JARE Syowa Station 11-m Antenna, Antarctica

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Abstract In 2013, the 53^{rd}, the 54^{th}, and the 55^{th} Japanese Antarctic Research Expeditions (hereinafter, referred to as JARE–53, JARE–54, and JARE–55, respectively) participated in six OHIG sessions — OHIG82, 83, 84, 85, 86, and 87. These data were recorded on hard disks through the K5 terminal. The hard disks for the OHIG82 session were brought back from Syowa Station to Japan in April 2013 by the icebreaker Shirase while those for the other five sessions are scheduled to arrive in April 2014. The data obtained from the OHIG79, 80, 81, and 82 sessions by JARE–53 and JARE–54 were transferred to the Bonn Correlator via the servers of National Institute of Information and Communications Technology (NICT). At Syowa Station, JARE–55 will participate in six OHIG sessions in 2014.

1 General Information

To investigate polar science, the National Institute of Polar Research (NIPR) is managing Japanese Antarctic Research Expeditions (JAREs). The 30 members of JARE–54 overwintered at Syowa Station, East Ongul Island, East Antarctica in 2013.

Syowa Station has become one of the key observation sites in the Southern Hemisphere's geodetic and geophysical networks (as shown in Figure 1, see [1] for details). As a 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 cumulative total of 108 quasi-regular geodetic VLBI experiments were performed by the end of 2013.

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 frontend system has not changed from the description in [2]. Syowa's K4 recording terminal was 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

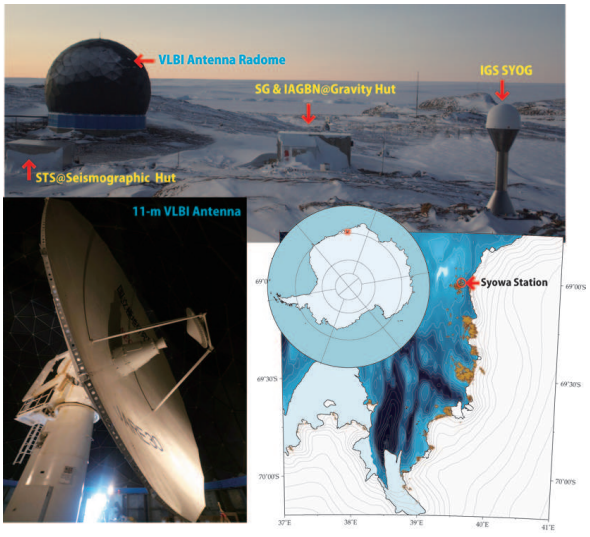

Fig. 1 Syowa VLBI antenna.

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Table 1 Staff members.

Name	Affiliation	Function	Notes
Kazuo SHIBUYA	NIPR	Project coordinator	until March 2013
Koichiro DOI	NIPR	Project coordinator	since April 2013
Yuichi AOYAMA	NIPR	Liaison officer	
Hideaki HAYAKAWA	NIPR	Chief operator of JARE–53	
Takeshi YOSHIOKA	NEC	Antenna engineer for JARE–53	
Noriaki OBARA	NIPR	Chief operator of JARE–54	
Hiroshi TANAKA	NEC	Antenna engineer for JARE–54	
Takuya MASUNAGA	NIPR	Chief operator of JARE–55	from Nov. 2013 to Jan. 2015

JARE–53: February 2012 – January 2013 JARE–54: February 2013 – January 2014

1999. Data transfer through an Intelsat satellite link from Syowa Station to NIPR has been available since 2004. However, its recent bandwidth has been about 2 MB and its effective speed of FTP transfer has been about 100kB/sec, which is too slow to practically transfer the huge VLBI data.

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. Prof. Shibuya retired on March 31, 2013, so K. Doi took over as the project coordinator of our institute. OHIG sessions in 2013 were performed primarily by the staff of JARE–54 as shown in Figure 2. The staff of JARE–53 supported them in the OHIG82 session, in order to hand over the operation and maintenance of the 11–m antenna to them. T. Masunaga, a member of an advance team of JARE–55, came to Syowa Station on November 15 by airplane. Consequently, he could join the OHIG87 session as their successor.

Fig. 2 Syowa VLBI staff of JARE–54, N. Obara (left) and H. Tanaka (right).

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. However, HM–1002C was brought back to Japan in January 2011 for an overhaul. We attempted to return HM–1002C to Syowa Station immediately. But it was impossible to transport it, because the icebreaker Shirase could not approach Syowa Station in the 2011/2012 and 2012/2013 austral summer seasons due to dense and thick sea ice. Because it was expected that it would be difficult for Shirase to approach Syowa Station in the 2013/2014 austral summer season, we decided to maintain HM1002C at Anritsu Co., Ltd. without transporting it to Syowa Station.

The other hydrogen maser, HM–1001C, has operated for VLBI observations since January 2011. On March 11, 2011, trouble occurred in its ion pump and in an uninterruptible power supply (UPS) for HM–1002C because of instability in both voltage and frequency of the generator for power supplies at Syowa Station. In January 2013, the UPS was repaired by replacing sealed batteries and the failed charging circuit.

Table 2 Status of OHIG sessions as of December 2013.

Code	Date	Station	Hour	Correlation	Solution	Notes
OHIG76	2012/Feb/15	Sy, Ft, Hh, Kk, Oh, Tc	24 h	Yes	Yes	J53
OHIG77	2012/Feb/28	Ft, Kk, Oh, Tc -Sy	24 h	–	–	†1
OHIG78	2012/Feb/29	Ft, Hh, Kk, Oh, Tc -Sy	24 h	No	No	†2
OHIG79	2012/Nov/06	Sy, Hb, Kk	24 h	Yes	Yes	
OHIG80	2012/Nov/07	Sy, Ft, Hb, Kk, Tc	24 h	Yes	Yes	
OHIG81	2012/Nov/14	Sy, Hb, Hh, Kk, Tc	24 h	Yes	Yes	
OHIG82	2013/Feb/11	Sy, Hh, Kk, Oh, Tc	24 h	Yes	Yes	J54
OHIG83	2013/Feb/13	Sy, Hh, Kk, Oh, Tc	24 h	–	–	
OHIG84	2013/Feb/20	Sy, Ft, Kk, Oh, Tc	24 h	–	–	
OHIG85	2013/Nov/11	Sy, Ft, Hb, Ke, Kk, Tc, Ww, Yg	24 h	–	–	
OHIG86	2013/Nov/13	Sy, Ft, Hb, Ke, Kk, Tc, Ww, Yg	24 h	–	–	
OHIG87	2013/Nov/20	Sy, Ft, Hb, Hh, Ke, Kk, Tc, Ww, Yg	24 h	–	–	

J53: JARE–53, op H. Hayakawa eng T. Yoshioka J54: JARE–54, op N. Obara eng H. Tanaka
†1 : Canceled because of malfunction of HM–1001C.
†2 : No fringes because of malfunction of HM–1001C.

On the other hand, the ion pump began to abnormally stop on occasion since March 11, 2011. In 2013, such abnormal stops, which caused a low vacuum inside the HM–1001C and attenuated the hydrogen maser oscillator, occurred on January 6, May 8, July 5, September 11, November 5, November 21, and November 26. The JARE–54 staff had to form high vacuum and check the hydrogen maser generation at all such times. Especially, abnormal stops occurred on November 21 during the OHIG87 session. The ion pump stopped suddenly at 00:00 UTC just before the 36^{th} scan, and the staff could not restart the ion pump until 00:12 UTC. The IF level of the hydrogen maser was recovered and synchronized with GPS around 01:55 UTC before the 45^{th} scan. There may be about two hours of unavailable data in the OHIG87 recorded data.

To avoid such critical situations, we purchased a new hydrogen maser, SD1T03B, last year. SD1T03B was miniaturized in order to be loaded on a helicopter. Therefore, we could transport it to Syowa Station on December 16. SD1T03B was connected to UPS for HM1002C, and its startup was accomplished on December 20.

In preparing the OHIG82 session, the power modules of units 1 and 2 of K5 were broken. The malfunctioning modules were replaced with spare parts, so that there was no apparent influence on the subsequent OHIG sessions.

A system for Delay calibration (D–Cal) recording is independent of the K5 system. D–Cal signals used to be recorded at start/end of each Syowa scan onto floppy disk (FD) by using an N88 BASIC program on an ancient NEC PC. Although its FD drive broke down in November 2012, it was replaced by a spare in January 2013, and D–Cal signals resumed being stored on FD. The D–Cal recording program hung-up twice (45^{th} and 85^{th} scans) during the OHIG85 session. As a consequence, the D–Cal signal data from scans 1 to 44 was broken.

In the direction of north in the field of view of the antenna, a few interference waves in S band were detected in the output signal of the video converter with a spectrum analyzer. The obvious peaks appeared in the frequencies of 212.1 MHz and 260.0 MHz in the intermediate frequency of S band. We continue to investigate their source.

4.2 Session Status

Table 2 summarizes the status of processing as of December 2013 for the sessions starting in 2012. The OHIG sessions involved Fortaleza (Ft), O'Higgins (Oh), Kokee Park (Kk), TIGO Concepción (Tc), Hobart 12-m antenna (Hb), HartRAO (Hh), Warkworth (Ww), Katherine (Ke), Yarragadee (Yb), and Syowa (Sy). In 2005, Syowa joined the CRD sessions, but after 2006, Syowa participated only in OHIG sessions. Syowa took part in six OHIG sessions in 2013.

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 2013, Syowa had contributed 97 sessions from 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 52.6 $\pm$ 0.9 mm/yr. The Syowa–HartRAO baseline shows a slight increase in its length with a rate of 13.1 $\pm$ 0.6 mm/yr. The Syowa–O'Higgins baseline also shows a slight increase, although its rate is only 3.0 $\pm$ 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].

5 Future Plans

Dismantling the current Syowa VLBI antenna is scheduled for the 2015/2016 austral summer season. We presented a budget proposal for construction of a new VGOS antenna after 2017. We will make every effort until this proposal is approved. Simultaneously, we are preparing to install a small geodetic VLBI antenna in collaboration with NICT. We would like to shorten the discontinuation period of VLBI observations as much as possible.

References

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