Tsukuba 32-m VLBI Station

Takahiro Wakasugi[1], Ryoji Kawabata[1], Shinobu Kurihara[1], Yoshihiro Fukuzaki[1], Jiro Kuroda[1], Tadashi Tanabe[1], Syota Mizuno[1,2], Takafumi Ishida[1,2]

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 in 2013. 115 sessions were observed by using Tsukuba 32-m and other GSI antennas in accordance with the IVS Master Schedule of 2013 except for the interruption period due to the repair of the antenna base of Tsukuba 32-m. We have been constructing the new observing facilities that will be fully compliant with VGOS for the first time in Japan.

Fig. 1 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 three regional stations besides Tsukuba: Shintotsukawa, Chichijima, and Aira, which form a geodetic VLBI network in Japan covering the whole country (Figure 2).

GSI has carried out 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

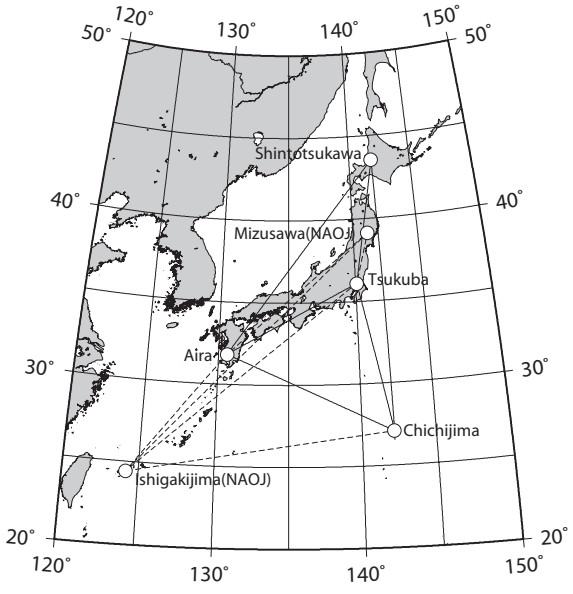

Fig. 2 Geodetic VLBI network in Japan.

Japan and to monitor plate motions for the advanced study of crustal deformation around Japan. Additionally, some JADE sessions include Mizusawa and Ishigakijima, which are part of the VERA network of the National Astronomical Observatory of Japan (NAOJ), and 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. Takahiro Wakasugi newly joined in our group and was in charge of station operation mainly. Routine operations were primarily performed under contract with Advanced Engineering Service Co., Ltd. (AES). Syota Mizuno and Takafumi Ishida replaced Yasuko Mukai and Takashi Nishikawa as new operators since November.

Table 2 Member list of the GSI VLBI group.

Name	Main Function
Tadashi TANABE	Supervisor
Jiro KURODA	Management, Co-location
Yoshihiro FUKUZAKI	Installation of VGOS
Shinobu KURIHARA	Correlation, Analysis, IVS Directing Board member
Ryoji KAWABATA	Operation, Co-location
Takahiro WAKASUGI	Operation
Kazuhiro TAKASHIMA	Research
Syota MIZUNO	Operation(AES, Co., Ltd)
Takafumi ISHIDA	Operation(AES, Co., Ltd)
Toshio NAKAJIMA	System engineer(I-JUSE)

4 Current Status

4.1 Geodetic VLBI Observations

The regular sessions in the IVS Master Schedule that were observed by using the GSI antennas are shown in Table 3. The Tsukuba 32 m participated in 39 domestic and international 24-hr VLBI sessions and in 56 Intensive 1-hr sessions for dUT1 measurement in 2013. The Tsukuba 32 m could not participate in the IVS sessions from the beginning of May to the end of November due to the repair of the antenna base (see Section 4.2). The other GSI antennas, Shintotsukawa, Chichijima, and Aira participated in not only domestic but also some international sessions.

Table 3 The number of regular sessions carried out by using the GSI antennas in 2013.

Sessions	Tsukuba	Shintotsukawa	Chichijima	Aira
IVS-R1	21	–	–	10
IVS-R4	5	–	–	–
IVS-T2	3	–	7	7
APSG	1	2	2	2
VLBA	3	–	–	–
IVS-R&D	3	–	–	–
IVS-CRF	0	–	–	–
JADE	3	7	9	9
IVS-INT1	7	–	–	–
IVS-INT2	34	–	–	–
IVS-INT3	15	–	–	–
Total	95	9	18	28

4.2 Repair of the Tsukuba 32-m Antenna

At the end of April, we found that the damage of the antenna base was very serious from the results of a pointing check with X-band and decided to interrupt all experiments after early May. We investigated the damage of the antenna immediately and found that there were some gaps between the sole plates under the rail tracks and cementitious grout, which could cause the subsidence of the antenna (Figure 3). Then, we filled all gaps with new firm grout in order to prevent the antenna from subsiding. After confirming that the result of the pointing check was alright, we resumed IVS sessions with the Tsukuba 32 m from the end of November. Although we confirmed that the rail track level was almost the same as before the repair, we will perform field surveys in early 2014 in order to make sure the reference point does not move.

We carried out R1 sessions 10 times by using Aira from the end of September to the end of November on behalf of the Tsukuba 32 m after modifying the down converter to receive the R1 sessions' frequency band. These sessions were performed with a high-speed A/D sampler ADS3000+ and K5/VSI system, which have been developed by our collaborator NICT. We plan to continue R1 sessions by using Aira until the end of March 2014 in parallel with the Tsukuba 32 m.

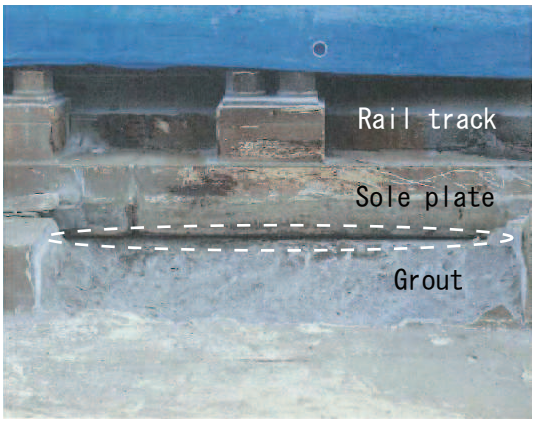

Fig. 3 A gap under a sole plate detected after excavating grout.

4.3 VGOS Project by GSI

In 2012, we had started construction of the new GSI VGOS observing facilities in Ishioka city located about 17 km northeast from Tsukuba (Figure 4). Some part of the antenna and observing cabin were delivered to the site by the end of 2013 and the construction of the antenna will be completed by the end of March 2014 (Figure 5). The other equipment such as a front-end feed, up-down converter, data processing and acquisition system and so on were already delivered to GSI. We decided to call the new site iGOS (Ishioka Geodetic Observing Station) that includes GNSS continuous observation system and gravity observing point in order to play an important role of the geodetic site based on GGOS (Global Geodetic Observing System) in Japan.

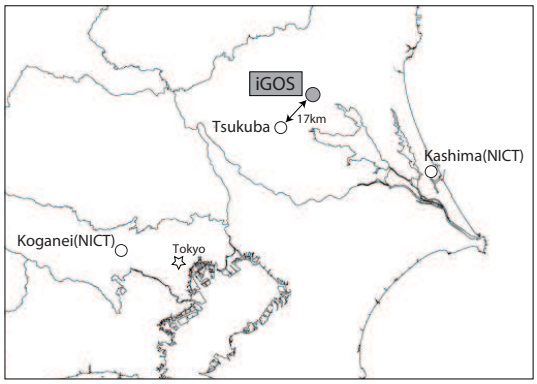

Fig. 4 Location of iGOS site.

5 Future Plans

As mentioned above, the new VGOS station in Ishioka will be installed by the end of March 2014. We will carry out some tests and adjustments to obtain fringes between the existing system and the new one. Subsequently, we plan to carry out parallel operation from 2015 to 2016. After these sessions, we plan to participate in VGOS sessions thoroughly from 2017.

On the other hand, we have to consider the deterioration of the regional stations. We decided to close Shintotsukawa, which was installed in 1995, from the

Fig. 5 Construction of the antenna.

beginning of 2014 because of aging. We will also continue to consider the other GSI stations.