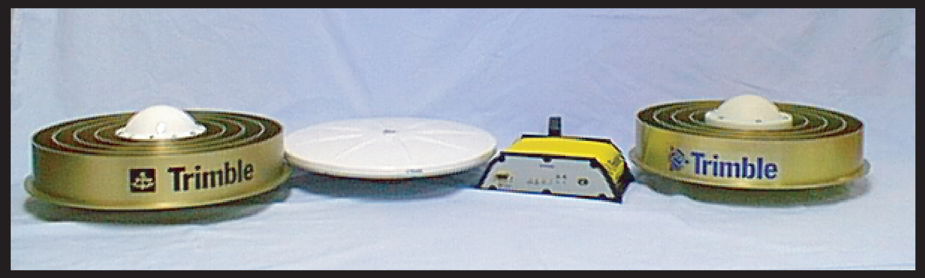
Research and Development at the UNAVCO Boulder Facility

Receiver & Antenna Testing

Sokkia GSR2600 GPS Receiver and SK-600 dual frequency antenna



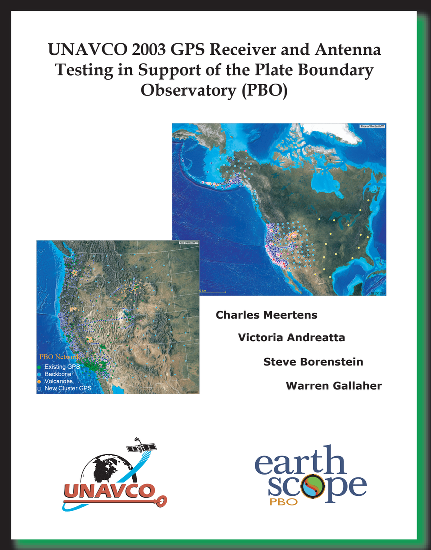
Trimble NetRS GPS receiver with (left to right) Trimble Dorne Margolin Choke, Zephyr Geodetic, and Trimble Zephyr Choke ring antennas.

Trimble R7 GPS receiver and Zephyr Geodetic Antenna

Topcon GB-1000 GPS receiver and PG-A1 antenna.

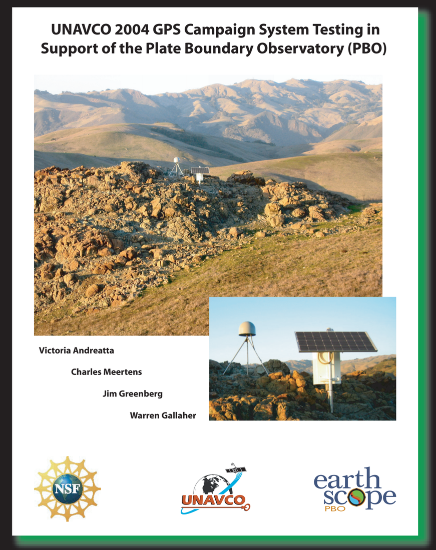
Primary rooftop testing area at UNAVCO Facility.

Topcon Odyssey RS GPS receiver and PG-A1 antenna.



UNAVCO staff discuss results of receiver testing

UNAVCO staff explore functionality of receivers being tested.

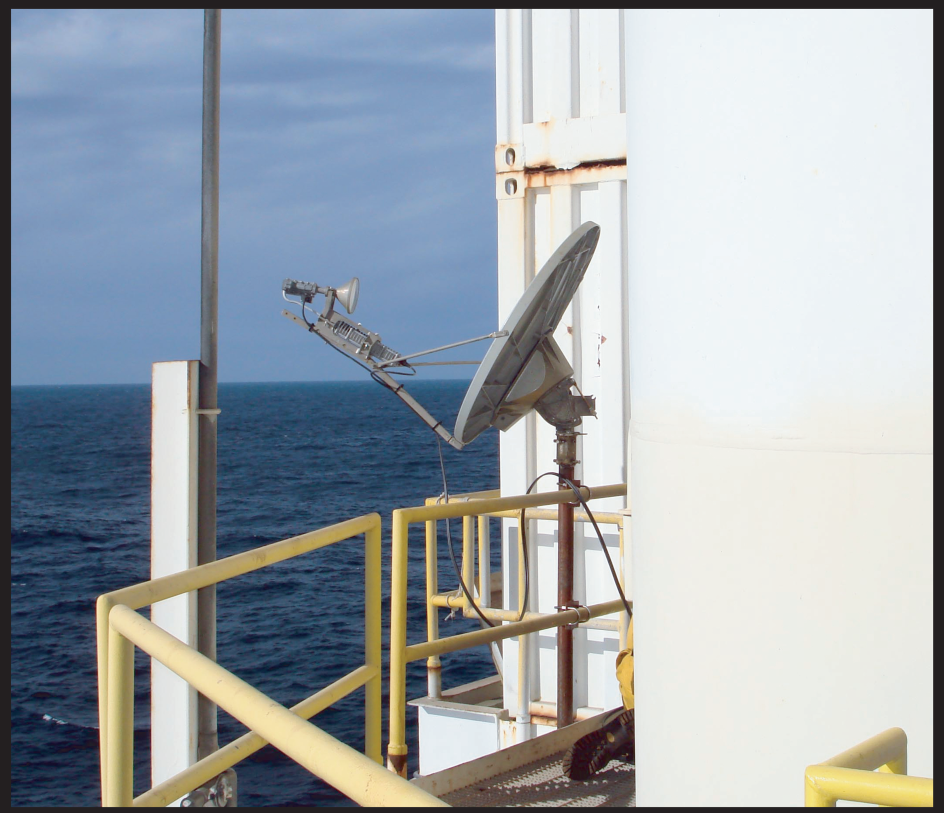


Please see the following URL for the complete testing reports:
http://facility.unavco.org/science_tech/dev_test/testing/testing.html

The UNAVCO Facility performs receiver and antenna testing as a service to the community when issues arise, when new equipment is released by a manufacturer, and for large project procurement. Receiver Tracking and Data Quality Tests are based on statistics determined from UNAVCO's Translation, Editing, and Quality Checking program (TEQC), and contain information that can be determined from a single GPS file (one receiver/antenna). Listed below are examples of tracking percentages, cycle slip counts, multipath statistics, and signal-to-noise ratio strength for L1 and L2. All of these parameters are taken into consideration when comparing different receiver types.

Communication Hardware Testing

Marshall Field Test Site near Boulder, Colorado, uses a pair of wireless ethernet bridges which communicate through a repeater located up at the National Center for Atmospheric Research (NCAR).



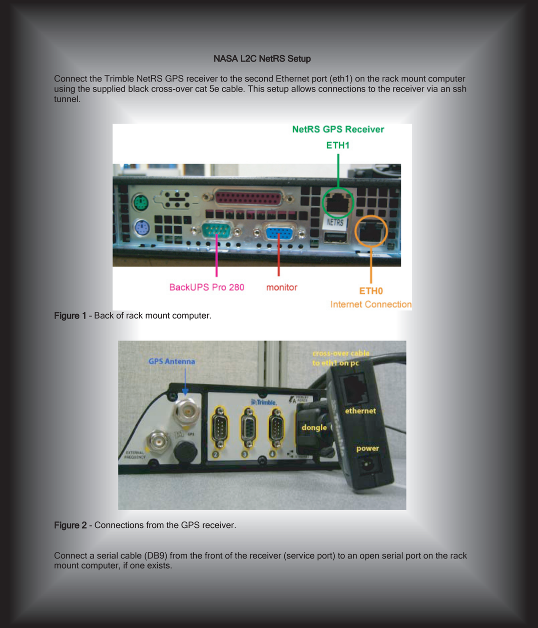
VSAT communications system on Harvest Oil Platform. VSAT provides internet for the various scientific instruments aboard the platform.

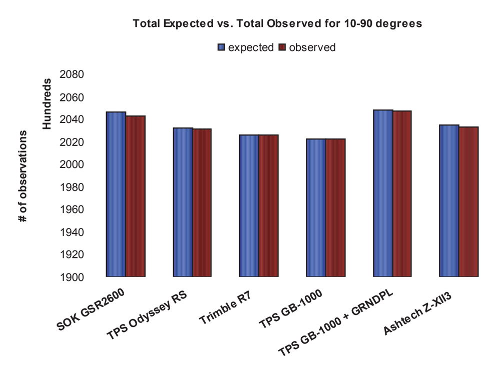
Yagi directional antenna connected to repeater used for communication to Marshall field test site.

Box that houses repeater up at NCAR for Marshall field wireless ethernet connection.

RAD modem used in Armenia at station NSSP.

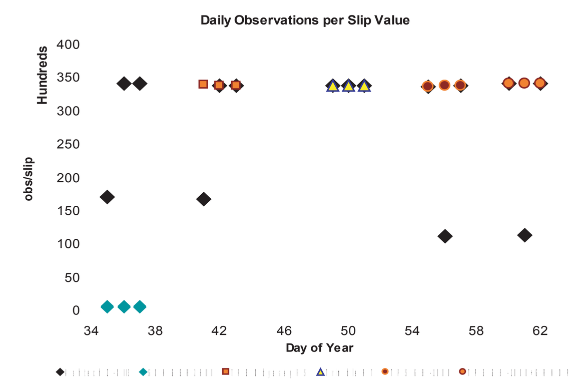
Linux Computer Configurations





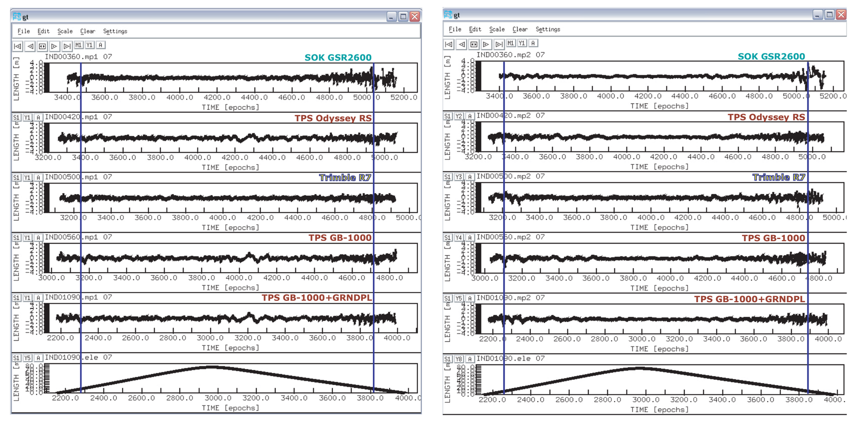
Expected data volume verses observed data volume for all receiver/antenna pairs tested. Ashtech Z-XII3 is shown for reference and has been scaled down to represent 6 days of data instead of 15 days. The Ashtech Z-XII3 has the approximate mean value of the five systems tested, its total expected and total observed span the entire testing period.

Receiver	Antenna	Total Expected	Total Observed	% obs/exp
SOK GSR2600	SOK600	204634	204252	99.81%
TPS Odyssey RS	TPS PG-A1 Geod	203176	203146	99.99%
Trimble R7	TRM 41249 Geod	202578	202577	100.00%
TPS GB-1000	TPS PG-A1 Geod	202272	202272	100.00%
TPS GB-1000	TPS PG-A1 Geod + GRNDPL	204771	204759	99.99%
Ashtech Z-XII3	ASH701945E_M	203452	203313	99.93%

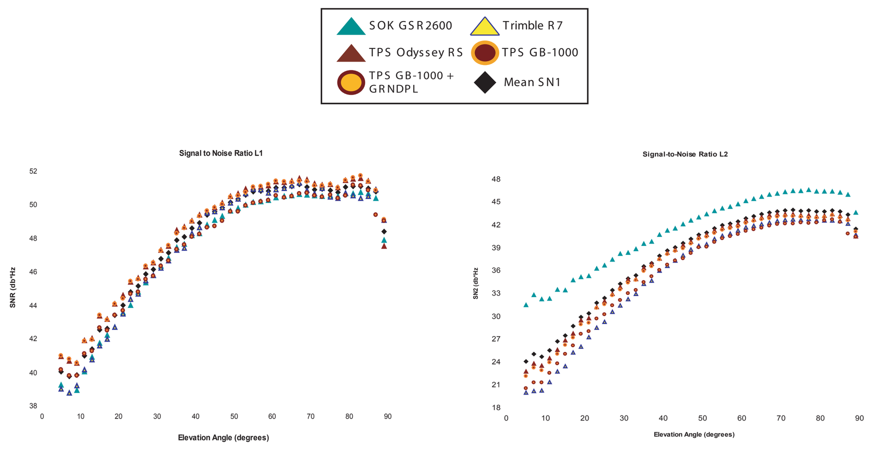


Total number of observations divided by total number of slips for each day of testing. The SOK GSR2600 had a lower daily mean observation per slip value due to the high number of cycle slips. The day numbers for the TPS GB-1000+GRNDPL have been changed to 60-62 for visual plotting purposes only.

Receiver	Antenna	Total Slips (IOD + MP)	Mean obs/slip	Sigma	Min	Max
SOK GSR2600	SOK600	351	590	77.3	500	681
TPS Odyssey RS	TPS PG-A1 Geod	0	33858	14.8	33841	33874
Trimble R7	TRM 41249 Geod	0	33763	14.6	33747	33780
TPS GB-1000	TPS PG-A1 Geod	0	33712	11.7	33700	33726
TPS GB-1000	TPS PG-A1 Geod+GRNDPL	0	34127	3.1	34122	34130
Ashtech Z-XII3	ASH701945E_M	2	32421	4906.1	16851	34145

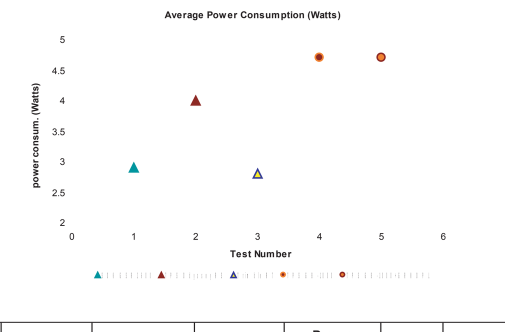


An example of MP1 and MP2 multipath for satellite 07. The vertical blue lines are approximate indicators of a 10 deg. elevation angle. Multipath and receiver noise increase at lower elevation angles, shown by the larger amplitude on the traces (more sinusoidal variation than linear). Vertical scale is from -4 m to 4 m.

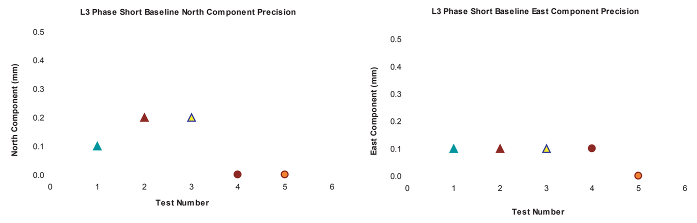


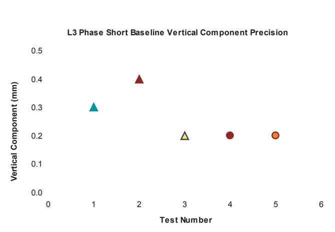
Signal-to-noise ratio for L1 & L2. The averages of all SN values (for 1 and 2) is denoted by the black diamonds. All systems are within a few db*Hz of the mean. The TPS Odyssey RS and the TPS GB-1000 are slightly above average for signal-to-noise ratio on L1. The SOK GSR2600, TPS GB-1000+GRNDPL, and the Trimble R7 are slightly below the mean of all systems tested at higher elevation angles.

Power testing was completed using custom made hardware and LabView.



Receiver	Receiver Serial #	Antenna	Antenna Serial #	Power Consumption (Watts)	Sigma	Average	Sigma
SOK GSR2600	NUA03480011	SOK600	NRK03480039	2.9	0.13	2.9	0.08
SOK GSR2600	NUA03480019	SOK600	NRK03480035	3.0	0.14		
TPS Odyssey RS	231-0105	TPS PG-A1 Geod	268-0494	4.1	0.51	4.0	0.01
TPS Odyssey RS	231-0102	TPS PG-A1 Geod	268-0663	4.0	0.52		
Trimble R7	220326017	TRM 41249 Geod	12578598	2.8	0.34	2.8	0.03
Trimble R7	220326020	TRM 41249 Geod	12560273	2.8	0.36		
TPS GB-1000	220072	TPS PG-A1 Geod	268-0663	4.8	0.36	4.7	0.08
TPS GB-1000	220073	TPS PG-A1 Geod	268-0494	4.6	0.40		





For the baseline processing tests, short baseline processing was performed using the Bernese 4.2 processing software. These results resemble actual geodetic processing results. On very short baselines, most propagation effects cancel, putting the emphasis on receiver/antenna performance. All observation files were also run through AutoGIPSY (http://milhouse.jpl.nasa.gov/ag), JPL's automated point positioning processing software in order to compare repeatability's with Bernese results.

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