

## 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 (hereafter GSI). This report summarizes the activities of the Tsukuba 32-m VLBI station in 2011.

Over 200 sessions were observed with the Tsukuba 32-m and other GSI antennas in accordance with the IVS Master Schedule of 2011. The Tsukuba 32-m could not participate in the IVS sessions for nearly one month due to the 2011 earthquake that occurred off the Pacific Coast of Tohoku and the following aftershocks which occurred in March. Fortunately, the Tsukuba 32-m had no serious damage and came back to IVS observing on April 4.

### 1. General Information

The Tsukuba 32-m VLBI station is located at GSI in Tsukuba Science City which is about 50 km to the northeast of the capital Tokyo (Figure 1). GSI has three regional stations besides TSUKUB32: SINTOTU3, CHICHI10, and AIRA, which form the 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)”. The main purposes of the JADE series are to define the reference frame of Japan and to monitor the plate motions for the advanced study of crustal deformations. Additionally, Mizusawa (VERAMZSW) and Ishigakijima (VERAISGK), which are part of the VERA network of the National Astronomical Observatory of Japan (NAOJ), have also participated in the JADE sessions.



Figure 1. Tsukuba 32-m VLBI station.

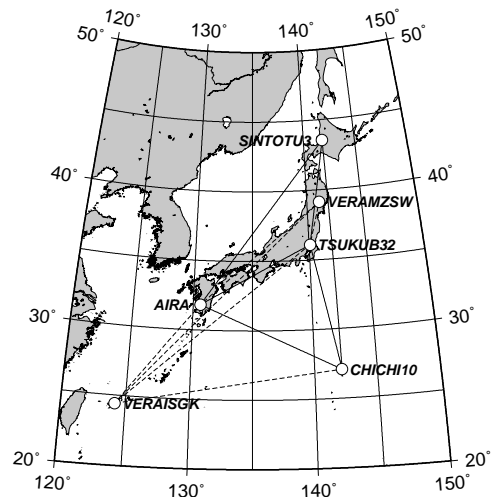


Figure 2. Geodetic VLBI network in Japan.

## 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 system	Az-El
Antenna design	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 / 75 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 DBBC

## 3. Staff

Table 2 lists the regular operating staff belonging to the GSI VLBI observation group. In December 2011, Yoshihiro Fukuzaki re-joined our group in order to investigate and determine the specifications of the new station for VLBI2010, which will be installed near Tsukuba as mentioned in Section 5.

Routine operations were mainly performed under contract with Advanced Engineering Service Co., Ltd. (AES). Daisuke Tanimoto resigned from our group at the end of March. To replace him, Takashi Nishikawa became a new member in June.

Table 2. Staff list of the GSI VLBI group.

Name	Position/Company	Function
Misao ISHIHARA	Director of Space Geodesy Div.	Supervisor
Jiro KURODA	Deputy Director of Space Geodesy Div.	Management, Co-location
Yoshihiro FUKUZAKI	Technical Officer	Specification of VLBI2010 system
Shinobu KURIHARA	Chief of Very Long Baseline Sec.	Responsible official, IVS DB member
Kensuke KOKADO	Chief of Baseline Analysis Sec.	Correlation, Analysis, Data transfer
Ryoji KAWABATA	Very Long Baseline Sec.	VLBI operation, miscellaneous work
Kazuhiro TAKASHIMA	Chief Researcher of Space Geodesy Research Div.	Research
Yasuko MUKAI	AES, Co., Ltd.	Observation
Takashi NISHIKAWA	AES, Co., Ltd.	Observation and Correlation
Toshio NAKAJIMA	I-JUSE	System engineer

## 4. Current Status and Activities

### 4.1. Geodetic VLBI Observations

The regular sessions in the IVS Master Schedule carried out by GSI antennas are shown in Table 3. TSUKUB32 participated in 88 domestic and international 24-hr VLBI sessions and 116 Intensive 1-hr sessions for dUT1 measurement in this year. SINTOTU3, CHICHI10, and AIRA participated not only in domestic sessions but also in some international sessions.

Table 3. The number of regular sessions carried out by GSI antennas in 2011. The numbers in parentheses show those of canceled sessions listed in the IVS Master Schedule.

Sessions	TSUKUB32	SINTOTU3	CHICHI10	AIRA
IVS-R1	44(3)	–	–	–
IVS-T2	6(1)	–	6(1)	5(2)
APSG	2	2	2	0(2)
VLBA	6	–	–	–
IVS-R&D	6(1)	–	–	–
CONT	15	–	–	–
JADE	8	7	4	3(2)
JAXA	1	–	1	1
IVS-INT2	79(1)	–	–	–
IVS-INT3	37(1)	–	–	–
Total	204(7)	9	13(1)	9(6)

### 4.2. The 2011 Earthquake Off the Pacific Coast of Tohoku

On March 11, a massive earthquake with a moment magnitude of 9.0 hit Japan, and we experienced a severe shake in Tsukuba. The elevation drive gear of the Tsukuba 32-m shook from side to side due to the earthquake. Nevertheless, the antenna and other observation devices had no serious damage, though some computer displays fell from the desks in the building of the observatory.

Many aftershocks following the main earthquake continued for nearly one month. Therefore we decided to stop the observation of the Tsukuba 32-m until the beginning of April, since we were afraid that the antenna might have serious damage caused by the aftershocks. The Tsukuba 32-m returned to IVS observing on April 4. These sessions enabled us to determine the new position of the Tsukuba 32-m, and we found large co- and post-seismic displacements of Tsukuba.

### 4.3. Ultra Rapid dUT1 Experiments in CONT11

The Tsukuba 32-m participated in the CONT11 campaign from September 15 to 29. We transferred the data of the Tsukuba 32-m to the Tsukuba correlator via high-speed network. The data of the Onsala Space Observatory in Sweden was also transferred via high-speed network to the Tsukuba correlator and converted to the K5 data format in near real-time. Then both data sets were correlated and analyzed automatically. This was the first success for us to obtain continuous ultra rapid dUT1 values during 15 days, though the observation of the Tsukuba 32 meter was interrupted for nearly one day due to a typhoon which struck Tsukuba during the CONT11 campaign. The details of the results are shown in the annual report of the Tsukuba

analysis center.

#### 4.4. Co-location Survey of the Tsukuba 32-m

From June through July, we performed field surveys in order to measure the relative vector of the reference points of the Tsukuba 32-m and TSKB, which is the IGS point in Tsukuba. We needed 10 intermediate points in order to determine the relative vector of the Tsukuba 32-m and TSKB, since the distance between the two points is approximately 300 m. We determined the relative vector of two points with precisions of 3.0 mm horizontally and 0.9 mm vertically as a preliminary result. Further analysis is in progress.

#### 5. VLBI2010 Project in GSI

We obtained a budget for surveys of the RFI environment and the underground condition at the candidate sites for a VLBI2010 station. We checked the radio interference in two candidate sites and will survey the underground condition by March 2012.

Moreover we obtained a special budget for the installation of a VLBI2010 station, which includes antenna, feed, receiver, data recorder, hydrogen masers, and operation building. Our group has investigated and discussed the specifications of the new system for VLBI2010 and prepared some documents for the installation of the new station. Construction of the new station will be completed by the end of March 2013.