Outline and Preliminary Results of GPS/MET Japan Dense Net Campaign 2000 in Tsukuba

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Inhomogeneous distribution of water vapor inside a circle with its center at a GPS receiver and radius of about 10 km has large influence on the precise estimation of position and atmospheric delay. A campaign observation was conducted at Tsukuba in 2000 autumn. GPS receivers were set densely at 75 sites within a 20 km x 20 km area. A preliminary analysis by GIPSY showed that during a passage of the border of rain and clear weathers, precipitable water vapor became smaller in cleared sites while it remained large in rainy sites. This indicates the observation succeeded to capture small-scale variation of water vapor. We will conduct tomography and numerical model experiment to investigate 3-dimensional structure of water vapor and its effect on GPS analysis.

Recent research efforts to improve the accuracy of GPS-based positioning have been revealed that inhomogeneous and anisotropic distribution of water vapor inside a circle centered at a GPS receiver with radius of about 10 km has large influence on the precise estimation of position and atmospheric delay.

To study spatial distribution of water vapor with a scale less than 10 km and its temporal variation, a campaign filed experiment was conducted at Tsukuba for 30 days from October 14 to November 13, 2000. GPS receivers were set densely at 75 sites within a 20 km x 20 km area with 1 to 3 km intervals between neighbor sites in order to observe detail distribution of water vapor below 10 km scale. Water vapor radiometers and Lidars was operated to measure water vapor and upper air radio soundings were performed 3 hourly for 30 days. Surface meteorological measurement was also conducted at 10 sites.

A preliminary analysis has been made by GIPSY with standard parameters. Site positions were first determined once a day, with varying constraint from 900 m to 1 mm. Next, atmospheric delays and their gradient parameters at each sites were estimated by fixing site positions to 30-day time mean values. Zenith wet delay and precipitable water vapor (PWV) were calculated with surface pressure and temperature extrapolated from MRI meteorological observation.

One of the precipitation events showed that during a passage of the border of rain and clear area over the campaign sites, precipitable water vapor became smaller in cleared sites while it remained large in rainy sites. There was a considerable gradient of water vapor over the campaign area and the gradient was not linear as assumed in most mapping function. This indicates the observation succeeded to capture a small-scale variation of water vapor.

However, there are some problems in the patterns of PWV. Some sites showed singular values and a time-independent systematic pattern was observed, which may be related with geographical location or GPS antenna/receiver types. To improve the accuracy of derived atmospheric delay and PWV, we will elaborate the GPS analysis. For example, GPS analysis will be compared with water vapor radiometers and other observation data. Then, tomography will be applied to slant path delay data to estimate three-dimensional structure of water vapor. Numerical model experiments will also performed. These results will contribute to improve the accuracy of the GPS analysis.