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Monitering of atmospheric precipitable water using GPS and microwave radiometer

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Temporal variations of precipitable water (PW) from fixed continuous GPS observations are compared with those from microwave radiometer (MR) observations and radiosonde measurements. All data were collected at the same site (Kochi University) for about one month in June 2010. GPS data were processed with the precise point positioning method of GIPSY-OASIS II ver.6.0 using precise satellite orbits and clocks, Vienna mapping function, and Onsala ocean loading correction coefficients. Zenith wet delay was estimated every five minutes after resolving phase ambiguities and then converted to GPS-PW by multiplying a constant coefficient. No significant difference was recognized ($<$ 1 %) even when time-variant coefficients expected from hourly surface temperature measurements were used. The MR measured zenith brightness temperatures of the atmosphere at 23 GHz and 36 GHz frequencies every ten seconds. We have newly calculated conversion coefficients from the brightness temperature to PW based on the GPS-PW estimates. Correlation coefficient between GPS-PW and MR-PW is as high as 0.974 after abnormal MR measurements at the rain fall are excluded. Since the MR is highly mobile and capable of real-time measurements, it is applicable to the direct monitoring of water vapor disturbance in an urban area where infrastructure has been highly developed and GPS is no longer an effective observation tool.

Next we investigate effects of satellite orbit information and mapping function on the GPS atmospheric delay estimation. We processed one-year GPS data at Kochi (GEONET 0083) using the final precise orbits and Vienna mapping function and also using the ultra-rapid orbits and Global mapping function. Two time series of zenith wet delay from different combination of sattelite orbits and mapping function are consistent with one another within 2.36 mm in rms. Atmospheric delay and resultant PW estimated from quasi-real-time GPS data processing are highly reliable and applicable to the wide variety of atmospheric studies.

Keywords: GPS, precipitable water, radiosonde, radiometer, mapping function