Geodetic Observatory Wettzell - 20m Radiotelescope
Status Report of 2009-2010

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Abstract

In the year 2009 the 20m radio telescope 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 20m Radio telescope 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 following geodetic space techniques and local systems are collocated 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) is under construction.
• GPS receivers involved in global network IGS, in the European network EUREF, in the national network GREF and in time transfer experiments.
• G, a large laser gyroscope or ring laser, dedicated for monitoring of daily variations of Earth rotation.
• local techniques, as time and frequency, meteorology, super conducting gravity meter, water vapor observations and a regularly local surveying system

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

2. Staff

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

Name	Affiliation	Function	Working for
Johannes Ihde	BKG	interim head of the FSW (till June 2009 and since January 2010)	FSW
Ullrich Schreiber	BKG/FESG	head of the FSW (July 2009 to Dec. 2009)	FSW
Alexander Neidhardt	FESG	head of the RTW group and VLBI station chief	RTW (partly O'Higgins), SOSW
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, VWR)
Reinhard Zeitlhöfler	FESG	electronic engineer	RTW

Thomas Klügel Rudolf Stöger	BKG BKG	responsibility for O'Higgins logistics and administration at Wettzell (since Jan. 2010) O'Higgins logistics at Wettzell	FSW, G FSW
Daniel Helmbrecht	FESG/BKG	student (till May 2009)	RTW
Alexander Bauer	FESG/BKG	student (till May 2010)	RTW
Thomas Guggeis	FESG/BKG	student	RTW
Martin Riederer	FESG/BKG	student	RTW
Johannes Vogl	FESG/BKG	student	RTW

3. Observations in 2009

The 20m-RTW supports the geodetic VLBI-activities of the International VLBI Service for Geodesy and Astrometry and partly for other partners, as the EVN, since over 25 years. All successfully observed sessions in the year 2009 are summarized in table 2. According to ”masterplan 2009”, RTW was the most engaged IVS network station with 24h-geodetic-VLBI-sessions again. The daily one-hour INTENSIVE-sessions (INT) in order to determine UT1-UTC were continued in addition to the 24h-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 was also active for the IYA09, which was an astrometric session in the International Year of Astronomy 2009.

In addition the ESA Venus Express spacecraft was observed at X-band with the Wettzell radio telescope in October-December 2009 and also partly in 2010 in a framework of the assessment study of 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 to achieve a milliHz level of the spectral resolution accuracy and to extract 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.

24h programme	**2009**
IVS-R1	50
IVS-R4	51
IVS-T2	7
IVS-R&D	9
EVGA-Europe	6
RDV/VLBA	6
IYA09	11
Total **Total (in hours)**	**130** **3120**

1h programme	**2009** **(in hours)**
IVS-INT1 (Wettzell-Kokee)	236
IVS-INT2 (Wettzell-Tsukuba)	103
IVS-INT3 (Wettzell-Tsukuba-Ny Alesund)	48
Total (in hours)	**387**

Special programs	2009 (in hours)
VENUS Express S/O (7 obs.)	7
Test Mk5B Crimea	1
Total (in hours)	**8**

4. Technical improvements and maintenance

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

In 2009/2010 the following developments and maintenance tasks have been 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 nivel on the basis of a new mathematical model done by Michael Lösler (Geodetic Institute of the University Karlsruhe, Germany)
  - – installation of a tachymeter for 3 month 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 as laser tracker and nivel while moving the telescope determined
  - – an internal report shows a reference point stability of about 15/100 to 20/100 mm over one day

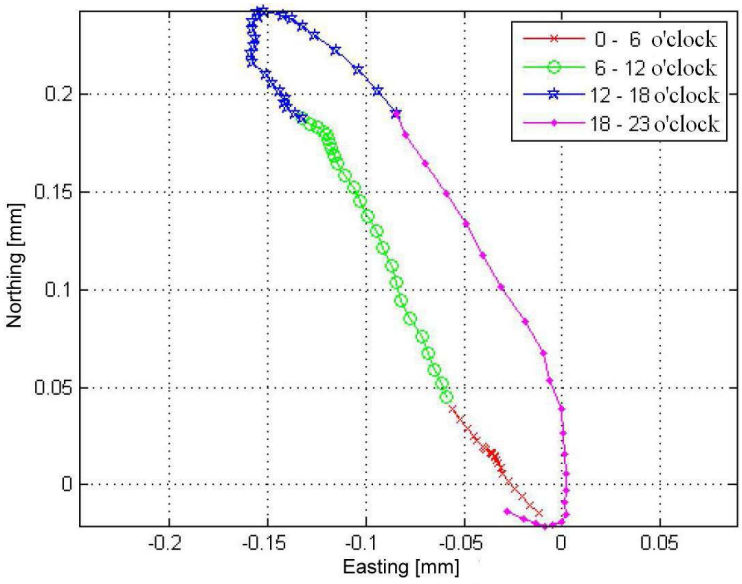

Figure 1. Estimated daily variation of reference point

• Calculation of orbits for Global Navigation Satellite Systems satellites for observations at partner telescopes
• Completion of the mechanical work at the replacement dewar and starting with the testing phase
• Regularly tasks and maintenance days (obtaining replacements for the hardware, 8-pack reparations, gear maintenance, field system updates, cryo system maintenance, servo replacements, 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 on March 2009
  – Discussions about the new eleven feed from Prof. Kildal (Chalmers University Göteborg/Schweden)
  – Presentations of the new design of the TWIN radio telescopes 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 constructions
  – design of the operation building
  – construction of the new towers and the control building started on September 2009

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

• Participation at the NEXPRES project to realize remote access and a monitoring system for VLBI telescopes
• First attempts to realize a monitoring system at the RTW (student project)
  – Re-write the strain meter sensor software
  – Realize monitoring points for different sensor types
  – Cooperation with MIT Haystack Observatory to develop a draft list of monitoring points
• Detection of a bearing problem and planning of a maintenance concept
  – Observe and measure a tilt of the elevation axis (right side 2 mm, left side 0.5 mm)
  – Inspection done by Vertex Antennentechnik GmbH
  – Prepare a the maintenance task with an external company for end of year 2010
  – Reduce the observations to 40% in total to reduce the destruction

5. Plans

Dedicated plans are:

- Do the maintenance to solve the elevation bearing problem
- Usage of the digital baseband converters (DBBC) and preparation for TWIN
- Offer a public release and a download possibility for the extension for remote control to the NASA field system
- Continuous construction for the VLBI-2010 TWIN-telescopes (metal structure, elevation cabin, etc.)
- Integration of the Wetzell system monitoring at the RTW
- Plans to replace the existing radar system at the laser ranging system with a VLBI2010 conform solution
- Starting the NEXPRES realizations
- Increase internet connection to 1Gbit/sec