Koganei-11m Report for 2023-2024

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Abstract Koganei 11-m antenna has been participating in IVS sessions of T2, APSG, and AOV. Though, it stopped operation due to trouble of antenna drive/control system in Nov. 2023. Although we tried our best to recover, the system does not recover for normal operation. Unfortunately, we have to give up keeping Koganei 11-m antenna in operation, and it is going to be dismantled in 2025. Multiple space geodesy measurements with SLR, VLBI and GNSS have been continued at the NICT Koganei campus. A local tie survey connecting these space geodetic facilities was conducted in 2022, and its result was submitted to the ITRF center.

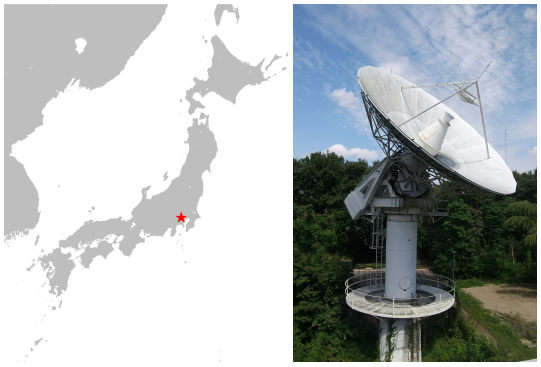

Fig. 1 Left: Location of NICT-Koganei, Right: Koganei 11-m VLBI station.

1 General Information

Koganei 11m-m diameter VLBI station has been operated by geodesy group of the Space-Time Standards Laboratory of the National Institute of Information and Communications Technology (NICT). The antenna site is located at the northern campus in the headquarters of the NICT in Koganei Tokyo (Figure 1).

History of VLBI technology development started in 1974 at Kashima branch of Radio Research Laboratory, which is the former name of NICT until 1988. Kashima 26-m diameter antenna played an important role in detecting plate motion around Pacific and East Asia region in early stage of VLBI history. Space geodetic observation at Koganei campus started with satellite laser ranging (SLR) observation with 1.5-m diameter optical telescope installed in 1990. In 1993, the Communications Research Laboratory (former organization of NICT in 1988-2004) started Key Stone Project (KSP)[1], where VLBI, SLR, and GPS techniques were jointly used to monitor crustal deformation around metropolitan area around Tokyo. Cassegrain type 11-m diameter VLBI antenna was installed in Koganei, and the same type of space geodetic facilities were installed at four suites, Koganei, Kashima, Miura, and Tateyama. In the middle of 2000, there was crustal deformation related to volcanic activities at Izu Islands, which is about 150-km south of Tokyo. The Kashima-Tateyama baseline of the KSP detected a baseline length change of over 20-mm per month[2, 3]. After the project was terminated in 2001, two VLBI antennas of Miura and Tateyama were transferred to Hokkaido and Gifu Universities respectively for research in the field of radio astronomy. Kogane and Kashima 11-m antenna had been used in NICT as tools for research and technology developments, in

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Table 1 List of participated IVS sessions. Due to antenna stop in Nov. 2023, AOV088 in Oct. was the last one for Koganei 11-m antenna.

Session	Session Number
T2	p158, 159, 160, 161, 162, 163
APSG	52, 53
AOV	79, 80, 81,82,83,84,85,87,88

addition to participation of international and domestic VLBI observations. In 2019, Kashima 11-m and Kashima 34-m antennas were damaged at receiver system and antenna structure[4], respectively. Finally, Kashima VLBI group was dissolved in 2021[5].

Koganei 11-m antenna had been jointly operated by space time standards laboratory (STSL) and space environment laboratory (SEL) of NICT. The STSL operates the antenna for participating in IVS sessions a few times a month. The rest of time, the antenna was used for data downlink from STEREO satellite by SEL.

Radio emission in S-band from mobile phone base station has been getting strong enough to saturate LNA. For a workaround of that, we planned insertion of low loss band-pass filter in front of LNA in 2023. In Nov. 2023, the antenna stopped operation because of drive system problems. It was difficult to recover the antenna to normal state. Then, dismantle of the antenna was decided.

2 Activities during the Past Year

2.1 Participating IVS sessions

Koganei 11-m antenna participated in IVS sessions about a few times in a month. Participated IVS sessions are listed in Table 1. In preparation for observation session AOV089, we found antenna does not work properly due to antenna drive problem. Although, we tried fixing it by replacement with spare parts and inspection by manufacturer, the antenna does not recover for normal operation. Since the antenna is about 30 years old, it was difficult to repair antenna control system (ACU) and DCPA control system even by the manufacturer. The state of the antenna drive system is as follows: Each one of two motor drives for azimuth (Az) and elevation (El) are malfunctioning. The antenna does not work in command position mode, then Computer-controlled radio source tracking is not possible. Finally, we decided to dismantle the antenna by the end of March in 2026.

2.2 Local Tie Survey

NICT Koganei site has started observation of satellite laser ranging (SLR) with 1.5-m diameter optical telescope installed in 1990. In 1993, the Communications Research Laboratory (former name of NICT) started crustal deformation monitoring project named Key Stone Project (KSP), where VLBI, SLR, and GPS technologies were jointly used[1]. Then, collocation of multi space geodetic techniques were in the scope of project. Geodetic local tie surveys had been conducted from 1996 to 1999[6]. An additional local tie survey at Koganei site was performed in 2013 under the initiative by Dr. Kunimori of NICT.

In 2022, a local tie survey at Koganei for VLBI, SLR, and GNSS observation facilities was conducted by Dr. Kunimori again. The 75-cm SLR telescope installed in KSP was going to be replaced with an optical telescope for satellite communication by 2024. An additional 1.0-m diameter telescope had been installed for optical satellite communication as well. Determination of ITRF coordinates of these two telescopes was formal aims of the survey, which was conducted by satellite communication laboratory.

The survey was performed by combination with GPS observation, leveling survey (LV), and total station (TS). Targets of the survey are listed in table 2. Figure 2 shows map of targets and control points of the survey over the map of Koganei campus.

Table 2 List of fiducial points as targets of local tie.

Target	Domes Number
VLBI/11-m Antenna	21704S004 / 7327
SLR/1.5-m Telescope	21704M002 /7308
SLR/75-cm Telescope	21704M001 / 7328
GNSS/PGPS2	21704S005 / KGNI(*)

GPS solutions in SINEX format were obtained by using online GPS analysis service provided by Geoscience Australia[8]. Total collocation analysis was performed with 'pyaxis' software developed

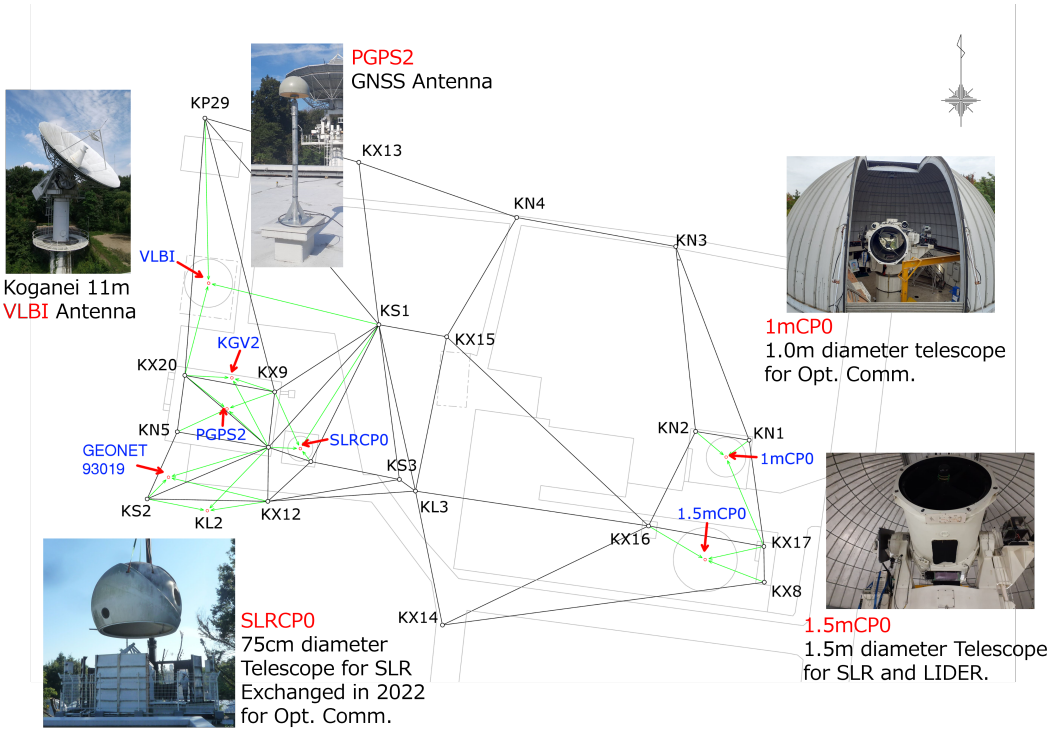

Fig. 2 Map of survey target points and pictures of target facilities. Mutual tie vector between fiducial points of those targets facilities were determined by this survey.

by Land Information New Zealand (LINZ)[7]. Data of GPS solutions in SINEX format, leveling data, total station (distance, horizontal angle, and zenith angle) data, and geoid gradient data were used as Input data for the 'pyaxis' software. Then, coordinates of target points and covariance matrix in SINEX format are derived as output of 'pyaxis'. Figure 3 is three dimensional local-tie vectors with respect to control point 'KS2' depicted in 2-D panels of East-West vs Height, and East-West vs North-South.

The ITEF center in encouraging contribution of local tie vector with covariance matrix for improvement of future ITRF release. Unfortunately, activities on space geodetic observations are shrinking in NICT, and enhancement of observation is not planned. Even though this local-tie information may contribute to improvement of consistency among multiple techniques by re-analysis of legacy data with new local-tie information input. Expecting such good luck, we have submitted this collocation information and collocation report[9] of the Koganei site to the ITRF center.

3 Current Status

At present, only one motor is active for each axis and is not capable of working in command position mode. Thus, computer-controlled tracking does not work, but it can still drive Az and El direction by slew rate mode, slowly.

A volunteer group of amateur radio operators including NICT staff proposed to conduct an experiment on lunar bounce communications using amateur radio signal before the dismantle. The proposed idea was that a transmitter/receiver circuit was connected to the S-band feed, transmitting to the lunar surface at a frequency of 2.4 GHz, and receive the signal at the 11-m and another amateur radio station on Earth, and vice versa. This proposal was approved and performed in April-June 2025. In this experiment, tracking of the Moon was made by manually adjusting the antenna drive speed on ACU. On 12th May, an amateur radio operator transmitted signal to the Moon with 3-m diameter dish with power of 100 W. The reflected signal from the lunar surface was successfully received

with 11-m antenna. In an experiment conducted on 24th May, transmitted 2.4 GHz signal with 2 W power from Koganei 11-m antenna bounced at lunar surface and received with 11-m antenna successfully. This lunar bounce communication became the final experiment using Koganei 11-m antenna.

Some component parts of the antenna, such as antenna control unit (ACU), DC amplifier (DCPA), Video converter, VLBI samplers are going to be transferred to University as spare parts for maintenance of the same type of the 11-m antenna. Koganei 11-m antenna is going to be dismantled by the end of March 2026.

4 Conclusion

VLBI research contributes to quite a broad field of science and engineering subject. its accurate observation is based on theory of relativity, Electromagnetics and contributes to Geodesy, Astronomy, Atmospheric Science, Metrology (Time), planetary science, and space navigation. From the nature of VLBI that is enabled by collaboration between distant radio telescopes, it generates harmonized collaborative atmosphere and it bears many scientists, fruitful collaborations between laboratories and individuals over the globe. We are proud that we are in that community and we could participated contribution to the science and technology development through VLBI.

Acknowledgements

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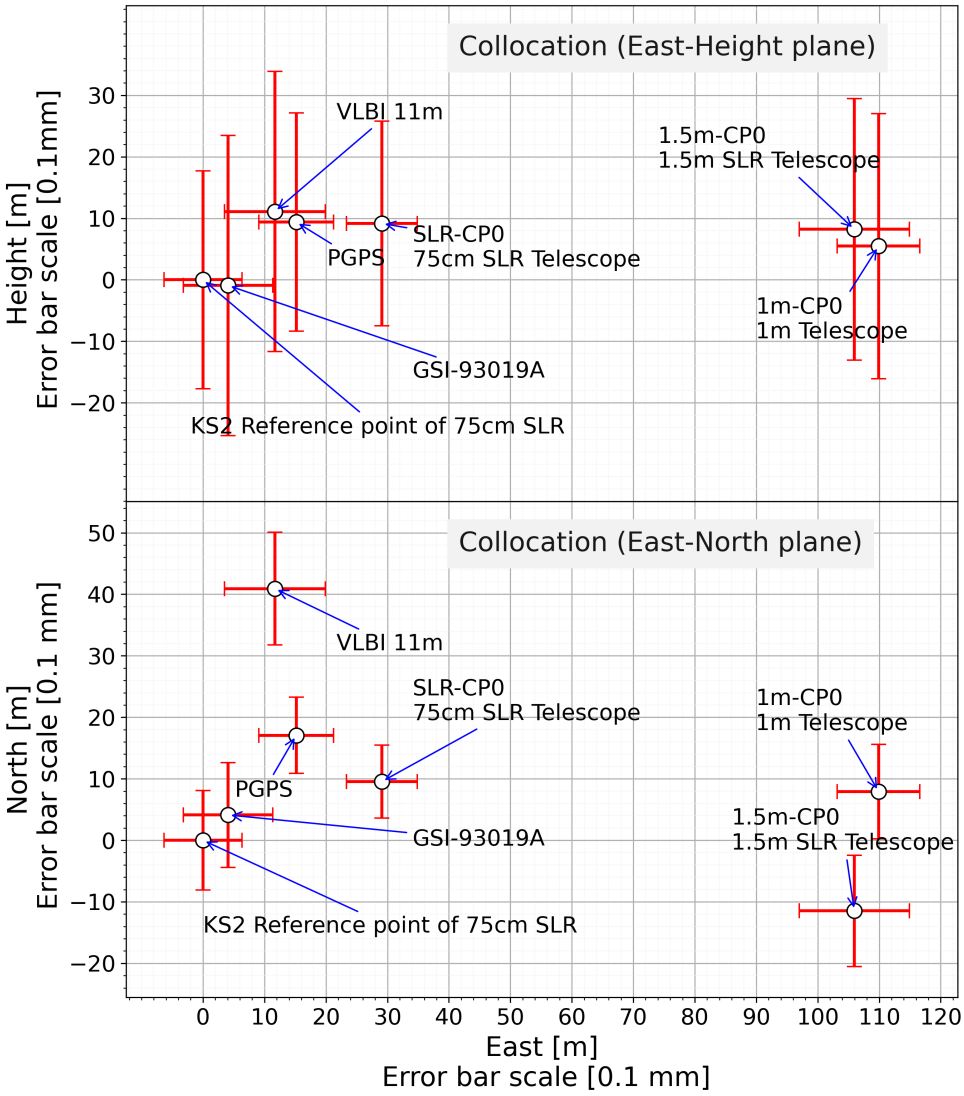

Fig. 3 Three dimensional local tie vectors and their uncertainties are displayed in East-West vs Hight, and East-West vs North-South planes. Position of fiducial points are plotted with respect to the position of 'KS2' as origin. Coordinates of the targets fiducial points are indicated by units of meters. Their uncertainties are magnified by 10^4 times for visibility, thus indicated in unit of 0.1 mm.