Smal-scale variations of ionospheric TEC observed with a hyper-dense GNSS receiver network

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We employ the GNSS meteorology to estimate TEC (total electron content) and PWV (Precipitable Water Vapor) in the ionosphere and troposphere, respectively, from the propagation delay of GNSS signal. We established a hyper-dense GNSS receiver network in Uji using 7 to 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 system, 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. The resulting error of PWV compared with DF solution was about 1.50 mm in RMS. By improving the time resolution of the interpolation from 30 to 1sec, error is suppressed by about 70%.

Keywords: GNSS meteorology, hyper-dense GNSS receiver netwrok , PWV (precipitable water vapor), TEC (total electron content), ionospheric propagation delay

