Geodetic Observatory Wettzell - 20 m Radiotelescope

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Abstract

In the year 2009 the 20-m radiotelescope at the Geodetic Observatory Wettzell, Germany contributed again very successfully and strongly to the IVS observing program. Technical changes, developments, improvements, and upgrades have been done to increase the reliability of the entire VLBI observing system.

1. General Information

The 20-m radiotelescope in Wettzell (RTW) is an essential component of the Geodetic Observatory Wettzell (GOW) and is jointly operated by Bundesamt für Kartographie und Geodäsie (BKG) and Forschungseinrichtung Satellitengeodäsie (FESG) of the Technical University Munich. In addition to the RTW, the following geodetic space techniques and local systems are co-located at the GOW:

- laser ranging systems involved in ILRS: Wettzell Laser Ranging System (WLRS) and a new implementation called Satellite Observing System Wettzell (SOS-W), which is under construction.
- GPS receivers involved in the global network IGS, in the European network EUREF, in the national network GREF, and in time transfer experiments.
- G, a large laser gyroscope or ringlaser, dedicated for monitoring of daily variations of Earth rotation.
- local techniques, such as time and frequency, meteorology, super conducting gravity meter, water vapor observations, and a regularly operated local surveying system.

Within the responsibility of the GOW are also the TIGO system in Concepción, Chile, mainly together with the Universidad de Concepción, and the German Antarctic Receiving Station (GARS) O'Higgins in Antarctica, together with the German Space Center (DLR) and the Institute for Antarctic Research Chile (INACH).

2. Staff

The staff of the GOW consists of ,in total, 33 members for operations, maintenance, repair issues, and the improvement and development of the systems. The staff operating RTW is summarized in Table 1.

3. Observations in 2009

The 20-m RTW has supported geodetic VLBI activities—e.g., of the International VLBI Service for Geodesy and Astrometry and other partners, such as the EVN—for over 25 years. All successfully observed sessions in the year 2009 are summarized in Table 2. According to the IVS 2009 Master Schedule, RTW was the most utilized network station for 24-hour geodetic VLBI sessions. The daily one-hour Intensive sessions (INT), that are run in order to determine UT1-UTC,

Table 1. Staff - members of RTW

Name	Affiliation	Function	Working for
Johannes Ihde	BKG	interim head of the GOW (until June 2009)	GOW
Ullrich Schreiber	BKG	head of the GOW (July to December 2009)	GOW
Alexander Neidhardt	FESG	head of the RTW group and VLBI station chief	RTW, SOSW (partly O'Higgins)
Erhard Bauernfeind	FESG	mechanical engineer	RTW
Ewald Bielmeier	FESG	technician	RTW
Gerhard Kronschnabl	BKG	electronic engineer	RTW (partly TIGO and O'Higgins)
Christian Plötz	BKG	electronic engineer	O'Higgins, RTW
Raimund Schatz	FESG	software engineer	RTW
Walter Schwarz	BKG	electronic engineer	RTW (partly O'Higgins and WVR)
Reinhard Zeitlhöfler	FESG	electronic engineer	RTW
Daniel Helmbrecht	FESG/BKG	student (January to May 2009)	RTW
Alexander Bauer	FESG/BKG	student	RTW
Thomas Guggeis	FESG/BKG	student (August to December 2009)	RTW

were continued in addition to the 24-hour sessions. For these sessions the complete data transfer is done with e-VLBI techniques. RTW now routinely uses the increased Internet connection capacities of 622 Mbit/sec for the e-transfers to Bonn, Tsukuba, and Haystack. According to the implementation of a field system extension for remote control, weekend Intensives were done by remote attendance or completely unattended. In addition to the standard sessions, RTW also participated in the IYA09, which was an astrometric session for the International Year of Astronomy 2009.

In addition, the ESA Venus Express spacecraft was observed at X-band with the Wettzell radiotelescope in October–December 2009 in the framework of a study to assess the possible contribution of the European VLBI network to the upcoming ESA deep space missions. The first goal of these observations was to develop and test the scheduling, data capture, transfer, processing, and analysis pipeline. The high dynamic range of the detections allowed the achievement of a mHz level of spectral resolution accuracy and the extraction of the phase of the spacecraft signal carrier line. Apart from other important results, the measured phase fluctuations of the carrier line at different time scales can be used to determine the influence of the Solar wind plasma density fluctuations on the accuracy of the astrometric VLBI observations.

Table 2. RTW observations in 2009

program	number of 24h-sessions
IVS R1	50
IVS R4	51
IVS T2	7
IVS R&D	9
RDV/VLBA	6
EUROPE	6
IYA09	1
total	**130**
total (in hours)	**3120**

program	number of 1h-sessions
INT1(Kokee-RTW)	236
INT2/K(Tsukuba-RTW)	103
INT3/K(Tsukuba-RTW-NyAl)	48
total (in hours)	**387**

special program	in hours
VENUS Express (7 obs.)	7
Test Mark 5B Crimea	1
total (in hours)	**8**

4. Technical Improvements and Maintenance

VLBI observations require high reliability of all participating stations. Therefore careful servicing of all components is essential to ensure successfully performed VLBI measurements throughout the year. Additionally the 20-m RTW has to be kept at a high technical standard and has to be improved according to technological advancements.

In 2009 the following developments and maintenance tasks were done:

- Test setup of the new Digital Baseband Converter (DBBC)
  - running of test schedules and data acquisitions
  - writing of controlling code to run the DBBC via Ethernet
- Continued software implementations for a remotely controllable extension for the NASA Field System
  - regular uses with RTW
  - preparing an official release to offer the basic software also for other telescopes
- Permanent reference point determination with laser tracker, tachymeter, and leveling instrument on the basis of a new mathematical model done by Michael Lösler (Geodetic Institute of the University Karlsruhe, Germany)
  - installation of a tachymeter for three months to monitor the movements of the reference point permanently
  - installation of a scintillometer for refraction calibration
  - collecting additional information–e.g., meteorological data or invar cable measurements
  - experiments with additional equipment, such as a laser tracker and a leveling instrument, while moving the telescope
  - an internal report from Lösler shows a reference point stability of about 15/100 to 20/100 mm over one day

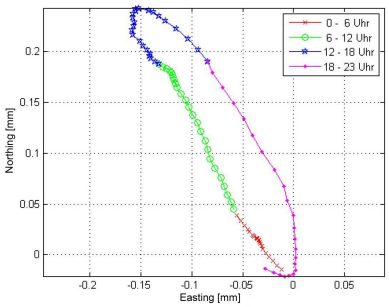

Figure 1. Estimated daily variation of reference point (M. Lösler)

- Calculation of orbits for Global Navigation Satellite Systems satellites for observations at partner telescopes

- Completion of the mechanical work at the replacement dewar and commencement of the testing phase
- Regular tasks and maintenance days (obtaining replacements for the hardware, 8-pack repairs, gear maintenance, Field System updates, cryo system maintenance, servo replacements, and improvements by using EVN-PCs for e-VLBI issues)
- IVS VLBI2010 Workshop on Future Radio Frequencies and Feeds (FRFF)
  - 60 international scientists discussed the new developments for VLBI2010 in Wettzell/Höllenstein in March 2009
  - Discussions about the new Eleven feed from Prof. Kildal (Chalmers University Göteborg/Sweden)
  - Presentations of the new design of the TWIN radiotelescopes Wettzell
  - Results offered guidelines for the future developments (frequencies, bands, developments, digital backends and so on)
- Building of the new TWIN radiotelescope Wettzell (TTW)
  - final project design and design review with fixation of the construction
  - design of the operation building
  - construction of the new towers and the control building started in September 2009

Figure 2. Construction of the concrete tower for the TWIN telescopes

5. Plans for 2010

During 2010, dedicated plans are:

- Usage of the digital baseband converters (DBBC)
- Extension of the software developements for remote control and the NASA Field System extension
- Continuous construction of the VLBI2010 TWIN-telescopes
- Integration of the Wettzell system monitoring at the RTW
- Plans to replace the existing radar system at the laser ranging system with a solution that conforms to VLBI2010