University NAVSTAR Consortium UNAVCO

GPS Support to the National Science Foundation Office of Polar Programs

1997-98 Season Report

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Cover photo: Survey of Ice Stream C Shear Margin

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Table of Contents:

Summary

UNAVCO provides year round support for scientific applications of the Global Positioning System (GPS) 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. UNAVCO maintains a satellite facility at McMurdo Station during the austral summer research season, providing a full range of support services including GPS equipment, training, project planning, field support, technical consultation, data processing, and data archiving. A total of 23 projects, encompassing a range of applications, were supported throughout the field season.

The 1997-98 season was the busiest yet supported by UNAVCO and required a substantial increase in the number of GPS receivers used for project support. All projects received the level of support requested from UNAVCO prior to the field season, and prioritizing or excluding projects was not necessary. A field engineer was based at McMurdo Station during the entire field season, and additional project support requests at McMurdo were also met on a resource available basis. Table 1 summarizes projects using UNAVCO support, while Appendix A provides a more detailed discussion of individual project support.

In addition to providing direct project support, UNAVCO installed a differential GPS station covering McMurdo Sound and Taylor Valley, benefiting both science and operational support. The Polar Program section of the UNAVCO web page was also expanded to serve as a central information source of available UNAVCO support, as well as to provide direct access to Antarctic geodetic GPS data. The front Polar web page is included as Appendix B.

GPS Base Station at Meteorite City, Polar Plateau

Table 1 - 1997-98 Projects Using UNAVCO Support

Event	Principal Investigator	Receiver Days Used	Support Level*	Preseason Request
S-180	Sridhar Anandakrishnan	240	Low	Yes
S-176	Howard Conway	195	Low	Yes
S-178	Gordon Hamilton	120	Low	Yes
S-042W	Bob Wharton	100	High	Yes
S-171	Ed Waddington	90	Low	Yes
S-099	Terry Wilson	84	Medium	No
S-157	Hermann Engelhardt	70	High	Yes
S-081	Philip Kyle	60	Medium	Yes
S-173	Bob Bindschadler	45	Low	Yes
S-084	Ian Whillans	42	Low	Yes
S-166	Beata Csatho	30	Low	Yes
S-042FO	Andrew Fountain	30	Low	Yes
S-163	Charlie Raymond	15	Low	Yes
S-156	George Denton	14	Medium	No
S-058	Ralph Harvey	4	Low	Yes
ICAIR	Matt Lythe	4	Low	No
S-022	Bill Baker	2	Low	Yes
S-302	Hunter Lenihan	2	Low	No
S-098	Donald Blankenship	2	Low	Yes
ASA Surveying	Jeff Scanniello	2	Low	Yes
Aircraft Operations	Tom Quinn	2	Low	No
S-042FR	Diana Freckman	1	Low	No
S-005	Art DeVries	1	Low	No

* Low - one to five days of technical support provided.
Medium - six to ten days of technical support provided.
High - more than ten days of technical support provided.

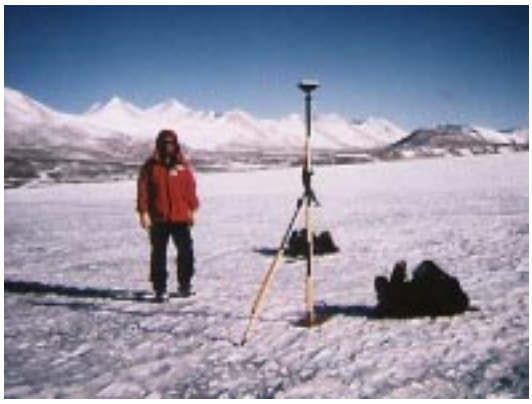
Science Support

Training

UNAVCO offers flexible options in providing field team training, including training before deployment to the field, training in the field, and direct field engineering support during the project. The level of training is tailored to the experience of each group. For the 1997-98 season, all science team training was provided at McMurdo Station immediately prior to deployment to more remote field locations. Training was provided to S-022, S-042FR, S-042W, S-058, S-081, S-157, S-171, S-180, and S-302.

Field Support

A field engineer[1] was present at McMurdo Station throughout the mainbody season. The primary responsibilities of the field engineers are managing the large equipment pool and providing technical support to field projects. Direct field support was provided to S-005, S-042W, S-081, S-098, S-156, S-157, S-163, S-302, ASA Aircraft Operations, and ASA Surveying. In addition, the field engineers installed the differential GPS system, which was used to support several local projects (S-005, S-022, S-042FR, and ASA Surveying).



Velocity Measurement on Canada Glacier, Taylor Valley

Data Processing

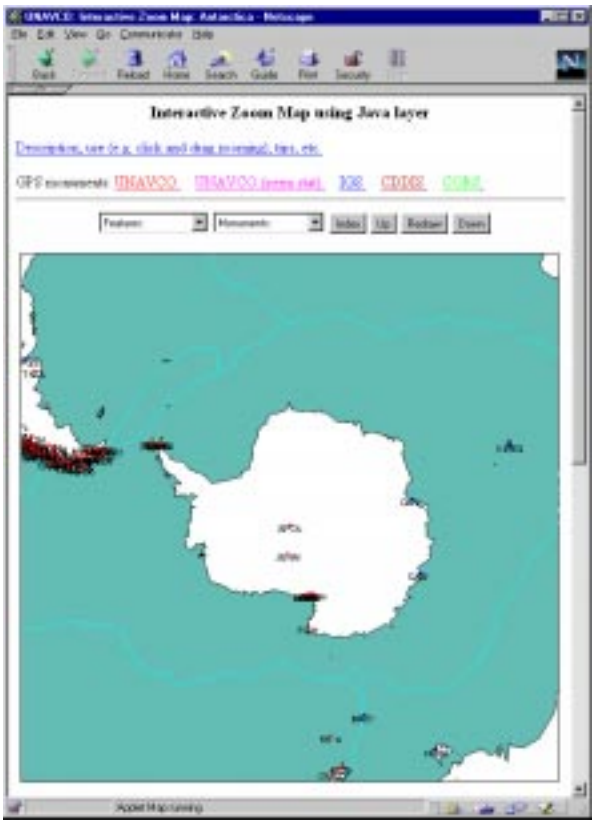
Post-processing of differential GPS data is necessary to achieve the precision requested. UNAVCO supports data processing in the field using the Trimble GPSurvey software, of which five packages were available for project use this field season. As in previous seasons, an effort was made to ensure that most data processing was completed before field teams (that do not have their own data processing resources) left McMurdo. UNAVCO also continues to provide post-season data processing support, including advanced post-processing techniques for problem data sets. Data processing support in the field was provided to S-042FO, S-042W, S-081, S-084, S-098, S-099, S-156, S-157, S-163, S-166, S-171, S-173, S-178, S-302, ASA Aircraft Operations, and ASA Surveying. Post-season support was also provided to S-058, S-081, S-157, S-173, and S-180.

[1] Bjorn Johns and Oivind Ruud

Data Archiving

All GPS data handled by UNAVCO are archived, both locally at McMurdo Station and at the UNAVCO Facility archive. The data are sorted by project event number and Antarctic field season, and can be accessed via the UNAVCO web page.

Antarctic data collected to geodetic standards on UNAVCO supported projects are also archived by site name at UNAVCO. These high quality geodetic data are of interest as they improve geodetic control on the continent, provide base site coordinates for future projects, and may provide first epoch measurements for future crustal deformation projects in the area. Access to site coordinates and data is provided directly from the UNAVCO Polar Program web page. As this database of GPS coordinates continues to grow, future projects benefit by not having to first establish geodetic control in their field study areas. This season GPS control points were added at sites in Taylor Valley, Victoria Valley, and Mount Erebus. The UNAVCO Facility has designed a map based graphical interface to improve access to GPS project data and metadata. Graphical access to Antarctica GPS project data will be available on the Polar Programs web page prior to the next field season.



The UNAVCO Polar Program web page also contains links to the other sources of Antarctic geodetic data, including Land Information New Zealand (LINZ), Australian Surveying and Land Information Group (AUSLIG), and U.S. Geological Survey (USGS). Discussions regarding participation in the UNAVCO seamless archive have been started with USGS. Links to the large scale geodetic projects conducted under USAP will be added in the future if the information becomes available on the web.

Equipment

Twenty receivers from the UNAVCO pool (eighteen Trimble 4000 SSE/SSi receivers and two Trimble GeoExplorer receivers) were provided for support throughout the field season. All necessary ancillary equipment (such as field computers, data processing software, solar panels, batteries, chargers, tripods, and cables) was also provided, and real-time differential equipment was available for use around McMurdo Station and Taylor Valley. Prior to the field season, all Trimble receivers were updated with the most recent firmware. Per NSF request, the two TurboRogue receivers previously in the UNAVCO equipment pool were transferred to the Support Office for Aerogeophysical Research (SOAR) prior to the field season.

New real-time differential GPS (DGPS) equipment was purchased prior to the season, including extra radio modems, a repeater to provide coverage to Taylor Valley, and two Trimble GeoExplorer handheld receivers capable of providing meter level accuracy in real-time. These receivers and radio modems are specifically for use with the differential GPS base station.

Trimble Geodetic Receiver System

Trimble GeoExplorer DGPS Receiver

An assessment of current demand versus resources available indicated a need to provide more USAP owned receivers to the UNAVCO pool. Currently USAP has four geodetic quality receivers in the pool, while the seasonal demand is approaching 20. To ensure a future capacity to meet predicted demands, UNAVCO will purchase three new Trimble 4000 SSi GPS receivers on behalf of USAP. Two of these receivers will be added to the UNAVCO/USAP equipment pool, while the third receiver will be dedicated to the McMurdo DGPS base station to allow year-round operation. Recommendations for similar equipment purchases will continue in future seasons if necessary after re-assessing equipment pool resources and demands.

McMurdo Differential GPS Base Station (DGPS)

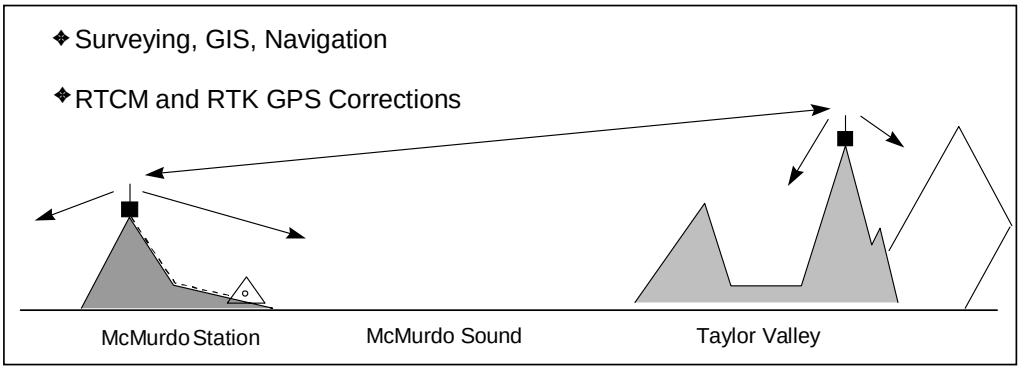
System Overview

The differential GPS (DGPS) broadcasting system that was tested, evaluated, and proposed for permanent installation during the 1996-97 season was set up for permanent operation this season. The system provides meter level accuracy in real time from hand-held receivers (and centimeter level differential corrections (RTK) to properly equipped users in the vicinity of McMurdo), simplifying many GPS survey tasks that would otherwise require time consuming collection and post-processing of data.

The differential corrections are generated at the MCM4 IGS site (at the NASA McMurdo Ground Station), with a receiver operating in parallel to the NASA continuously tracking TurboRogue receiver. The system transmitter is on Crater Hill, providing full coverage in the McMurdo Station vicinity and line of sight coverage throughout McMurdo Sound. A repeater provides coverage in Taylor Valley. The hand-held DGPS receivers are easily mounted on vehicles or hand carried as appropriate.

The DGPS equipment has been purchased specifically for this application. The aim is to provide a simple, robust DGPS system that can be left in continuous operation. All components are owned by NSF-USAP and are not subject to other UNAVCO pool commitments. With ASA support, year round DGPS coverage will begin at the start of the 1998-99 season, allowing DGPS operations during the winter when UNAVCO personnel are not present at McMurdo. The communications equipment was installed with assistance from the ASA communications groups. NISE East has confirmed the DGPS frequency is included in the USAP Band Plan.

Figure 1 - McMurdo Differential GPS Base



User Equipment

The DGPS equipment purchased specifically for this application includes two Trimble GeoExplorer hand-held GIS receivers (meter level accuracy in differential mode) and GIS interface software for these receivers. This equipment is available for check out at McMurdo and can be requested prior to the field season. Dr. Scott Borg, NSF Geology and Geophysics Program Manager, received a demonstration of system capabilities at McMurdo Station.

In addition to providing the DGPS broadcast and rover receivers, UNAVCO also has spare receiving radios that can be checked out to any person interested in using the DGPS corrections with their own equipment.

Science Applications

The DGPS system provides a portable, easy to operate, meter-level survey system for scientists working at McMurdo Station, in McMurdo Sound, and in Taylor Valley. By using the DGPS receivers for lower accuracy applications, the more complex and costly geodetic quality receivers remain dedicated to support projects requiring higher precision. The available precision is well suited for applications such as mapping dive holes, soil sample locations, instrument locations, etc. The RTK capability provides centimeter level precision in the vicinity McMurdo Station for applications that previously required post-processing of data. The system has been used by S-005, S-022 , and S-216 in McMurdo Sound, and by S-042FR in Taylor Valley.

In addition to providing meter-level precision from handheld receivers, these Trimble GeoExplorer receivers have significant GIS capabilities. They are capable of recording attribute information along with position data, which allows for accurate digitization of features such as roads, cracks, buildings, ice holes, instrument locations, area boundaries, etc. The data can be output as standard GIS files, both for use with the Trimble Pathfinder Office GIS software available from UNAVCO, or for use with common GIS software including ArcView and ArcInfo.

Operational Applications

As an added benefit, the DGPS system already in place can be used in many applications to support McMurdo Operations. The correction broadcast is available for anyone to receive, provided they use compatible equipment. During the previous two seasons, UNAVCO has provided thorough DGPS demonstrations to the ASA surveyors and the search and rescue team. Potential operational applications include:

-Annual ice runway layout
-Annual ice shelf survey
-Surveys of Ice, Williams Field, and Pegasus runways throughout field season
-Precise drilling hole locations on sea ice
-SAR rescue vehicle navigation
-Helicopter flight following
-General survey applications

The DGPS infrastructure is currently in place to support applications like these at the beginning of the 1998-99 field season.

Operational Support

Like most logistical science support "workcenters" at McMurdo, UNAVCO provides a support service with potential overlap between science and operational support. While the support and resources that UNAVCO provides are dedicated to science support, some natural overlap with operations occurs. Operational support is provided by UNAVCO on a "non-interference" basis, and as a result, Operations does not receive the pre-season resource allocation and planning that is provided to science projects. However, consultation on technical issues related to GPS is available, and additional support could be provided if requested by ASA and approved by NSF.

With an operational DGPS station at McMurdo beginning with the 1998-99 field season, increased GPS applications for McMurdo Operations are anticipated. Within the current level of UNAVCO resources and funding, UNAVCO can provide GPS consultation, equipment recommendations, limited training, and technical support. As discussed in the previous section, there are numerous operational applications of the new DGPS system for local surveying, SAR, and construction requiring precise positioning.

The following operational activities have either received UNAVCO support during the previous two seasons, or can benefit from future UNAVCO support.

ASA Surveying

The ASA surveying section owns Trimble SE receivers which are similar to the UNAVCO pool receiver and operate in the same manner. UNAVCO resources at McMurdo typically allow for some technical support but no equipment support. During the past two seasons, UNAVCO has provided considerable assistance to the surveyors to complete GPS surveys of the McMurdo runways, usually using the DGPS system. UNAVCO also updated the obsolete firmware on the ASA GPS receivers, and conducted a two day training course covering GPS data collection and data processing for ASA surveyor Jeff Scanniello in Boulder prior to the 1997-98 field season.

Much of the support provided at McMurdo was necessary due to insufficient ASA Surveying GPS resources. At the beginning of the season a meeting between Bjorn Johns (UNAVCO), Jeff Scanniello (ASA), and Jim Greenberg (Trimble consultant to ASA) was held to identify the GPS equipment requirements for ASA. These recommendations were presented to ASA by Mr. Greenberg, and UNAVCO is working with ASA to coordinate use of the DGPS station for surveying applications. With a minimal investment in proper equipment by ASA, appropriate UNAVCO support to ASA Surveying would be limited to training, consultation and on-site technical support.

Fixed Wing Aircraft Operations

VXE-6 and ASA Fixed Wing Aircraft Operations requested that UNAVCO provide runway coordinates from McMurdo and deep field locations. These requests occur during the field season at McMurdo, and are supported when the resources are available. At the beginning of the past season a meeting between Bjorn Johns, Jeff Scanniello (ASA), Tom Quinn (ASA), Kristin Scott (ASA), and Jim Green (VXE-6) was held to discuss the need to provide GPS runway coordinates. All agreed the responsibility is ASA's, but UNAVCO assistance was requested for to convenience and due to insufficient ASA GPS resources.

LC-130 Hercules Grounded by Fog at Siple Dome

The DGPS equipment significantly simplifies surveys of the McMurdo runways. With a minimal investment in DGPS equipment, ASA Engineering would be equipped to perform these surveys without UNAVCO assistance. Likewise, by purchasing GPS data processing software, ASA would also be equipped to obtain deep field coordinates without borrowing data processing equipment from UNAVCO, which is frequently unavailable due to science project use.

Future requests for UNAVCO assistance in providing runway coordinates should be discussed prior to the field season. This will allow for proper scheduling and planning to ensure the work is completed by the dates desired.

Geographical Information Systems (GIS) Applications

The common element of all Geographic Information Systems (GIS) activities is the association of geographical coordinates with the input data. The McMurdo DGPS broadcasts combined with handheld DGPS/GIS receivers provides a powerful tool for GIS position data collection. DGPS/GIS receivers such as the Trimble GeoExplorers available from UNAVCO are capable of recording attribute information along with position data, which allows for accurate digitization of features such as roads, cracks, buildings, ice holes, instrument locations, area boundaries, etc. The data can be output as standard GIS files, both for use with the Trimble Pathfinder Office GIS software available from UNAVCO, or for use with common GIS software including ArcView and ArcInfo.

UNAVCO is available for technical consultation and encourages cooperation to support McMurdo GIS efforts. The DGPS system at McMurdo provides a complementary function to the GIS capabilities currently being developed by ASA. UNAVCO encourages coordination between NSF, ASA and UNAVCO to allow for successful integration of GPS data collection to GIS development efforts.

Appendix A - Detailed Summary of Support Provided

ASA Aircraft Operations (Tom Quinn)

UNAVCO obtained precise GPS coordinates from the Siple Dome skiway centerlines which provided the air crews with the capability to fly non-precision approaches using GPS. This work was performed in conjunction with UNAVCO science support activities at Siple Dome. UNAVCO also provided data processing equipment to the ASA surveyors to process South Pole skiway data. GPS equipment and assistance was provided for the survey of the Williams Field and Pegasus runways. These surveys were performed using the real-time DGPS equipment.

ASA Surveying (Jeff Scanniello)

UNAVCO provided equipment and technical assistance to the ASA surveyors. A GPSurvey hardware key was provided (as available) to allow the surveyors to post-process GPS data collected with their own equipment. Real-time DGPS equipment and field assistance was provided to allow the surveyors to quickly survey the Williams Field and Pegasus runways. UNAVCO also provided equipment and assistance for surveying the edge of the McMurdo Ice Shelf using GPS from a helicopter.

ICAIR (Matt Lythe)

At the start of the field season, UNAVCO received a request from the International Centre for Antarctic Information and Research (ICAIR) to obtain ground control at three locations at McMurdo station to geo-reference aerial photographs. The surveys were performed by the UNAVCO field engineer, and post-processed results were provided to ICAIR.

S-005 (Art DeVries)

Field assistant Steve Munsell requested GPS support to accurately digitize the location of the Pegasus Crack and the nearby edge of the McMurdo Ice Shelf. This area has been the subject of S-005 study due to both the undisturbed ice crystal formations and as an access point to the colder water under the ice shelf. Position data are valuable both for GIS applications and for monitoring annual changes to the crack and edge of the ice shelf. The meter level GPS survey was performed by mounting the new GeoExplorer receiver on a snowmobile and driving along the features surveyed. The DGPS broadcast station provided differential corrections in real-time, eliminating post-processing requirements.

S-022 (Bill Baker)

S-022 requested UNAVCO provide meter level GPS coordinates for dive hole locations. After a brief training, graduate research assistant Chris Moeller performed the survey using the new GeoExplorer receivers and the DGPS broadcast corrections. This support is an example of the benefits of the DGPS station; meter-level surveys in McMurdo Sound are now performed directly by grantees using handheld DGPS equipped receivers, with no post-processing of data required. With the new GeoExplorer receivers, UNAVCO is now able to support such requests without using the geodetic quality Trimble receivers that are more complex to operate and in considerable demand for higher accuracy applications.

S-042FO (Andrew Fountain)

Dr. Fountain requested GPS support to obtain precise coordinates to measure glacial velocity and topography. Two receivers and data processing software were provided to the S-042 LTER project at Lake Hoare for the entire season, in support of both S-042FO and S-042W requests. Field assistant Paul Langevin, who has received substantial training from UNAVCO during the previous two seasons, was responsible for the S-042FO GPS work.

S-042FR (Diana Freckman)

S-042FR requested UNAVCO assistance to obtain precise GPS coordinates for soil sampling sites in Taylor Valley. After a brief training, graduate research assistant Dan Bumberger performed the survey using the new GeoExplorer receivers broadcast corrections from the Taylor Valley DGPS repeater. This support is an example of the benefits of the DGPS station; meter-level surveys in Taylor Valley are now performed directly by grantees using handheld DGPS equipped receivers, with no post-processing of data required. With the new GeoExplorer receivers, UNAVCO is now able to support such requests without using the geodetic quality Trimble receivers that are more complex to operate and in considerable demand for higher accuracy applications.

S-042W (Robert Wharton)

Dr. Peter Doran requested GPS support to obtain precise coordinates in support of lake bathymetry surveys and lake perimeter measurements in Taylor, Wright, and Victoria Valleys. Two receivers and data processing software were provided to the S-042 LTER project at Lake Hoare for the entire season, in support of both S-042FO and S-042W requests. UNAVCO provided GPS training to field assistant Camilla Correll at McMurdo immediately prior to the field project, and provided initial assistance with field surveys at Lake Hoare. During the field season, UNAVCO also provided data processing support from McMurdo, providing precise processed benchmark coordinates to the field team during the field season. This support allowed the field team to process data with precise information in the field, eliminating the need to re-process and adjust data after the field season. Project data were archived by UNAVCO at McMurdo.

S-058 (Ralph Harvey)

GPS support was provided to obtain precise coordinates for the S-058 Far Western Icefield Station benchmark near Allen Hills. Field researcher John Schutt received a brief training at McMurdo, and was provided one Trimble 4000 SSE receiver for his brief field visit to this area at the end of the field season. Upon his return to McMurdo, UNAVCO archived the data. UNAVCO post-processed the data after the field season. Due to problems with the McMurdo IGS Station receiver, local base station data were not available for processing, necessitating advanced post-processing techniques to provide the high precision required.

S-081 (Philip Kyle)

Dr. Kyle requested GPS receivers to survey tephra locations on Mount Erebus and to position tag atmospheric sampling data collected from a helicopter while flying in the Erebus plume. The field team received GPS training in McMurdo prior to moving to the Erebus Lower Hut. Two GPS receivers and data processing equipment were provided, and UNAVCO installed a GPS benchmark at the hut to provide a precise GPS base location for this and future projects in the area. Atmospheric sampling missions were flown from the hut, and GPS data were collected in kinematic mode by mounting the GPS antenna on the dash of the ASTAR helicopter. Data processing and archiving assistance was provided after the field project, and a GPSurvey data processing hardware key was loaned to graduate research assistant Chris Harpel in New Mexico after the field season.

S-084 (Ian Whillans)

Dr. Whillans requested GPS receivers to measure ice displacement in the Allen Hills area. Two receivers were shipped to The Ohio State University prior to the field season for familiarization and practice. At McMurdo, graduate research assistant Erik Venteris was provided with two receivers and data processing software for the field work at Allen Hills. The data were archived by UNAVCO upon project completion.

S-098 (Donald Blankenship)

The two TurboRogue receivers typically provided to SOAR each season were permanently transferred to the SOAR facility in Austin, Texas prior to the field season. S-098/SOAR requested UNAVCO technical support to survey the project's GPS base station locations at Siple Dome. The UNAVCO engineer collected GPS data from these locations, and post-processed the data at McMurdo to provide accurate reference coordinates prior to the start of the airborne surveys. UNAVCO provided additional data processing support from McMurdo during the field season, and satellite visibility planning information for the South Pole portion of the SOAR surveys.

S-099 (Terry Wilson)

UNAVCO GPS support was requested as the project was preparing to go in the field to improve and complement the GPS equipment already being used for their aerogeophysical surveys of the Transantarctic Mountains. Two complete Trimble systems and one GPSurvey processing key were provided along with kinematic and static survey instructions, and post-processing assistance. One receiver was used as a local base station, and the other was used onboard the helicopter to measure elevation during aeromagnetic surveys.

S-156 (George Denton)

UNAVCO supplied two complete GPS systems and in-field support for static and kinematic surveying in Victoria Valley on two separate occasions. Ground penetrating radar profiles, glacier boundaries, and old lake shore lines were surveyed in kinematic mode. Geological points in the valley and base station positions were surveyed with static surveys. The project was conducted in cooperation with ASA surveyor Jeff Scanniello who provided conventional survey equipment to complement the UNAVCO GPS equipment. UNAVCO also provided post processing and analysis of the GPS data. One new benchmark was put in at Victoria Valley lower camp.

S-157 (Hermann Engelhardt)

GPS support was requested to continue an ice stream velocity survey on Ice Stream C. A profile across the southern shear margin was surveyed during the 1996-97 season. Results from that survey raised scientific questions of the ice stream behavior across the northern shear margin, which was measured this season. Training on GPS field procedures and full field support was provided. In November a velocity profile line of evenly spaced stakes was placed and surveyed using the rapid static technique. A long baseline tie was made between McMurdo and Ice Stream C to establish absolute reference coordinates for the project. The survey was repeated in January to measure stake displacements. Data archiving and all data processing were completed by UNAVCO.

S-163 (Charlie Raymond)

Although S-163 did not deploy to the field this season, Dr. Raymond requested GPS equipment and field support to re-measure ice displacement stakes at Siple Dome. Three UNAVCO GPS receivers were provided (combined with support to S-173) and the survey was performed as a joint effort between the S-173 field team and UNAVCO engineer. The data were archived by UNAVCO and delivered to graduate research assistant Nadine Nereson for processing at the University of Washington.

S-166 (Beata Csatho)

Dr. Csatho was provided with two GPS receivers for collecting kinematic GPS measurements at Siple Dome in conjunction with the SOAR aerogeophysical research flights. Due to the field team's GPS experience, UNAVCO training or technical support was not necessary.

S-171 (Ed Waddington)

Dr. Waddington received three GPS receivers and GPSurvey data processing equipment to measure ice displacements at Taylor Dome. UNAVCO provided GPS surveying and data processing refresher training at McMurdo immediately before the field project.

S-173 (Bob Bindschadler)

Research assistant Xin Chen received three GPS receivers and GPSurvey data processing software for ice measurements of the Western Antarctic Ice Sheet. A very brief GPS refresher training session was provided at McMurdo prior to field deployment. The project data were backed up in the UNAVCO archive upon project completion. Post-project advanced data processing assistance was provided for a data set corrupted by a receiver malfunction.

S-176 (Howard Conway)

UNAVCO provided three GPS receivers to S-176 for the entire field season to support radar investigations of former shear margins at Roosevelt Island and Ice Stream C. Prior to field deployment, the field team conducted a shakedown survey at McMurdo, and UNAVCO provided backup data processing software and modified power cables as appropriate.

S-178 (Gordon Hamilton)

Dr. Hamilton was provided four GPS receivers and a GPSurvey equipped data processing computer to measure ice sheet displacements at various locations. The equipment was divided between two independent field teams working on the Western Antarctic Ice Sheet and on the Polar Plateau. Training and direct support were not necessary due to the field team's experience. During the project, a receiver swap was arranged to replace an inoperative, cold soaked receiver on the Polar Plateau with a spare receiver from the McMurdo pool. The GPS data were archived by UNAVCO upon project completion.

S-180 (Sridhar Anandakrishnan)

Prior to the field season, Dr. Anandakrishnan was provided with a GPS receiver at Pennsylvania State University for development work to integrate the GPS data stream with Reftek seismometer data. UNAVCO provided GPS consultation and recommendations during this development. The field team shipped the receiver to McMurdo, and installed it with the Antarctic Network of Unattended Broadband Seismometers (ANUBIS) prototype at Siple Dome. The receiver was removed from the station at the end of the field season. An additional receiver was provided to re-survey a shear line on Ice Stream C. This survey was never performed due to inclement weather. After the field season UNAVCO provided data processing and technical support to evaluate the GPS data collected.

S-302 (Hunter Lenihan)

Dr. Lenihan requested support from UNAVCO at McMurdo to provide coordinates for several dive hole locations on the sea ice. Meter level positions were desired since the dive holes were directly above experiments left under the sea-ice. UNAVCO collected and post-processed data since this support was provided before the DGPS system was operational. The accurate coordinates, combined with a DGPS capability next season, will allow new dive holes to be located precisely over the sea floor study areas, greatly improving the current trial and error drilling method. To realize this advantage, ASA operations will need to use DGPS equipment when locating drilling locations on the sea ice. UNAVCO is prepared to provide DGPS support for this application.

Appendix B - UNAVCO Polar Web Page