German Antarctic Receiving Station (GARS) O'Higgins

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Abstract After the update of the receiver front-end was finished in 2014, it was installed in O'Higgins in early 2015. The remote capabilities of the new receiver and the long service lifetimes of the dewar now allows the realization of VLBI sessions even when no BKG expert is on site. The integration of the VLBI schedules into the Satellite Monitor and Control Software (SMCS) of our partner DLR is currently in progress.

1 General Information

The German Antarctic Receiving Station (GARS) is jointly operated by the German Aerospace Center (DLR) and the Federal Agency for Cartography and Geodesy (BKG, belonging to the duties of the Geodetic Observatory Wettzell (GOW)). The Institute for Antarctic Research Chile (INACH) coordinates the logistics. The 9-m radio telescope at O'Higgins is mainly used for downloading of remote sensing data from satellites such as TanDEM-X and for the commanding and monitoring of spacecraft telemetry. DLR operating staff and a Chilean team for maintaining the infrastructure (e.g., power and freshwater generation, technical support) attend the station the entire year. During dedicated campaigns in the Antarctic summer it is also used for geodetic VLBI. BKG staff was on site from January to the end of February 2015 and from the beginning of February to early March 2016. During these two campaigns a total of seven 24-hour IVS sessions were recorded. In addition, the O'Higgins telescope participated in four 24-hour sessions by remote control.

Carriage of passengers and cargo by air and by ship was organized by the Chilean Antarctic Institute (INACH) in close collaboration with the Chilean Army, Navy and Airforce, and with the Brazilian and Uruguayan Airforce. All technical material and food for the entire stay are delivered from Punta Arenas via Base Frei on King George Island to O'Higgins on the Antarctic Peninsula. The conditions for landing on the glacier are strongly weather dependent and involve an increasing risk due to climate change; in general, transport of staff and cargo is always a challenging task. Arrival and departure times strongly depend on the climate conditions and on the logistic circumstances.

After each Antarctic winter the VLBI equipment at the station must be checked again. Damages resulting from the climate conditions or strong storms have to be identified and repaired. Shipment of each kind of material, such as special tools, spare parts, or upgrade kits, has to be carefully prepared in advance. The new hydrogen maser EFOS-50 is continuously running and doesn't need to be heated-up when the staff arrives. The maser status is permanently monitored remotely.

Besides the 9-m VLBI antenna, which is used for the dual purposes of receiving data from and sending commands to remote sensing satellites and performing geodetic VLBI, other geodetic-relevant instruments are also operated on site:

- currently two H-masers (EFOS-10 and EFOS-50), an atomic Cs-clock, a GPS time receiver, and a Total Accurate Clock (TAC) offer time and frequency.
- two GNSS receivers OHI2 and OHI3, operating in the frame of the IGS network, while both are

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Fig. 1 The Web cam image of the VLBI antenna from December 01, 2016.

Fig. 2 The daily companions of the O'Higgins team.

Galileo enabled. The receivers worked without failure.

- a meteorological station providing pressure, temperature, humidity, and wind information, as long as the temporarily extreme conditions did not disturb the sensors.
- a GPS referenced radar tide gauge being operated only during the Antarctic summer and a permanent recording underwater sea level gauge; operation ended in 2015.
- two SAR corner reflectors, which were installed in March 2013 as part of a network to evaluate the localization accuracy of the TerraSAR-X mission.

The geodetic reference points of the VLBI antenna and the GNSS antennas are surveyed on a more or less regular basis. The last local survey was done in February 2016 when also the reference points of the SAR corner cubes were precisely determined. The last absolute gravity measurement was done in 2012.

2 Staff

The members of staff for operation, maintenance, and upgrade of the VLBI system and other geodetic devices are summarized in Table 1.

Table 1 Staff members.

Name	Group	Function	Mainly working for
Torben Schüler	BKG	head of the GOW	GOW
Christian Plötz	BKG	electrical engineer (chief engineer RTW)	O'Higgins, RTW, TTW
Reiner Wojdziak	BKG	software engineer	O'Higgins, IVS Data Center Leipzig
Andreas Reinhold	BKG	geodesist	operator Leipzig, survey O'Higgins
Jan Müller	BKG	geodesist	operator Leipzig, survey O'Higgins
Theo Bachem	BKG	electrical engineer	SLR Wettzell, operator O'Higgins
Thomas Klügel	BKG	geologist	administration laser gyro/ local systems Wettzell
Swetlana Mähler	BKG	geodesist	survey, SLR Wettzell, logistics O'Higgins
Olaf Lang	BKG	electrical engineer	local systems/ SLR Wettzell, logistics O'Higgins
Alexander Neidhardt	FESG	head of the microwave group, VLBI chief	RTW, TTW
Gerhard Kronschnabl	BKG	electrical engineer (chief engineer TTW)	TTW, RTW

3 Observations in 2015—2016

GARS participated in the following sessions of the IVS observing program:

Antarctic summer campaign (January—February 2015):

- IVS-OHIG94 February 04-05, 2015
- IVS-OHIG95 February 10-11, 2015
- IVS-OHIG96 February 11-12, 2015
- IVS-T2102 February 17-18, 2015

Antarctic summer campaign (February—March 2016):

- IVS-OHIG100 February 09-10, 2016
- IVS-OHIG101 February 10-11, 2016
- IVS-OHIG102 February 17-18, 2016

Remotely operated sessions:

- IVS-T2106 October 06-07, 2015
- IVS-T2107 November 10-11, 2015
- IVS-OHIG99 November 18-19, 2015
- IVS-T2108 December 15-16, 2015

At O'Higgins, the recorded scans were copied locally to portable hard disks which were carried by the staff at their return to Wettzell. From there the data were transferred via Internet to the Bonn correlator.

4 Technical Improvements and Maintenance

Fig. 3 The new data acquisition rack with (from top) backup system, Field System PC, Mark 5B+ data recorder, and ADS3000+ gigabit sampler.

The VLBI receiver front-end, which was nearly completely re-built in 2014, was installed at the end of January 2015. After that, the complete VLBI data acquisition back-end was upgraded. This comprises the replacement of the analog baseband converters and the Mark IV formatter by an ADS3000+ Gigabit sampler and a Mark 5B+ recording system. A new Field System PC was also installed. All four following IVS sessions during this campaign were recorded on both the old and the new data acquisition systems to ensure that the new system was working properly.

The cooling system was maintained in February 2016 (compressor adsorber replacement, dewar heating, and evacuation).

The IT network was completely rearranged to prepare the system for a software controlled switching between satellite tracking and VLBI observation mode. The limited bandwidth of the satellite link of 2 MBit/s only allows low transfer rates on the communication line so that Internet transfer of VLBI data is not yet practicable.

Since the installation of the new maser EFOS-50 in February 2014, both masers have been running in parallel, where EFOS-50 is the primary one and EFOS-10 is in standby.

The radar tide gauge was temporarily installed in January 2015. Due to frequent failures of the system and the difficult to access site, it is no longer operated. The same applies to the underwater pressure gauge, which yielded no continuous time series due to failures and iceberg collisions.

The extreme environmental conditions in the Antarctic requires special attention to the GARS telescope and the infrastructure. Corrosion frequently results in problems with connectors and capacitors. Defective equipment needs to be detected and replaced. Special attention was given to the wind sensors, which are important for the operational safety of the antenna. Due to frequent corrosion of the ultrasonic sensor heads by salt and storm, classical wind anemometers recording up to 60 m/s wind speed were installed in addition. Also, the Web cams are regularly maintained.

5 Future Plans

A full integration of the VLBI schedules into the SMCS software of DLR is envisaged for the next months. Then a more regular participation in IVS observations should be feasible. For the next two years a substantial modernization of GARS O'Higgins is currently being prepared by DLR. The work will focus on the infrastructural facilities (2017—2018) and the 9-m antenna (2018—2019). Further ideas concern the use of Ka-band receiving systems.