Kashima and Koganei 11-m VLBI Stations

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Abstract The Kashima and Koganei 11-m stations have been used for geodetic and astronomical monitoring observations and as an R&D test bed of VLBI technology. Unfortunately the Kashima 11-m station has stopped due to an accidental cable break that happened in October 2013. This will be fixed in early March 2014. The Koganei 11-m antenna has been constantly operated for VLBI and satellite down-link observations.

1 General Information

A pair of 11-m diameter antennas is operated by the VLBI group of Space-Time Standard Laboratory (STSL) of the National Institute of Information and Communications Technology (NICT). The Kashima 11-m antenna is located in Kashima Space Technology Center (KSTC), on the east coast of the Japanese main island. The Koganei 11-m antenna is located in the headquarters of the NICT in Tokyo (Figure 1). The 11-m VLBI antennas at Kashima and Koganei (Figure 2) were established and have been operated for the monitoring of crustal deformation of the Tokyo metropolitan area (Key Stone Project) since 1995 [1]. After regular VLBI observations, the KSP VLBI Network terminated in 2001. Since then, the 11-m VLBI stations at Kashima and Koganei have mainly been used for research and technology developments. “The Tohoku earthquake” that occurred in March 2011

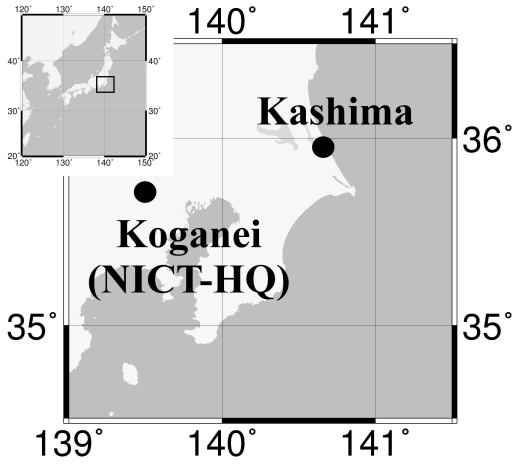

Fig. 1 Location of NICT-Koganei Headquarters, and Kashima.

affected Kashima city and the KSTC by the destruction of some buildings and by a tsunami. Fortunately the damage to the Kashima 11-m antenna was not as severe as that of the Kashima 34-m antenna. The Koganei 11-m antenna in Tokyo was also safe. Thus two antennas could be used for measurements of post-seismic crustal deformation of the Kashima-Koganei baseline. The Kashima and Koganei 11-m stations participated in IVS-R1, T2, and APSG sessions from May 2011 and August 2011, respectively.

NICT Space-Time Standards Laboratory/Kashima Space Technology Center

NICT KSP Network Station

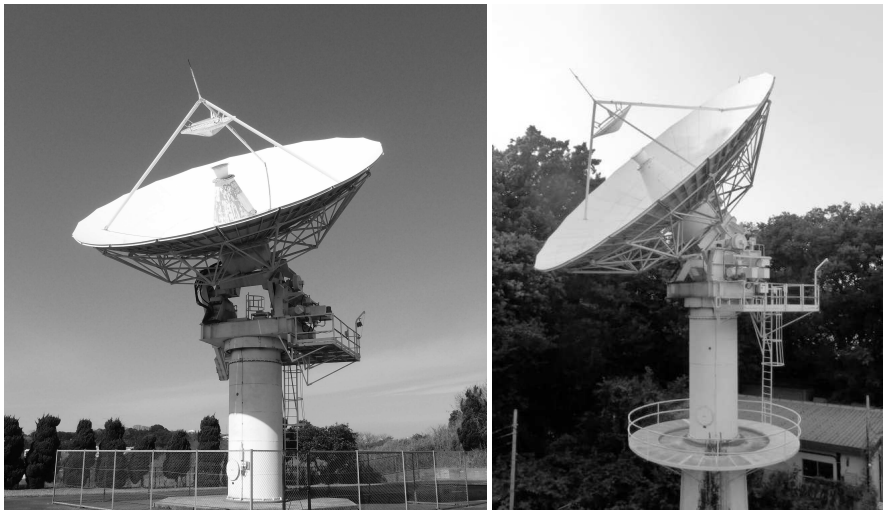

Fig. 2 11-m VLBI antennas at Kashima (left panel) and Koganei (right panel).

Table 1 The antenna parameters of the 11-m antennas.

		Kashima	Koganei
Antenna Type		Cassegrain type	
Diameter		11-m	
Mount Style		Az El mount	
Latitude		N 35° 57' 19.46"	N 35° 42' 37".89
Longitude		E 140° 39' 26.86"	E 139° 29' 17".06
Altitude		62.4 m	125.4 m
Rx Freq. [MHz]	S band	2212 ∼ 2360	2212 ∼ 2360
	X Low band	7700 ∼ 8200	7700 ∼ 8200
	X High band	8180 ∼ 8680	8100 ∼ 8600
Local Freq. [MHz]	S band	3000	3000
	X Low band	7200	7200
	X High band	7680	7600
SEFD [Jy]	X-band	5700	9500
	S-band	3300	5500

2 Component Description

2.1 Antenna

The antenna parameters of Kashima-11 and Koganei-11 are summarized in Table 1. The band-pass filters for S-band (2212-2360 MHz) were installed in 2010 for radio frequency interference mitigation at both stations.

2.2 Data Acquisition System: Sampler

Two sorts of sampler are available at both stations as summarized in Table 2. The K5/VSSP32 [2] has four channels of video band signal input per unit. Four units of K5/VSSP32 constitute one geodetic VLBI terminal with 16 inputs. This system is constantly used for geodetic VLBI observations. This sampler has digital filter functionality realized by FPGA in it. The input video signal is digitized with 8-bit quantization with 64 MHz sampling. Then the frequency bandwidth is restricted and output by reduced data rate for requested sampling mode. The output data is written to a standard Linux file system in K5/VSSP32 format. Data format conversion from K5/VSSP32 to Mark IV, VLBA, and Mark 5B are possible with conversion tools[1].

The ADS3000+ [3] is a sampler with digital baseband conversion (DBBC) function. Several kinds of data acquisition modes (personalities) are switchable by loading FPGA program. The DBBC mode enables flexible selection of 16 video frequency channels with any of 4/8/16/32 MHz bandwidth. Therefore this can be compatible with conventional 16 channels of geodetic VLBI observations. One channel of 8 bits with 128 MHz sampling mode has been used for astronomical observations with a higher dynamic range, such as pulsar observations. Another channel of 1/2-bit 1024 MHz

[1] Observation and data conversion software for K5/VSSP are freely available from `http://www2.nict.go.jp/aeri/sts/stmg/K5/VSSP/index-e.html`

Table 2 VLBI data sampler/DAS system available at the Kashima and Koganei 11-m stations.

System	K5/VSSP32(4 units)	ADS3000+(K5/VSI)
Video Converter	K4/KSP 16ch	not necessary
# of Input Channels	4 /unit x 4 units	1 or 2
# of Output Channels	16	1,2, 16
Input Freq. Range	0 - 300 MHz	0 - 2 GHz
Sampling Rate [Msps]	0.04,0.1,0.2,0.5,1, 2,4,8,16,32,64	128, 256, 1024, 2048,4096
Quantization bit	1,2,4,8 bit	
Max. data rate [Mbps]	256 /unit x 4	4096
Output Interface	USB 2.0	VSI-H

sampling is used for wide-band single channel VLBI observations. This mode is going to be used in the Gala-V project [4].

2.3 Network Connection

The local area network connections from the Kashima 34-m antenna site to the Kashima 11 m and the Koganei 11 m are 10 Gbps and 1 Gbps, respectively. The observational data of IVS sessions are gathered to the e-VLBI data server at the Kashima 34-m site, and then those data are provided to the correlator through a 1 Gbps network link of the Japanese research network JGN-X.

3 Staff

Kawai Eiji: In charge of station care/maintenance and IVS observations.

Hasegawa Shingo: Supporting staff for IVS observation preparation, operation, and maintenance of file servers for e-VLBI data transfer.

Ichikawa Ryuichi: In charge of GNSS station care and GNSS observations.

Sekido Mamoru: In charge of overall activities of the Kashima and Koganei VLBI stations.

4 Current Status and Activities

The Kashima and the Koganei 11-m stations are participating in geodetic VLBI sessions IVS-T2, APSG, and JADE, about once a month. These two stations are used as a test bed of R&D experiments including a feasibility study of frequency comparison with VLBI. In addition, flux monitoring of Sgr-A* with the Kashima — Koganei baseline has been performed in collaboration with S. Takekawa and T. Oka of Keio University [5].

However a tear of cables (coaxial cables and status-control lines) happened at the Kashima 11-m antenna in October 2013 by accident. It was caused by aging and the breaking of strings for cable binding. Loosened cables were caught on the antenna structure during observing. Then they were stretched and torn by antenna motion. The work of replacing the cables was contracted and expected to be finished by early March 2014.

The Koganei 11-m antenna is jointly operated by two groups in the NICT; the STSL and the Space Weather and Environment Informatics Laboratory (SWEIL). When the antenna is not used for VLBI observations, it is used for down link observations from the Stereo satellite [2] by the SWEIL.

5 Future Plans

As medium size radio telescopes, the Kashima and the Koganei 11-m antennas have good slew speed (3 degrees/sec) and stable observation performance. This interferometer will be continuously used for good R&D VLBI experiments.

Acknowledgements

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[2] http://www.nasa.gov/mission_pages/stereo/main/index.html

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