JARE Syowa Station 11-m Antenna, Antarctica

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Abstract

In 2011, the 51^{st} and the 52^{nd} Japanese Antarctic Research Expeditions (hereinafter, referred to as JARE–51 and JARE–52, respectively) participated in six OHIG sessions, OHIG70, 71, 72, 73, 74, and 75. These data were recorded on hard disks through the K5 terminal. The hard disks for the former three sessions were brought back from Syowa Station to Japan in April 2011, by the icebreaker, Shirase, while those for the latter three sessions are scheduled to arrive in April 2012. The data obtained from the OHIG70, OHIG71, and OHIG72 sessions by JARE–51 and JARE–52 have been transferred to the Bonn Correlator via the NICT's servers. At Syowa Station, JARE–52 and JARE–53 will participate in six OHIG sessions in 2012.

1. General Information

With the objective of conducting studies of polar science, the National Institute of Polar Research (NIPR) is managing the Japanese Antarctic Research Expeditions (JAREs). The 30 members of JARE–52 overwintered at Syowa Station, East Ongul Island, East Antarctica in 2011.

Syowa Station has become one of the key observation sites in the Southern Hemisphere's geodetic network, 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 cumulative total of 97 quasi-regular geodetic VLBI experiments had been observed by the end of 2011.

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]. A K5 recording system was introduced at Syowa Station in September 2004. 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 maximum transfer speed is about 200 kB/sec, which is too slow to be practical for the transfer of the amount of VLBI data.

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

The 11–m S/X–band antenna at Syowa Station is operated and maintained by JARE and NIPR. The staff members are listed in Table 1. OHIG sessions in 2011 were performed primarily by the staff of JARE–52 as shown in Figure 1. The staff of JARE–51 greatly supported JARE–52 during OHIG70 – OHIG72, in order to hand the operation and maintenance of the 11–m antenna over to their successor (JARE–52).

Table 1. Staff members

Name	Affiliation	Function
Kazuo SHIBUYA	NIPR	Project coordinator
Koichiro DOI	NIPR	Liaison officer
Yuichi AOYAMA	NIPR	Liaison officer
Iuko TSUWA	University of Tokyo	Chief operator of JARE–51
Yoshinao KINJYO	NEC	Antenna engineer for JARE–51
Syunsuke IWANAMI	Tomakomai National College of Technology	Chief operator of JARE–52
Shinobu TAKAHIRA	NEC	Antenna engineer for JARE–52

JARE–51: February 2010 – January 2011
JARE–52: February 2011 – January 2012

Figure 1. Syowa VLBI staff of JARE–52, S. Iwanami (left) and S. Takahira (right).

4. Current Status and Activities

4.1. Notes on System Maintenance

The hydrogen maser (Anritsu RH401A; HM–1002C) was transported to Japan by the icebreaker Shirase in April 2011, because of the trouble with the 10 MHz output unit that occurred in December 2010. The HM–1002C was repaired and overhauled by technical experts of Anritsu and was loaded again on the Shirase in the middle of October 2011. We planned to re-install the HM–1002C at Syowa Station as the backup system. However, it was impossible to transport the HM–1002C from the Shirase to the Syowa Station, because the Shirase could not approach the Syowa Station in this austral summer season due to dense and thick sea ice. The HM–1002C will

be back in Japan in April 2012 and will be deployed at the Syowa Station again in the next austral summer.

Another hydrogen maser (Anritsu RH401A; HM–1001C) has been used for VLBI observations since January 2011. On 11 March 2011, its ion pump was interrupted by instability in both voltage and frequency of the generator for power supplies at Syowa Station. In addition, an uninterruptible power supply (UPS) for the HM–1002C broke down simultaneously. Due to a low vacuum inside the HM–1001C, the hydrogen maser oscillator was stopped. In July 2011, the staff of JARE–52 restored its high vacuum and confirmed the hydrogen maser generation. We immediately compared 1 PPS and 10 MHz signals of the HM–1001C with those of GPS using an oscilloscope, and we observed no apparent differences between the HM–1001C and GPS. The HM–1001C kept stable after its restarting.

A significant clock offset of the Syowa system was found in the correlation procedure for the OHIG68 session. This offset also appeared in the correlation procedures for the OHIG69, 70, 71, and 72 sessions, although the hydrogen maser was replaced before the OHIG70 session. We pinpointed the cause of the clock offset during preparation for the OHIG74 session. Although we had believed that the 1 PPS signal of the HM–1001C, which was synchronized with GPS 1 PPS, was being directly used as the reference of the K5 recording system, in actuality, the K5 system was referred to 1 PPS signals of the SONY DFC-1100. The DFC-1100 internally generates 1 PPS by synchronizing to HM–1001C's 1 PPS, which was the external reference. The staff of JARE-53 found a warning of this synchronization system of DFC-1100 on November 8, 2011. The synchronization system had probably failed since February 2010. The clock delay of DFC-1100's 1 PPS in comparison with GPS was about 700 msec measured with the oscilloscope. After resetting the synchronization system, the clock delay became insignificant. However, we changed an arrangement of 1 PPS signal cables on November 8 as follows: 1 PPS signal cables from HM–1001C were connected to DFC-1100 and directly to K5 system; 1 PPS signal cable from DFC-1100 was connected to the HP universal counter for checking the clock offset in comparison with GPS.

4.2. Session Status

Table 2 summarizes the status of processing as of December 2011 for the sessions after 2008. The OHIG sessions involved Fortaleza (Ft), O'Higgins (Oh), Kokee Park (Kk), Parkes (Pa), 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 six OHIG sessions in 2011.

Until 2004, K4 tapes containing the OHIG sessions' data from Syowa Station were copied to Mark IV tapes at GSI, and the Mark IV tapes were sent to the Mark IV Correlator for final correlation. Since the introduction of the K5 system, K5 hard disk data brought back from Syowa Station have been transferred by ftp to the MIT Haystack Observatory or the Bonn Correlator through a NICT server and converted to the Mark 5 format there.

4.3. Analysis Results

As of December 2011, Syowa had contributed 88 sessions from May 1999. Among them, 77 sessions up to February 2011 had been analyzed with the software CALC/SOLVE developed by NASA/GSFC. According to the result analyzed by the BKG IVS Analysis Center, the length of the Syowa–Hobart baseline is increasing with a rate of 55.0 ± 0.8 mm/yr. The Syowa–HartRAO

Table 2. Status of OHIG sessions as of December 2011.

Code	Date	Station	Hour	Correlation	Solution	Notes
OHIG62	2009/Feb/04	Ft, Ho, Kk, Oh, Tc	24 h	Yes	Yes	J50
OHIG63	2009/Feb/10	Ft, Ho, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG64	2009/Feb/11	Ft, Ho, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG65	2009/Nov/10	Ho, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG66	2009/Nov/11	Ho, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG67	2010/Feb/03	Ft, Kk, Oh, Tc	24 h	Yes	Yes	J51
OHIG68	2010/Feb/09	Ft, Ho, Kk, Oh, Tc, Hb	24 h	Yes	Yes	
OHIG69	2010/Feb/10	Ft, Ho, Kk, Oh, Tc, Hb	24 h	Yes	Yes	
OHIG70	2011/Feb/02	Hb, Hh, Ho, Kk, Oh, Tc	24 h	Yes	Yes	J52
OHIG71	2011/Feb/08	Hb, Hh, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG72	2011/Feb/09	Hh, Kk, Oh, Tc	24 h	No	No	
OHIG73	2011/Nov/01	Ft, Kk, Ww	24 h	–	–	
OHIG74	2011/Nov/08	Ft, Kk, Tc, Ww	24 h	–	–	
OHIG75	2011/Nov/09	Ft, Kk, Tc, Ww	24 h	–	–	

J50: JARE–50, op Y. Murakami eng Y. Yamaguchi J51: JARE–51, op I. Tsuwa eng Y. Kinjyo
J52: JARE–52, op S. Iwanami eng S. Takahira

baseline shows a slight increase in its length with a rate of 11.1 ± 0.9 mm/yr. These results agree approximately with those of GPS. The Syowa–O'Higgins baseline also shows a slight increase, although its rate is only 2.1 ± 1.0 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

NIPR has already started to discuss how to remove the Syowa VLBI antenna during December 2015 – February 2016. Therefore, we must make a concrete plan and obtain a budget for replacing the Syowa antenna within a few years.

References

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