Onsala Space Observatory – IVS Network Station

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Abstract

During 2011 we contributed to 38 IVS sessions, including the CONT11 campaign. We used the majority of the sessions that involved both Onsala and Tsukuba to do ultra-rapid dUT1 observations together with our colleagues in Tsukuba. In particular, the whole CONT11 campaign was operated in ultra-rapid mode. Furthermore, we observed one additional one-baseline ultra-rapid dUT1 session, a three-station ultra-rapid EOP-session, the Venus Express space probe, and the RadioAstron satellite.

1. General Information

The Onsala Space Observatory is a fundamental geodetic station with equipment for geodetic VLBI, GNSS, a superconducting gravimeter, and several radiometers for atmospheric measurements. Figure 1 shows an aerial photo taken on October 13, 2011.

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

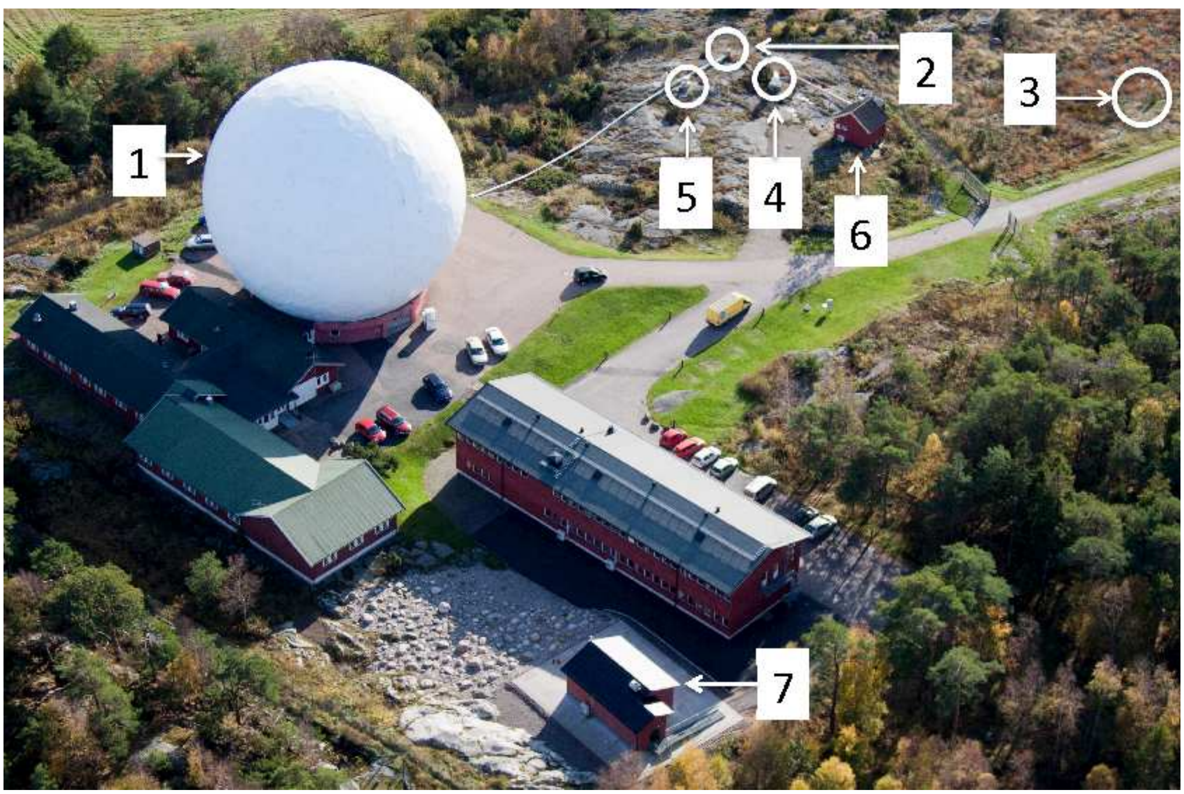

Figure 1. The radome enclosed 20-m radio telescope used for geodetic/astrometric VLBI (1), the IGS antenna (2), a new GNSS-monument erected in 2011 (3), the water vapor radiometers Astrid (4) and Konrad (5), the old laboratory for visiting gravimeters (6), and the new gravimeter laboratory (7).

2. VLBI Observations for Geodesy and Space Navigation

Onsala was involved in the four IVS observing series EUROPE, R1, T2, and RD and participated in the CONT11 campaign, see Table 1. Observations were acquired during 38 IVS sessions. All experiments were recorded with our Mark IV VLBI-rack and recorded on the Mark 5A unit. Most of the experiments whose data were correlated at the Bonn correlator were recorded in parallel on the PCEVN-computer that is daisy-chained to the Mark 5A unit. The observed data of these experiments were then e-transferred off-line using the Tsunami protocol, and no Mark 5 modules were actually sent to Bonn. The data to be correlated at the Haystack correlator were shipped on Mark 5 modules. However, the data of the last RD-session in 2011 were e-transferred off-line to the Haystack correlator, and no modules were shipped. The observational data of the CONT11 campaign were shipped on Mark 5 modules to the Washington correlator.

We used the majority of the sessions involving both Onsala and Tsukuba to perform ultra-rapid dUT1 observations. This was done for many of the R1- and RD-sessions, and all of the CONT11-sessions. In these cases the Onsala data were e-transferred in real-time to the Tsukuba correlator using the Tsunami protocol. The data were correlated with the corresponding data from the Tsukuba station in near real-time, followed by a near real-time analysis to determine dUT1. Using this automated strategy, dUT1 results were already determined during the ongoing VLBI observations using a "sliding window" approach. This strategy worked very well and produced a continuous dataset of dUT1 values for the whole 15-day-long campaign. Only during CONT11.07 was it not possible to derive dUT1 values since the Tsukuba telescope had to be stowed because of a typhoon.

In the second half of the year, a DBBC was installed at Onsala. In order to gain experience with the new digital system, we performed several parallel recordings with Mark IV/Mark 5A and DBBC/Mark 5B+. First fringes on all 14 S/X-channels were found by the Tsukuba correlator using Onsala DBBC/Mark 5B+ data and Tsukuba K5 data for RD.11.04 observed on June 21.

In collaboration with our colleagues in Tsukuba we observed a 12-hour long one-baseline dUT1-experiment in January. In November we observed the first three-station ultra-rapid EOP experiment, together with Tsukuba and Hobart. The observational data from Onsala and Hobart were e-transferred in real-time to the Tsukuba correlator, where the data of the three baselines were correlated and analyzed in near real-time. Again, a sliding window approach was used, and polar motion and dUT1 were determined in ultra-rapid mode, i.e. during the ongoing session.

We also participated with X-band observations in several campaigns for spacecraft navigation. We observed four sessions for the determination of the orbit of the Venus Express spacecraft and participated in one session to determine the orbit of the RadioAstron satellite.

Radio interference due to UMTS mobile telephone signals continued to be a disturbing factor for the S-band observations.

3. Monitoring Activities in 2011

We continued with the monitoring activities as described in previous annual reports:

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. The measurements are available at `wx.oso.chalmers.se/pisa/`.

Table 1. VLBI observations for geodesy and space navigation at Onsala during 2011: information is given on whether the data were e-transferred in real-time (RT) and/or off-line (OL) and to which correlator, whether modules were shipped to a correlator, and whether ultra-rapid dUT1 (UR-dUT1) results were produced.

Exper.	Date	E-transfer		Module	UR-	General remarks from the observations
		RT	OL	ship.	dUT1	and the final correlation
R1-464	01.03	–	Bonn	–	–	OK
EUR-109	01.17	–	Bonn	–	–	OK
R1-466	01.18	–	Bonn	–	–	OK
UR-11.019	01.19	Tsuk	–	–	yes	OK, 12 h of ultra-rapid dUT1
R1-477	02.21	–	Bonn	–	–	OK, PCal problems for about 6 h
RD-11.01	02.22	Tsuk	–	Hays	yes	OK, four scans lost due to Mark 5 problems
EUR-110	03.23	–	Bonn	–	–	OK
VEX-03.25	03.25	–	JIVE	–	–	OK, Venus Express observations, 2 h
VEX-03.28	03.28	–	JIVE	–	–	OK, Venus Express observations, 2 h 45 min
VEX-03.31	03.31	–	JIVE	–	–	OK, Venus Express observations, 2 h
R1-476	03.28	–	Bonn	–	–	OK
RD-11.02	03.29	–	–	Hays	–	OK, several scans missed due to Mark 5 problems
R1-477	04.04	Tsuk	Bonn	–	yes	OK, phase-cal problems for 5 h
T2-076	05.03	–	Bonn	–	–	OK
R1-484	05.23	–	Bonn	–	–	OK, some scans lost due to Mark 5 problems
EUR-111	05.24	–	Bonn	–	–	OK, some scans lost due to Mark 5 problems
R1-488	06.20	Tsuk	Bonn	–	yes	OK
RD-11.04	06.21	Tsuk	–	Hays	yes	OK
R1-496	08.16	Tsuk	Bonn	–	yes	OK
R1-497	08.22	Tsuk	Bonn	–	yes	OK
T2-077	08.23	Tsuk	–	Hays	yes	no correlation report yet
R1-498	08.29	–	Bonn	–	–	OK
R1-500	09.12	Tsuk	–	Wash	yes	OK
C11-01	09.15	Tsuk	–	Wash	yes	OK, spurious signal in PCal for X-band Ch-2
C11-02	09.16	Tsuk	–	Wash	yes	no correlation report yet
C11-03	09.17	Tsuk	–	Wash	yes	no correlation report yet
C11-04	09.18	Tsuk	–	Wash	yes	no correlation report yet
C11-05	09.19	Tsuk	–	Wash	yes	OK, spurious signal in PCal for X-band Ch-2
C11-06	09.20	Tsuk	–	Wash	yes	no correlation report yet
C11-07	09.21	Tsuk	–	Wash	–	no correlation report yet
C11-08	09.22	Tsuk	–	Wash	yes	no correlation report yet
C11-09	09.23	Tsuk	–	Wash	yes	no correlation report yet
C11-10	09.24	Tsuk	–	Wash	yes	no correlation report yet
C11-11	09.25	Tsuk	–	Wash	yes	no correlation report yet
C11-12	09.26	Tsuk	–	Wash	yes	OK, spurious signal in PCal for X-band Ch-2
C11-13	09.27	Tsuk	–	Wash	yes	no correlation report yet
C11-14	09.28	Tsuk	–	Wash	yes	no correlation report yet
C11-15	09.29	Tsuk	–	Wash	yes	OK, spurious signal in PCal for X-band Ch-2
R1-501	10.03	Tsuk	Bonn	–	yes	OK
VEX-11.14	11.14	–	JIVE	–	–	OK, Venus Express observations, 2 h 20 min
RA-11.15	11.15	–	JIVE	–	–	OK, RadioAstron observations, 1 h 10 min
R1-509	11.28	–	Bonn	–	–	receiver/antenna problems, session lost
RD-11.06	11.29	Tsuk	Bonn	–	yes	no correlation report yet
UREOP.01	11.30	Tsuk	–	–	yes	OK, ultra-rapid EOP Onsala-Tsukuba-Hobart
RD-11.07	12.06	Tsuk	Hays	–	yes	no correlation report yet

Microwave radiometry

The water vapor radiometer Astrid was in operation continuously during 2011, mainly observing in a so-called sky-mapping mode. However, after the first week of the CONT11 campaign the azimuth drive of the instrument failed, and it could only be operated in tip-curve mode. The second water vapor radiometer Konrad was successfully upgraded and is in operation again since CONT11.

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 instrument was installed at Onsala in late 2002 and has been calibrated at SMHI's main facility in Norrköping every 1–2 years since then. The latest calibration was on October 11, 2011. Since the installation of a new VLBI pressure sensor in 2008 the agreement between the Onsala pressure sensor and the SMHI pressure sensor has been on the level of ± 0.1 hPa.

Sea level monitoring

We continued to operate the GNSS-based tide gauge at the coastline at 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. In August 2011 the GNSS-based tide gauge was moved to a new location at the observatory, where it was installed semi-permanently. The new installation has a number of advantages, e.g., that the instrumentation can be mounted at different heights, in steps of 25 cm, between approximately 1.5 m and 3.5 m above the mean sea level.

Superconducting gravimetry

The superconducting gravimeter (SCG) operated continuously during 2011 and produced a highly precise record of gravity variations. Of course it recorded earthquakes and free oscillations of the earth, e.g. in connection to the Sendai 2011 earthquake. Further information on the SCG and its observations is available at `froste.oso.chalmers.se/hgs/SCG/`. Measurements of the auxiliary sensors for monitoring, e.g., bedrock temperature below the gravimeter house are available at `wx.oso.chalmers.se/gravimeter/`.

Absolute gravimetry

We supported visiting absolute gravity measurement campaigns by the University of Hannover (Germany) and Lantmäteriet, the Swedish mapping, cadastral and land registration authority.

Seismological observations

The three-axis seismometer provided by Uppsala University and the Swedish National Seismic Network (SNSN) has been operated continuously on the lower level of the gravimeter laboratory during 2011. The recorded data are valuable auxiliary observations for the analysis of absolute gravity measurements.

4. Outlook

The Onsala Space Observatory will continue to operate as an IVS Network Station and to participate in the IVS observation series. For 2012 we plan to participate in 40 IVS sessions, and we hope that we eventually can switch over to using the digital backend in operational mode. We also plan to continue our ultra-rapid project with our Japanese colleagues.

A proposal to construct a VLBI2010 twin-telescope at Onsala was submitted in 2011 to the Wallenberg foundation. A decision concerning this proposal is expected in 2012. Regardless of the outcome, we will strive to make the station fully VLBI2010-compatible in the coming years.