The German Antarctic Receiving Station O'Higgins and Its VLBI Capabilities

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Abstract The German Antarctic Receiving Station (GARS) O'Higgins started in the early 1990s with regular VLBI operations. Because of its remote position on the Antarctic Peninsula, the VLBI observing was mostly restricted to the Antarctic summer months. New equipment, a continuous operation by the German Aerospace Center (DLR), and new realizations of observation schedules may open the door for regular observations over the whole year. This paper reports the upgrades carried out in hard- and software and the latest results.

Keywords Antarctica VLBI, O'Higgins, GARS

Fig. 1 9-m radio telescope O'Higgins.

1 Introduction: GARS O'Higgins at a Glance

The German Antarctic Receiving Station (GARS) is jointly operated by the German Aerospace Center (DLR) and the Federal Agency for Cartography and Geodesy (BKG, Geodetic Observatory Wettzell). The Institute for Antarctic Research Chile (INACH) coordinates the activities and logistics. The 9-m radio telescope at O'Higgins is mainly used for downloading of remote sensing data from radar satellites and for the commanding and monitoring of spacecraft telemetry. During dedicated campaigns it is also used for geodetic VLBI in the Antarctic summer.

In recent years, special flights using "C-130 Hercules" aircraft and small "DHC-6 Twin Otter" aircraft, as well as transportation by ship, were organized by INACH in order to transport staff, technical material, and food for the entire stay from Punta Arenas via Base Frei on King George Island to O'Higgins. The conditions for transport and landing are strongly weather dependent and involve an increasing, challenging task.

The site is also equipped with other geodetic instruments:

- different time receivers in combination with an H-maser and Cs-standard,
- several GNSS receivers,
- a meteorological station,
- a radar tide gauge and an underwater sea level gauge.

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2 Installed Equipment

2.1 Receiver Frontend

The VLBI receiver was renewed because of failures of the cryogenic system and some HF-components. This new receiver for both receiving frequency ranges in S- and X-band for standard dual-band and right-hand circular polarization was designed and built in the labs of the Observatory Yebes, Spain. New high performance cryogenic low noise amplifiers are used for first stage amplification of the incoming noise signal from the quasars. This improves the SEFD of the entire receiving chain. The down-converters were also renewed to simplify the maintenance.

Fig. 2 New S-/X-band VLBI receiver at O'Higgins.

The monitoring of the VLBI receiver is Ethernet-based. This gives more flexibility for remote control and supervision from Wettzell.

2.2 Data Acquisition Backend

To complete the receiving chain with new, stable equipment, a new data acquisition rack was populated with state-of-the-art components in parallel to the existing VLBA4 rack.

The focus was on digital sampling components. Therefore a very stable and flexibly configurable ADS3000+ baseband converter was installed in combination with a Mark 5B+ data recording system. A new Field System PC is available with one of the latest NASA Field System versions to control all the equipment.

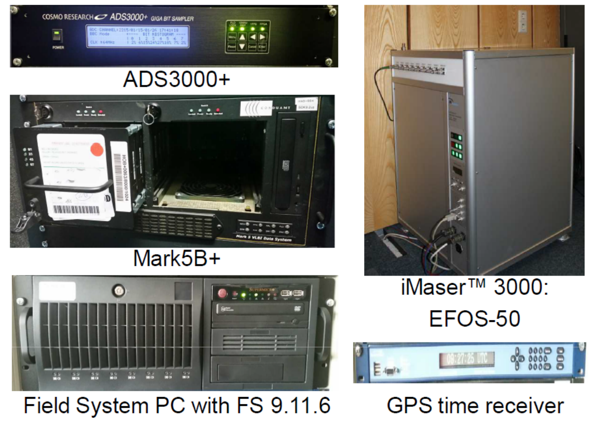

Fig. 3 Newly installed data acquisition systems for VLBI.

An EFOS-50 maser now builds the basis for stable frequency and timing. The UTC connection is managed with a new GPS time receiver with NTP.

2.3 Control Room

Fig. 4 New combined satellite tracking and VLBI control room.

To enable flexible control of satellite missions as well as of VLBI sessions, a new combined control room was built together with the DLR. The tasks can be controlled there from two operator desks.

First plans were discussed to integrate VLBI schedules into the scheduling system Remote Planning System (RPS) and the control software Satellite Mission Control System (SMCS) of the DLR to enable flexible scheduling of observations of satellite passages and intermediate VLBI sessions.

The VLBI sessions can also be controlled remotely at the new control room of the TWIN radio telescopes in Wettzell, using the software e-RemoteCtrl. This should extend the possibilities for VLBI observations.

3 Integration Tests in January and February 2015

The integration of the new receiver frontend and the data acquisition backend was done during the VLBI campaign from January to February 2015. The new VLBI receiver was successfully installed into the antenna's elevation cabin. The VLBI sampler ADS3000+ and the Mark 5B+ were mounted into an existing and available rack in the DLR control room in parallel to the old and still working VLBA4 rack with the Mark 5A VLBI data recorder.

The new system was tested in parallel to the existing equipment during four VLBI sessions:

- OHIG94
- OHIG95
- OHIG96
- T2102

Since then the T2 sessions T2106 and T2108 and the OHIG sessions OHG100, OHG101, and OHG102 were successfully recorded, proving the technical capability of the entire receiving and recording chain as well as the remote accessibility.

The OHIG sessions are dedicated to measure the southern reference frame. The T2 sessions are used to determine the terrestrial reference frame. Sample data scans were copied and sent to the Bonn correlator already during the ongoing sessions to evaluate the data quality of the new VLBI instrumentation. The first feedback from the correlator showed good data quality and performance.

4 Conclusion and outlook

Goals for the upgrades are an increase of the amount of time in which maintenance is not needed and higher automation. The idea behind these goals is to enable the observation of one geodetic VLBI session per month in a more frequently used southern VLBI network (see Figure 5). The VLBI sessions should be scheduled as intermediate observations within the satellite tracking and control sessions of the DLR. Parts of the VLBI sites may be operated remotely in such a scenario.

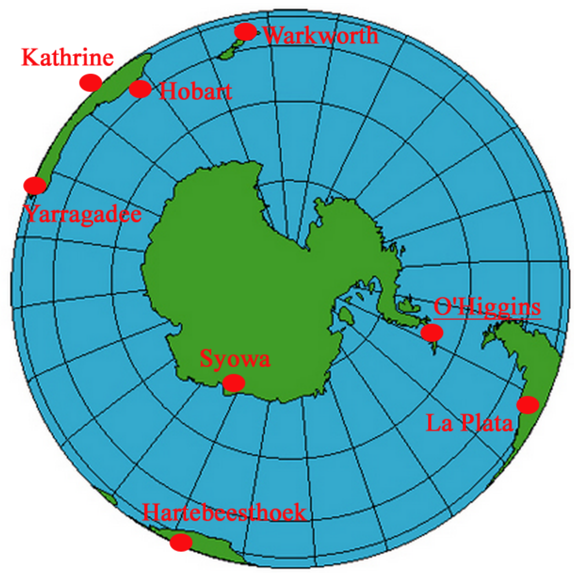

Fig. 5 A possible southern VLBI network for geodesy. The map is courtesy of Bruce Jones Design Inc. and FreeUSandWorldMaps.com.

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