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An up to date GPS derived precipitable water vapor (PW) dataset for Antartica, and the effect of the GPS analysis strategy on PW retrievals

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Homogeneously reprocessed GPS data offer the possibility of an accurate, stable and increasingly long-term record of integrated precipitable water vapor (PW) or Zenith Tropospheric delay (ZTD), of particular value in data sparse regions such as Antarctica. GPS has long been known to be able to make such measurements of the troposphere. However over recent years, GPS models and analysis techniques have advanced – changes which we show here have resulted in systematic changes in the magnitude of GPS observations.

We present a global reanalysis of GPS data, focusing on 12 Antarctic sites. We show step-wise improvements of GPS Zenith Total Delay (ZTD) estimates upon adoption of each of: (i) absolute antenna phase centre variations, (ii) VMF1 tropospheric mapping functions, and (iii) an accurate model of a priori Zenith Hydrostatic Delay (ZHD) from observed surface meteorological data. The cumulative effect of these three additions to the analysis is a systematic decrease in the magnitude of GPS estimates of ZTD at Antarctic sites, by an average of $\sim$11 mm ZTD ($\sim$1.8 mm PW).

We compare our final GPS dataset to radiosonde measurements, as well as observations from the AIRS and MODIS instruments. Our GPS measurements show a mean bias to radiosonde measurements of -0.48 mm PW – we conclude that, in Antarctica at least, a proportion of the widely observed bias between GPS and radiosonde measurements can be explained by earlier GPS analysis deficiencies. GPS offers agreement with MODIS and AIRS is at the sub-millimetre level of PW.

We believe that PW estimates from reprocessed GPS solutions using state-of-the-art models now have greater potential for assimilation into regional or global Numerical Weather Models (NWMs).