# Koganei-11m Report

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**Abstract** The Koganei 11-m antenna participated in the IVS session series T2, APSG, and AOV. However, it stopped operations due to antenna drive/control system problems in November 2023. Although we tried our best to recover, the system did not return to normal operations. Eventually, we had to give up keeping Koganei 11-m antenna in operation, and the telescope will be dismantled in 2026. We continued performing multiple space geodesy measurements at the NICT Koganei campus using SLR, VLBI, and GNSS. A local-tie survey connecting these space-geodetic instruments was conducted in 2022, and the results were sent to the ITRF center.

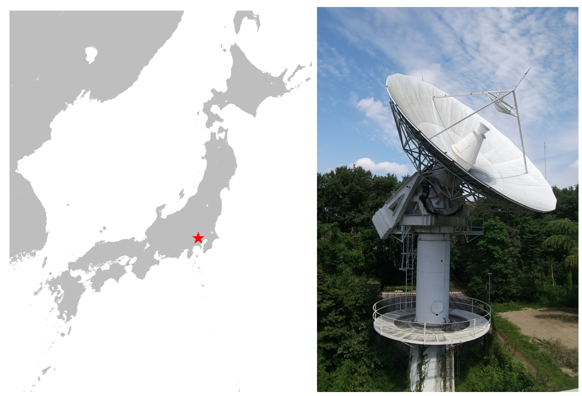

**Fig. 1** (left) Geographic location of NICT Koganei. (right) View of the Koganei 11-m VLBI station.

## 1 General Information

The Koganei 11-m diameter VLBI station was operated by the 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).

The development of VLBI technology at the Kashima branch of the Radio Research Laboratory, the former name of NICT (until 1988), started in 1974. The Kashima 26-m diameter antenna played an important role in detecting plate motion in the Pacific and East Asia region in the early years of VLBI. Space-geodetic observations at the Koganei campus started with satellite laser ranging (SLR) observations with the 1.5-m diameter optical telescope installed in 1990. In 1993, the Communications Research Laboratory (former organization of NICT from 1988–2004) started the Key Stone Project (KSP) [1], in which the VLBI, SLR, and GPS techniques were jointly used to monitor crustal deformation around the Tokyo metropolitan area. A Cassegrain type 11-m diameter VLBI antenna was installed at Koganei, and the same type of space-geodetic facilities were installed at four sites: 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, the VLBI antennas of Miura and Tateyama were transferred to Hokkaido and Gifu Universities, respectively, for research in the field of radio astronomy. The Koganei and Kashima 11-m

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antennas were used by NICT as tools for research and technology development and to participate in international and domestic VLBI observations. In 2019, the Kashima 11-m and 34-m antennas were damaged in their receiver system and antenna structure [4], respectively. The Kashima VLBI group was dissolved in 2021 [5].

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

Radio emissions in S-band from mobile phone base stations reached the level of saturating the LNA. As a workaround, we planned to insert a low-loss bandpass filter in front of the LNA in 2023. In November 2023, the antenna stopped operating because of drive system problems. It was difficult to bring the antenna back into normal state. Eventually it was decided to dismantle the antenna.

## 2 Activities during the Past Year

### 2.1 Participation in IVS Sessions

The Koganei 11-m antenna participated in a few IVS sessions per month. Table 1 lists the IVS sessions observed during the report period.

**Table 1** Participation in IVS sessions. Due to the cessation of operations in November 2023, AOV088 in October 2023 was the last session that was observed by the Koganei 11-m antenna.

| Session Type | Session Number |
|---|---|
| T2, T2P | 158, 159, 160, 161, 162, 163 |
| APSG | 52, 53 |
| AOV | 79, 80, 81,82,83,84,85,87,88 |

When preparating the observation of the session AOV089, we found that the antenna did not work properly due to antenna drive problems. Although we tried to fix the problems by installing spare parts and having the manufacturer inspect the drive, the antenna did not return to normal operation. Since the antenna was about 30 years old, it was difficult even for the manufacturer to repair the antenna control system (ACU) or the DCPA control system. The state of the antenna drive system was as follows: each of the two motor drives for azimuth (Az) and elevation (El) were malfunctioning. The antenna did not work in command position mode; computer-controlled radio source tracking was not possible. Finally, we decided to dismantle the antenna by the end of March 2026.

### 2.2 Local Tie Survey

The NICT Koganei site started satellite laser ranging (SLR) observations with a 1.5-m diameter optical telescope in 1990. In 1993, the Communications Research Laboratory (former name of NICT) started the crustal deformation monitoring project called Key Stone Project (KSP), where VLBI, SLR, and GPS technologies were jointly used [1]. The main scope of the project was the co-location of multiple space-geodetic techniques. In this context, geodetic local-tie surveys were conducted between 1996 and 1999 [6]. An additional local tie survey at Koganei was performed in 2013 under the initiative of Dr. Kunimori of NICT.

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

The survey combined a GPS campaign with a leveling survey (LV) and total station (TS) data. The observation targets of the survey are listed in Table 2.

**Table 2** Targets (fiducial points) of the local-tie survey.

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

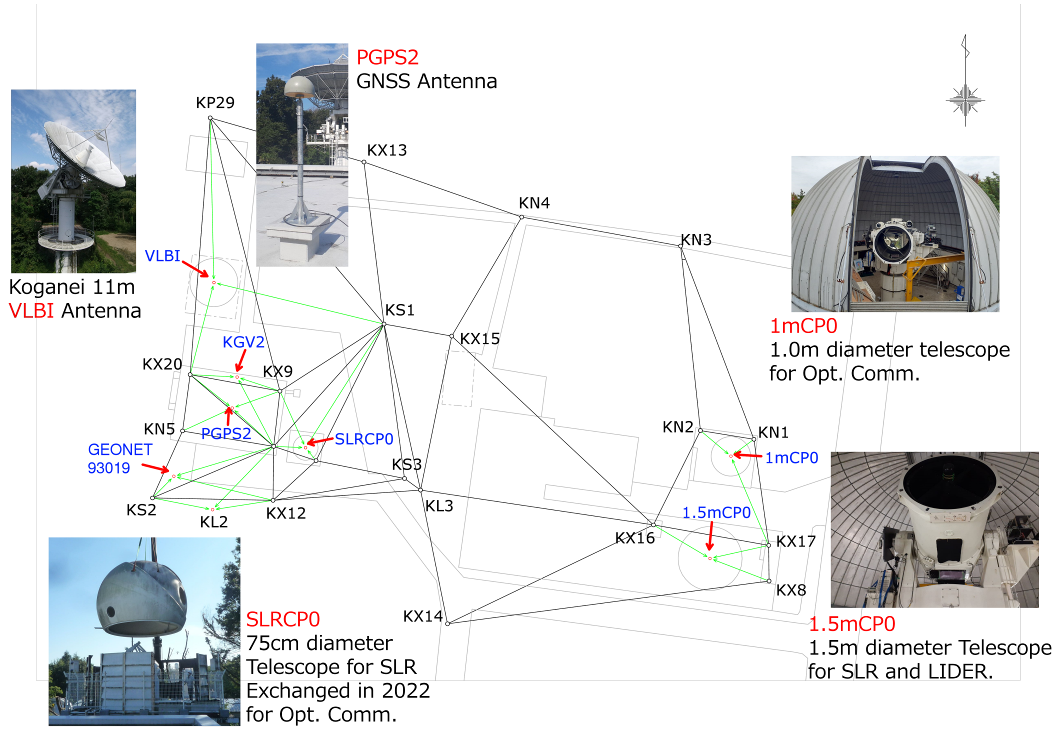


**Fig. 2** Plan of survey target points and pictures of target facilities. The survey determined the mutual tie vector between the fiducial points of these target facilities.

Figure 2 shows a plan of the targets and control points of the survey at the Koganei campus.

The GPS solutions in SINEX format were obtained by using the online GPS analysis service provided by Geoscience Australia [8]. The total co-location analysis was performed with 'pyaxis' software developed by Land Information New Zealand (LINZ) [7]. The data of the GPS solutions in SINEX format, the leveling data, the total station (distance, horizontal angle, and zenith angle) data, and the geoid gradient data were used as input data for the 'pyaxis' software. Then, the coordinates of the target points and the covariance matrix in SINEX format were derived as output of 'pyaxis.' Figure 3 shows the three-dimensional local-tie vectors with respect to the control point 'KS2' depicted in 2-D panels of East-West vs. Height and East-West vs. North-South.

The ITRF center encourages contributing local-tie vectors with covariance matrix to improve future ITRF releases. Unfortunately, activities on space-geodetic observations are being reduced at NICT. Hence, an enhancement of observations is not planned, even though local-tie information may contribute to improving the consistency among multiple techniques (by the re-analysis of legacy data using new local-tie information). Nonetheless, we hope that the submission of our co-location information and co-location report [9] about the Koganei site to the ITRF center will assist in this effort.

## 3 Current Status

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

A volunteer group of amateur radio operators, including NICT staff, proposed to conduct an experiment on lunar bounce communications using amateur radio signals before dismantling the antenna. The proposed idea was that a transmitter/receiver circuit would be connected to the S-band feed, transmit to the lunar surface at a frequency of 2.4 GHz, and receive the signal

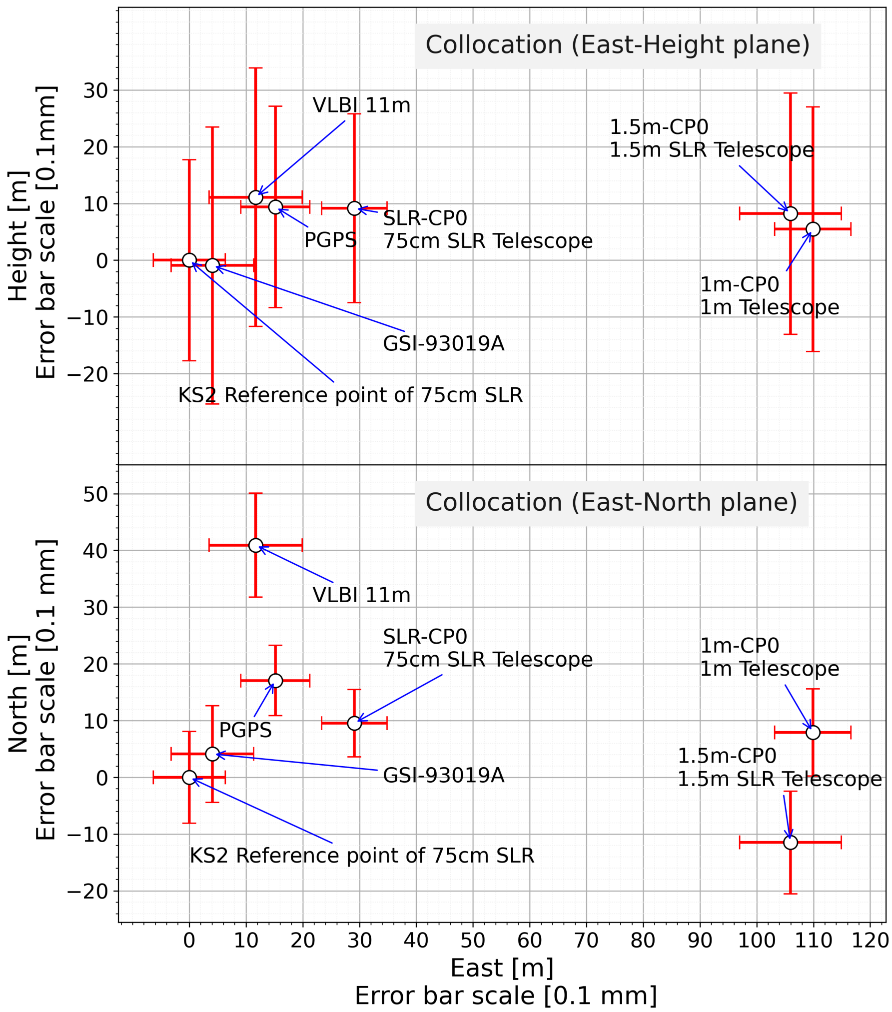


**Fig. 3** Three-dimensional local-tie vectors and their uncertainties depicted in the East-West vs. Height and East-West vs. North-South planes. The positions of the fiducial points are plotted with respect to the position of 'KS2' as origin. The coordinates of the target fiducial points are shown in units of meters. Their uncertainties are magnified for visibility by a factor of $10^4$, indicated by the unit of 0.1 mm.

at the 11-m as well as another amateur radio station on Earth, and vice versa. This proposal was approved and performed in April–June 2025. In this experiment, tracking the Moon was done by manually adjusting the antenna drive speed in the ACU. On 12 May 2025, an amateur radio operator transmitted a signal to the Moon from a 3-m diameter dish with a power of 100 W. The reflected signal from the lunar surface was successfully received at the 11-m antenna. In an experiment conducted on 24 May 2025, a transmitted 2.4-GHz signal of 2-W power from Koganei 11-m antenna bounced from the lunar surface and was received at the 11-m antenna successfully. This lunar bounce communication became the final experiment using the Koganei 11-m antenna.

Some component parts of the antenna, including the antenna control unit (ACU), the DC amplifier (DCPA), the video converters, and the VLBI samplers, are going to be transferred to the university as spare parts for the maintenance of the same type of the 11-m antenna. The Koganei 11-m antenna is scheduled to be dismantled at the end of March 2026.

## 4 Conclusion

VLBI research contributes to a broad field of science and engineering subjects. Its accurate observations are based on the theory of relativity and electromagnetics, and it contributes to geodesy, astronomy, atmospheric science, metrology (time), planetary science, and space navigation. By its very nature, the collaboration between distant radio telescopes, VLBI generates a harmonized collaborative atmosphere. It brings together many scientists in fruitful collaborations between laboratories and individuals around the world. We are proud that we have been part of this community and we were able to contribute to the science and technology development of VLBI.

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