

# JARE Syowa Station 11-m Antenna, Antarctica

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## Abstract

In 2012, the 52<sup>nd</sup> and the 53<sup>rd</sup> Japanese Antarctic Research Expeditions (hereinafter, referred to as JARE-52 and JARE-53, respectively) participated in five OHIG sessions — OHIG76, 78, 79, 80, and 81. These data were recorded on hard disks through the K5 terminal. Only the hard disks for the OHIG76 session have been brought back from Syowa Station to Japan, in April 2012, by the icebreaker, Shirase, while those of the other four sessions are scheduled to arrive in April 2013. The data obtained from the OHIG73, 74, 75, and 76 sessions by JARE-52 and JARE-53 have been transferred to the Bonn Correlator via the servers of National Institute of Information and Communications Technology (NICT). At Syowa Station, JARE-53 and JARE-54 will participate in six OHIG sessions in 2013.

## 1. General Information

To investigate polar science, the National Institute of Polar Research (NIPR) is managing Japanese Antarctic Research Expeditions (JAREs). The 31 members of JARE-53 overwintered at Syowa Station, East Ongul Island, East Antarctica in 2012.

Syowa Station has become one of the key observation sites in the Southern Hemisphere's geodetic and geophysical networks (shown in Figure 1), as reported in [1]. As part of these geodetic measurements, the JAREs have been operating the 11-m S/X-band antenna at Syowa Station (69.0°S, 39.6°E) for geodetic VLBI experiments since February 1998. A total of 102 quasi-regular geodetic VLBI experiments were performed by the end of 2012.

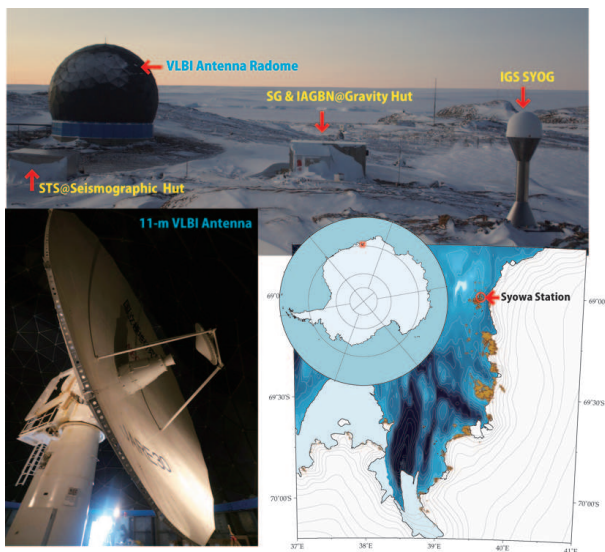


Figure 1. Syowa VLBI antenna.



Figure 2. Syowa VLBI staff of JARE-53, H. Hayakawa (right) and T. Yoshioka (left).

## 2. Component Description

For VLBI, the Syowa antenna is registered as IERS Domes Number 66006S004 and as CDP Number 7342. The basic configuration of the Syowa VLBI front-end system has not changed from the description in [2]. Syowa's K4 recording terminal had been fully replaced by K5 simultaneously with the termination of the SYW session at the end of 2004. Syowa has participated in the OHIG sessions in the austral summer season since 1999. Data transfer through an Intelsat satellite link from Syowa Station to NIPR has been available since 2004. However, its recent bandwidth is about 2 MB, and its effective speed of FTP transfer is about 100kB/sec which is too slow to transfer the huge VLBI data practically.

## 3. Staff of the JARE Syowa Station 11-m Antenna

The Syowa Station 11-m antenna is operated and maintained by JARE and NIPR. The staff members are listed in Table 1. OHIG sessions in 2012 were performed primarily by the staff of JARE-53 as shown in Figure 2. The staff of JARE-52 supported them in the OHIG76 session, in order to hand the operation and maintenance of the 11-m antenna over to JARE-53 as their successor.

Table 1. Staff members.

Name	Affiliation	Function
Kazuo SHIBUYA	NIPR	Project coordinator
Koichiro DOI	NIPR	Liaison officer
Yuichi AOYAMA	NIPR	Liaison officer
Syunsuke IWANAMI	Tomakomai Nationl College of Technology	Chief operator of JARE-52
Shinobu TAKAHIRA	NEC	Antenna engineer for JARE-52
Hideaki HAYAKAWA	NIPR	Chief operator of JARE-53
Takeshi YOSHIOKA	NEC	Antenna engineer for JARE-53

JARE-52: February 2011 – January 2012 JARE-53: February 2012 – January 2013

## 4. Current Status and Activities

### 4.1. Notes on System Maintenance

There used to be two hydrogen masers, Anritsu RH401A HM-1001C and HM-1002C at Syowa Station. Since a failure had occurred in the HM-1002C, it had been repaired and overhauled at Anritsu Co., Ltd. in Japan between April and October 2011. We attempted to return the HM-1002C to Syowa Station immediately. However, it was impossible to transport it, because the icebreaker, Shirase, could not approach Syowa Station in the 2011/2012 austral summer season due to dense and thick sea ice. Then the HM-1002C was turned back to Japan in April 2012 and was maintained at Anritsu Co., Ltd. until October 2012. Although we planned to re-install the HM-1002C at the Syowa Station again in the 2012/2013 austral summer season, we had to abandon its re-installation, because Shirase could not approach Syowa Station for a second consecutive year.

The other hydrogen maser, HM-1001C, has operated for VLBI observations since January

2011. On March 11, 2011, its ion pump was interrupted, and an uninterruptible power supply (UPS) for the HM-1002C was broken down by instability in both the voltage and the frequency of the generator for power supplies at Syowa Station. Since then, the ion pump has been interrupted occasionally. In 2012, such interruptions, which caused a low vacuum inside the HM-1001C and attenuated the hydrogen maser oscillator, occurred on February 25, August 15, September 2, and November 20. The JARE-53 staff had to form a high vacuum and to check the hydrogen maser generation at all such times. They also checked that there was no apparent difference in 1 PPS and 10 MHz between HM-1001C and GPS whenever they restarted the HM-1001C. For the purpose of lightening these work loads, we have purchased a new hydrogen maser, which is miniaturized to be carried on the helicopter. We will install the new one in Syowa Station in the next austral summer.

Write errors sometimes occurred during data recording to HDD of the K5 system, so that the K5 system froze. These were caused by inadequate setting for the ATA transfer mode. Starting with OHIG81, we configured the ATA transfer mode with UDMA66; therefore such problems were solved.

A system for delay calibration (D-Cal) recording is independent of the K5 system. D-Cal signals used to be recorded at the start and the end of each Syowa scan onto the floppy disk (FD) by using a Basic program based on the old NEC PC. However, timing to record D-Cal came to be unsynchronized with each Syowa scan since the updating of SKED in 2010. We have not modified this program yet. In addition, the FD drive broke down in November 2012, so that we could not record D-Cal during OHIG79-81. The broken FD drive was replaced by a spare in January 2013, and D-Cal signals resumed being stored on FD.

## 4.2. Session Status

Table 2 summarizes the status of processing as of December 2012 for the sessions after 2011. The OHIG sessions involved Fortaleza (Ft), O'Higgins (Oh), Kokee Park (Kk), TIGO Concepción (Tc), Hobart 26-m antenna (Ho), Hobart 12-m antenna (Hb), HartRAO (Hh), Warkworth (Ww), and Syowa (Sy). In 2005, Syowa joined the CRD sessions, but after 2006, Syowa participated only in OHIG sessions. Syowa took part in five OHIG sessions in 2012.

K5 HDD data brought back from Syowa Station were transferred to NICT servers and converted to the Mark 5 format data there. The converted data were transferred from the NICT servers to the Bonn Correlator by FTP.

## 4.3. Analysis Results

As of December 2012, Syowa had contributed 93 sessions starting in May 1999. According to the results analyzed by the BKG IVS Analysis Center, the length of the Syowa-Hobart baseline is increasing with a rate of  $55.5 \pm 1.1$  mm/yr. The Syowa-HartRAO baseline shows a slight increase in its length with a rate of  $12.3 \pm 1.1$  mm/yr. The Syowa-O'Higgins baseline also shows a slight increase, although its rate is only  $2.4 \pm 1.1$  mm/yr. Detailed results from the data until the end of 2003 as well as comparisons with those from other space geodetic techniques were reported in [3].

Table 2. Status of OHIG sessions as of December 2012.

Code	Date	Station	Hour	Correlation	Solution	Notes
OHIG70	2011/Feb/02	Sy, Hb, Hh, Ho, Kk, Oh, Tc	24 h	Yes	Yes	J52 †1
OHIG71	2011/Feb/08	Sy, Hb, Hh, Kk, Oh, Tc	24 h	Yes	Yes	†1
OHIG72	2011/Feb/09	Sy, Hh, Kk, Oh, Tc	24 h	No	No	†1
OHIG73	2011/Nov/01	Sy, Ft, Kk, Ww	24 h	Yes	Yes	†1
OHIG74	2011/Nov/08	Sy, Ft, Kk, Tc, Ww	24 h	Yes	Yes	
OHIG75	2011/Nov/09	Sy, Ft, Kk, Tc, Ww	24 h	Yes	Yes	
OHIG76	2012/Feb/15	Sy, Ft, Hh, Kk, Oh, Tc	24 h	Yes	Yes	J53
OHIG77	2012/Feb/28	Ft, Kk, Oh, Tc	24 h	–	–	†2
OHIG78	2012/Feb/29	Sy, Ft, Hh, Kk, Oh, Tc	24 h	–	–	
OHIG79	2012/Nov/06	Sy, Ft, Hb, Kk, Tc	24 h	–	–	
OHIG80	2012/Nov/07	Sy, Ft, Hb, Kk, Tc	24 h	–	–	
OHIG81	2012/Nov/14	Sy, Hb, Hh, Kk, Tc	24 h	–	–	

J52: JARE-52, op S. Iwanami eng S. Takahira

J53: JARE-53, op H. Hayakawa eng T. Yoshioka

†1 : Large clock offset occurred.

†2 : Syowa canceled participation in OHIG77 experiment because of malfunction of HM-1001C.

## 5. Future Plans

Dismantling the current Syowa VLBI antenna is scheduled for the 2015/2016 austral summer season. Because Shirase could not approach Syowa Station for two consecutive years, this schedule will possibly be postponed. We presented a proposal to budget for new VLBI2010 antenna construction in 2018. We will make every effort until this proposal is approved.

## References

- [1] Shibuya, K., Doi, K., and Aoki, S. (2003): Ten years' progress of Syowa Station, Antarctica, as a global geodesy network site. *Polar Geoscience*, 16, 29-52.
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- [3] Fukuzaki, Y., Shibuya, K., Doi, K., Ozawa, T., Nothnagel, A., Jike, T., Iwano, S., Jauncey, D.L., Nicolson, G.D., and McCulloch, P.M. (2005): Results of the VLBI experiments conducted with Syowa Station, Antarctica. *J. Geod.*, 79, 379-388.