The IVS Network Station Onsala Space Observatory

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Abstract

We summarize briefly the status of the Onsala Space Observatory in its function as an IVS Network Station. The activities during the year 2001, the current status, and future plans are described.

1. Introduction

The IVS Network Station at the Onsala Space Observatory (OSO) has been described to some extent in earlier IVS annual reports [1], [2]. During 2001 some minor changes in the technical setup of the station have been necessary, mainly due to maintenance related repair work. The staff associated with the IVS Network Station remained mainly the same as reported in [1].

2. Geodetic VLBI Observations during 2001

During 2001 the observatory has been involved in the three regular VLBI-experiment series EUROPE, CORE-3, and RDV, and in the special series CONT-M. In total OSO participated in 25 geodetic VLBI experiments during 2001 (see Table 1).

Table 1. Geodetic VLBI experiments at the Onsala Space Observatory during 2001.

Exper.	Date	Remarks (problems)	Exper.	Date	Remarks (problems)
CORE3007	0110	sometimes high parity errors	CORE3016	0516	
CORE3008	0124	highly varying parity errors	EURO60	0618	
RDV25	0129		CORE3019	0627	one scan lost due to tape drop
CORE3011	0307		CORE3020	0711	high parity errors
RDV26	0312	formatter jump	CORE3022	0725	period of high parity errors
CORE3012	0321		CORE3024	0808	lost: recorder brake failure
CONT-M3	0326		CORE3026	0822	relatively high parity errors
CONT-M4	0327		EURO61	0903	high parity errors
CONT-M5	0328		CORE3028	0905	
CORE3013	0404		CORE3033	1017	maser instabilities
CORE3014	0418	high voltage on VC4	CORE3035	1031	maser instabilities
CORE3015	0502		EURO62	1210	
RDV28	0509	RFI S-band channel 1			

The experiment CORE-3024 was unfortunately lost due to a failure of the recorder brakes. During the two experiments CORE-3033 and CORE-3035 the maser had severe instability problems with several phase jumps. The recorded data could be correlated but the correlator output could not be analysed because of a very high number of necessary clock breaks. Thus, Onsala unfortunately had to be discarded from the VLBI databases of these two experiments.

3. Performance Monitoring and Maintenance of the VLBI System

In order to produce VLBI data of as good quality as possible, the performance of the VLBI system at OSO is monitored continuously. As one source of valuable information, the log files of the experiments are analysed in order to detect problems and fix them accordingly. Key parameters like the cable delay, the difference between GPS and formatter time, the physical temperature in the dewar for the front end HEMT amplifiers of the receivers, the measured system temperatures and the parity errors are monitored [2], [3].

Table 2 gives an overview of the maintenance and upgrade work of the OSO VLBI system during 2001. OSO is a “thin-tape-only-station” since January 2001 in order to overcome the problems related to different tape types and vacuum levels that we envisaged in the past.

Nevertheless, the recording quality in 2001 was still unstable, often producing highly varying levels of parity errors. In the middle of the year the parity errors for forward recording were significantly worse than those for reverse recording and the parity errors in general were on a high level [3]. One possible reason for this was identified in summer 2001 when a leakage at the glass windows of the vacuum chamber was detected which caused small fluctuation of the vacuum level by about 5%. After repair of this window, the levels of parity errors stabilised to some extent.

During his visit at OSO in June 2001, Ed Himwich inspected the OSO VLBI system and checked for obvious defects. Together with the staff at OSO, Ed perfomed all necessary technical checks, but no obvious defects could be identified. However, Ed pointed out small bumps in the bandpass that could be due to reflecting signals in the IF distributor. The IF distribution box was removed and inspected but no obvious defect was found. The reasons for the small bumps in the bandpass are still unknown.

During experiment CORE-3024 the recorder brakes blocked the tape movement completely due to a total wear-out of the brake-disc on one of the reel-motors. The brake assemblies had been working at OSO for some 20 years without any failure. New brake assemblies were installed at both reel motors and have worked fine since then.

In October and November the Russian maser CH1-75 at OSO had instability problems with frequent phase jumps and bad emission (see Figure 1). The Swiss maser EFOS-7 was connected

Table 2. Maintenance and upgrade work of the Onsala VLBI system during 2001

January	OSO is “thin-tape-only” station
January	formatter firmware upgraded to enable barrel rolling
March	2nd formatter firmware upgrade
June	Ed Himwich visited OSO and checked the VLBI system, no obvious defects identified
July	repair of a window of the vacuum chamber
August	new brake assembly installed
August	new vacuum filters installed
October	upgrade of the field system to FS 9.5.2
October	new decoder installed
November	Swiss maser connected to the frequency distribution system since Russian maser instable, (bad emission, phase jumps)
November	new attenuators installed in the IF1 distribution
December	new idle roller installed, drastically improved parity errors
December	Russian maser stable again after increasing the hydrogen flow

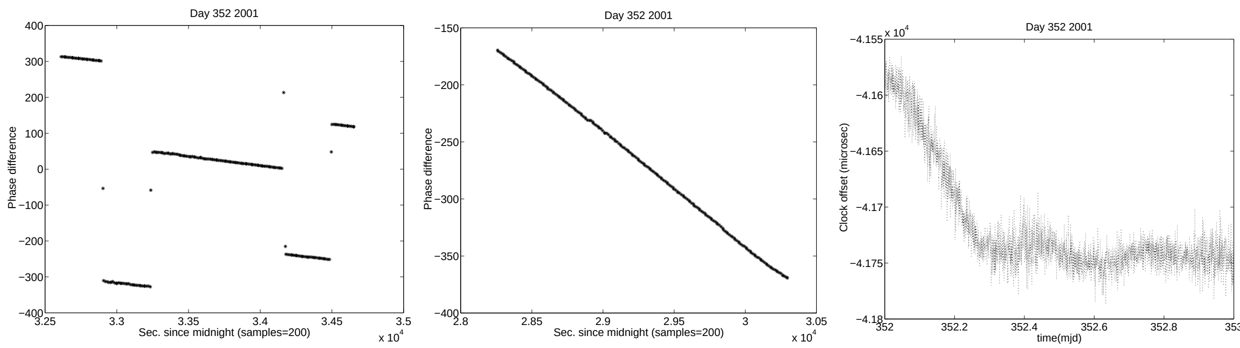

Figure 1. Left: Phase differences between the two masers EFOS-7 and CH1-75 at OSO. Shown are 10 second samples for day 351 in 2001. The scale of the y-axis is in mV where 500 mV correspond to a phase difference of 180°. The maser CH1-75 is unstable with frequent phase jumps. Middle: The maser CH1-75 is stabilized by increasing the hydrogen flow and the phase difference between the two masers shows a stable drift again. Right: Clock offset between the maser CH1-75 and GPS during day 352 in 2001. The clock drift reduces drastically due to repair of the maser.

to the VLBI system. The output frequency of the Russian maser could be stabilized by increasing the hydrogen flow (see Figure 1) and is connected to the VLBI system again since January 2002.

In December a new idle roller was installed. This led to drastically improved parity errors. The forward-reverse offset of the head calibration (see [4]) reduced significantly from 50 microns to 5 microns. Also the shift of tape position as a function of tape vacuum changes (*vacuum shift*, see [4]) reduced drastically, from 35 microns to 5 microns.

4. Local Tie Monitoring, Telescope Stability and Footprint Measurements

The campaign based GPS measurements using an antenna mounted on top of the VLBI telescope [5] have been continued during 2001 [6]. Due to a high demand of telescope time for astronomy, only three observation campaigns in the summer could be performed. For the coming year more regular observations with a more even distribution in time are planned.

The monitoring of vertical changes of the telescope tower by an invar monitoring system [7] has been continued, see Figure 2.

Additionally, in the spring of 2001 a local and regional GPS campaign at the observatory and

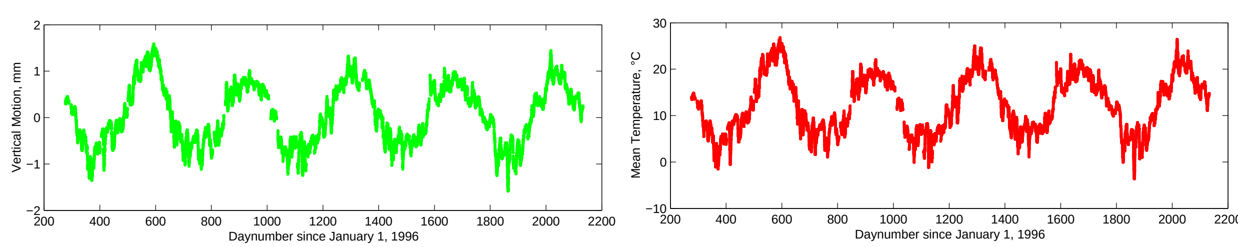

Figure 2. Vertical height of the OSO telescope tower (left plot) and mean temperature of the concrete foundation of the telescope (right plot) measured by the invar and temperature sensors between October 1996 and October 2001.

the surrounding region was performed to re-measure the OSO footprint. The campaign lasted for 37 days and in total 14 stations were included in the GPS analysis. However, not all of the sites were occupied for the whole length of the campaign. We obtain typical rms repeatabilities on the level of 1–2 and 2–3 mm for the horizontal and the vertical components, respectively. Two sites show significantly larger repeatabilities. One had only a short observation series and the other was exposed to disturbances from a nearby mobile telephone transmitter. A comparison and Helmert transformation to an earlier realization of the footprint with GPS and classical geodetic measurements performed in the 80s and 90s did not reveal any displacement on the level of the achieved repeatablities. The OSO footprint appears to be stable at the level of some millimetres.

5. Outlook

The Onsala Space Observatory will continue to participate in the IVS observation series. For the year 2002 a total of 15 experiments in the series EUROPE, RDV, IVS-R and IVS-T is planned.

The monitoring of vertical height changes with the invar measurement device and the local-tie measurements using GPS on top of the VLBI telescope will be continued. The latter will be performed on more regular intervals compared to earlier years with observations for 2–3 days every three months. Additionally, we plan to sporadically perform measurements with the GPS equipment on a slewing VLBI telescope in a kinematic mode.

Re-observations of the local and regional footprint by GPS are planned to be performed every second to third year. During 2002 we plan a realization of the tie between the GPS and VLBI reference points by classical geodetic observations. A network of necessary observing pillars is presently under construction.

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