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Ground-based GPS-derived Precipitable Water Vapour Estimates for Climate Application in Australia

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Atmospheric water vapour is a critical component of the greenhouse effect and plays a significant role in the global climate system. The knowledge of the long-term spatial and temporal variability of water vapour is vital for understanding climate change. The Global Positioning System (GPS) has long offered the prospect of retrieving column integrated Precipitable Water Vapour (PWV) profiles from the time-varying tropospheric Zenith Path Delay (ZPD), which can be retrieved by stochastic filtering of the GPS measurements. However, observing GPS-PWV for climate studies requires a homogenous and long-term time series of GPS data. We present a regional reanalysis of GPS data focussing on the Australian Regional GPS Network stations from 1997 to 2012 (15 years). These stations are selectively chosen to provide a representative regional distribution of GPS sites on the Australian continent while ensuring conventional meteorological observations (surface-based data) are available for PWV conversion and other PWV sensors (e.g. upper-air data from radiosondes) for validation purposes. The research work is divided into three components: 1) estimation of homogenous long-term tropospheric ZPD from GPS measurements that are accurate, stable and consistent; 2) conversion of tropospheric ZPD to PWV estimates given surface temperature and pressure readings, and 3) intertechnique comparison and validation of the GPS-derived PWV. The derived data will be used to investigate the secular trend and seasonal variation PWV time series and its implications for climate application. This research represents the first attempt to utilise the Australian regional network of GPS stations to study the climate processes and variations from the long-term time series of GPS-PWV.