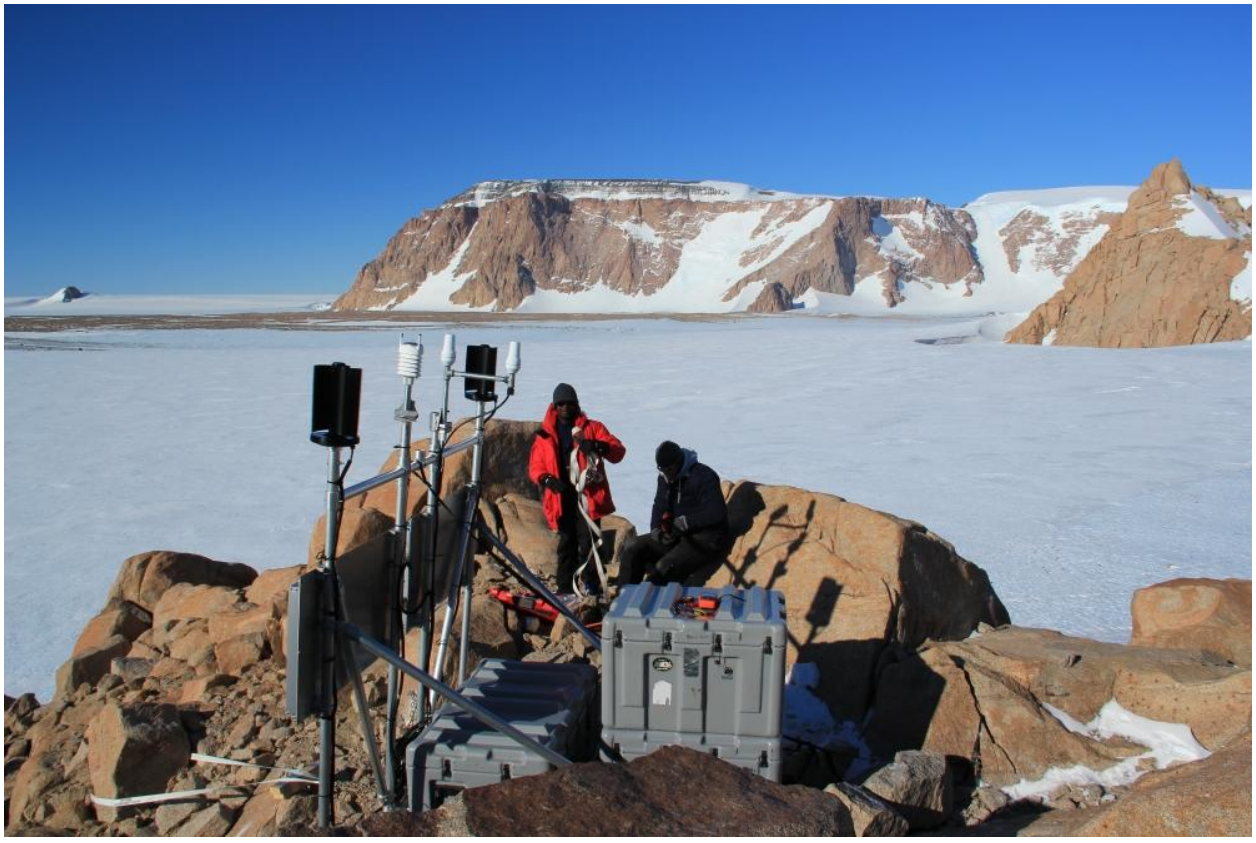
Geodetic Technologies Support to the National Science Foundation

Office of Polar Programs Antarctic Program

2010-2011 Season Report



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2010-2011 Season Report

Submitted by

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www.unavco.org/polar

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*Geodesy Advancing Earth Science Researc*h

Cover photo: POLENET installation at the Bennett Nunataks, December 2010.

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Summary

UNAVCO provides year-round support for scientific applications of geodetic technologies (GPS, ground based LiDAR, remote autonomous power and communications) to the National Science Foundation's Office of Polar Programs (NSF/OPP) Antarctic Program. This support includes pre-season planning, field support, and post-season follow-up, as well as development work for supporting new applications. Resources and expertise from the other core UNAVCO support areas, including NSF-EAR investigator support, NASA-Global GNSS Network operations, the EarthScope / Plate Boundary Observatory facility construction and operation, and the UNAVCO community data archive are leveraged to apply state-of-the-art technologies at a reasonable cost.

A "satellite" facility is staffed at McMurdo Station, Antarctica during the austral summer research season, providing a full range of support services including ground based LiDAR and GPS equipment, training, project planning, field support, system fabrication, technical consultation, data processing, and data archiving. UNAVCO continues to maintain permanent GPS stations for the community at McMurdo Station, at South Pole Station, at WAIS Divide camp, and at Palmer Station. Table 1 summarizes the 35 Antarctic projects that received UNAVCO support, while Appendix A provides more detailed discussions of individual projects. In addition, 10 letters of support, six with supplemental budgets, were issued to Principal Investigators submitting to NSF-OPP Antarctic research solicitations in 2011.

In 2010 the scope of Polar activities at UNAVCO effectively outgrew the Cooperative Agreement, and a new proposal, Enhanced Support for GPS Networks and Terrestrial Laser Scanning in Polar Regions (ANT-1053220) was awarded. This award includes funds for enhanced core UNAVCO Facility support in two primary areas. The first is network engineering to support the ~100 station continuously operating GPS receivers installed in Greenland (GNET) and in Antarctica (POLENET). The second is polar support for Terrestrial Laser Scanning.

Ground based LiDAR demand remains robust, and 9 LiDAR projects were supported during the season, including one based off the Icebreaker Oden. The Terrestrial Laser Scanners (TLS) are complimentary to GPS equipment, and allows for much higher spatial density surveys of short distances. While the Optech ILRIS 3D scanner purchased in 2007 is approaching obsolescence, UNAVCO has acquired four new scanners with NSF-EAR funding and these instruments are available for polar project support as the schedule allows.

Figure 1: The Terrestrial Laser Scanner acquiring imagery at the Discovery Hut, McMurdo Station.

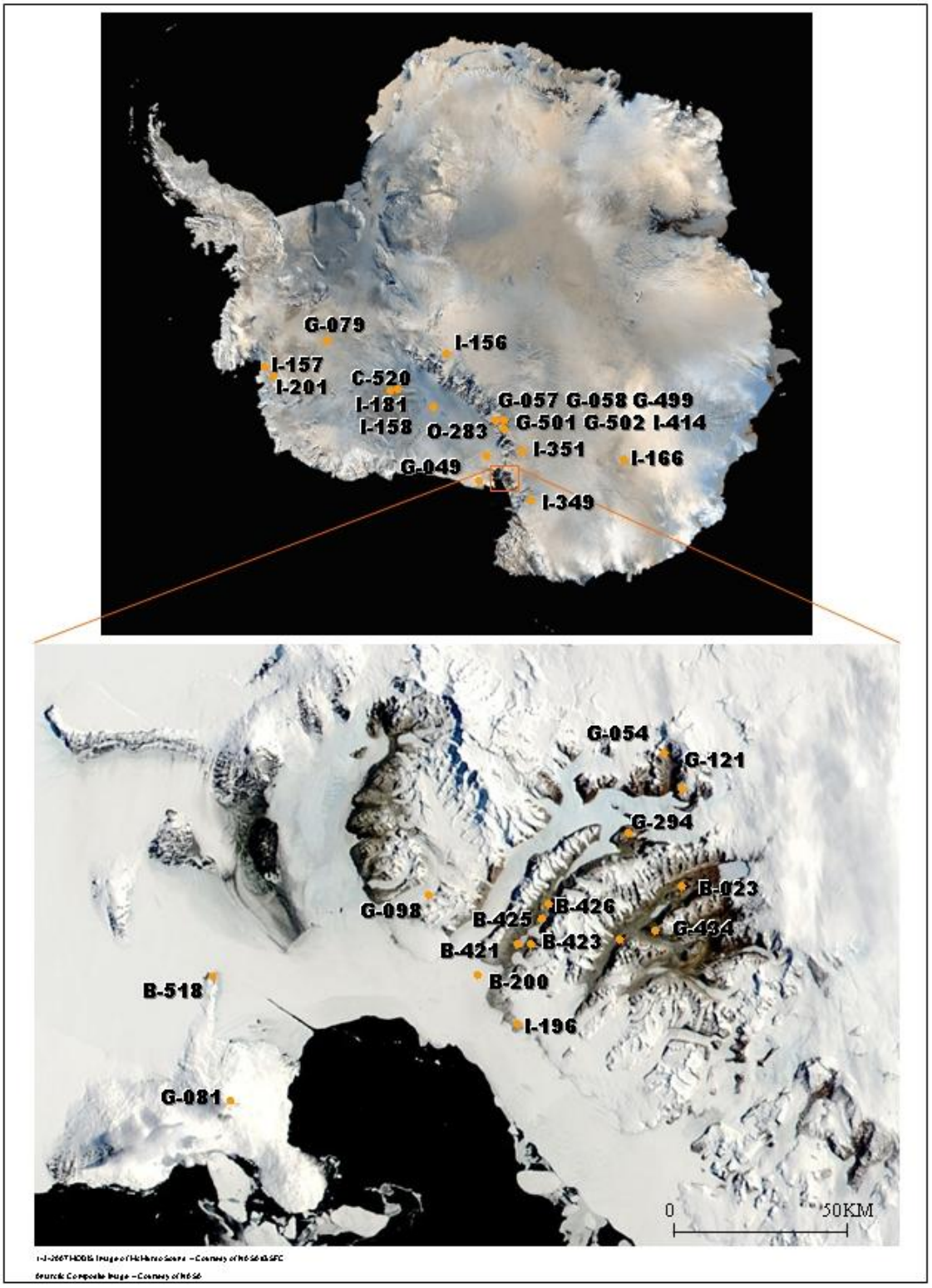

Figure 2: Project locations with UNAVCO support during the 2010-2011 field season.

Table 1: 2010- 2011 Antarctic Project Support Provided

Project	Principal Investigator	Support Effort %	Equipment Load	Field Support	Training	Data Archived	Data Processed	Preseason Request
B-023	Barrett	2	Y	Y	Y	N	N	Y
B-200	Oliver	1	Y	N	Y	N	N	Y
B-421	McKnight	1	Y	Y	N	N	N	Y
B-423	Virginia	1	Y	N	Y	N	N	N
B-425	Fountain	1	Y	Y	N	N	N	Y
B-426	Doran	1	Y	N	Y	N	N	Y
B-518	Kennicut	2	Y	N	Y	N	N	Y
C-515	Domack	2	Y	N	N	Y	N	Y
C-520	Anandakrishnan	14	Y	N	Y	Y	N	Y
G-049	Rack	4	Y	Y	Y	Y	N	Y
G-054	Marchant	2	Y	Y	Y	N	N	Y
G-057	Harvey	2	Y	N	Y	N	N	Y
G-058	Harvey	2	Y	N	Y	N	N	Y
G-079	Wilson	18	Y	Y	N	Y	N	Y
G-081	Kyle	4	Y	Y	Y	N	N	Y
G-098	Blankenship	1	Y	N	N	N	N	Y
G-121	Sletten	3	Y	Y	Y	N	N	Y
G-294	Ashworth	3	Y	Y	Y	N	N	Y
G-434	Morin	1	Y	N	Y	N	Y	Y
G-499	Licht	2	Y	N	Y	N	Y	Y
G-501	Putkonen	1	Y	N	Y	N	N	Y
G-502	Ashworth	1	Y	N	N	N	Y	Y
I-156	Balco	1	Y	N	Y	N	N	Y
I-157	Joughin	1	Y	N	Y	N	N	Y
I-158	Rupper	2	Y	N	Y	N	N	Y
I-166	Pettit	2	Y	N	N	N	N	Y
I-181	Winberry	6	Y	N	Y	N	N	Y
I-196	Hall	1	Y	N	Y	N	N	Y
I-209	Conway	1	Y	N	N	N	N	Y
I-349	Kurbatov	2	Y	N	Y	N	N	Y
I-351	Stearns	10	Y	N	Y	N	N	Y
I-414	Stone	1	Y	N	N	N	N	Y
O-269	Ackley	2	Y	N	Y	N	N	Y
O-283	Lazzara	2	Y	Y	N	N	N	Y

Long-term Continuous Data Collection and Network Support

Technology Development

Remaining funds from the completed MRI project Development of a Power and Communication System for Remote Autonomous GPS and Seismic Stations in Antarctica were used to issue a subcontract to Xeos Technologies to develop a scalable and instrument independent Iridium Router-based Unrestricted Digital Internetworking Connectivity (RUDICS) based communications for geodetic GNSS networks and other sensors. Enhanced features include the ability to host standard “network appliance” devices using the Ethernet interface and TCP/IP protocol, improved bandwidth, reduced power consumption, cold hardening, and improved system control. Two systems were delivered and field testing is currently in progress.

The proposal Enhanced Support for GPS Networks and Terrestrial Laser Scanning in Polar Regions includes 0.5 FTE for network engineering to support the ~100 station continuously operating GPS receivers installed in Greenland (GNET) and in Antarctica (POLENET). Part of this effort is for sustaining engineering activities specifically for the requirements to transition from development activities to an operational role in supporting the polar autonomous GPS networks, provide a systematic approach to keeping up with ever changing technologies, and make the MRI developed systems available to the broader community. Specific efforts over the past year included improving the IT infrastructure of the Iridium communication hub at UNAVCO, working with Xeos technologies on the subcontracted RUDICS development activities mentioned above, improved system grounding at remote sites, and testing the “plateau” wind turbine system in a windier “margin” environment.

Figure 3: The www.unavco.org/polartechnology website provides detailed documentation of the best-practices, current systems fielded by UNAVCO remote autonomous polar observations.

POLENET

The POLENET IPY project is an international effort led by Terry Wilson of the Ohio State University to install continuous GPS stations (Figure 4) and seismometers throughout Antarctica. The purpose is to apply bedrock geodesy to measure the response to past and present day ice sheet mass change while using seismic profiling to better understand the structure and evolution of the Antarctic plate. Most of the sites are remote and rely on solar and wind power and satellite data retrieval.

Figure 4: POLENET installation at the Clark Mountains, West Antarctica.

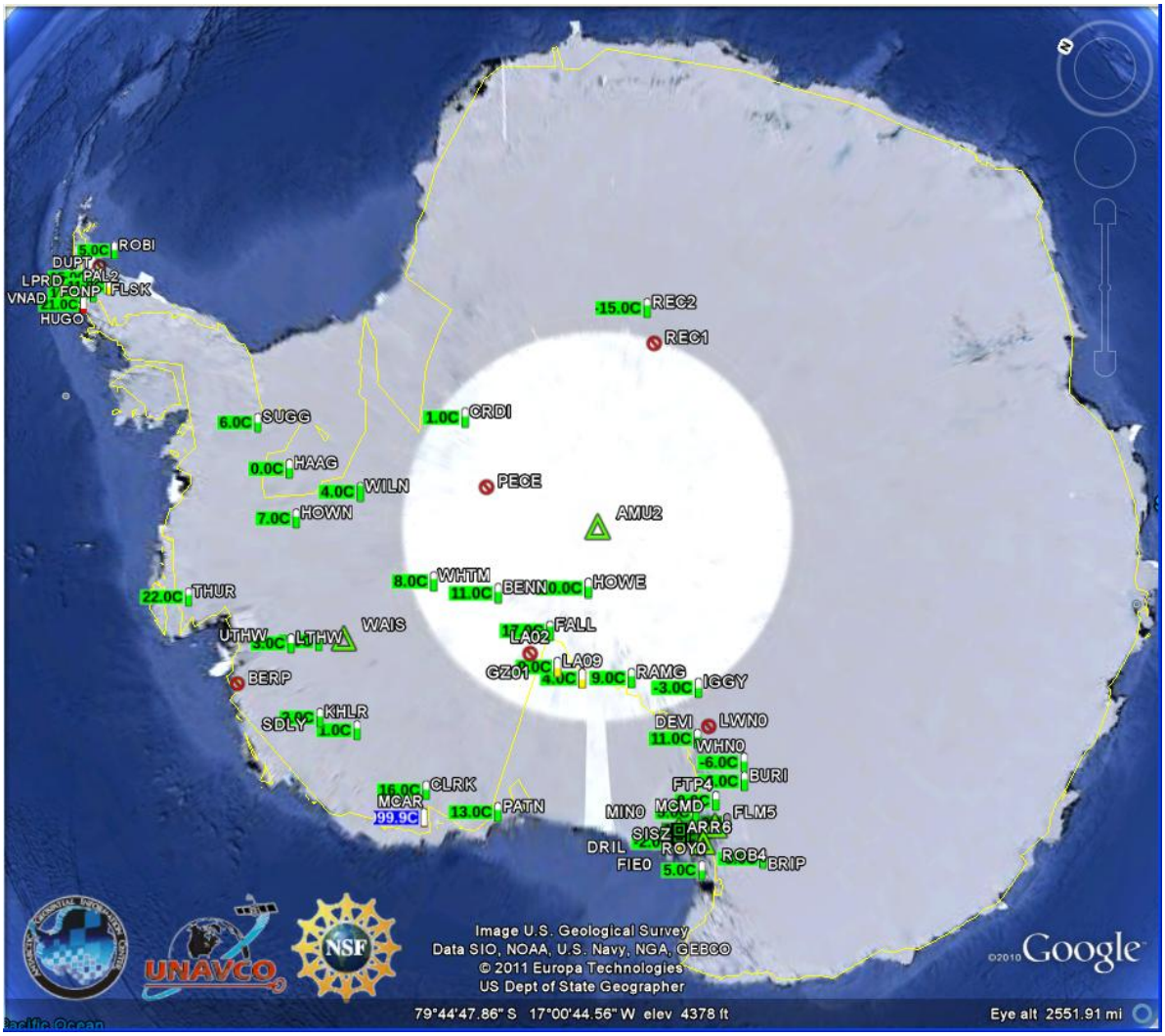

Figure 5: State-of-health snapshot from the broad network of continuously operating and telemetered GPS stations in Antarctica.

Figure 5 and Table 2 show the network and status in the middle of the 2011 austral winter. UNAVCO provided engineering design, procurement, shipping and field support. Field engineer Jeremy Miner took the lead on supporting the field deployment portion of the project while other UNAVCO staff also spent several months assisting with the planning, preparation, and field activities. Data management is provided by UNAVCO, and an Iridium based download system allows for full data retrieval from the remote stations with open data access at facility.unavco.org/data.

Weather limitations in the West Antarctic and tight aircraft resource allocation limited deployment to 5 out of the 9 hoped for systems. At Franklin Island the existing TAMDEF station was upgraded and renamed FRKI. Maintenance visits were also made to 24 sites. At the time of POLENET team's departure from Antarctica, 100% of the Antarctic sites were functional. There are currently 40 stations in the Antarctic POLENET network.

Table 2: POLENET network status as of 20 August 2010

Site	Agency	Communication	Status as of 10 July 2011
BENN	OSU	Iridium	Operational
BERP	OSU	Iridium	Operational
BRIP	OSU	Iridium	Operational
BURI	LINZ	Iridium	Operational
CAPF	Hamilton College	Iridium	Comms down since Mar 2010 – Maint. planned
CLRK	OSU	Iridium	Operational
COTE	OSU	Radio	Operational
CRDI	OSU	Iridium	Operational
DEVI	OSU	Iridium	Operational
DUPT	Hamilton College	Iridium	Comms down since Aug 2011 – Maint. planned
FALL	OSU	Iridium	Operational
FIE0	OSU	Iridium	Operational
FLM5	OSU	Radio	Operational
FONP	Hamilton College	Iridium	Operational
FTP4	OSU	Iridium	Operational
FRKI	OSU	Iridium	Comms down since February 2011
HAAG	OSU	Iridium	Operational
HOWE	OSU	Iridium	Operational
HOWN	OSU	Iridium	Operational
HUGO	Hamilton College	Iridium	Operational
IGGY	OSU	Iridium	Operational
KHLR	OSU	Iridium	Operational
LWN0	OSU	Iridium	Operational
LTHW	Penn State U	Iridium	Operational
MCAR	OSU	Iridium	Operational
MIN0	OSU	Iridium	Operational
PATN	OSU	Iridium	Operational
PECE	OSU	Iridium	Operational
RAMG	OSU	Iridium	Operational
ROB4	LINZ	Radio	Operational
ROBI	Hamilton College	Iridium	Operational
SCTB	LINZ	Ethernet	Operational
SDLY	OSU	Iridium	Operational
SUGG	OSU	Iridium	Receiver down since Mar 2010 – Maint. planned
THUR	OSU	Iridium	Operational
UTHW	OSU	Iridium	Operational
VNAD	Hamilton College	Iridium	Operational
WHN0	OSU	Iridium	Operational
WHTM	OSU	Iridium	Operational
WILN	OSU	Iridium	Operational

LARISSA

LARISSA: Larsen Ice Shelf System, Antarctica is a National Science Foundation funded initiative that brings an international, interdisciplinary team together to address a significant regional problem with global change implications, the abrupt environmental change in Antarctica's Larsen Ice Shelf System. As part of this effort, three bedrock CGPS stations were installed along the western side of the Peninsula in April 2009, and another three on the east side in February 2010 to measure post-glacial rebound to help reconstruct the detailed configuration of the northern Antarctic Peninsula Ice Sheet (APIS) during the Last Glacial Maximum (LGM) and subsequent retreat (Figures 5 and 6). Two more CGPS sites were installed on outlet glaciers from the Bruce Plateau. The bedrock CGPS stations are also a part of the POLENET initiative. Support was provided for maintenance visits to the Caper Framnes and Leppard Glacier sites in November 2010.

Erebus Network

Technical support, maintenance, data handling, and archive services are provided for the operation of the Mt. Erebus GPS Network (Philip Kyle PI). A maintenance visit was paid to the CONZ site to ensure the system was in good physical condition for the upcoming winter, and maintenance was performed on the CGPS site MACZ, upgrading the frame and replacing a broken wind turbine and communications antenna. Data was retrieved from Abbott Peak (ABBZ) and placed in the UNAVCO archive. Data retrieval from the Cape Roberts and Mt. Fleming POLENET sites continues through the Truncated Cones repeater site on Mt. Erebus.

South Pole Station

The South Pole base system AMU2 is maintained for both local and global GPS operations. A backup GPS receiver and antenna are kept on-site as a precaution against a wintertime failure when supplying spares is not possible. The data are archived at UNAVCO and NASA-CDDIS and available online. Requests for high rate GPS data in support of airborne projects in the vicinity are common, and this year such data were provided for the ICECAP project.

Palmer Station

The Palmer GPS system is maintained for both local and global GPS operations and includes a community GPS base station (PAL2), a real-time kinematic (RTK) GPS system, and the NASA GGN station PALM. The UNAVCO base system PAL2, which uses the same antenna as PALM, provides centimeter level RTK differential corrections to properly equipped users in the vicinity of Palmer Station, and a rover RTK GPS receiver is available. Publicly available geodetic data are archived at UNAVCO with minimal latency, and high rate (1Hz) data are available on station and from JPL. Requests for high rate GPS data in support of airborne projects in the vicinity are common, and this year such data were provided for the NASA ICEBRIDGE project.

McMurdo Station

The McMurdo GPS system is maintained for both local and global GPS operations and includes a community base station (MCMD), a real-time kinematic (RTK) GPS system, and the NASA GNSS Global Network (GGN) station MCM4. The data are available from UNAVCO and NASA archives. MCM4 high rate data was supplied to two projects this season – ICECAP and ICEBRIDGE.

WAIS Divide Camp

The permanent station at WAIS Divide Camp continues to provide summertime continuous data during the operational field season. UNAVCO installed the community GPS base station in November 2005 to support local projects and provide a consistent time series for the duration of the camp. A wireless ethernet link to

WAIS camp allows automatic data downloads to a designated computer at the camp, and UNAVCO supports camp staff in setting up a data download routine for the season. Publicly available data from this site are archived at UNAVCO. This season the system was raised and repositioned and a faulty radio modem replaced.

Community Equipment Pool

GPS Receivers

One hundred and seventy five geodetic quality dual-frequency receivers (74 Trimble NetRS, 35 NetR9's 12 NetR8's, 30 Trimble R7, 22 Trimble 5700, 2 Trimble 4700) were provided from the UNAVCO pool for Antarctic support (including POLENET) throughout the field season. All necessary ancillary equipment, such as data processing software, solar panels, batteries, bipods, chargers, enclosures, tribrachs, tripods, and cables, was also provided.

The receiver pool is upgraded annually to best meet the current science needs. The UNAVCO GPS pool increased by 48 systems to a total of 177 NSF-OPP USAP receivers as of 31 December 2010. This includes 13 new NetR8's and 35 new NetR9's receivers fielded at the Whillans Ice Stream and the Byrd Glacier. To meet the full demands of opposite peak field seasons, equipment from the OPP-Arctic and USAP pools are shared. Table 3 provides a summary of the major USAP equipment in the pool. The number also reflects the loss of one USAP owned Trimble R7 receiver in transit to Alaska.

LiDAR Terrestrial Laser Scanner

Interest for Terrestrial Laser Scanning in Antarctica has continued to be robust. After wrapping up late season TLS projects in Barrow, Alaska, the LiDAR gear was sent to Antarctica where 9 separate events requested TLS support, including one based off the icebreaker Oden. Support was provided for applications including change detection (Mt. Erebus lava lake, Taylor Valley snow fields, and Dry Valley glaciers), geological features mapping and sea ice surface characterization. The growing demand for this resource led to the request to NSF-OPP for an additional FTE to meet the resource requirements needed to adequately support the survey and data processing complexity of this new technology in future seasons.

While the Optech ILRIS 3D scanner purchased in 2007 is approaching obsolescence, UNAVCO has acquired four new scanners with NSF-EAR funding and these instruments will be used for polar project support as the schedule allows. Efforts are continuing to further develop the necessary software and IT support to enable the community to process the acquired data sets to obtain merged and geo-referenced point cloud images. The related **INTERFACE** project (**INTER** disciplinary alliance for digital **F**ield data **AC**quisition and **E**xploration), also managed by UNAVCO, is working to further this effort and help geoscientists with the technical hurdles in obtaining precise high resolution 3D surface data. A workshop is scheduled in October, 2011 to gather community input to the future of UNAVCO TLS support.

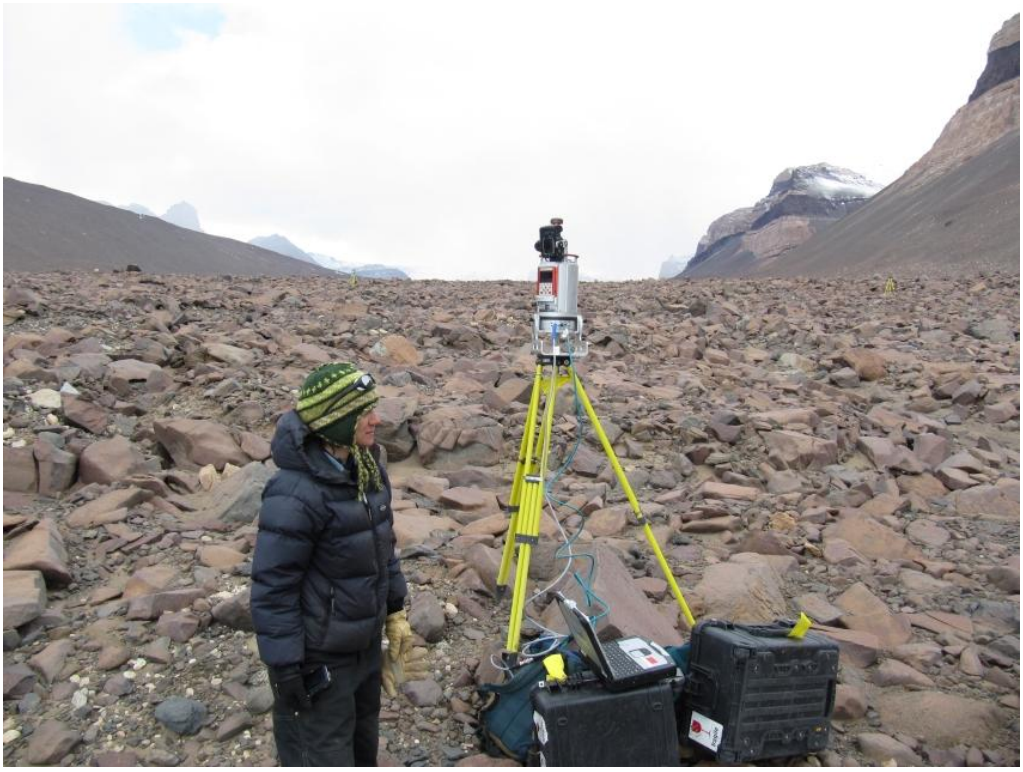

Figure 6: UNAVCO Engineer Marianne Okal uses the TLS to scan features in the lower beacon Valley.

Table 3: The UNAVCO/USAP Equipment Pool 31 December 2010

Item	Qty	Features and Applications	Average age (yr)
Trimble 4700	4	Robust receiver for short term data collection and kinematic surveys where a handheld survey controller is used.	12
Trimble 5700	17	Modern low power, high memory receiver suited for both short term and continuous data collection.	9
Trimble R7	27	Same as the 5700, but also capable of tracking the new L2C GPS signal.	7
Trimble NetRS	81	State-of-the-art reference station receiver with computer and web browser interface, well suited for continuous data collection applications.	5
Trimble NetR8	13	State-of-the-art reference station receiver with computer and web browser interface, well suited for continuous data collection applications.	1
Trimble NetR9	35	State-of-the-art reference station receiver with computer and web browser interface, well suited for continuous data collection applications.	1
Trimble survey controllers	10	Handheld controller used with Trimble R7 and 5700 for field programming and survey measurements.	-
Pacific Crest RTK radios	13	Low power radios for RTK surveys	-
LiDAR scanner	1	Optech ILRIS 36D Terrestrial laser scanner	3
Pan/tilt base	1	Optech - for ILRIS 36D scanner	2

Equipment Deployed Long Term

Table 4 provides an overview of UNAVCO/USAP equipment deployed long term at remote locations. While the applications differ, the equipment is standardized as much as possible to limit the efforts of tracking and maintaining the systems.

Table 4: UNAVCO/USAP Equipment deployed Long Term at Remote Locations

Location	**GPS receivers**	**Communication modems**	**Other equipment (value > $1000)**
McMurdo Station GPS Base MCM4/MCMD	1 TNL NetRS	1 PC RFM96-2W	
McMurdo Station Mt. Erebus/ TAM data hub		1 FreeWave FGR115 2 Intuicom Ethernet bridge	
McMurdo Station Ob-Hill testbed	1TNL NetRS	1 Xeos Technologies modem	1 Vaisala WXT-510 metpack
Mt. Erebus Abbot Peak Mt. Erebus MACZ Mt. Erebus Truncated Cones Mt. Erebus BOMZ	1 TNL R7 1 TNL NetRS 1 TNL NetRS 1 TNL R7	1 Intuicom Ethernet bridge 1 FreeWave FGR115 1 Intuicom Ethernet bridge	1 Vaisala WXT-510 metpack
Palmer Station GPS base PALM/PAL2	1 TNL NetRS 1 TNL R7		1 TSC2 survey controller
Pine Island Glacier	1 TNL NetRS	1 NAL A3LA Iridium	
POLENET	1 TNL R7 40 TNL NetRS	1 FreeWave FGR115 1 Intuicom Ethernet bridge 33 NAL A3LA Iridium	28 Vaisala WXT-520 metpack
Recovery Lakes	2 TNL NetRS	2 NAL A3LA Iridium	2 Vaisala WXT-520 metpack
South Pole Station GPS base AMU2	2 TNL NetRS		
WAIS Divide camp	1 TNL NetRS	2 Intuicom Ethernet bridge	
Whillans Ice Stream	10 TNL NetRS 13 NetR9	3 NAL A3LA Iridium Stand alone, continuous ops	
LARISSA	8 TNL NetRS	8 NAL A3LA Iridium	
Total:	**86**	**59**	**33**

Science Support Services

The UNAVCO Facility provides GPS project management, equipment and field engineering support, and data services for principal investigator projects and for installing, operating and maintaining continuous GPS networks world-wide. These capabilities are drawn upon to provide support tailored to the needs of Antarctic research scientists as summarized below. Field activities are supported from UNAVCO's office and shop space located in the Crary Lab at McMurdo Station. This is an excellent base of operations for UNAVCO, although as the UNAVCO support role has grown so has the on-Ice space requirements. Both the volume of equipment handled as well as the stock and inventory requirements that accompany continuous GPS station installation and maintenance highlight the need for larger workspace and additional storage. The UNAVCO milvan is well utilized throughout the season and left full during the winter as the primary UNAVCO on-ice storage location. The long-term desire still remains to obtain dedicated space at McMurdo Station, rather than work from space that must be formally requested in the RPSC Support Information Package every year and requires frequent shuttling of equipment to and from a storage container on another part of the station. During the 2010-11 field season, UNAVCO was once again provided dedicated space in Crary Lab room 239 which met the project needs well and contributed to the success of the mission.

Science Advisory Committee

The Polar Networks Science Committee (PNSC) is chartered to coordinate input to IRIS and UNAVCO from the science community regarding polar geodetic and seismic instrumentation, networks and science requirements, and to provide information to the research community on the capabilities of the facilities. This eight member committee is charged with engaging and advising on polar GPS and proposal initiatives and assisting with the development of acquisition proposals for polar remote station components and systems. The PNSC reports to both the IRIS and UNAVCO Boards of Directors. It is the forum for the direct participation of the polar science community in UNAVCO as a consortium that provides them with considerable resources in the era of large polar GPS networks such as POLENET. The PNSC meets annually and UNAVCO and IRIS share the responsibilities of providing travel and meeting logistical support. (http://www.unavco.org/community/governance/committees/committees.html)

Training

UNAVCO offers flexible options for project training, including training prior to and during field deployment, as well as training in post-processing data. Training is tailored to the experience level of each project team. For the 2010-11 season all of the training was provided in Antarctica with the exception of O-269 (Ackley) whose team members were trained on the TLS. This training session was held at the UNAVCO facility.

The following courses from UNAVCO's Short Course Series and Workshops were relevant to polar investigators:

GPS Data Analysis and Modeling Using GAMIT/GLOBK/DEFNODE
16-19 November 2010 University of Miami, FL This workshop will combine GPS data processing and analysis using the GAMIT/GLOBK software with modeling of secular and time-dependent motion of GPS stations using DEFNODE. Participants will be expected to have exercised the software on their own before the workshop and should bring laptops with the software installed or with remote access to their own labs. The format will include both presentations and one-on-one tutoring using the participants' own data. Instructors: Bob King, MIT; Rob McCaffrey, Portland State; Tim Dixon and Shimon Wdowinski, Miami.

TLS: Terrestrial Laser Scanning (Ground-Based LiDAR) Methods and Applications in Geologic Research and Education
October 30, 2010, Geolocial Society of America 2010 Annual Meeting, Denver, CO This workshop will provide faculty, students, and professionals with the basic principles of Terrestrial Laser Scanning (TLS), aka ground-based LiDAR, workflows and best practices for the acquisition and processing of TLS data, an overview of various TLS platforms, and examples of science and education applications. This one-day workshop will consist of lectures and hands-on application of TLS equipment and data processing. TLS provides very high-resolution images over relatively small areas, is relatively inexpensive to acquire, and has been used successfully to support a wide range of geoscience investigations from outcrop mapping to deformation monitoring. Limited financial support is available for students. For more information and to register, visit the GSA 2010 Short Course Website. Instructors: John Oldow, University of Texas at Dallas;

Field Support

Five UNAVCO engineers, Marianne Okal, Jeremy Miner, Seth White, Joe Pettit and Lisa Siegel, were present in Antarctica Station during the Mainbody season. Additionally, Rob Bauer, from the National Snow and Ice data Center was contracted by UNAVCO to help support the POLENET filed activities. The UNAVCO field season generally begins in early October and runs through mid February. The primary responsibilities of the field engineers are managing the large equipment pool, providing technical support to field projects, and supporting infrastructure such as the McMurdo GPS base station system, the South Pole reference station, the WAIS Divide GPS station, and the Mount Erebus and POLENET continuous station networks. Refresher training is also provided as needed to the RPSC science technician on maintaining systems over the winter. Direct field support was provided to projects as noted in Table 1.

Data Processing

Post-processing of differential GPS and ground based LiDAR data is necessary to achieve the centimeter level precision required for most projects. UNAVCO supports GPS field data processing using Trimble Geomatics Office commercial software and the Canadian Spatial Reference System on-line data processing service. Most science groups are trained to process their data in the field to ensure data quality before the end of their field activities. LiDAR data processing is evolving from the initial PolyWorks processing package to other software that is accompanying the newer suite of LiDAR instruments. UNAVCO also continues to provide post-season data processing support using commercial software, on-line data processing services, short courses, and referrals for advanced post-processing requirements.

Data Archiving

All GPS data handled by UNAVCO are archived, both locally at McMurdo Station and at the UNAVCO Boulder archive, to ensure data safeguarding and future accessibility. Antarctic project data are sorted by project event number and Antarctic field season. Permanent station data are organized by network and site ID and are in most cases publicly available. UNAVCO archiving services are available to all NSF sponsored geodetic GPS projects—not just those directly supported by UNAVCO—and all investigators are encouraged to archive their data soon after project completion. Data collected to geodetic standards are archived by site name and precise site coordinates, and site descriptions are readily available on-line (www.unavco.org/polar). As this database of precise GPS coordinates continues to grow, future projects benefit by having pre-established geodetic control in their field study areas.

Appendix A - Detailed Summary of Support Provided

B-023 (Barrett)

Drs. Barrett and Gooseff returned to the McMurdo Dry Valleys to continue their study of microbial structures and biogeochemistry in snow patch drainage areas. The group requested UNAVCO's TLS and GPS support, including the use of one field engineer to scan and map six snow patches at the end of the austral summer. This was done to measure volume change across the snow patch. In addition to the field support, UNAVCO provided TLS data processing.

B-200 (Oliver)

This project is an evolution of Dr. Stacy Kim's SKINI ROV into a working tool. Dr. Oliver teamed with Dr. Stacey Kim to deploy SCINI, an underwater ROV to assess benthic communities in the McMurdo Sound area. This included a return to a 1960's experiment staged in New Harbor. The ROV's underwater navigation is controlled via precisely positioned transducers dropped through the ice. UNAVCO provided RTK equipment and training, although ultimately the precision gear was deemed unnecessary.

B-421 (McKnight)

Dr. McKnight's field team was provided both GPS and ground based LiDAR support to augment their ongoing research in the Taylor Valley and the McMurdo Dry Valleys LTER. A UNAVCO Field Engineer traveled to the Taylor Valley to take GPS measurements and scan features of interest. TLS data processing training was provided prior to the Antarctic season, and the group will process their own data.

B-423 (Virginia)

Dr. Virginia came to UNAVCO with a late request for precision GPS gear to use in mapping drainages in the Taylor Valley. With approval from the NSF, UNAVCO provided two GPS systems to the field team, along with refresher training. Dr. Virginia's team processed its own data with assistance from UNAVCO.

B-425 (Fountain)

Dr. Andrew Fountain, a McMurdo LTER participant, returned to the Taylor Valley with his field team to continue research on the Commonwealth, Canada and Taylor glaciers, as well as features in the Garwood and Beacon valleys. Studies focused on surface snow and ice accumulation and ablation, while monitoring solar and other environmental influences on the overall dynamics of the glaciers. This season the B-425 team once again requested use of the ground based terrestrial LiDAR to scan portions of the Commonwealth Glacier and Don Juan Pond and a new site in the Garwood Valley. A UNAVCO engineer performed the laser scans and provided data post processing. GPS RTK gear was supplied for the season as well.

B-426 (Doran)

Dr. Doran and the B-426 team studied lake systems in the dry valleys. UNAVCO provided GPS gear for PPK and static measurements, training and post processing. UNAVCO GPS support was used to measure surface ice movement on dry valley lakes. Refresher training was provided.

B-518 (Kennicutt)

Dr. Kennicut and his team are studying the temporal and spatial impact of human activities in the McMurdo vicinity. The group used the real-time kinematic (RTK) and post-processed kinematic (PPK) GPS system to locate stations for environmental sampling. UNAVCO provided refresher training and one RTK system, along with data processing support. Data was archived.

C-514/515 LARISSA (Domack)

LARISSA: Larsen Ice Shelf System, Antarctica is a National Science Foundation funded initiative that brings an international, interdisciplinary team together to address a significant regional problem with global change implications, the abrupt environmental change in Antarctica's Larsen Ice Shelf System. As part of this effort, three bedrock CGPS stations were installed along the western side of the Peninsula in April 2009, and another three on the east side in February 2010 to measure post-glacial rebound to help reconstruct the detailed configuration of the northern Antarctic Peninsula Ice Sheet (APIS) during the Last Glacial Maximum (LGM) and subsequent retreat (Figures 5 and 6). Two more CGPS sites were installed on outlet glaciers from the Bruce Plateau. The bedrock CGPS stations are also a part of the POLENET initiative. Support was provided for maintenance visits to the Caper Framnes and Leppard Glacier sites in November 2010. Telemetered data are archived at UNAVCO.

C-520 (Anandakrishnan)

C-520 WISSARD represents a large cooperative scientific study along the West Antarctic Ice Sheet (WAIS) with particular interest in the glacial behavior of the Whillans Ice Stream. UNAVCO supported two distinct parts of this event in 2010-11. One aspect was a continuation of the effort first started by Dr. Slawek Tulaczyk (I-345) and then taken up by Dr. Helen Fricker involving a broad network of continuous GPS stations set up on the Whillans. This season, 13 new sites were added to the network, including one with Iridium comms. This brought the total number of continuous stations on the Whillans Ice Stream to 23, including 3 with Iridium comms. Telemetered data are archived at UNAVCO.

In another aspect of the WISSARD project, Dr. Huw Horgan returned to study the flow dynamics of the lower Whillans Ice Stream. UNAVCO supplied 10 static GPS receivers designed to run continuously through the summer deployment.

G-049 (Rack)

In a multiyear effort the ANDRILL project is seeking to investigate Antarctica's role in Cenozoic global environmental change. Taking deep cores through the Ross Ice Shelf, the team is able to obtain direct reference records of two stratigraphic intervals from the Antarctic continental shelf: the early Miocene and Oligocene, and the Eocene to possibly Cretaceous. Moving this year to the Coulman High region, ANDRILL has requested long term GPS coverage in order to quantify tidal and other significant movements of the Ross Ice Shelf in anticipation of the next drilling phase. UNAVCO provided one wintering continuously operating GPS system with Iridium comms (DRIL) and three summer-only systems. UNAVCO field engineers assisted with the deployment of the wintering system. Data archiving has been provided for the telemetered system.

G-054 (Marchant)

Dr. Marchant's team is focusing on the debris covered glaciers of the Beacon Valley. In particular, the team is interested in the properties of the ice itself and how that may help define the history of the region. UNAVCO provided two GPS receivers, training and LiDAR imaging. UNAVCO provided assistance with processing a difficult data set.

G-057 (Harvey)

In an effort to expand the potential geographic arena in the search for Antarctic meteorites, a second ANSMET event was funded this season to provide reconnaissance in areas not previously explored for meteorites. Reconnaissance targets include northeastern regions of the LaPaz Icefields area, icefields in the Patuxent Range, and icefields adjacent to the Omega and Whichaway nunataks. UNAVCO provided G-057 with two GPS receivers so that sites with high recovery potential could be mapped for future field visits.

G-058 (Harvey)

As part of an annual search for meteorites in the Antarctic, the G-058 team returned to the Trans Antarctic Mountains to collect specimens and map their locations. Based out of the CTAM camp among other locations, Harvey's group used UNAVCO GPS equipment to carefully plot the locations of each meteorite find for future reference. UNAVCO provided G-058 with four receivers for PPK measurements.

G-079 (Wilson)

The POLENET IPY project is an international effort led by Terry Wilson of the Ohio State University to install continuous GPS stations and seismometers throughout Antarctica. The strategy is to apply bedrock geodesy to measure the response to past and present day ice sheet mass change to better understand the structure and evolution of the Antarctic plate. Most of the POLENET sites are remote and rely on solar and wind power and satellite data retrieval.

Four of nine planned new sites were installed this season. Additionally, maintenance visits were made to 24 sites. There are currently 40 stations in the Antarctic POLENET network.

G-081 (Kyle)

Dr. Kyle returned to the Mt Erebus again this season and requested UNAVCO support for both permanent and campaign measurements. The data is used to carefully monitor the deformation of the volcano caused by internal magma dynamics. Two campaign style receivers and training were given to the field team, and data archiving was provided at the end of the season.

The Terrestrial LiDAR Scanner (TLS) was used to repeat a time series scan of the lava lake within the main caldera. A separate TLS and engineering assistance was made available to scan the interior of several

fumoroles near the top of the volcano.

UNAVCO performed maintenance to two of three permanent GPS systems on Erebus and added a new wintering receiver to the BOMZ site. The Trimble R7 data card at Abbott Peak was swapped out at the end of the season and the data archived. Continuous station MACZ was visited and significant maintenance performed. The site was rebuilt to bring it up to more robust design standards similar to those of the Antarctic POLENET sites. High winds had stripped the system of one wind generator and damaged the telemetry antenna, and the acidic atmosphere was taking a toll on the metal components of the frame. These were replaced with more robust designs.

G-098 (Blankenship)

UNAVCO provided GPS gear in support of the G-098 ICAP project. Gravimetry and laser flights around large areas of east Antarctica required precise timing and spatial data to be collected during the entire duration of each survey. A useful byproduct of the precision GPS on board was the ability to accurately track the aircraft orientation in space, critical in the laser altimetry measurements. The team was provided four Topcon GPS receivers which integrate well into the aircraft, and high rate data from the McMurdo cGPS site, MCMD.

G-121 (Sletten)

Dr. Sletten and his team set out to test the hypothesis that Dry Valley volcanic ashes are redeposited from older deposits at five sites of key importance for the chronostratigraphy of the Dry Valleys: Beacon/Arena Valley, Rhone Platform, Wright Valley, the Labyrinth, and the Asgard Range. UNAVCO provided the group with 2 GPS receivers and terrestrial LiDAR support. Refresher training was provided prior to the team departing McMurdo. Two UNAVCO field engineers spent time in the Beacon Valley to assist with TLS and GPS data collection efforts.

G-294 (Ashworth)

Dr. Ashworth and the G-294 team used UNAVCO provided GPS gear for PPK and static measurements, to create detailed maps of fossil study sites in the upper Taylor Valley. Additionally, UNAVCO provided ground based LiDAR scanning of key fossil study areas. In-depth GPS training and post processing support was provided by UNAVCO at McMurdo Station.

G-434 (Morin)

Paul Morin and the Antarctic Geospatial Information Center (AGIC) team were provided two refresher training session on the use of Trimble GPS with fast static and PPK techniques. Their intent this season was to continue detailed mapping of the McMurdo region, with particular emphasis on features in the Dry Valleys. This will be used to geo-reference satellite imagery to a 50cm scale. The team was provided 2 GPS systems and some assistance in post processing data.

G-499 (Licht)

Dr. Licht's Antarctic work this season involved investigating the compositional variation of tills across two concentric sequences of Pleistocene moraines located adjacent to the heads of East Antarctic outlet glaciers in the Transantarctic Mountains. UNAVCO provided the group with 2 GPS receivers plus solar power. Training was provided prior to the team's departure into the field and processing assistance was given after the field season.

G-501 (Putkonen)

Dr. Putkonen's team set out to gain information that would help them determine the landscape evolution in the Transantarctic mountains in time scales from years to millions of years. They requested training, plus a GPS base and rover with solar power for taking static measurements. UNAVCO also provided rock bolts to the team to use as monuments for future measurements.

G-502 (Ashworth)

Dr. Ashworth and the G-502 team used UNAVCO provided GPS gear for PPK and static measurements, enabling detailed mapping of fossil study sites in the central Transantarctic mountains. In-depth GPS training and some post processing support was provided by UNAVCO at McMurdo Station. A request for TLS support for this project was not met, due to poor weather conditions at the site.

I-156 (Balco)

Dr. Balco and his group worked this season to reconstruct ice surface elevation change between the Last Glacial Maximum (ca. 15,000 yrs ago) and the present at the Foundation Ice Stream in the Pensacola Mountains. UNAVCO provided the group with 5 GPS receivers plus solar panels. Training was provided prior to the team departing McMurdo for the field.

I-157 (Joughin)

Ian Joughin and his team worked in West Antarctica to produce accumulation estimates for the Pine Island and Thwaites catchments that provide basin wide multi decadal estimates of total accumulation. UNAVCO provided the group with 2 GPS receivers plus solar power. Training was provided prior to the team departing McMurdo.

I-158 (Rupper)

Dr. Rupper and the I-158 research team gathered data to characterize accumulation patterns and trends across WAIS Divide using shallow ice cores, near surface radar, and satellite data. UNAVCO provided the group with technical assistance, and 3 GPS receivers plus solar power for continuous operation of the base system.

I-181 (Winberry)

Dr. Winberry requested a large number of GPS receivers to create a network to study the stick – slip flow dynamics of the Whillans Ice Stream. UNAVCO supplied 17 static GPS receivers with solar power designed to run continuously through the summer campaign.

I-166 (Pettit)

Dr. Pettit's goal was to enhance the understanding of how crystal fabric records climate information and the feedback mechanism between ice flow and fabric development. This involved a field event near Concordia Station to access the Dome C borehole to lower an instrument that measures sonic velocity in the ice and make direct measurements on ice from the Dome C ice core. Dr. Pettit's team was provided 3 GPS instruments set up for RTK measurements, plus solar power.

I-196 (Hall)

Dr. Hall's work involved studies of the glacial history of the valleys fronting the Royal Society Range and, by doing so, constrain the history of the Ross Sea ice sheet over the last two glacial/interglacial cycles. Dr. Hall was provided with a pair of Trimble GPS receivers and brief refresher training.

I-209 (Conway)

Howard Conway and the I-209 field team investigated the potential for rapid de-glaciation of the West Antarctic Ice Sheet. Research took place on Roosevelt Island, where the field team installed and surveyed a network of markers using 5 UNAVCO provided GPS receivers. These makers will be resurveyed next season to calculate surface motion.

I-349 (Kurbatov)

The I-349 team, working under Andrei Kurbatov set up camp on the Alan Hills blue ice area to measure ice ablation and movement. The team also collected ice core samples in an attempt to quantify green house gasses trapped within the ice stream dating past the last two significant climate change events. The team

was provided with training and two complete GPS systems. UNAVCO also provided data archiving.

I-351 (Stearns)

Dr's Leigh Stearns and Gordon Hamilton deployed a large network of continuously operating GPS receivers along the length of the Byrd Glacier during the first half of the 2010-11 filed season. The aim of the Byrd Glacier research is to improve the understanding of outlet glacier dynamics in East Antarctica through an in-depth field study of Byrd Glacier. UNAVCO provided instrumentation for 8 wintering GPS sites and 15 summer GPS sites plus installation training. The team was unable to install one of the wintering sites due to time and weather constraints.

I-414 (Stone)

Dr. Stone and his team worked in the southern Transantarctic range to determine the thickness and retreat history of Shackleton and Beardmore Glaciers during and since the last glaciation of the southern Ross Sea. UNAVCO provided the group with 2 GPS receivers plus solar panels. Training was provided prior to the team departing McMurdo.

O-269 (Ackley)

Dr. Ackley's team spend a field season on the icebreaker ODEN to determine the properties and processes governing the sea ice cover in the Amundsen Sea during Antarctic summer and through the fall freeze up and winter season. UNAVCO provided the team with instrument training and a Terrestrial LiDAR Scanner.

O-283 (Lazarra)

UNAVCO provided one Trimble 5700 GPS receiver, training and data archiving to O-283 in their ongoing effort to produce accurate site elevations used in climate models. These surveys are conducted on an "opportunity" basis during scheduled maintenance visits to the AWS sites.