Co-location Surveys&Results in GSI's Space Geodetic Network

Shigeru Matsuzaka, Hiromichi Tsuji,
Yuki Hatanaka and Kazuhiro Takashima

Geographical Survey Institute
1 Kitasato, Tsukuba, Ibaraki, 305-0811 Japan
Contact: S. Matsuzaka, e-mail: shigeru@gsi.go.jp

Methods

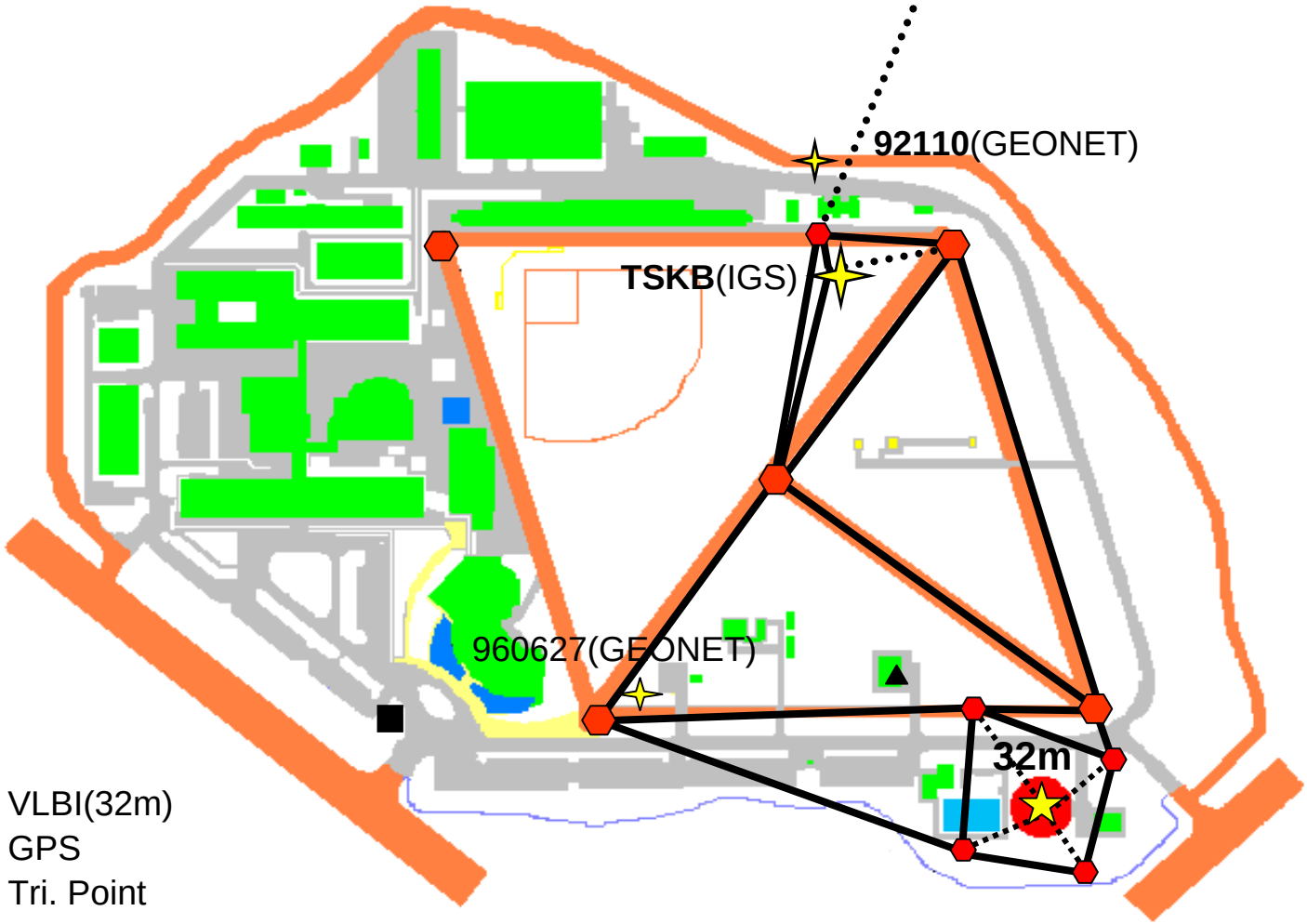
- Co-location survey
  - Precise local-tie by conventional survey techniques
  - Transformation from local to global reference system via GPS
- Comparison of solution vectors by the two techniques

Local-tie

- Precise ground surveys were carried out to connect the reference points with permanent observation pillars in the local networks.
  - Total stations with Cateye reflector, first class tilting level were used.
- Phase calibration observations for GPS antennas were employed to correct for site/instrument specific effects.

Network for local-tie at GSI Tsukuba between VLBI32m and TSKB(IGS)

Ground monument



Determination of VLBI reference point

- A target (Cateye: 120° entry angle) was attached to the supporting structure of the antenna (see below) and observed simultaneously from two ground monuments.
- Observations were made at 20 or more antenna positions (4-6 azimuths and 4-6 elevations).
- A least squares fit program was used to determine the reference point as the non-moving center of the sphere traced by the target.

Local-tie Results

- Tsukuba:

  32m, TSKB(IGS), ground monuments

  – Network adjustment of 3D positions: s.d. ~ 1mm
  – Least squares fit for VLBI ref. :

    (dn, de, du) ~ (0.5, 0.5, 1.0) mm

- Sintotsukawa:

  3.8m, 942001(GEONET), ground monuments

  – Network adjustment of 3D positions: s.d. ~ 1 to 4mm
  – Least squares fit for VLBI ref. :

    (dn, de, du) ~ (0.7, 0.8, 1.0) mm

Local to Global

- GPS observations at VLBI sites(10 to 300m apart) and direction markers(7 to 13km away)
  - Analysis by GAMIT10.06
  - Solution vectors: s.d. ~ 5mm
  - Antenna phase calibration (Hatanaka et al., 2000)
- Deflection of the vertical
  - Tsukuba: direct observation (1980-1983)
    - (☢, 🗀) = (-13.57, 4.72)
  - Sintotsukawa: interpolation from Geoid model (GSIGEO2000, Kuroishi)
    - (☢, 🗀) = (1.65, 8.29)

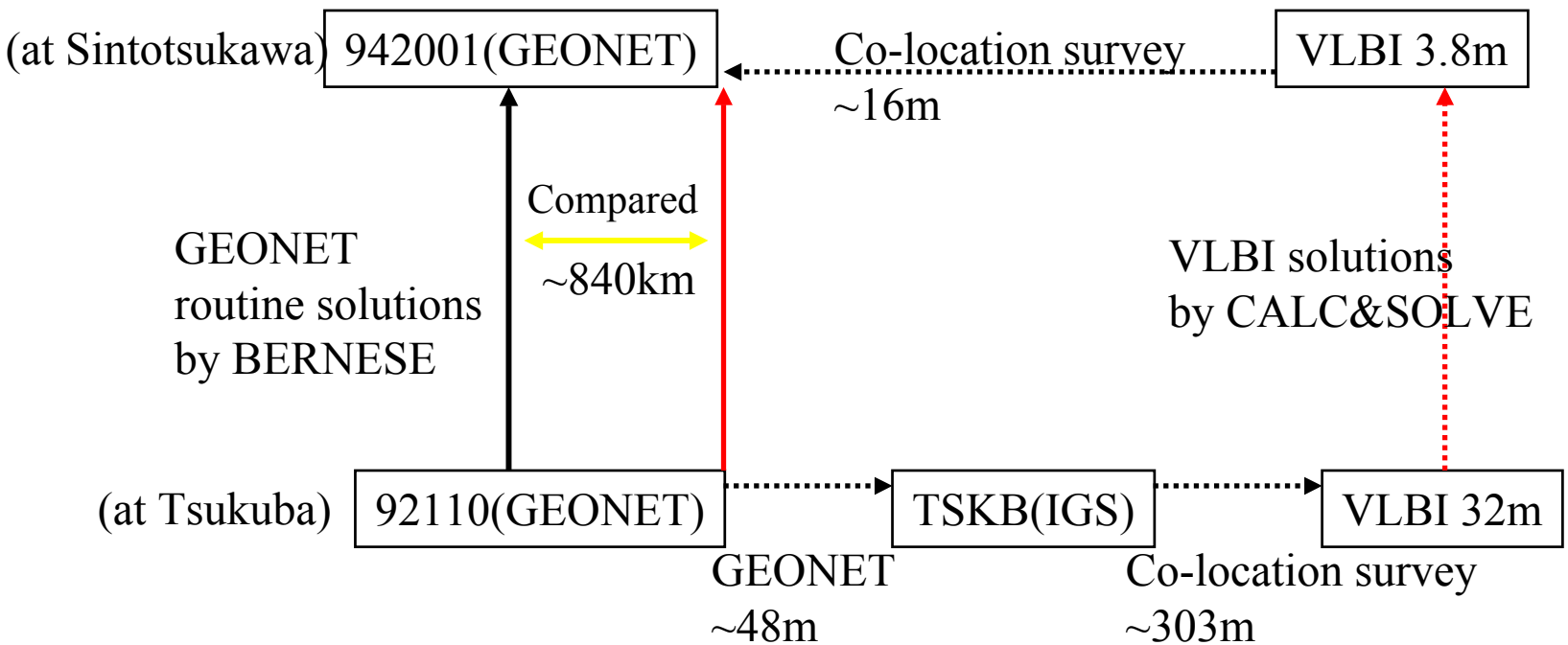
From GPS to VLBI

Relative vectors from GPS to VLBI Reference (ITRF00, unit: m)

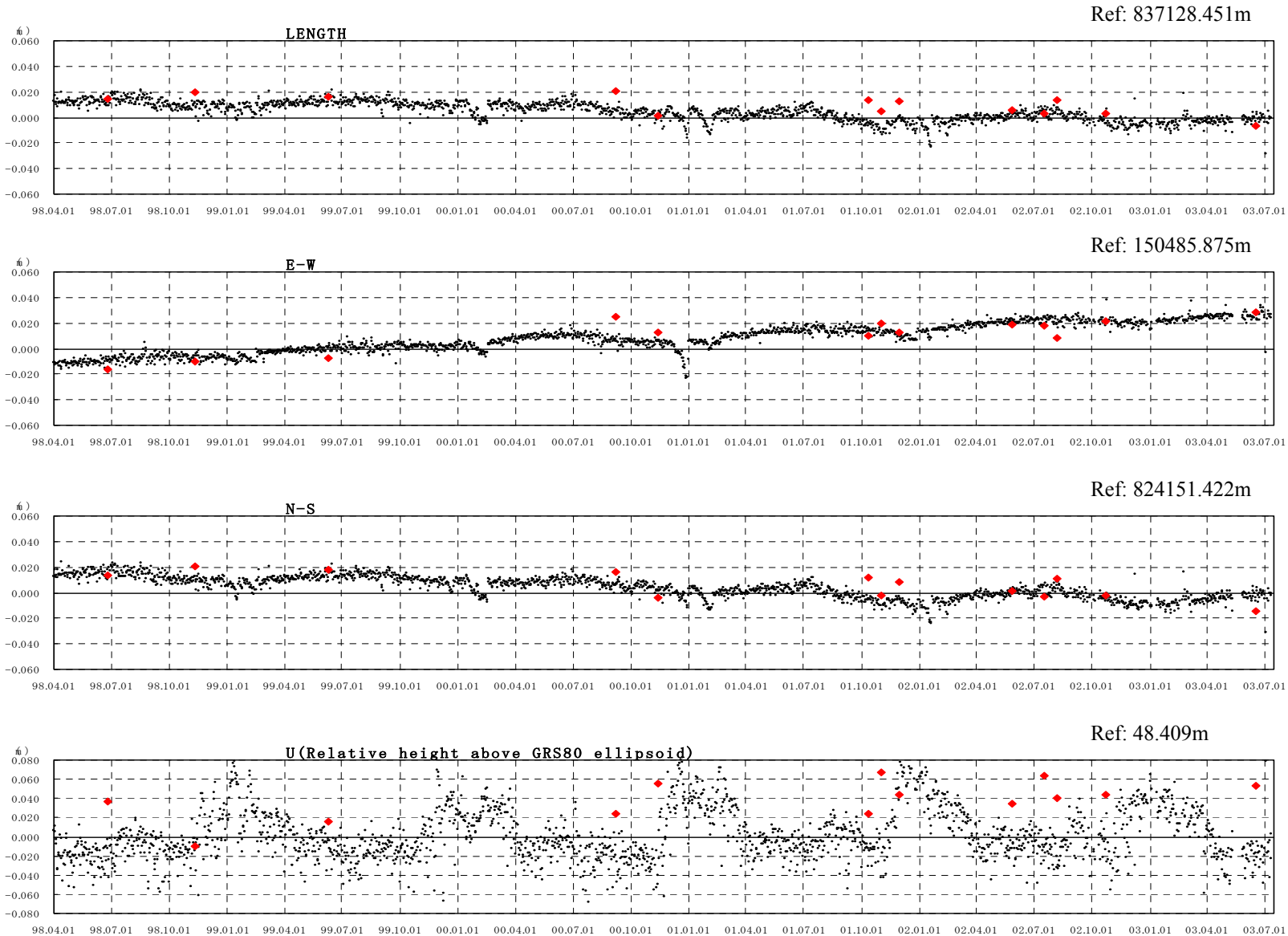
	X	Y	Z	L
TSKB to 32m	-209.5453	29.7219	-216.8837	303.0366
942001 to 3.8m	6.5162	14.3860	-3.9314	16.2749

Comparison of domestic VLBI and GEONET GPS solutions

GEONET and VLBI+co-location solutions were compared on the baseline vector (942001-92110) .



TSUKBA-SINTOTSUKAWA Time Series (GPS• , VLBI◆)



Horizontal components are essentially differences of longitudes and latitudes of the two sites (times average angle to length ratio).

Conclusions and Considerations

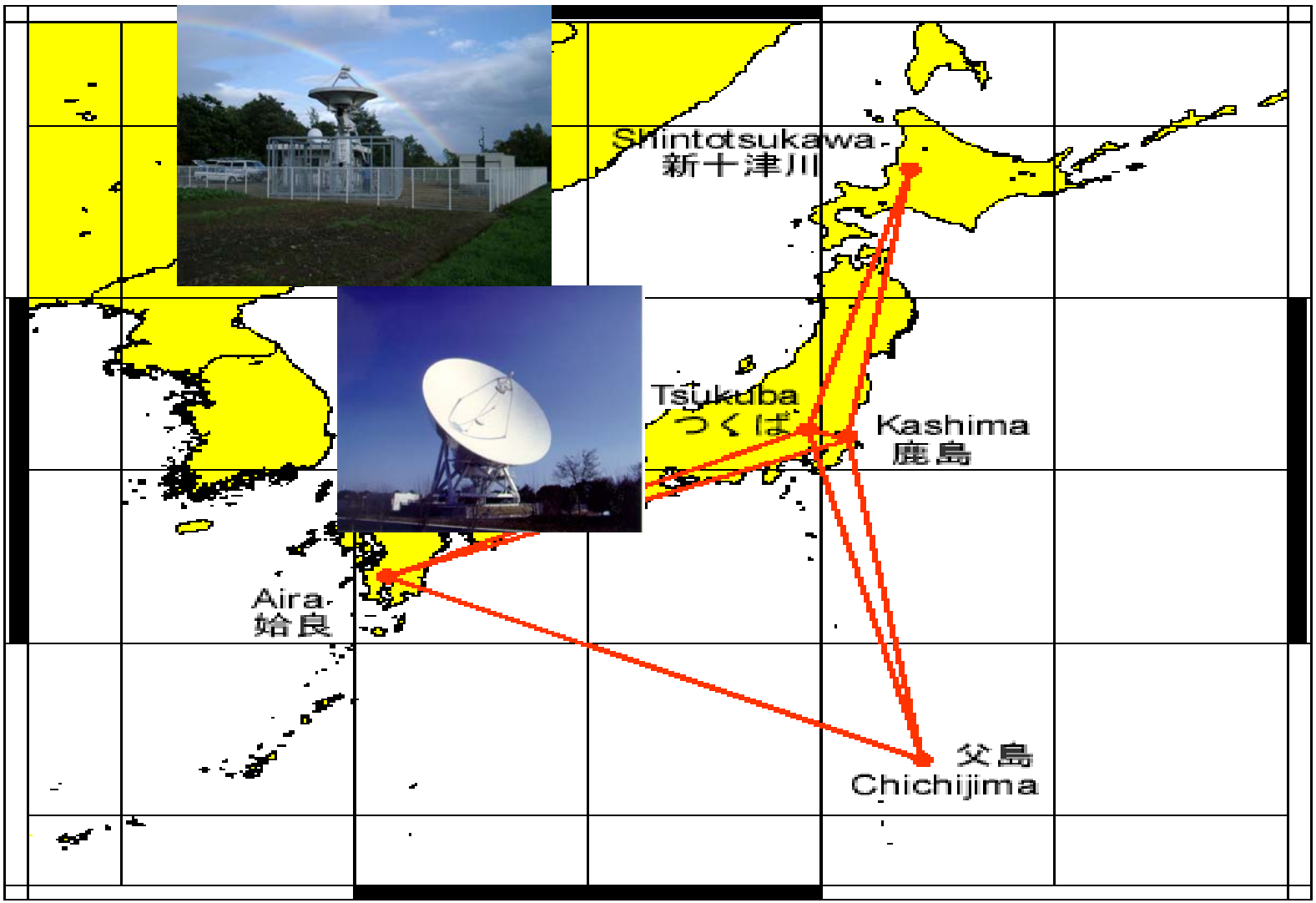
- VLBI and GPS agrees within 1cm in horizontal and length, which suggests there is no systematic differences exceeding 10^{-8}.
- Reasons of a few cm discrepancies in vertical need investigation.
- Local site movement and VLBI antenna deformation, especially in vertical, must be considered/measured for more precise and stable ties.
- Repeated surveys and observations will be necessary to reveal possible annual/seasonal variations and establish tighter connection.
- Domestic VLBI sessions by GSI have been increased to once per month from seasonal in 2003.
- Other site surveys and analysis will be finished soon.

Objectives

- Connection of VLBI and GPS at mm-level in our space geodetic networks in Japan (see next 2 slides)
- Double check for both techniques in geodetic and geophysical study
- Possible integration of both solutions for better reference system

Current Domestic VLBI Network by GSI

(Tsukuba 32m, Sintotsukawa 3.8m, Aira and Chichijima 10m, Kashima 26m stopped operations in 2002)



Nationwide GPS network by GSI (GEONET, 1200 sites)