

On the vertical repeatability of GPS measurements at the Tsukuba GPSMET dense-network campaign

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In the 'GPS/MET Japan' project, we carried out Tsukuba dense-network campaigns in 2000 and 2001 using about 75 GPS receivers in 20 x 20 km area with the interval of the 1.5km - 3.0km spans. One of the goals is the evaluation of the precision of GPS in the relatively flat topography, especially for the vertical component.

In this paper, we analyzed the GPS data using GAMIT/GLOBK software, and examine the time variations of the determined site positions and baseline vectors, and the relations of the baseline repeatability and the baseline length. Thus we try to find the error sources of the vertical component coordinate estimations.

In the analysis the same type of antennas is consisted of analyzing group(s) to cancel the antenna phase center variations. As fiducial site each group includes the seven IGS sites in and around Japan. All day data are analyzed with 24 hours per session. For each day the GLOBK program is used to unify all local groups and SIO (Scripps Institutions of Oceanography) IGS global network analysis data. In the GLOBK analysis as fiducial the fourteen global site horizontal coordinates are tightly constrained. For the satellite ephemeris IGS final solutions are applied.

In the analysis of the Tsukuba 2000 campaign data, the time variations of the vertical position of the campaign sites show that the most sites move together, indicating the rigid motion of the campaign site network because of loose constraint of the vertical component of TSKB site. The variation is ranging 20 - 30 mm with the one-sigma repeatability of 4 - 8 mm. Then we examine the vertical components of the baseline vectors of each site relative to one site. We select TSKB site as the reference site because only TSKB site has the complete tracking dataset for all days in the campaign. The time variations of the vertical components of the campaign site relative to the TSKB site reduce the rigid motion although some rigid motion is seen during DOY 293 - 297 probably because the deviated motion of the TSKB site caused by specificational limitation of the old Turbo-Rogue eight-channel receiver. The variation is ranging 10 - 20 mm with the one-sigma repeatability of 2 - 6 mm. At the last we examine the relationship between the baseline length and repeatability of the baseline vector among the network sites. The baseline length dependency of the repeatability of the vertical component of the baseline vector shows dependency of the repeatability to the baseline length. The dependency is represented as the linear regression formula, $3.17\text{mm} + 0.11\text{ppm} \times L$ where L is the baseline length (mm).

In the analysis of the Tsukuba 2001 campaign data, judging from the 2000 campaign, we conclude the time variations of the absolute vertical motion is mostly rigid motion of the network. Thus we examine the time variations of the vertical positions of the baseline vectors relative to one site among the campaign sites. The time variations of network sites relative to a site locating the central area in the Tsukuba 2001 campaign shows the variations range around 10 mm in general and smaller around DOY 220 and larger around DOY 240 probably indicating the amount of water vapor in the troposphere, and time variations are almost random, indicating homogeneous distribution of the water vapor in the troposphere. In the next we examine the relationship between the baseline length and repeatability of the baseline vector among the network sites. The baseline length dependency of the repeatability of the vertical component of the baseline vector shows strong dependency of the repeatability to the baseline length. The dependency is represented as the following linear regression formula, $3.36\text{mm} + 0.17\text{ppm} \times L$ where L is the baseline length (mm).