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Data assimilation of GPS precipitable water vapor to NWP model and its impact on ray-traced atmospheric slant delays

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We have developed a state-of-art tool to obtain atmospheric slant path delays by ray-tracing through the meso-scale analysis data from numerical weather prediction (NWP) provided by the Japan Meteorological Agency (JMA). The tool, which we have named 'KAshima RAytracing Tools (KARAT)', is capable of calculating total slant delays and ray-bending angles considering real atmospheric phenomena. One advantage of KARAT is that the reduction of atmospheric path delay will become more accurate each time the numerical weather model are improved (i.e. time and spatial resolution, including new observation data). Shoji et al. [2009] presented the GPS PWV data assimilation can improve the prediction of a heavy rainfall. On October 27, 2009 the JMA started data assimilation of zenith wet delay obtained by the GPS Earth Observation Network System (GEONET) operated by Geospatial Information Authority of Japan (GSI) for meso-scale NWP model. The improved NWP model data assimilating the GPS PWV data has the potential to correct the atmospheric path delay more precisely. Meteorological Research Institute (MRI) of Japan has evaluated the impact of ground-based GPS precipitable water vapor (GPS PWV) derived from the GEONET on meso-scale NWP model under the localized heavy rainfall event in Tokyo, Japan on 5 August 2008. A terrific thunderstorm occurred across the Kanto area of Japan, and it caused flooding in downtown Tokyo. During the event, the rainfall intensity increased to over 100 mm per hour within thirty minutes. We are now processing the atmospheric slant delays using KARAT through the MRI NWP model during that event. We will also perform the same analysis using the conventional NWP model (i.e. the model without assimilating GPS PWV data). We will present the preliminary results of the comparison study.

Keywords: GNSS, ray tracing, numerical weather prediction, data assimilation, GPS precipitable water vapor, mesoscale