Tsukuba 32-m VLBI Station

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Abstract The Tsukuba 32-m VLBI station is operated by the Geospatial Information Authority of Japan. This report summarizes activities of the Tsukuba 32-m VLBI station and other stations operated by GSI in 2014. 75 24-hour sessions including CONT14 and 148 Intensive sessions were observed using Tsukuba 32-m and other GSI antennas in accordance with the IVS Master Schedule of 2014. We have been constructing a new observing facility that will be fully compliant with the VGOS concept for the first time in Japan. The construction of the antenna was completed in March, and the inauguration of the new Ishioka VGOS antenna was held in October.

Fig. 1 The Tsukuba 32-m VLBI station.

1. Geospatial Information Authority of Japan
2. Advanced Engineering Service Co., Ltd.

1 General Information

The Tsukuba 32-m VLBI station (Figure 1) is located at the Geospatial Information Authority of Japan (hereafter GSI) in Tsukuba science city, which is about 50 km to the northeast of Tokyo. GSI has two regional stations besides Tsukuba: Chichijima and Aira, which form a geodetic VLBI network in Japan (Figure 2).

GSI has observed the domestic VLBI session series called JADE (JApanese Dynamic Earth observation by VLBI) since 1996. The main purposes of the JADE series are to maintain the reference frame of Japan and to monitor plate motions for the advanced study of crustal deformations around Japan. Additionally, most JADE

Fig. 2 Geodetic VLBI network in Japan.

sessions include Mizusawa and Ishigakijima, which are part of the VERA network of the National Astronomical Observatory of Japan (NAOJ), the two antennas in Kashima (11-m and 34-m), and the Koganei 11-m station, which belong to the National Institute of Information and Communications Technology (NICT).

2 Component Description

The specifications of the Tsukuba 32-m antenna are summarized in Table 1.

Table 1 Tsukuba 32-m antenna specifications.

Owner and operating agency	Geospatial Information Authority of Japan
Year of construction	1998
Radio telescope mount type	Az-El
Antenna optics	Cassegrain
Diameter of main reflector	32 m
Azimuth range	10 – 710°
Elevation range	5 – 88°
Az/El drive velocity	3°/sec
Tsys at zenith (X/S)	50 K / 65 K
SEFD (X/S)	320 Jy / 360 Jy
RF range (X1)	7780 – 8280 MHz
RF range (X2)	8180 – 8680 MHz
RF range (X3)	8580 – 8980 MHz
RF range (S with BPF)	2215 – 2369 MHz
Recording terminal	K5/VSSP32 ADS3000+ with DDC

3 Staff

Table 2 lists the regular members belonging to the GSI VLBI observation group. Kojin Wada replaced Tadashi Tanabe from April as the supervisor. There is no major change in other aspects. Routine operations were primarily performed under contract with Advanced Engineering Service Co., Ltd. (AES).

Table 2 Member list of the GSI VLBI group.

Name	Main Function
Kojin WADA	Supervisor
Jiro KURODA	Management, Co-location
Yoshihiro FUKUZAKI	Installation of VGOS
Shinobu KURIHARA	Correlation, Analysis, IVS Directing Board member
Ryoji KAWABATA	Operation, Co-location The secretary of AOV
Takahiro WAKASUGI	Operation
Syota MIZUNO	Operation (AES, Co., Ltd)
Takafumi ISHIDA	Operation (AES, Co., Ltd)
Toshio NAKAJIMA	System engineer (NTT-ATC)

4 Current Status

4.1 Geodetic VLBI Observations

The regular sessions in the IVS Master Schedule that were conducted by using the GSI's antennas are shown in Table 3. Tsukuba 32 m participated in 75 international and domestic 24-hour VLBI sessions, and in 148 Intensive one-hour sessions for dUT1 measurement in 2014. The other GSI antennas, Chichijima and Aira, participated in not only domestic but also some international sessions such as IVS-T2 and APSG.

We observed the CONT14 campaign, which lasted fifteen days from 6 to 20 May, by using Tsukuba 32 m. Although we faced a small problem concerning a data recording server, most scans were recorded successfully. During the campaign, Tsukuba also observed regular Intensive sessions four times. Switching between CONT and Intensive sessions was done fully automatically. The obtained data were transferred via the Internet to the Bonn correlator.

Table 3 The number of regular sessions observed by using the GSI's antennas in 2014.

Sessions	Tsukuba	Aira	Chichijima
IVS-R1	44	10	–
IVS-T2	7	7	7
APSG	2	2	2
IVS-R&D	1	–	–
CONT14	15	–	–
JADE	5	5	5
JAXA	1	1	1
IVS-INT2	101	–	–
IVS-INT3	47	–	–
Total	223	25	15

4.2 VGOS Project by GSI

In 2012, we started a new project for constructing a VGOS station in Japan. The construction of the antenna has been completed (Figure 3) and the necessary equipment (Front-end, Back-end, H-maser, and so on) has also been delivered. In order to achieve broadband receiving, Eleven feed and Quadruple Ridged Flared Horn (QRFH) systems have been purchased. In addition, a tri-band feed system developed by Spanish IGN (Yebes observatory) has also been purchased for compatibility with the legacy S/X band receiving. After installing the Eleven feed and tri-band feed systems on the antenna, the performance of the new antenna was measured. As a preliminary result, we obtained SEFD 1250 Jy and 1700 Jy for X-band and S-band, respectively.

We held the inauguration ceremony of the new antenna in October (Figure 4). The Ishioka VGOS station will start to observe in regular IVS sessions in the legacy S/X mode for two years as a first step in order to establish a strong tie relation with Tsukuba and other legacy antennas. The full VGOS mode of observation will start after this S/X mode session series. The technical development for broadband receiving will also be performed during this period.

4.3 Influence of the Repair on the Tsukuba 32-m Antenna

As reported in the previous IVS Annual Report [1], the Tsukuba 32-m antenna was forced to suspend all IVS sessions from May to November in 2013 due to damage to the antenna basement [2], and R1 sessions in the last quarter were observed by using AIRA instead of Tsukuba. In the first quarter in 2014, AIRA continued to participate in R1 sessions after Tsukuba rejoined them [3]. Tsukuba showed a satisfactory performance as before the repair. Furthermore, the result of the local tie survey conducted after the repair was very close to that before the repair. In conclusion, the repair finished well, and the Tsukuba 32 m is still in good condition. Additionally, we showed the usefulness of a high speed A/D sampler ADS3000+ with a K5/VSI data recording and transferring system for regular VLBI experiments by the result of AIRA's performance in many R1 sessions.

5 Future Plans

The Asia-Oceania VLBI Group for Geodesy and Astrometry (AOV) was newly established in 2014 as a subgroup of IVS in cooperation with twelve organizations in the Asia and Oceania region. Ryoji Kawabata was appointed secretary and will engage himself in processing and managing the AOV project with the chair, Jim Lovell (University of Tasmania). GSI will also make a substantial contribution to developing new technologies, obtaining new scientific knowledge that will lead to the decrease of damage caused by natural disasters, and establishing a regional reference frame by using the Tsukuba and Ishioka antennas. On the other hand, we will terminate the operation of the other regional antennas, Aira and Chichijima, by March 2015, because it has been a long time since they

Fig. 3 The Ishioka 13.2-m antenna.

Fig. 4 Inauguration ceremony in October.

were constructed, and GNSS has become able to play the role that had been implemented by the domestic VLBI network. Consequently, the year 2015 will be a major milestone for us. We will concentrate on the new VGOS project and AOV sessions with Tsukuba and Ishioka instead of the domestic JADE sessions including Chichijima and Aira so far.

References

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