions to the development of the EarthScope O&M proposal.

A highlight this quarter was the permitting and installation of a Nucleus VSAT communication relay at the Shoshone Education and Research (SHEAR) Facility near Death Valley in Shoshone, CA. SHEAR is a geological field camp and research facility jointly operated by faculty of UTEP and the Universities of Washington and Oregon, and its participation Nucleus and PBO will open the door to Education and Outreach opportunities for the projects with the SHEAR facility users. SHEAR director and UTEP Professor Terry Pavlis visited the UNAVCO Facility in December to discuss the details. The relay currently serves a single Nucleus station (SHOS) but data from future PBO and BARGEN/Caltech stations will also pass through this facility.

Nucleus was represented at the AGU fall meeting in San Fracisco by a poster presentation "PBO Nucleus Project Status: Integration of 209 Existing GPS Stations into the Plate Boundary Observatory", and the project's Year 2 Annual Progress Report was submitted to and accepted by NSF Program Management who released year 3 funding at proposed levels.

Metrics: 209 Permanent stations monitored, 18 upgraded, 25 remote troubleshooting events, 27 troubleshooting events that included site visits (excluding upgrade visits)

EarthScope/PBO Project Support

The EarthScope-funded pool of 100 Topcon GB-1000 systems was used to support three continuing projects this quarter: Hawaii Earthquake Emergency Response (B. Brooks and J Foster, U. of HI. PI's), Cascadia ETS 2006 (Rick Bennett, U of Az. PI), and the Rio Grande Rift (A. Sheehan, S. Nerem, U of CO, A. Lowry, U.S.U., and M. Roy, U of NM PI's).

Support was requested to provide ground control for the GeoEarthScope Airborne Lidar survey of the northern San Andreas Fault, which will be conducted in Q2 of this year. Planning and equipment preparation for the project has been completed; the project will require 15 campaign systems and will be continuously staffed by one or more UNAVCO field engineers during the 5 week duration of the project. UNAVCO project managers and field staff will train and support USGS volunteers and Ohio State university students who will conduct high-rate GPS surveys on benchmarks along the flight path.

A long-awaited fix from Topcon Positioning Systems, which addressed heat-induced failures of the LCD displays on the GB-1000 receivers, was delivered in January. The

new systems were successfully tested in UNAVCO's temperature chamber over a 4-day period and accepted for field use. A rotating RMA process has been implemented with Topcon providing 15 LRU's for use while UNAVCO's units are being repaired. To date 7 of our units have been fitted with the new displays and 15 more are in progress. Topcon has also reported progress on a new cross-platform user interface for the GB-1000 which has been developed at the urging of and collaboration with UNAVCO management. A beta release is expected in mid-to-late Q2 of this year.

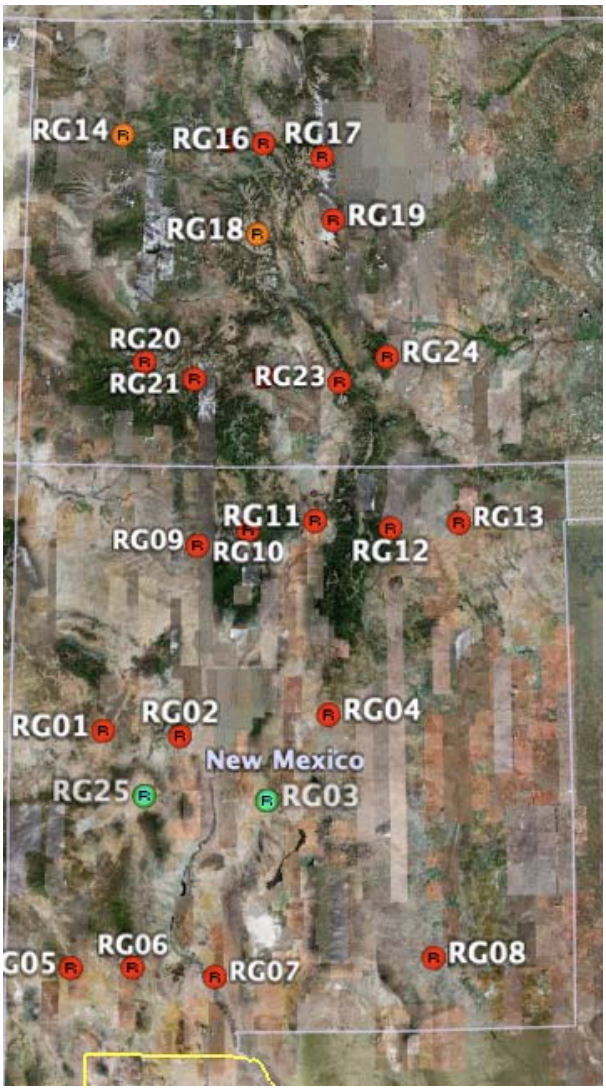

Figure 12. Map of Rio Grande Rift stations.

Three more stations of the Rio Grande Rift project were built this quarter. As of now 21 of the 25 stations have been completed by UNAVCO staff. Although the project initially specified a 24 station network, UNAVCO has worked under budget to date and recommended to principal investigators and NSF-EarthScope management that at least one additional station be added to the network. The figure at right shows the current station status, with operational stations shown in red, permitted stations in orange, ongoing reconnaissance in green. Work on the project was slowed by severe weather in the area this winter, but CU and UNM staff were trained and able to make four site visits in northern New Mexico. All operating stations in the network now have up-to-date firmware that will allow the stations to operate unattended for 14 months rather than the previous 4 months. This project has represented a huge collaborative effort between the PI Institutions and UNAVCO Staff; construction of all stations is expected to be complete by late April.

UNAVCO is also coordinating efforts by the Colorado NGS advisor to incorporate Rio Grande stations into CORS and future Colorado RTRN construction, and a meeting with UNAVCO and PBO staff, RGR PI's and NGS and CDOT staff was hosted at UNAVCO in Februrary.

Metrics: 3 Projects supported, 100 Receivers in Pool, 1 PI Proposal Support Request,1 Development/Testing Project Completed (Topcon Hardware Acceptance).

1.3 Data Highlights

Archiving and Data Management

WBS Metrics. The table shows WBS Metrics reporting in the area of Data and Data Products. The metrics are very similar to the prior quarter.

WBS Report – Facility Data Group –December 2006-February 2007		
WBS Element	**Metric**	**Quantity**
1.1.2.1.2	Campaign files archived	6,815
1.1.2.1.2	Permanent station files archived	105,349
1.1.2.1.3	Campaign files accessed	1,298
1.1.2.1.3	Permanent station files accessed	1,105,372
1.1.2.1.4 and 1.2.2.4	Community software – TEQC downloads	1,912
1.2.2.2	Permanent stations handled	67

Holdings. Archive holdings in the online repository, which is the primary copy of all GPS related files and products, total 2.5 Tb in compressed form (4.9 Tb when uncompressed to their usable form). Holdings in the ftp pickup area, where the RINEX copy of all GPS-related files and products, total 4.1 Tb. The bar graphs show annual and cumulative archive data volume growth through time for the primary copy of GPS files.

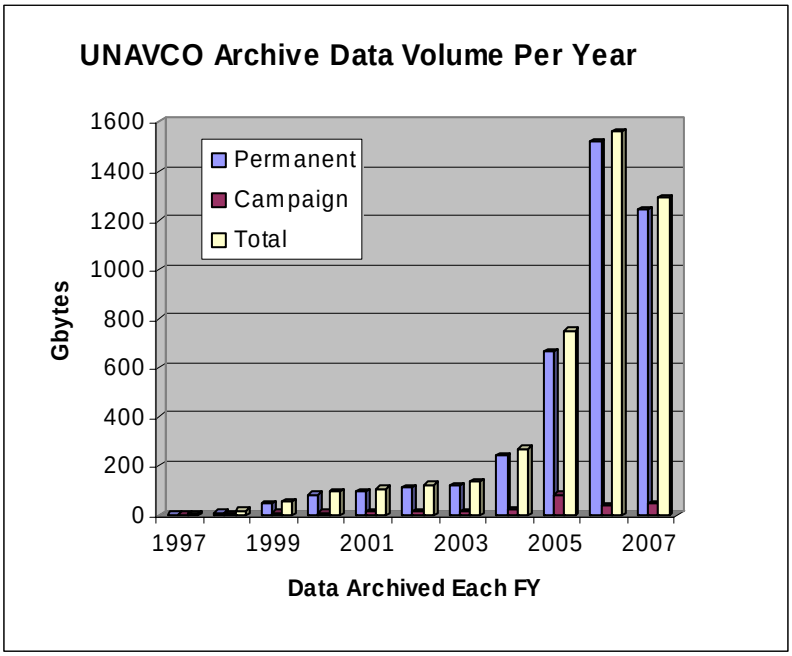

Figure 13. Archive data volume per year.

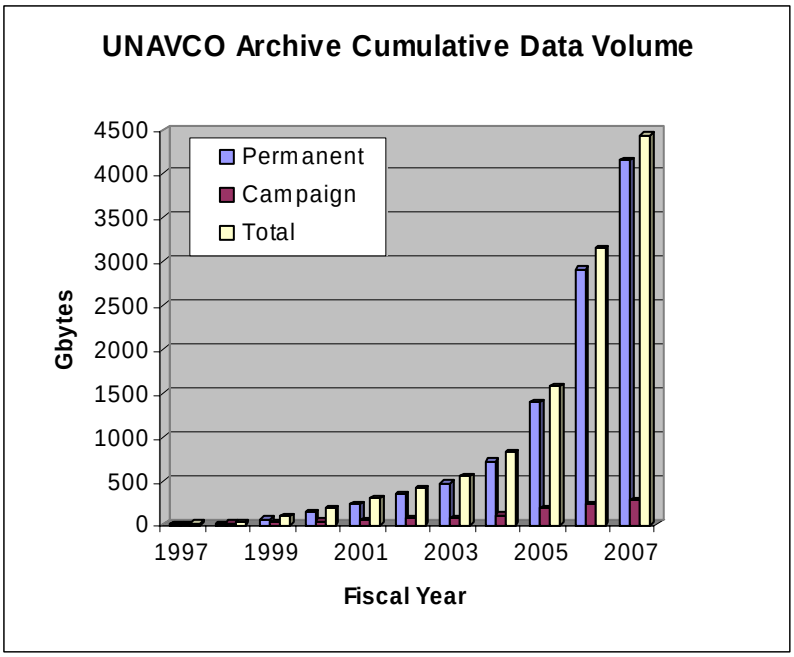

Figure 14. Cumulative archive data volume per year.

Permanent Stations. Currently, 1254 active global permanent stations are being archived at UNAVCO. An additional six sites from a variety of global networks (not including PBO) were added this quarter for automated daily archiving.

Campaigns. Archiving was completed for eight campaigns this quarter (IARC 2006, ISEA 2006, Kamchatka 2006, Kenai 2006, Kodiak 2006, PBO Ties 2006, RETREAT - Italy 2006, STEEP 2006).

Plate Boundary Observatory Data Support. Fifty new PBO sites were added this quarter. High-rate data from 191 PBO stations collected in association with the January 13, 2007 Kuril earthquake contributed to the more than 400 Gb total of high-rate data archived during the quarter.

GGN-SENH Data Support. New scripts for hourly connectivity checks for GGN stations were implemented with results incorporated into network monitoring repots that are emailed to GGN operational personnel.

Data Pickup. A monthly average of 368,000 data files were picked up from the Archive ftp server. Additionally, a monthly average of 209,000 QC files, sitelogs, GSAC holdings files, product files, campaign log images, and other GPS-related files were picked up from the Archive ftp server.

IT Infrastructure and Software. The architecture of how the Archive manages storage for files that are being curated for the long term has been realigned. Each month's additions are kept on logical storage which is frozen after the close of the month. Deletions are

handled via database flags, while the physical storage is left untouched. This structure allows for simplification of backups of one of the Archive's largest file systems because a large fraction of the storage does not change. This reduces the need for frequent level 0 backups. For recovery from a catastrophic failure of the Oracle server, tests of recovery from backed-up database files and archived transaction log files on a separate system were successful. The total storage for the primary archived copy and the public copy of all GPS data in the archive has been doubling at a nine-interval over the past two years. The graph indicates a recent decrease in this doubling time.

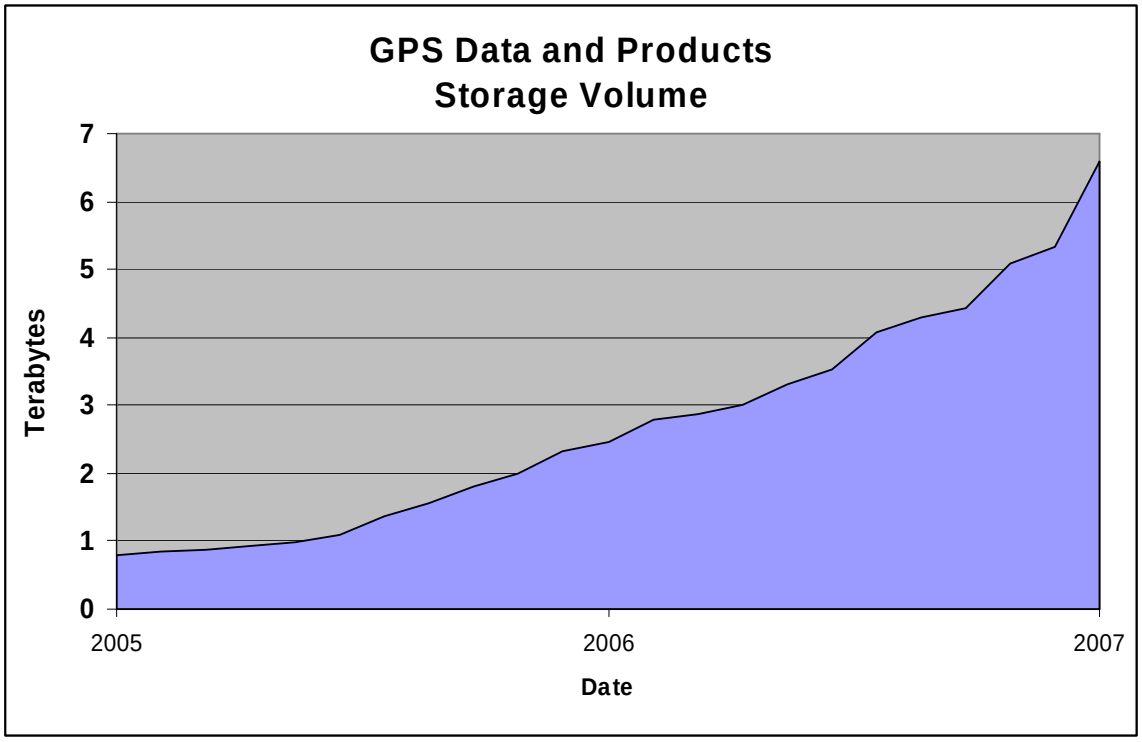

Figure 15. GPS data and products storage volume.

1.4 Education and Outreach Activities

UNAVCO's AGU booth had new printed materials, current equipment. Much of November and early December was dedicated to producing UNAVCO's new printed brochures. These are adaptable to several different uses including web resources.

UNAVCO Educational Rulers were produced for outreach and were very popular at AGU. A web page was developed in support of the images on the ruler and to provide additional scientific content.

http://www.unavco.org/edu_outreach/unavco_rules.html

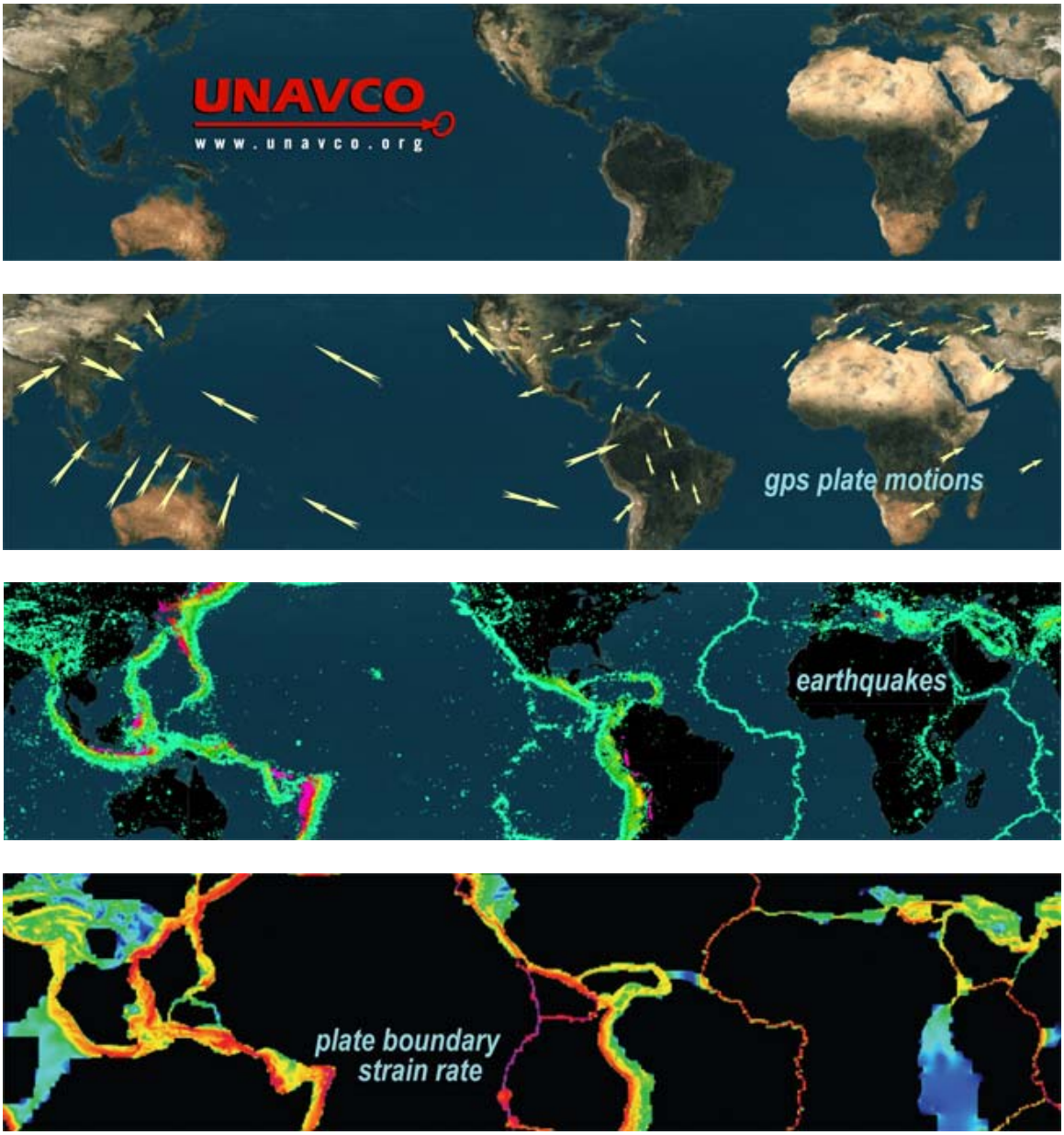

Figure 16. The datasets shown in these images are from the Global Strain Rate Map Project and were generated using UNAVCO's Jules Verne Voyager web mapping tool. From top to bottom are 1) "Face of the Earth" image, 2) GPS plate motion vectors, 3) Earthquakes colored by depth, 4) the "magnitude" of the lithospheric strain rate as the 2nd invariant of the model's strain rate tensor, demonstrating that the zone of deformation at plate boundaries can be quite broad. The colors indicate the magnitude of the strain rate: magenta = very high strain rates, blue = very low strain rates.

AGU abstracts

1. S. Eriksson, T. Wilson, S. Anandakrishnan, R. Aster, B. Johns, K. Anderson, and J. Taber, Disseminated Museum Displays and Participation of Students from Underrepresented Populations in Polar Research: Education and Outreach for Joint Projects in GPS and Seismology Solid Earth Science Community

2. R. Pandya and S. Eriksson, Alliances for Undergraduate Research in the Geosciences through Collaborative Recruitment

3. Mike Jackson, Susan Eriksson, Sarah Venator, Krista Barbour, David Mencin, William Prescott. Using EarthScope construction of the Plate Bouldary Observatory to provide locally based experiential education and outreach

Ice Fest – March 10, University of Colorado, Boulder. UNAVCO had a booth at Family Day with a slide show, outreach materials, and equipment. Attendance was not great, but it was good exposure to local organizations and a good partnership-building exercise with other local organizations involved in IPY.

Professional development workshops

- **GSA –** 10 College Faculty – Oct, 07
- **SACNAS** Teacher Professional Development, October 28, 2006, Tampa Florida, 12 Teachers
- **AGU –** GIFT – 20 teachers – Dec, 06
- **EarthScope Meeting** – March, 07, 14 teachers
- **NSTA – March, 07**
  - 4-hr Short course for teachers: Exploring Plate Tectonics Using the Global Positioning System (GPS)
  - 1-hr workshop: Exploring Plate Tectonics Using the Global Positioning System

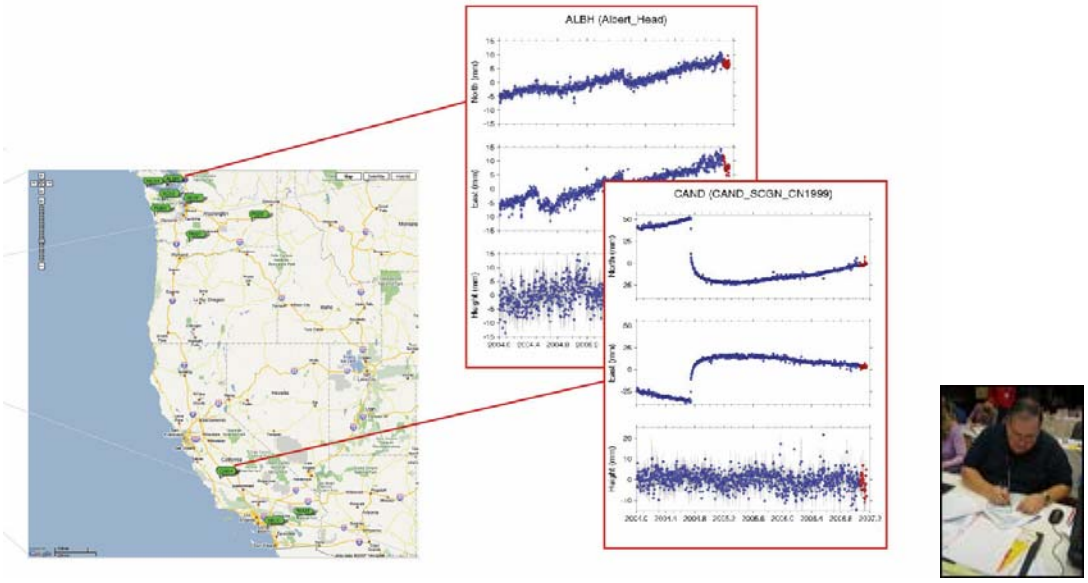

Figure 17. Sample PBO GPS time series viewing tools presented at the NSTA workshop.

Broader impacts

Staff continue to work with UNAVCO PI's in defining and supporting their work for broader impact in funded projects. Several letters of support were provided this past quarter, and UNAVCO has helped design projects in which we will be involved, if the PI is funded.

Working with others

1) Represented the National Association of Black Geologists and Geophysicists at the Geol. Soc of America GeoSociety Meeting, March 10, 11 in Boulder

2) Organized a meeting of E&O Managers from NSF GEO large projects, facilities, and centers, March 12-14, Arlington, Virginia, funded by a $39,000 grant from NSF to UNAVCO. 24 people and 6+ NSF program officers attended.

3) Staff helped design transition plan for EarthScope E&O. See metrics for dollar. Eriksson organized the upcoming March 27 Teacher Workshop for EarthScope Meeting.

4) Eriksson attended the Iris E&O March 15-16 to discuss present and future collaborations.

Other administrative work

Staff attended some workshops for professional development and representing UNAVCO E&O.

- January 24, 2007 - Designing and Implementing High Quality Professional Development for Teachers of Mathematics and Science, Centennial, CO

- **March 2 – 3, 2007 – Coalition for Earth System Education, Boulder, CO**
  Approximately 35 Earth science professionals, including scientists, teachers, education & outreach specialists and leaders, and federal and state agency representatives, from around the country attended this conference. During this conference Shelly Olds introduced UNAVCO's "Data for Educators" website and discussed the application of using GPS data in the classroom to learn about plate tectonics and the science and math education standards these activities support.

- **March 7-8, 2007 – Project Design and Evaluation, Boulder, CO**
  This seminar was provided by Coastal Services Center to become better acquainted with evaluation methods for education and outreach projects. Many of the techniques provided in this seminar will be useful for developing the Implementation plan so that it dovetails with the E&O Strategic Plan and Evaluation Plans.

Acknowledgements: This report contains significant contributions from Steve Fisher, Fran Boler, Bjorn Johns, Jim Normandeau, Oivind Ruud, Freddy Blume, David Phillips, Susan Eriksson and Charles Meertens.

Appendix
AGU Presentations and Posters Presented by UNAVCO Staff

Pandya, Eriksson, Haacker-Santos, R Calhoun, A , Alliances for Undergraduate Research in the Geosciences Through Collaborative Recruitment

Eriksson, S C, Wilson, T J, Anandakrishnan, S, Aster, R C, Johns, B, Anderson, K, Taber, J, Disseminated Museum Displays and Participation of Students from Underrepresented Populations in Polar Research: Education and Outreach for Joint Projects in GPS and Seismology Solid Earth Science Community

Jackson, M, Eriksson, S, Barbour, K, Venator, S, Mencin, D, Prescott, W, Using EarthScope Construction of the Plate Boundary Observatory to Provide Locally Based Experiential Education and Outreach

Wier, S, Bensen, G D, Meertens, C M, Keller, G R, Seber, D , Integrated Analysis of Seismological Models Using GEON Resources: an Illustration From the Western United States

S. Eriksson, T. Wilson, S. Anandakrishnan, R. Aster, B. Johns, K. Anderson, and J. Taber, Disseminated Museum Displays and Participation of Students from Underrepresented Populations in Polar Research: Education and Outreach for Joint Projects in GPS and Seismology Solid Earth Science Community

R. Pandya and S. Eriksson, Alliances for Undergraduate Research in the Geosciences through Collaborative Recruitment

Mike Jackson, Susan Eriksson, Sarah Venator, Krista Barbour, David Mencin, William Prescott. Using EarthScope construction of the Plate Bouldary Observatory to provide locally based experiential education and outreach

Blume F, Prescott W, Anderson, G, Eriksson, S, Feldl, N, PBO Nucleus Project Status: Integration of 209 Existing GPS Stations into the Plate Boundary Observatory

C. Meertens, S. Wier, D. Murray, J. McWhirter A. Memon , The GEON IDV (Integrated Data Viewer) for Data Exploration and Discovery in the Geosciences

Tim Ahern, Greg Anderson, Bob Arko, Fran Boler, Suzanne Carbotte, Rob Casey, Linus Kamb, James Matykiewicz, Joanna Muench, Chris Stolte and Bruce Weertman, GeoWS: enabling data discovery within the geosciences

Erin C. Pettit, Thomas Nylen, Andrew G. Fountain, and Bernard Hallet, Ice Cliffs and the Terminus Dynamics of Polar Glaciers

Also See AGU Web Site: http://www.agu.org/meetings/fm06/waisfm06.html Enter “UNAVCO” in the search term field

Acknowledgements: This report contains significant contributions from Steve Fisher, Fran Boler, Bjorn Johns, Jim Normandeau, Oivind Ruud, Freddy Blume, David Phillips, Susan Eriksson and Charles Meertens.