Last Year of Operation of the TIGO VLBI Station in Concepción

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Abstract After more than 12 years of continuous operation, the TIGO VLBI station at Concepción, Chile came to an end due to the termination of the scientific-technical cooperation in the TIGO-project between Germany and Chile. 36 scheduled VLBI sessions were successfully recorded during the first semester. In parallel the preparation of the disassembling of the observatory for its transportation to La Plata in Argentina determined the main activities. During the second semester the entire observatory was packed to be moved. Besides that, the reflector was surveyed, future Argentinean colleagues were trained in TIGO by the Chilean staff, an inventory software for an observatory was developed, and a study on VGOS/GGOS network expansion was published.

1 General Information

The TIGO-project is based on a bilateral agreement between the Federal Republic of Germany and the Republic of Chile. Since 2002, TIGO has been located in the terrain of the Universidad de Concepción (long. 73.025 degrees West, lat. 36.843 degrees South), in Concepción Chile, and has served the IVS, ILRS, IGS, IGFS, BIPM, and IERS with observational data. Between the main project partners BKG and Universidad de Concepción the cooperation was officially closed by the end of 2014. The reason to do so was the lack of interest to support a non-profit geodetic observatory by the Chilean government after the earthquake on February 27, 2010. The German government looked for other partners and made an agreement with the Argentinean National Research Council (CONICET) about the creation of an Argentinean-German Geodetic Observatory (AGGO) in 2012. 2014, the last year of the TIGO-project, was full of activities to prepare the instruments for the transport to the new AGGO site near La Plata, Argentina. The acronym TIGO will stay in Chile, while the new station will be called AGGO.

For more than ten years, TIGOCONC was among the three most productive IVS-sites (Figure 1).

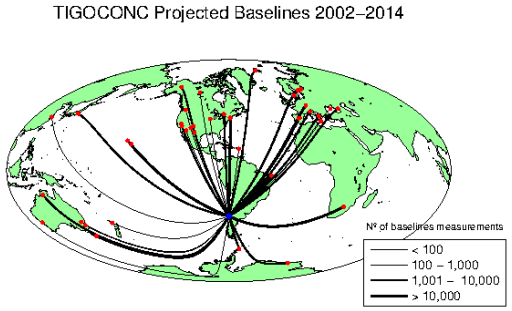

Fig. 1 TIGOCONC as the 'center' of the VLBI world. The baselines measured with Concepción are projected to the Earth's surface. The line width indicates the number of repetitions of baseline determinations during 2002—2014, demonstrating a solid Southern hemisphere reference point which is very well connected to six continents by its continuous measurements.

TIGOCONC has been the VLBI reference point in South America with most observations during 2003—2013. It participated in total in 1,269 IVS sessions with a total of 247,723 successful quasar observations. In

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2. Universidad de Concepción (UdeC)

Table 1 TIGO VLBI support staff in 2014.

Staff	Function	Email	Remark
Hayo Hase	Head	hayo.hase@tigo.cl	
Cristian Herrera	Informatic Engineer	cristian.herrera@tigo.cl	
Felipe Pedreros	Telecommunications Engineer	felipe.pedreros@tigo.cl	
Sabina Rayo	student of mechanical engineering	sabina.rayo@tigo.cl	until May 2014
Pablo Figueroa	student of telecommunications	pablo.figueroa@tigo.cl	until May 2014
Luis Feres	student of aerospace engineering	luis.fuentes@tigo.cl	until May 2014
all VLBI operators		vlbistaff@tigo.cl	

addition, a few astronomical sessions were conducted for the TANAMI project.

2 Component Description

The IVS network station TIGOCONC constitutes the VLBI-part of the Geodetic Observatory TIGO, which was designed to be a fundamental station for geodesy. Hence, the VLBI radio telescope is co-located to an SLR telescope (ILRS site), a GPS/Glonass permanent receiver (IGS site), and other instruments such as a seismometer and a superconducting and an absolute gravity meter.

The atomic clock ensemble of TIGO consists of two hydrogen masers, three cesium clocks, and four GPS time receivers realizing the Chilean contribution to the Universal Time scale (Circular T, BIPM).

The technical parameters of the TIGO radio telescope as published in [1] have not been changed.

3 Staff

The 2014 VLBI staff consisted of six persons, as listed in Table 1. The team (Figure 2) was complemented by students Luis Feres, Pablo Figueroa, and Dr. Sabina Rayo performing night shifts until the closure of operations by the end of May 2014.

Fig. 2 The TIGO VLBI staff on top of the geodetic platform, and the 6-meter telescope ready for shipment in the background. The remaining geodetic reference marker is still visible at the bottom edge (student operators absent).

4 Current Status and Activities

4.1 IVS Operation

During 2014 TIGO was scheduled to participate in 36 regular IVS experiments. Table 2 gives an overview about the participation of TIGOCONC in 2014. Out of 36 requested observation days, 33 could be observed successfully, reaching an efficiency of 91.6%. The main reason for data loss have been related to technical problems in the refrigerating system of the receiver, recording problems on bad data carriers, and unexpected delays in the customs liberation procedure of data carriers. According to previous schedules of moving TIGO to Argentina, the CONT14 scheduling was made without TIGO. Due to delays in the execution of the move, the possibility of including TIGO again in

Fig. 3 (Left) The VLBI telescope primary mirror covered with reflecting targets for photogrammetry measurements. (Right) Pictures taken at different angles with the telescope pointing at 110 degrees of elevation. Credits: Rolando Dünner/AIUC.

CONT14 was not considered, as the preparations were at an advanced stage.

Table 2 TIGO's IVS observation statistics for 2014. The operation was closed on May 31, 2014.

Name	R1xxx	R4xxx	OHIGxx	Total IVS
# of Exp.	16	17	3	**36**
Correlated	13	17	3	**33**
No result	3	0	0	**3**

4.2 Reflector Surface Survey

A photogrammetry measurements campaign was performed on January 25 and 26, 2014, in order to measure the primary mirror surface accuracy. This work was requested to the Centro de Astro-Ingeniería of the Pontificia Universidad Católica de Chile (AIUC) [2].

The surface of the primary mirror was covered with 112 reflecting targets, and measurements were done by using a VSTARS camera and software from Geodetic Systems Inc.. Measurements were performed with the telescope pointing at 2 degrees, 38 degrees, and 110 degrees of elevation to estimate gravity deformations on the reflector's surface. Subsequent analysis of the pictures taken at different locations and angles around the telescope allowed estimation of the mirror surface RMS error of 0.25 [mm] at an elevation of 2 degrees, 0.26 [mm] at 38 degrees, and 0.28 [mm] at 110 degrees. Results showed a surface RMS error 70 μm greater than the design goal of 200 μm, meaning a 35% degradation for the last 12 years of operation. However, this implies a loss of antenna gain less than 1% at 10 GHz. Figure 3 shows the telescope primary mirror with the reflecting targets attached to its surface, as well as the photogrammetry measurements being performed.

4.3 Training of AGGO Staff

Federico Salguero, José Vera, and Augusto Cassino from CONICET, Argentina, visited TIGO in order to gain a first introduction into the operation of VLBI and later of the disassembling of the radio telescope.

4.4 Telescope Decommissioning

After 12 years of continuous operations and the preparations for the upcoming move to the new site in La Plata (Argentina), an overhaul of the telescope was required. This major task was assigned to the company MT-Mecatrónica, who performed tests, parts replacement, lubrication, repainting, and the disassembly of the telescope. Once in La Plata, MT-Mecatrónica will be responsible for the re-commissioning of the telescope.

In addition, the cryogenic dewar was shipped to the laboratories at the Wettzell Observatory for major maintenance due to previous leakage problems.

Fig. 4 The staff of the TIGO, Wettzell, and AGGO observatories and the contracted MT-Mecatrónica company preparing the transport to Argentina in front of the disassembled radio telescope, before storing it in its 40 ft. shipping container.

4.5 Observatory Inventory System

For the purpose of crossing the border between Chile and Argentina, an inventory list of the Observatory had to be made. Cristian Herrera developed a tailor made software solution for the data acquisition by tablets, storage in a database and creation of reports with filters. In order to not confuse already inventoried parts, a barcode label was introduced for any registered part. Each part of the observatory is registered in a database with the following fields: name, part no., serial no., provenience, value, currency, manufacture date, place, responsibility, auxiliary information, and photo. The text information is barcoded and the photo, making the identification easy, is also part of the database. It is not made for VLBI only but for any part used in an observatory.

This system contains all the information for custom purposes and can be used later on as the inventory system for AGGO.

Finally, the more than 2,000 items of TIGO were registered with this system during February and December 2014.

4.6 Study of the VGOS/GGOS Network

Felipe Pedreros and Hayo Hase finished a study of densifying the global VGOS network with additional new radio telescope sites to create a homogeneous site distribution of VGOS sites. As backbone for GGOS the obtained configuration was extended with co-located SLR sites in order to obtain an optimal GGOS network site distribution under the constraints of continental surface. This study was published in the Journal of Geodesy [3].

5 Future Plans

The VLBI activities in 2015 will be focused on:

- Transporting TIGO to La Plata in Argentina.
- Setting up the new site in La Plata, Argentina.
- Educating new operators in VLBI operations.
- Resuming the execution of the 2015 IVS observation program.

References

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