ABSTRACTS (MASTER THESIS)

An observational study on the time and spatial variations of precipitable water vapor with a dense GNSS receiver network

**(Graduate School of Informatics,
Laboratory of Atmospheric Sensing and Diagnosis, RISH, Kyoto University)**

Yuya Iwaki

The integrated amount of water vapor along the zenith angle, or PWV (Precipitable Water Vapor) can be estimated by GPS (GNSS) meteorology, which is a method to compute atmospheric parameters from troposphere-induced delays in signals of GPS (GNSS). We deployed a dual-frequency (DF) GNSS network around Uji campus of Kyoto University, Japan, with inter-station distances of few kilometers. By using this network, we built a basic system to observe PWV fluctuations occurring within a small horizontal scale (less than 10 km), which were then analyzed to identify possible precursors of local torrential rain.

We analyzed the variation of PWV on July 9 and 25, 2012, when localized heavy rain was observed. Both the averaged value and the variance of PWV between GNSS stations increased before a nearby meteorological radar detected the rain clouds. In the latter case, the difference of PWV among stations increased at most 5 mm.

For utilizing this network as a practical heavy rain early warning system, real-time satellite orbit and clock products are required. By introducing correcting method of predicted satellite clock information, the difference between the real-time PWV and that obtained in post processing by means of precise orbit and clock products for post processing was 1.5 mm in RMSE.

To build a dense GNSS network over urban areas, the usage of inexpensive single-frequency (SF) receivers would be beneficial for economic reasons. We implemented software to correct the effect of ionosphere delays on SF observations, according to a method called SEID. By applying SEID for SF PWV retrieval, the error in terms of PWV with respect to the DF solution was about 1.6 mm in RMSE. The PWV horizontal distribution obtained by SF analysis with this model could detect localized PWV inhomogeneity emerging prior to a rainfall which occurred within a small horizontal scale less than 3 km.

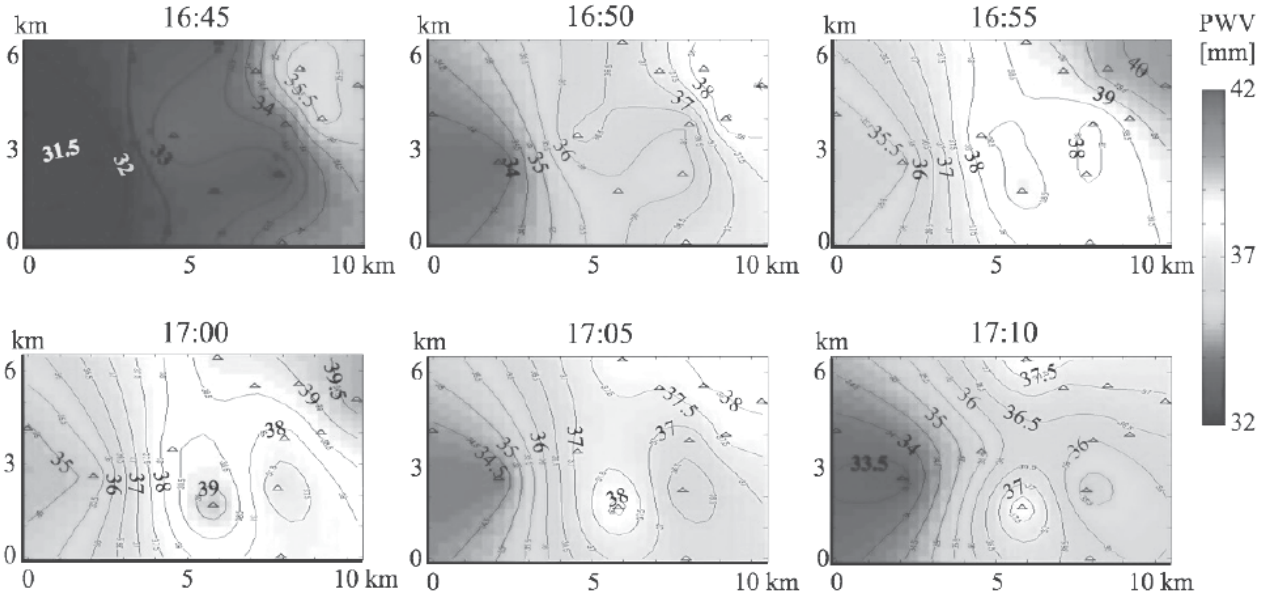

Figure 1. Horizontal distribution of precipitable water vapor (PWV) observed by a dense GNSS receiver network around Uji campus of Kyoto University on July 9, 2012.