JARE Syowa Station 11–m Antenna, Antarctica

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Abstract In 2014, the 54th and the 55th Japanese Antarctic Research Expeditions (hereinafter, referred to as JARE–54 and JARE–55, respectively) participated in six OHIG sessions — OHIG88, 89, 90, 91, 92, and 93. These data were recorded on hard disks through the K5 terminal. The hard disks storing the OHIG83–87 sessions' data were brought back from Syowa Station to Japan in April 2014 by the icebreaker Shirase, while those storing the OHIG88–93 sessions data are scheduled to arrive in April 2015. The data obtained from the five sessions — OHIG83–87 — by JARE–54 were transferred to the Bonn Correlator via the servers of National Institute of Information and Communications Technology (NICT). At Syowa Station, JARE–56 will participate in six OHIG sessions and in one Asia-Oceania VLBI (AOV) session in 2015.

1 General Information

To investigate polar science, the National Institute of Polar Research (NIPR) is managing Japanese Antarctic Research Expeditions (JAREs). The 26 members of JARE–55 overwintered at Syowa Station, East Ongul Island, East Antarctica in 2014.

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 114 quasi-regular geodetic VLBI experiments were performed by the end of 2014.

National Institute of Polar Research

JARE Syowa Station 11–m antenna

IVS 2014 Annual Report

2 Component Description

For VLBI, the Syowa Station 11–m antenna is registered as IERS Domes Number 66006S004 and as CDP Number 7342. The basic configuration of the Syowa Station VLBI frontend system has not changed from the description in [2].

The Syowa Station's K4 recording terminal was fully replaced by K5 simultaneously with the termination of the SYW session at the end of 2004. Syowa Sta-

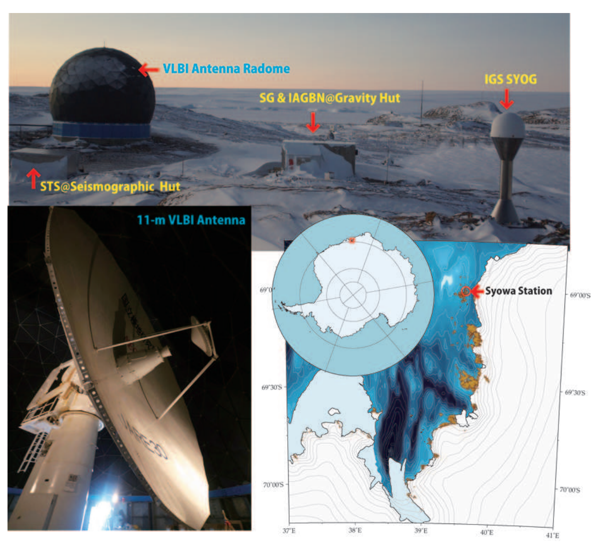

Fig. 1 Syowa VLBI antenna.

Table 1 Staff members. JARE–54: February 2013 – January 2014 JARE–55: February 2014 – January 2015.

Name	Affiliation	Function
Koichiro DOI	NIPR	Project coordinator
Yuichi AOYAMA	NIPR	Liaison officer
Noriaki OBARA	NIPR	Chief operator of JARE–54
Hiroshi TANAKA	NEC	Antenna engineer for JARE–54
Takuya MASUNAGA	NIPR	Chief operator of JARE–55
Yasufumi YOSHIKAWA	NIPR	Operator of JARE–55
Hirofumi MIZUTA	NEC	Antenna engineer for JARE–55

tion 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. But its recent bandwidth is about 3 Mbps and its effective speed of FTP transfer is 100–250 kB/sec, which is too slow to practically transfer the huge VLBI data.

Fig. 2 Syowa Station VLBI staff of JARE–55, Y. Yoshikara (left), T. Masunaga (center) and H. Mizuta (right).

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 2014 were performed primarily by the staff of JARE–55 as shown in Figure 2. The first session of 2014, OHIG88, was scheduled to be observed after the icebreaker Shirase left Syowa Station on February 8, and so the staff of JARE–54 could not use OHIG88 to instruct the staff of JARE–55 in the operation and maintenance of the 11-m antenna. Instead, the staff of JARE-54 used a simulation of a VLBI experiment to instruct the staff of JARE-55 by the end of January 2014.

4 Current Status and Activities

4.1 Notes on System Maintenance

There had been two hydrogen masers, Anritsu RH401A HM–1001C and HM–1002C, at Syowa Station until HM–1002C was brought back to Japan in January 2011 for an overhaul. 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, we could not return HM–1002C to Syowa Station. During this period, the unfavorable situation in which there was only one hydrogen maser at Syowa Station lasted.

In addition, the ion pump of this hydrogen maser, HM–1001C, began to abnormally stop on occasion after instability of the generator for power supplies occurred on March 11, 2011. Such trouble became sometimes an obstacle to VLBI observation. For example, the ion pump of HM–1001C stopped suddenly at 00:00 UTC, November 21, 2013 just before the 36^{th} scan of the OHIG87 session. This abnormal stop caused about two hours of unavailable data for the OHIG87 session.

To avoid such critical situations, we purchased a new hydrogen maser, SD1T03B, in 2013. SD1T03B was miniaturized in order to load it into a helicopter. Therefore we succeeded in transporting it to Syowa Station on December 16, 2013. SD1T03B was connected to the UPS for HM–1002C, and its startup was accomplished on December 20, 2013. Since SD1T03B has been used as the primary hydrogen maser from the OHIG88 session, there was no clock trouble in 2014. In

Table 2 Status of the OHIG sessions as of December 2014.

Code	Date	Station	Hour	Correlation	Solution	Notes
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	Yes	Yes	
OHIG84	2013/Feb/20	Sy, Ft, Kk, Oh, Tc	24 h	Yes	Yes	
OHIG85	2013/Nov/11	Sy, Ft, Hb, Ke, Kk, Tc, Ww, Yg	24 h	Yes	Yes	
OHIG86	2013/Nov/13	Sy, Ft, Hb, Ke, Kk, Tc, Ww, Yg	24 h	Yes	Yes	
OHIG87	2013/Nov/20	Sy, Ft, Hb, Hh, Ke, Kk, Tc, Ww, Yg	24 h	Yes	Yes	†1, †2
OHIG88	2014/Feb/19	Sy, Ft, Ht, Ke, Kk, Tc, Ww, Yg -Hb, Oh	24 h	–	–	J55
OHIG89	2014/Feb/25	Sy, Ft, Hb, Ht, Ke, Kk, Tc, Ww, Yg -Oh	24 h	–	–	
OHIG90	2014/Feb/26	Sy, Ft, Hb, Ht, Ke, Kk, Tc, Ww, Yg -Oh	24 h	–	–	
OHIG91	2014/Nov/12	Sy, Ft, Hb, Hh, Ke, Kk, Ww, Yg -Oh	24 h	–	–	
OHIG92	2014/Nov/18	Sy, Ft, Hb, Ht, Ke, Kk, Ww, Yg -Oh	24 h	–	–	
OHIG93	2014/Nov/19	Sy, Ft, Hb, Hh, Ke, Kk, Ww, Yg -Oh	24 h	–	–	

J54: JARE–54, op. N. Obara, eng. H. Tanaka J55: JARE–55, op. T. Masunaga and Y. Yoshikawa, eng. H. Mizuta
†1 : No fringes occurred during 0000–0055UT because the ion pump of HM–1001C stopped.
†2 : T. Masunaga joined the JARE–54 team.

January 2015, HM–1001C, which was operated as the secondary hydrogen maser in 2014, was replaced with HM–1002C and brought back to Japan for an overhaul.

During the OHIG88 session, failures occurred in the tracking system of the Syowa Station 11–m antenna. Consequently the 50^{th} – 61^{st} scans were missed.

4.2 Session Status

Table 2 summarizes the status of processing as of December 2014 for the sessions starting in 2013. The OHIG sessions involved Fortaleza (Ft), O'Higgins (Oh), Kokee Park (Kk), TIGO Concepción (Tc), Hobart 12-m antenna (Hb), HartRAO 26-m antenna (Hh), HartRAO 15-m antenna (Ht), Warkworth (Ww), Katherine (Ke), Yarragadee (Yg), and Syowa Station (Sy). In 2005, Syowa Station joined the CRD sessions, but after 2006, Syowa Station participated only in OHIG sessions. Syowa Station took part in six OHIG sessions in 2014.

K5 hard disks storing the OHIG 83–87 sessions' data were sent from Syowa Station to Shirase in early February, 2014. Shirase ran aground at 700 meters from the shore at the Molodezhnaya base in the return journey on February 16. Although Shirase was able to leave the sunken rock after a few days, it bilged and was flooded. But Shirase was able to return to Japan somehow, and we obtained the K5 hard disks in April, 2014.

The OHIG83–87 sessions' data were transferred to NICT servers immediately and converted to the Mark 5 format data there. The converted data were transferred from the NICT servers to the Bonn Correlator by FTP by the end of April. The OHIG 83–86 sessions' data have been correlated without any problem. In the OHIG87 session data, there appears to be a clock jump of about 22 μs due to the abnormal stop of the HM–1001C ion pump.

4.3 Analysis Results

As of December 2014, Syowa Station had contributed 114 sessions from May 1999. According to the results analyzed by the BKG IVS Analysis Center, the accuracy of the position and the velocity of the Syowa Station 11–m antenna are 1 mm and 0.2 mm/yr, respectively. In addition, the length of the Syowa Station–Hobart 12-m antenna baseline is increasing with a rate of 66.8 $\pm$ 7.0 mm/yr. The Syowa Station–HartRAO baseline shows a slight increase in its length with a rate of 12.2 $\pm$ 0.8 mm/yr. The Syowa Station–O'Higgins baseline also shows a slight increase, although its rate is only 1.2 $\pm$ 0.8 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 of the current Syowa Station antenna was scheduled for the 2015/2016 austral summer season. For this schedule, we presented a budget proposal for replacing the current antenna with either a VGOS antenna or a small geodetic VLBI antenna. In parallel, the project to develop the small geodetic VLBI antenna and its cryogenic system for feed and LNA was advanced in collaboration with Tsukuba University, NICT and Geospatial Information Authority of Japan. The project team concluded that the small antenna without the broadband receiving system could hardly realize precise VLBI observations, even if the cryogenic system would be installed. Although there was possibility that the budget for the small antenna might be approved in 2015, we gave up installing the small antenna.

Instead, we tried to prolong the available period of the current VLBI antenna. As a consequence, the importance of VLBI international observing was accepted within NIPR, and NIPR decided to postpone the dismantling schedule until the 2019/2020 austral summer season. We continue to present the budget proposal for construction of the VGOS antenna after 2021 and to make every effort until this proposal is approved.

Acknowledgements

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