


Comparison of Results from VLBI, GPS, and SLR Observations in the Keystone Network



Y. Koyama, R. Ichikawa, T. Kondo, T. Otsubo,
J. Amagai, K. Sebata, and H. Kunimori

Communications Research Laboratory

Outline

- Introduction
- Tie of the Key Stone Project Network to Global TRF
- Comparison of Site Coordinates
- Comparison of Site Velocities

Introduction

🗺️ Key Stone Project Network

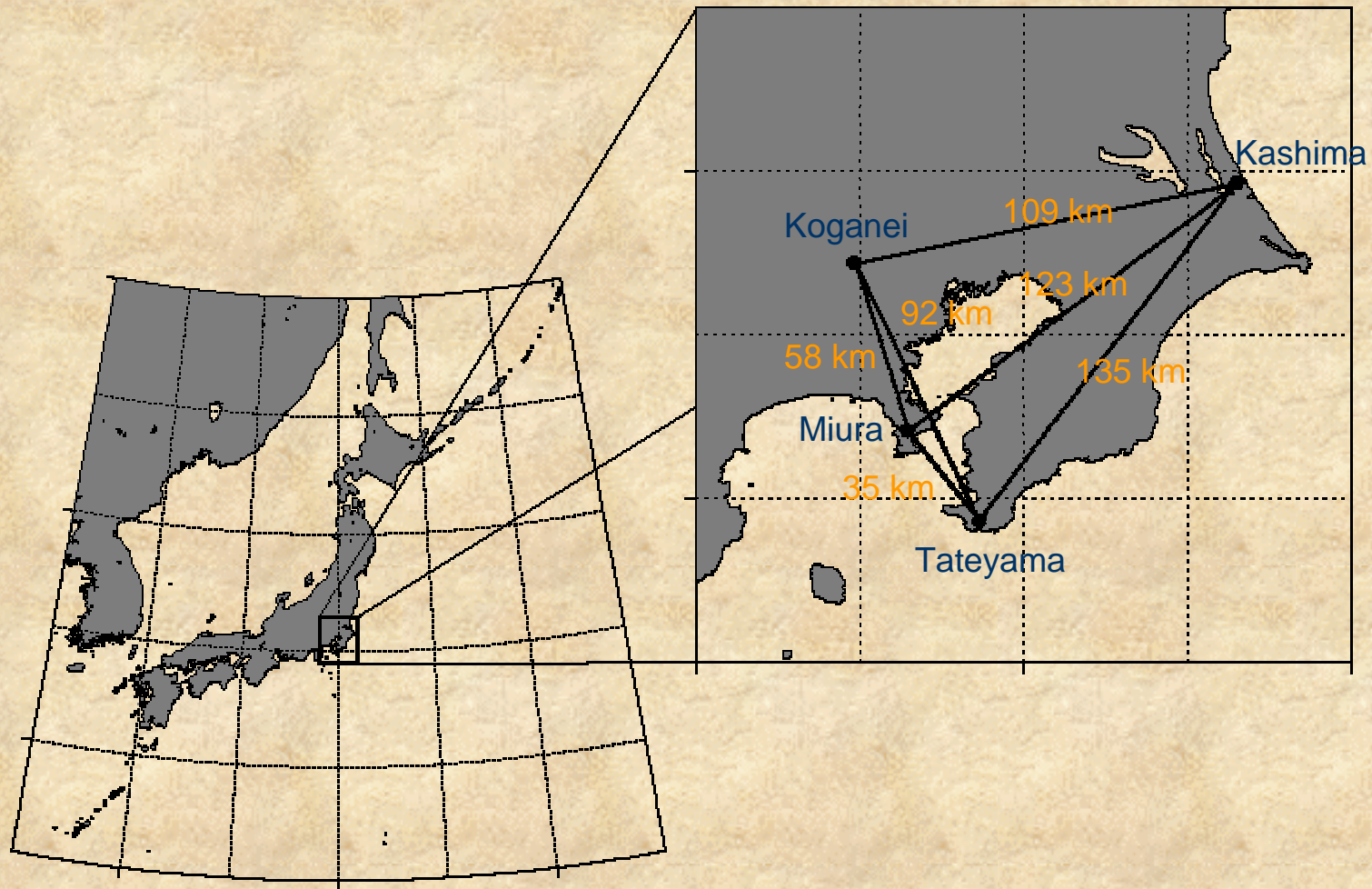
A compact space geodetic observation network around Tokyo

- 4 observation sites (Koganei, Kashima, Miura, and Tateyama).
- 3 space geodetic techniques (VLBI, SLR, and GPS) at each site.
- Observation facilities are collocated closely from each other.

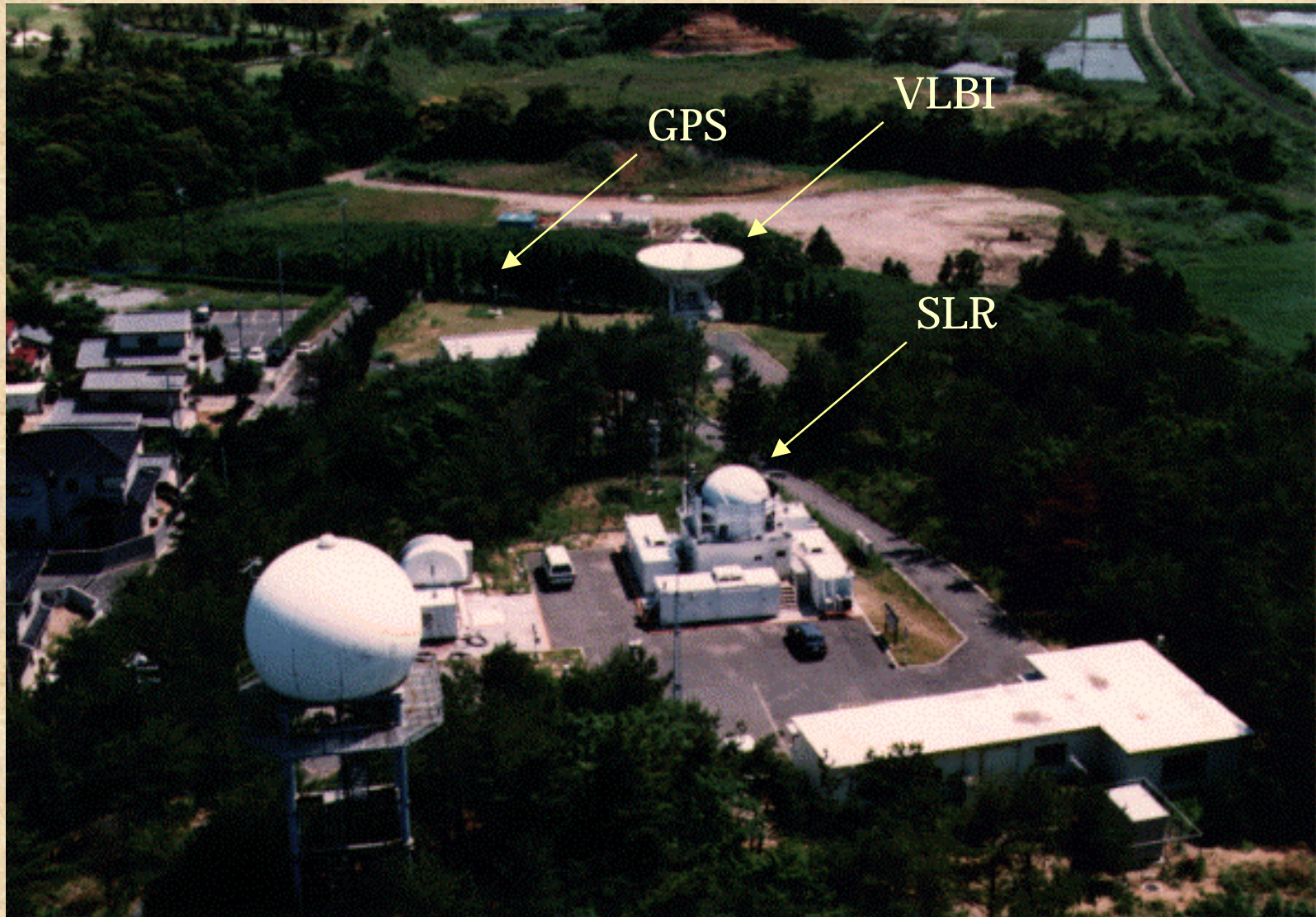
	VLBI-SLR	VLBI-GPS	SLR-GPS
Koganei	36m	24m	16m
Kashima	78m	31m	102m
Miura	76m	19m	87m
Tateyama	40m	39m	6m

Distances between each technique

Key Stone Project Network

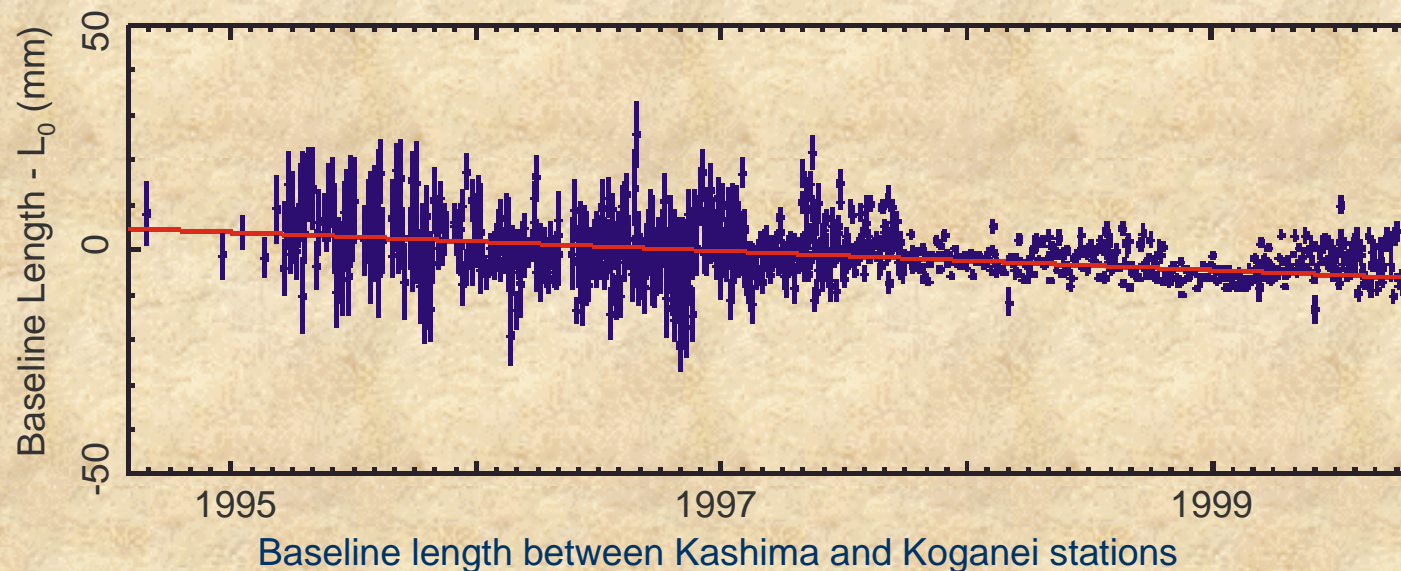


KSP Site View at Kashima



Observation Facilities (VLBI)

- 👁️ 10m antenna with a high slew rate capability
- 👁️ 256 Mbps data rate $> \times 4$ (conventional system)
- 👁️ Real-time processing with high speed communication
- 👁️ Frequent observing sessions (every two days)
- 👁️ Automated operations and data analysis



Observation Facilities (SLR & GPS)

SLR

- 75cm telescope system
- Remote operation capability under developments

GPS

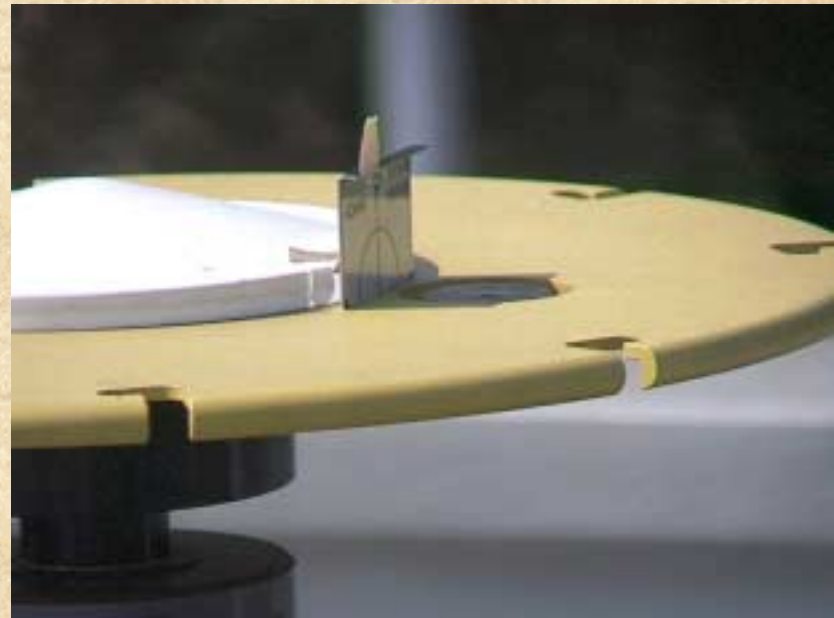
- Automated data acquisition
- 2 monuments at Kashima and Koganei (CRL's own and GSI dense network monuments)

Ground Survey

- ❖ Conventional survey measurements are periodically repeated (~ 1 year).



Ground survey target at VLBI reference point (Kashima)



Observations

VLBI

- August 29, 1994 ~
- Daily (January 1995 ~) or sub-daily (October 1997 ~)

SLR

- February 1996 ~
- Regularly from October 1998

GPS

- July 1997 ~, daily

Tie of the KSP VLBI Network to the ITRF96

- ❖ 9 tie experiments have been performed with KSP VLBI stations and Kashima 34m station. 2 of which were performed with Fairbanks station.
- ❖ 4 good results have been obtained.
- ❖ Repeatability : 5 mm horizontally and 2 cm vertically.
- ❖ Good agreement (< 1 cm) with ground survey measurements.
- ❖ Further experiments being coordinated with Wettzell, Tsukuba (32m), Kashima (26m), and Urumqi VLBI stations.

Comparisons of site coordinates

- ❖ VLBI : ITRF96 site coordinates except for KASHIM11 are estimated with respect to the KASHIM11 coordinate.
 - ❖ GPS : Four GPS site coordinates are estimated with constraints for IGS sites (Fairbanks, Kauai, Guam, Irkutsk, Shanghai, Usuda, and Tsukuba).
 - ❖ SLR : Four SLR site coordinates are estimated with fixed site coordinates for ITRF96 stations.
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- Agreements between VLBI, SLR, and GPS are < 2 cm horizontal and < 5 cm vertical.
 - Systematic differences suggest inconsistency between VLBI, GPS, and SLR site coordinates given in ITRF96.

Comparison of site velocities

- 🦉 VLBI site velocities from more than 3 years of data.
 - 🦉 GPS site velocities from about 1.3 years of data.
 - 🦉 SLR site velocities are not available yet.
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- Large discrepancies between VLBI and GPS velocities.
 - Good agreement if Kashima is fixed.
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- Suggesting inconsistency of site velocities between IGS sites and Kashim34 on ITRF96.

Conclusions and future prospects

- ✿ Agreements between ground survey measurements and space geodetic measurements ~ 5 mm horizontal and 2 cm vertical.
 - ✿ Discrepancies between VLBI and GPS site velocities ~ 15 mm/year (horizontal).
 - ✿ KSP VLBI Network has been accurately tied to ITRF96 through 9 tie experiments.
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- Better GPS site velocities.
 - Better SLR site coordinates and velocities.
 - Further tie VLBI experiments.