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A study on precision GPS height determination and its potential improvement with microwave radiometry

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The Global Positioning System (GPS) is applied in the scientific topics with the requirement of very high-precision positioning determination. Its major error sources are from several factors such as ionospheric refraction, orbital uncertainty, antenna phase center variation, signal multipath, and tropospheric delay, which have been reduced substantially in recent years. Nevertheless, efforts are still needed to further improve the positioning accuracy by GPS.

In this study, the GPS data collected by the GPS receivers that were established as continuously operating reference stations by International GNSS Service (IGS), Ministry of the Interior (MOI), Central Weather Bureau (CWB), and Industrial Technology Research Institute (ITRI) of Taiwan are utilized to investigate the impact of atmospheric water vapour on GPS positioning determination. The surface meteorological measurements that were concurrently acquired by instruments co-located with the GPS receivers include temperature, pressure and humidity data. To obtain the influence of the GPS height on the proposed impact study. A hydrodynamic ocean tide model (GOT00.2 model) and solid earth tide were used to improve the GPS height. The surface meteorological data (pressure, temperature and humidity) were introduced to the data processing with 24 troposphere parameters. The results from the studies associated with different GPS height were compared for the cases with and without a priori knowledge of surface meteorological measurements. The finding based on the measurements in 2003 is that the surface meteorological measurements have an impact on the GPS height. The associated daily maximum of the differences is 1.07 cm for the KDNM station. The impact is reduced due to smoothing when the average of the GPS height for the whole year is considered.

Finally, the ground-based microwave radiometer for sensing water vapour is utilized to validate the water vapour derived from GPS. Its incorporation into positioning determination by GPS is also discussed.