ABSTRACTS (MASTER THESIS)

A study on real-time spatio-temporal variations of precipitable water vapor with a dense GNSS receiver network

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We have employed the GNSS meteorology method to measure the PWV (Precipitable Water Vapor), which is the integrated amount of water vapor along the zenith angle. We will try to establish the real-time prediction technique of the local torrential rain, utilizing the time and spatial variations of PWV within a small range in advance to the rainfall. We deployed the hyper-dense GNSS receiver networks around Uji and Shigarki with inter-station distances of few kilometers. We observed the PWV fluctuations occurred within a small horizontal scale, then we studied a relation between the PWV increase and rainfalls.

With the Uji network, we analyzed the PWV variations on September 3, 2012, when a localized heavy rain was observed. The averaged PWV for stations increased before a meteorological radar detected the rain clouds. The spatial distribution of PWV between the GPS stations increased to about 5 mm. The Shigaraki network is installed in hilly forests, so we need to compensate the effect of the difference due to elevation difference (Figure 1). We estimated the averaged PWV from July to September in 2016 to define the bias at each station. After removing this bias from the measured PWV, the spatial variation of PWV between the stations was suppressed by about 73 %.

For a real-time estimating of PWV, we need to know the accurate satellite orbit and clock information on real-time, which are corrected by referring to GEONET. Difference of PWV between the real-time analysis and the post processing with the final orbit was 0.82 mm in standard deviation. 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 (the SEID model). By applying SEID for SF PWV retrieval, the error of PWV compared to the double-frequency (DF) solution was about 1.34 mm in standard deviation.

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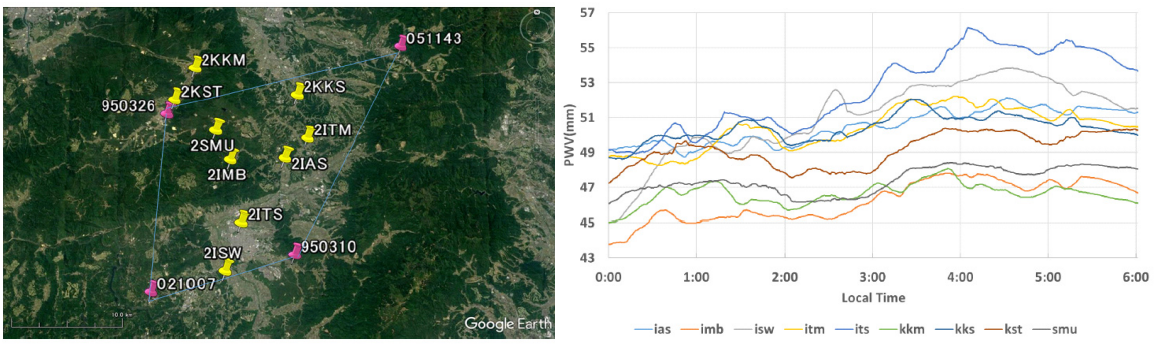

Figure 1. (left) The dense network of GNSS receivers installed near Shigaraki MU observatory in Shiga, Japan. (right) Temporal variations of the precipitable water vapor (PWV) observed from the Shigaraki dense GNSS receiver network.