Onsala Space Observatory – IVS Network Station

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Abstract

During 2010 the Onsala Space Observatory contributed as an IVS Network Station to 27 VLBI sessions organized by the IVS. We used the majority of these sessions to do ultra-rapid dUT1 observations together with our colleagues in Tsukuba. Furthermore, we observed several additional one-baseline ultra-rapid dUT1 sessions. This report briefly summarizes the activities during the year 2010.

1. General Information

The Onsala Space Observatory has a more than 40-year history in VLBI. Onsala was the first European observatory to be involved in geodetic/astrometric VLBI observations, and the first trans-atlantic VLBI observations were performed together with Haystack Observatory already in April 1968. Today Onsala is a fundamental geodetic station with equipment for geodetic VLBI, GNSS, a superconducting gravimeter, and several radiometers for atmospheric measurements. Figure 1 shows a recent aerial photo of the area around the 20-m telescope.

Figure 1. Aerial photo taken in December 2010. Shown are: (1) the radome enclosing the 20-m radio telescope used for geodetic/astrometric VLBI, (2) the IGS antenna, (3) the water vapor radiometer Astrid, (4) the old gravimeter house, (5) the new gravimeter house, and additional office and laboratory buildings.

2. Staff Associated with the IVS Network Station at Onsala

The staff associated with the IVS Network Station at Onsala remained the same as reported in last year's annual report. Contact information is found on the observatory Web page `http://www.chalmers.se/rss/oso-en/`.

3. Geodetic VLBI Observations for the IVS during 2010

In 2010 the Onsala observatory was involved in four IVS observing series: EUROPE, R1, T2, and RD10. In total, Onsala participated and acquired useful observations in 27 experiments, see Table 1. All experiments were recorded on Mark 5 modules. Most of the experiments whose data were correlated at the Bonn correlator were additionally recorded in parallel on the PCEVN-computer that is daisy-chained to the Mark 5 computer. The observed data of these experiments were then e-transferred using the Tsunami protocol, and no Mark 5 modules were actually sent to Bonn. Radio interference due to UMTS mobile telephone signals continued to be a disturbing factor for the S-band observations.

Table 1. Geodetic VLBI experiments at the Onsala Space Observatory during 2010.

Exper.	Date	Remarks	Correlated
R1-413	JAN.11	E-transfer to Bonn	o.k, but 30 min lost due to Mark 5 module failure
EUR-103	JAN.18	E-transfer to Bonn	o.k.
R1-415	JAN.25	E-transfer to Bonn	o.k.
R1-417	FEB.08	E-transfer to Bonn	o.k.
RD-10.02	FEB.17	module shipment to Haystack	o.k.
R1-420	MAR.01	E-transfer to Bonn	o.k.
EUR-104	MAR.02	E-transfer to Bonn	o.k., but some scans lost due to power failure
R1-425	APR.06	E-transfer to Bonn	o.k.
RD-10.03	APR.07	module shipment to Haystack	o.k.
R1-426	APR.12	E-transfer to Bonn	o.k.
R1-427	APR.19	E-transfer to Bonn	o.k.
R1-428	APR.26	E-transfer to Bonn	o.k., but some problems with phase-cal
RD-10.04	MAY.04	module shipment to Haystack	o.k.
R1-437	JUN.28	E-transfer to Bonn	o.k, but 40 min missed due to power failure
RD-1005	JUN.29	module shipment to Haystack	o.k.
EUR-106	JUL.05	E-transfer to Bonn	o.k.
R1-438	JUL.06	E-transfer to Bonn	o.k.
R1-440	JUL.19	E-transfer to Bonn	o.k.
R1-445	AUG.23	E-transfer to Bonn	o.k.
R1-446	AUG.30	E-transfer to Bonn	o.k.
R1-449	SEP.20	E-transfer to Bonn	o.k.
T2-071	SEP.21	module shipment to Haystack	o.k.
R1-450	SEP.27	E-transfer to Bonn	o.k.
T2-072	OCT.05	module shipment to Haystack	o.k.
R1-457	NOV.15	E-transfer to Bonn	o.k, but 6 scans missed due to Mark 5 problems
R1-461	DEC.13	E-transfer to Bonn	o.k.
R1-462	DEC.20	E-transfer to Bonn	o.k.

4. Fennoscandian-Japanese Ultra-rapid dUT1 Measurements

During 2010 we continued our involvement in the successful Fennoscandian-Japanese ultra-rapid dUT1 project. We used a number of standard 24-hour IVS sessions where both Onsala and Tsukuba (or Kashima) were involved to continuously determine dUT1 results during the ongoing VLBI observations. In total, 15 R1 sessions, three RD sessions, and two T2 sessions were used as ultra-rapid dUT1 sessions. Even one European session, EUR.104, was performed as an ultra-rapid experiment. In this case, both Onsala and Metsähovi sent their data in real-time to the Tsukuba correlator, where the data were correlated and analyzed. However, the dUT1 results were of low quality, mainly due to the short baseline Onsala-Metsähovi. Additionally, we performed a few dedicated one-baseline ultra-rapid dUT1 sessions. These sessions were observed for several hours during the European night hours after standard IVS sessions. In both cases the dUT1 results were determined already during the ongoing VLBI observations using a 'sliding window' approach with approximately 35 scans. Table 2 gives an overview of these additional one-baseline ultra-rapid dUT1 sessions.

Table 2. Dedicated Fennoscandian-Japanese ultra-rapid dUT1 experiments in 2010.

Exper.	Date	Duration	Baseline	Mbps	Transfer	Correlation	Analysis
UR0.271	SEP.28	8 h	Onsa-Kash	256	real-time	real-time	automated
UR0.279	OCT.06	8 h	Onsa-Tsuk	256	real-time	real-time	automated
UR0.348	NOV.16	12.5 h	Onsa-Tsuk	256	real-time	real-time	automated
UR0.355	DEC.21	12.5 h	Onsa-Tsuk	256	real-time	real-time	automated

5. Monitoring Activities in 2010

Monitoring activities were continued as described in previous annual reports.

Calibration of pressure sensor. We continued to calibrate the Onsala pressure sensor using a Vaisala barometer borrowed from the Swedish Meteorological and Hydrological Institute (SMHI). This Vaisala instrument was installed at Onsala in late 2002 and has been calibrated at SMHI main facility in Norrköping every 1–2 years since then. The agreement between the Onsala pressure sensor and the SMHI pressure sensor is on the level of ±0.1 hPa.

Vertical height changes of the telescope tower. We continued to monitor the vertical height changes of the telescope tower using the invar rod system at the 20-m telescope. New temperature sensors were installed and the measurements made available via Internet, see `http://wx.oso.chalmers.se/pisa/`.

Microwave radiometry. The water vapor radiometer Astrid was in operation continuously during 2010, mainly observing in a so-called sky-mapping mode. The second water vapor radiometer Konrad is still being upgraded in the electronic lab at the observatory.

Sea-level monitoring. We operated the GNSS-based tide gauge during several months at the coastline close to the observatory to monitor the local sea-level. The tidal analysis of the sea-level variations clearly shows the dominant ocean tides in the Kattegatt.

Superconducting gravimetry. The superconducting gravimeter (SCG) operated continuously during 2010. It produced a highly precise record of gravity variations, and it recorded earthquakes and free oscillations of the earth. Further information on the SCG can be found on the Web page `http://froste.oso.chalmers.se/hgs/SCG/`. Auxilliary sensors for bedrock temperature and rock deformation below the gravimeter house were installed in the spring of 2010. The measurements are available on a Web page, see `http://wx.oso.chalmers.se/gravimeter/`.

Seismological observations. A three-axis seismometer has been operated at the observatory since May 2010. Since the current operating site is slightly disturbed by man-made vibrations, the instrument has to be moved to a better site within the observatory premises. The actual location has not yet been identified.

Monitoring of the RFI environment. During 2010 a system to monitor the radio frequency interference (RFI) environment was developed as part of a master's thesis. The instrument will be installed permanently at the Onsala site in 2011.

6. New Contract with the Swedish Research Council

In connection with the international evaluation of the observatory carried out in 2009 by the Swedish Research Council (VR), a new contract between Chalmers University of Technology, the host university for the observatory, and VR was signed in late 2010. This contract states that the observatory has the role as a Swedish national infrastructure for radio astronomy as well as geodesy.

7. Outlook

The Onsala Space Observatory will continue to operate as an IVS Network Station and to participate in the IVS observation series. For 2011 a total of 41 experiments is planned, including the 15-day-long CONT11 campaign. We aim to use e-transfer of as many of the experiments as possible. We will also continue the Fennoscandian-Japanese ultra-rapid dUT1 project and focus on 24-h ultra-rapid dUT1 sessions, and additional one-baseline ultra-rapid sessions during the European night hours.

During 2011 we plan to carry out the following hardware improvements:

- Replacement of the analog VLBI backend by a digital one.
- Installation of the GNSS-based tide gauge at a new location for continuous observations. As a reference we will add a traditional tide gauge based on pressure sensors.
- A more permanent installation of the seismometer at a place at the observatory with fewer man-made vibrations.
- Monitoring of the RFI environment.

Encouraged by the positive evaluation of the observatory in 2009, and the new contract with the Swedish Research Council in 2010, we will start a discussion on a transition of Onsala to become fully VLBI2010-compliant.