ABSTRACTS (MASTER THESIS)

An observational study on the real-time precipitable water vapor with a dense GNSS receiver network

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We aim to observe the behavior of water vapor during a rainfall. We employ the GNSS meteorology to estimate a vertically integrated water vapor, so called PWV (Precipitable Water Vapor), from the propagation delay of GNSS signal. We established a dense GNSS receiver network in Uji using 15 receivers with 1-2 km spacing. We found difference of PWV in 10 km was 3-10 mm during a heavy rain. For a future GNSS network in a much wide area, we use inexpensive single-frequency (SF) receivers. Because SF receiver cannot eliminate the ionospheric delay, we interpolate the delay referring to the results from nearby dual frequency (DF) receivers.

We investigated ionospheric delay by the Uji network, taking advantages of QZSS (Quasi-Zenith Satellite System) that gives signals at high elevation angles. Effects of ionospheric perturbations due to sun-rise/sun-set and a geomagnetic storm were small, so they do not give serious influence on PWV. During a travelling ionospheric disturbance, a wavy structure with a horizontal scale of several tens km was recognized. These ionospheric effects can be compensated by a linear or quadratic interpolation.We corrected the ionospheric delay on SF observation with 30 sec sampling with SEID developed by GFZ (see Fig.1). The resulting error of PWV compared with DF solution was about 1.50 mm in RMS.

For a real-time estimating of PWV, we need to know accurate satellite orbit and clock products, which are calculated from real-time satellite clock information corrected by GEONET. Difference of PWV between the real-time analysis and the post processing by using the final orbit information was 0.68 mm in RMS.

In summary, we estimate overall error of PWV with a dense SF-receiver network on a real-time basis is 1.65 mm in RMS, which is accurate enough to depict the horizontal variations of PWV during a severe rainfall event. We hope our study will contribute to an early warning system for weather hazards.

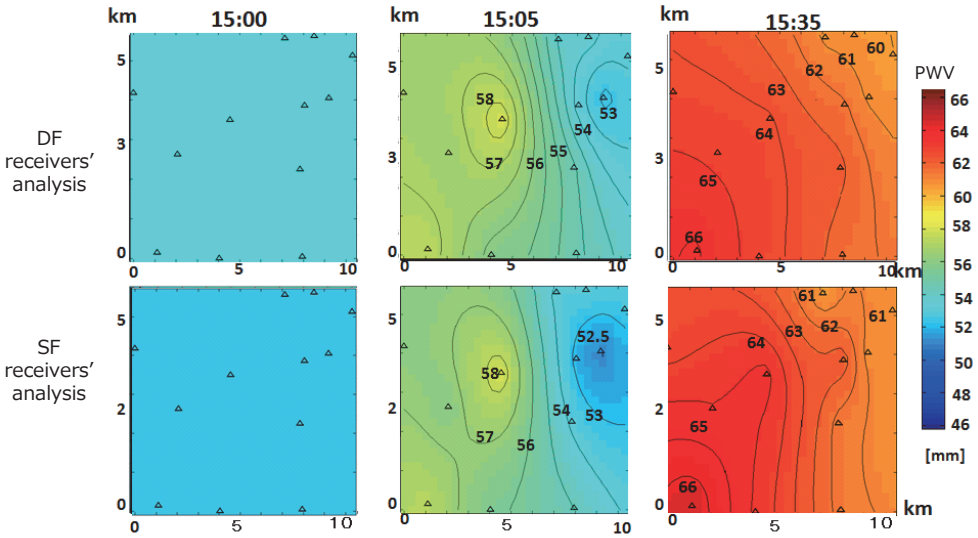

Figure 1. The horizontal distributions of precipitable water vapor (PWV) observed from a dense GNSS receiver network in Uji with the dual frequency analysis (upper panels) and the single frequency analysis (lower panels) on August 3, 2012.