Onsala Space Observatory – IVS Network Station

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Abstract

During 2009 the Onsala Space Observatory contributed as an IVS Network Station to 24 VLBI sessions organized by the IVS. We used four of these sessions to do ultra-rapid dUT1 observations together with our colleagues in Tsukuba. This report briefly summarizes the activities during the year 2009.

1. Staff Associated with the IVS Network Station at Onsala

There were some changes concerning the staff associated with the IVS Network Station at Onsala during 2009. One new PhD. student joined the Space Geodesy and Geodynamics group and is involved in geodetic VLBI. One the other hand, one post-doc left, and one software engineer retired. One new telescope scientist and one new software engineer started during 2009.

Table 1. Staff associated with the IVS Network Station at Onsala. All e-mail addresses have the ending @chalmers.se and the complete telephone numbers start with the prefix +46-31-772.

Function	Name	e-mail	telephone
Responsible P.I.	Rüdiger Haas	rudiger.haas	5530
Observatory director	Hans Olofsson	hans.olofsson	5520
Head of department	Gunnar Elgered	gunnar.elgered	5565
PhD. students	Tobias Nilsson (– 2009.04.30)	tobias.nilsson	5575
and post-docs	Tong Ning	tong.ning	5578
involved in GEO-VLBI	Johan Löfgren	johan.lofgren	5566
Responsible for	Michael Lindqvist	michael.lindqvist	5508
the Field System	Rüdiger Haas	rudiger.haas	5530
Responsible for the	Karl-Åke Johansson	karl-ake.johansson	5571
VLBI equipment	Leif Helldner	leif.helldner	5576
VLBI operator	Roger Hammargren	roger.hammargren	5551
Telescope scientists	Per Bergman	per.bergman	5552
	Henrik Olofsson (2009.11.01 –)	henrik.olofsson	5564
Software engineers	Lars Lundahl (– 2009.12.31)	lars.lundahl	5559
	Mikael Lerner (2009.06.01 –)	mikael.lerner	5581

2. Geodetic VLBI Observations for the IVS during 2009

In 2009 the Onsala observatory was involved in the four IVS series EUROPE, R1, T2, and RD09, and additionally contributed to the IYA09 very large astrometry session. In total, Onsala participated and acquired useful observations in 24 experiments; see Table 2. 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

Table 2. Geodetic VLBI experiments at the Onsala Space Observatory during 2009.

Exper.	Date	Remarks	Correlated
R1-361	JAN.12	e-transfer to Bonn	o.k.
R1-363	JAN.26	20 min lost at start, e-transfer to Bonn	o.k.
RD-0904	FEB.23	module shipment to Haystack	o.k.
R1-372	MAR.30	e-transfer to Bonn	o.k.
T2-061	APR.07	e-transfer to Bonn	o.k.
RD-0906	APR.15	20 min lost due to Mark 5 problems, module shipment to Haystack	o.k.
R1-377	MAY.04	e-transfer to Bonn	o.k.
EUR-099	MAY.25	e-transfer to Bonn	o.k.
R1-380	MAY.26	e-transfer to Bonn	o.k.
R1-385	JUN.29	14 scans lost due to overheated antenna PSU, e-transfer to Bonn	o.k.
R1-386	JUL.06	e-transfer to Bonn	o.k.
RD-0907	JUL.08	module shipment to Haystack	o.k.
R1-393	AUG.24	e-transfer to Bonn	o.k.
EUR-101	SEP.07	e-transfer to Bonn	o.k.
R1-397	SEP.21	e-transfer to Bonn	o.k.
RD-0908	SEP.23	module shipment to Haystack	o.k.
R1-399	OCT.05	module shipment to Bonn	o.k.
RD-0909	OCT.06	module shipment to Haystack	o.k.
IYA09	NOV.18	12 hours only, module shipment to Haystack	not yet
R1-406	NOV.23	e-transfer to Bonn	o.k.
EUR-102	NOV.26	e-transfer to Bonn	o.k.
R1-409	DEC.14	e-transfer to Bonn	o.k.
RD-0910	DEC.16	module shipment to Haystack	o.k.
R1-410	DEC.21	ca. 30 min. missed due to Mark 5 problems, e-transfer to Bonn	o.k.

Tsunami-protocol, and no Mark 5 modules were actually sent to Bonn. During 2009 the PCEVN raid-system was upgraded to a capacity of 4 Gigabytes.

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

3. Fennoscandian-Japanese Ultra-rapid dUT1 Measurements

We continued our involvement in the successful Fennoscandian-Japanese ultra-rapid dUT1 project. The aim for 2009 was to extend the approach with real-time data transfer and automated near real-time correlation and dUT1 analysis to complete 24-hour sessions. Only a small number of such sessions was performed using standard IVS sessions that involved both Onsala and Tsukuba; see Table 3. The highlights were two sessions in December 2009 with continuous determination of dUT1 results during the ongoing VLBI observations using a ‘sliding window’ of ca. 30 scans.

Table 3. Fennoscandian-Japanese 24-h ultra-rapid dUT1-experiments in 2009.

Exper.	Date	Stations	Mbps	Tranfer	Correlation	Comments
R1-385	JUN.29	Onsa-Tsuk	256	real-time	real-time	partly successful
RD-0907	JUL.08	Onsa-Tsuk	256	real-time	real-time	partly successful
R1-409	DEC.14	Onsa-Tsuk	256	real-time	real-time	continuous dUT1 during 24 h
RD-0910	DEC.16	Onsa-Tsuk	256	real-time	real-time	continuous dUT1 during 24 h

4. Monitoring Activities in 2009

Monitoring activities were continued as described in previous annual reports. This included the calibration of the Onsala pressure sensor using a Vaisala barometer borrowed from the Swedish Meteorological and Hydrological Institute (SMHI). This instrument has been installed at Onsala in late 2002 and has been calibrated at the SMHI main facility in Norrköping every 1–2 years since then.

Figure 1 shows the differences between the Vaisala (SMHI) pressure sensor and the pressure sensors used for the VLBI system. Since the beginning of 2008 the VLBI system has used a new Vaisala pressure sensor instead of the old Setra pressure sensor. The clear annual signal in the pressure differences disappears at the beginning of 2008. This indicated that the old sensor obviously suffered from a small systematic error, probably due to an unwanted temperature dependence.

The amplitude of this annual term is, however, small and can be neglected in all applications when the atmospheric effect is solved for in the data analysis. A pressure error of 1 hPa corresponds to an error of 2.3 mm in the Zenith Hydrostatic Delay (ZHD), and hence also in the Zenith Wet Delay (ZWD), which in turn is equivalent to an error of 0.35 kg/m^2 in the atmospheric Integrated Water Vapor (IWV). On the other hand, for the application of using VLBI to estimate long time series of the IWV, systematic effects of this size must be monitored in order to not affect estimated long-term trends.

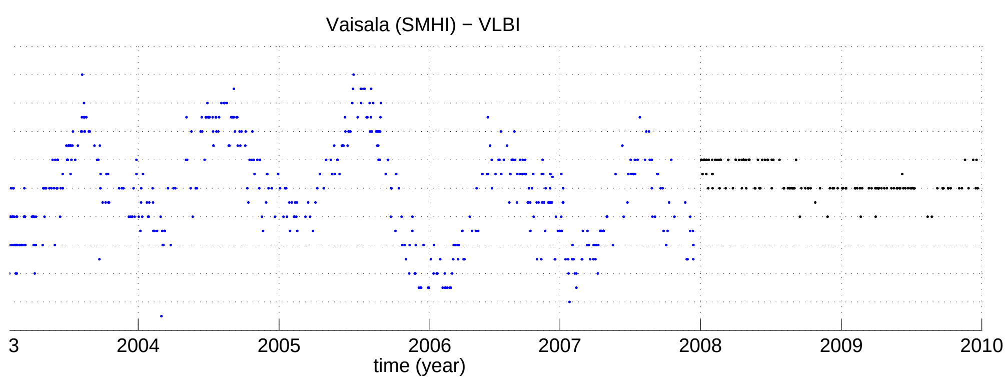

Figure 1. Time series of pressure differences between the Vaisala (SMHI) pressure sensor and the pressure sensors used for VLBI.

We also continued to monitor the vertical height changes of the telescope tower using the invar rod system at the 20 m telescope.

5. Gravimetry

In June 2009 a superconducting gravimeter was installed and taken into operation at the observatory. With this installation Onsala has become a true Fundamental Geodetic Station providing observations of the three pillars of geodesy, i.e. earth deformation, earth rotation, and the earth's gravity field. In connection with the superconducting gravimeter, a number of auxiliary sensors, e.g. to monitor ground water variations, will be installed in the near future.

6. The GNSS-based Tide Gauge

Encouraged by the first experimental results of a GNSS-based tide gauge, we decided to design a more permanent installation. We identified an appropriate location at the coast at the Onsala Space Observatory that has open sea towards the southward direction. This will maximize the potential reflection area on the sea surface. We designed an installation that will allow control of the vertical position of the GNSS antennas above the sea surface and will allow easy maintenance of the instrumentation. The necessary material was purchased, and the production of the installation equipment has started.

7. Evaluation of the Observatory

During 2009 the Swedish Research Council (VR) carried out an international evaluation of the activities at Onsala Space Observatory. The result of this evaluation was quite positive, and the evaluation committee wrote that the observatory "is fulfilling an important function in Sweden both in promoting research, in rearing a new generation of astronomers, geodesists, geophysicists and engineers, and in providing a focal point for Swedish national interests in various areas of astronomy and geodesy. In essence, OSO is helping to keep Sweden at the forefront of modern research and to provide the new generation of Swedish scientists." The committee recommended that the geodesy and geophysics activities, so far made on a "best effort" basis, should officially be incorporated into the observatory mission.

8. Outlook

The Onsala Space Observatory will continue to operate as an IVS Network Station and to participate in the IVS observation series. At the moment a total of 26 experiments is planned for the year 2010 in the EUROPE, R1, T2, and RD10 series. We are already discussing a potential increase of observing sessions for the second half of 2010. As in the previous years we aim to e-transfer the data of as many experiments as possible.

We will also continue the Fennoscandian-Japanese ultra-rapid dUT1-project. As in 2009, the focus will be on 24-h Intensive type ultra-rapid dUT1 sessions during regular IVS sessions.