Status Report of Geographical Survey Institute Japan

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Abstract

We briefly present a history of VLBI activities and the status of Geographical Survey Institute (GSI). Firstly GSI developed three mobile VLBI systems and had repeated observations with CRL. On the other hand, GSI installed 1000 permanent GSP stations all over Japan (GEONET). Then our VLBI strategy has been shifted from domestic mobile VLBI observation to permanent VLBI stations and international VLBI service. Last year GSI finished constructing GSI domestic VLBI network with five permanent VLBI stations and Tsukuba VLBI center with three baseline K-4 correlator. A main station of the network is Tsukuba VLBI station (32m). Tsukuba VLBI station also becomes a key station in the international VLBI networks. Now GSI analyzing survey results comparing with the data from GEONET.

1. History of VLBI activities at GSI

The Communications Research Laboratory (CRL) is a pioneer of VLBI in Japan. CRL established K series VLBI standard. With support of CRL, Geographical Survey Institute (GSI) started to introduce K series VLBI techniques in 1981. The first system is a mobile system with a 5m-diameter antenna. In 1984, GSI had the first VLBI experiment with Kashima VLBI station of CRL. From 1986, GSI participated in a project named 'VLBI Experiment for Geodetic Application' (VEGA) using the mobile system. The purposes of the VEGA project were the detection of crastal deformation, accuracy improvement of the Japanese precise geodetic network, and contribution to determination of GPS satellite orbit. From 1986 to 1994, GSI repeated mobile VLBI experiments at 8 sites in Japan. By comparing with the survey results in 1987 and 1989, GSI succeeded in detecting a velocity of the Philippine plate relative to Kashima as 3.7cm per year. This plate motion is asserted to be the main force of earthquakes in the Tokai area. The main station of these mobile VLBI experiments was Kashima VLBI station (26m).

GSI developed three mobile systems. Diameters of these antennas were 5-m, 2.4-m (with CRL) and 3.8-m. In1995 GSI had a cooperative VLBI experiment with National Geography Institute of Korea using the 3.8-m diameter mobile VLBI system.

Through these experiences GSI became a mastery of skills in VLBI operation. In 1992, GSI started international VLBI experiments participating in the DOSE project with Kashima VLBI station. In 1992, the ownership of Kashima VLBI station (26m) was transferred from CRL, and GSI became proprietary of it. Since 1997, GSI has been participating in CORE (Continuous Observation of the Rotation of the Earth). The Japanese geodetic network was connected to global geocentric reference frames such as ITRF (International Terrestrial Reference Frame) by series of the international VLBI experiments.

In parallel with a growth of the number of the permanent GPS stations, VLBI strategy was shifted from mobile VLBI systems to permanent VLBI stations. On the ground monument of Shintotukawa mobile VLBI station, a 3.8m-diameter permanent VLBI station was installed in 1995. Near Chichijima VLBI-SLR collocation site, a 10m-diameter permanent VLBI station was installed in 1997. A 10m-daimeter permanent VLBI station was installed in 1997 at Aira. GSI also installed a set of correlator for three stations and three baselines. In 1998 GSI opened Tsukuba VLBI Center as an operation, correlation and analysis center for domestic VLBI experiments. This means that GSI have full facilities for independent VLBI survey.

Installation of Tsukuba VLBI station (32m) was completed on 26 March 1998. Tsukuba VLBI station has taken place in Kashima VLBI station since June 1998. A performance of Tsukuba VLBI station is the top of the world VLBI standards. Tsukuba VLBI station is a key station in the GSI domestic VLBI network and in the international VLBI networks. In 1999, GSI nominated Tsukuba VLBI station as a network station and Tsukuba VLBI center as a correlation center of IVS (International VLBI Service for Geodesy and Astrometry).

2. Tsukuba VLBI station (32m)

GSI finish constructing Tsukuba VLBI station (32m) on 26th March 1998. Tsukuba VLBI station had first (official) experiment in June 1998. To realize a high performance, we introduced some ideas. The back panels and ventilation system keeps shape of the antenna surface. Antenna structure is covered with sunshade panels. GPS antenna is settled on the top of the VLBI antenna for collocation. Helium cooling system is installed for front-end receiver. The front-end and Back-end are connected with optical transmission devices to improve the SNR. Back-end room is shielded from radio noise and H-maser room is shielded from electromagnetic noise. Mark-IV and K-4 type recording is available. GSI also is developing a dubbing machine from K-4 to Mark-IV. Tsukuba VLBI station is settled near TSKB (IGS station). Soon IGS network and VLBI network will be collocated at Tsukuba.

In 1999, Tsukuba VLBI Station will participate in CORE, Japan-German Cooperative Experiments for UT1, Japan Tie with CRL, APSG (Asia Pacific Space Geodesy), Direct Tie with Antarctic Station (Showa) and collocation survey with IGS, etc.

Specifications of Tsukuba VLBI station are shown in the following table.

Specifications (Tsukuba VLBI station)

Installation March 1998	Surface smoothness better than 0.5mm
First (official) experiment 6 June 1998	Axes crossing error less than 1mm
Diameter 32m	Maximum speed 3 degree / sec
Antenna Type Cassegrain Az-El Mount	
S band 2.1 - 2.5 GHz	SEFD X band : 297 Jy S band : 322 Jy
X band 7.78 – 8.98 GHz	(average value of five quasars :Orion-a, Cas-a, Cygnus-a, Taurus-a, Virgo-a)
K band 19.5 – 25.0 GHz (receiver is not installed)	Tsys X band : 55.03 K S band : 61.09 K

3. GSI Domestic VLBI Network

GSI operates a domestic VLBI network with total five stations. Aira VLBI station and Chichijima VLBI station were installed in 1997. Recording system of the network is K-4 system. GSI carried out the first simultaneous experiment operating the five stations in June 1998. The coordinates of each stations were decided with precision of 2-5mm (one sigma) horizontally and 9-16mm (one sigma) vertically. GSI is planning to have four domestic experiments with the network to detect crastal movement in 1999. GSI is also planning to have some research experiments to improve accuracy and to test new automation techniques.

4. Tsukuba VLBI Center

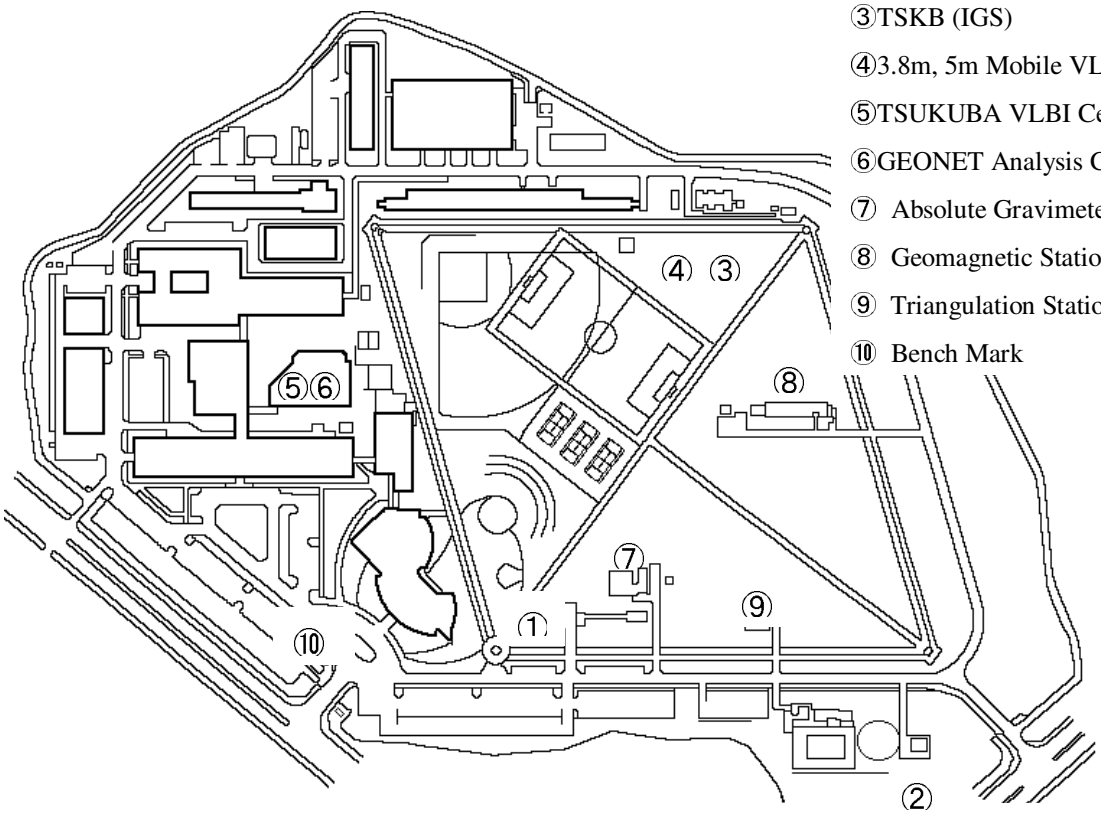
In 1998 GSI opened Tsukuba VLBI Center as an operation, correlation and analysis center. GSI installed a new correlator system for three stations three baselines. Cosmo Research Corp makes the correlator unit. Kety Corp. Ltd. makes the software that controls the each unit. Software for Bandwidth Synthesis and database producing is developed by CRL. SOLVE of NASA/GSFC is working as a baseline analysis software.

5. JGD2000

GSI is preparing a new geodetic framework named JGD2000 (Japanese Geodetic Datum 2000), planning to publish in 2000. GSI VLBI group is contributing to JGD2000. JGD2000 is being built by VLBI experiments and GPS campaign. Coordinates of the JGD2000 are based on ITRF94 and GRS80. JGD2000 is connected at the Kashima VLBI station to ITRF94 by international VLBI experiments. VLBI group determined three baselines precisely by mobile VLBI experiments. These baselines and permanent GPS stations are the backbone of JGD2000.

Site Map
Geographical Survey Institute

①GEONET
②TSUKUBA VLBI Station
③TSKB (IGS)
④3.8m, 5m Mobile VLBI
⑤TSUKUBA VLBI Center
⑥GEONET Analysis Center
⑦ Absolute Gravimeter
⑧ Geomagnetic Station
⑨ Triangulation Station
⑩ Bench Mark



① GEONET

④ 5m mobile VLBI

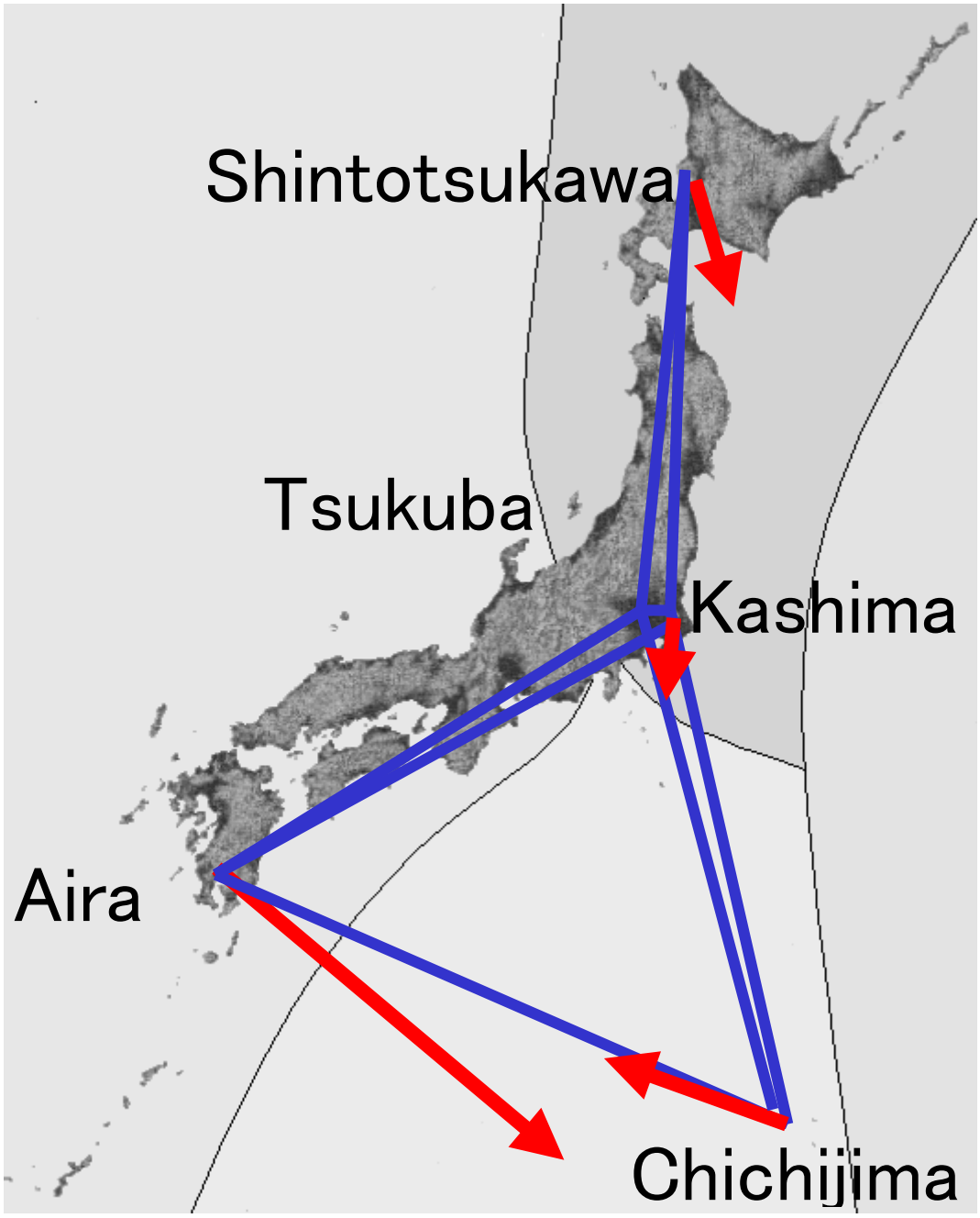
② Tsukuba 32m VLBI

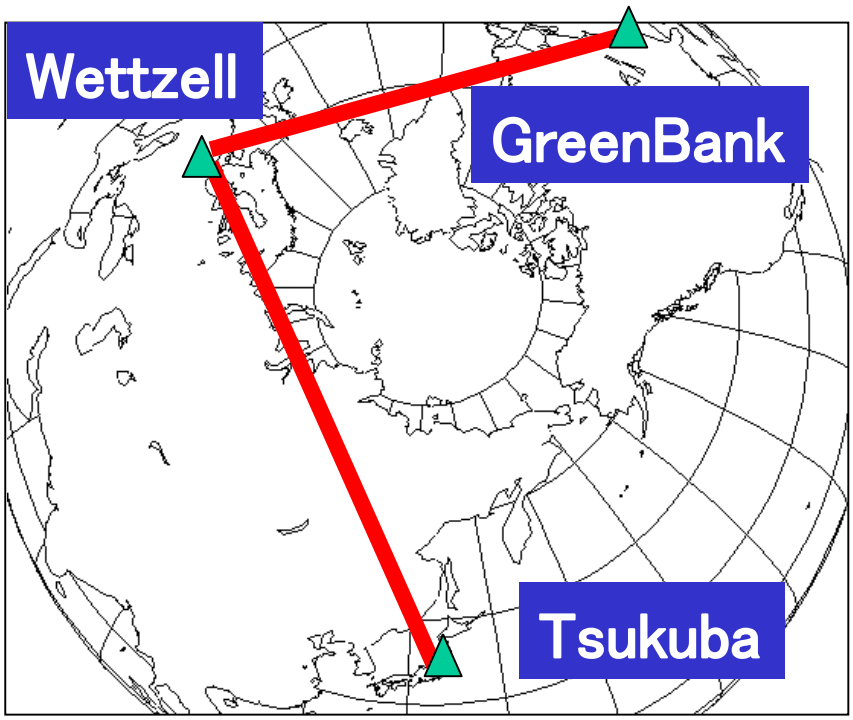
⑥ GEONET analysis center

⑤ VLBI center

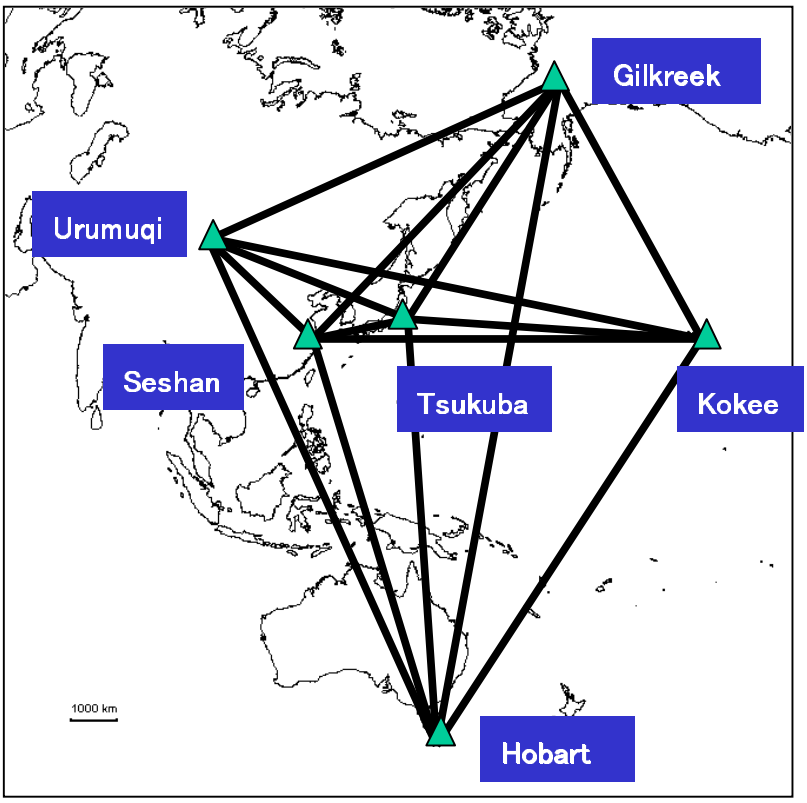
GSI Domestic VLBI Network and

Detected Velocities of Plates





Japan German Cooperative Experiments for UT1



APSG(Asia Pacific Space Geodesy)