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Atmospheric Effects in GPS Analyses

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Improvements in the analyses of Global Positioning System (GPS) observations yield resolvable mm to sub-mm differences in coordinate estimates, thus providing sufficient resolution to distinguish subtle differences in analysis methodologies. Here we investigate the effects on site coordinates of using different approaches to modelling atmospheric pressure loading deformation (ATML) and handling of tropospheric delays. The rigorous approach of using the time-varying VMF1 mapping function in conjunction with ray-traced zenith hydrostatic delays (ZHD) produces solutions with lower noise at a range of frequencies compared with solutions generated using the empirical Global Mapping Function and Global Pressure and Temperature ZHD model. This is particularly evident when ATML is accounted for. We find little difference in solutions when non-tidal ATML is applied either at the observation level or as a subsequent daily-averaged value. An additional finding of this study is the demonstration that failing to model tidal ATML at the diurnal and semi-diurnal frequencies can introduce anomalous aliased signals in GPS time series with a period that closely matches the GPS draconitic semi-annual period (351.4/2 days). This is evident in both stacked and single site power spectra, with each tide contributing roughly equally. The amplitude of the aliased signal reaches a maximum of 0.8 mm with a clear latitudinal dependence that is not correlated directly with locations of maximum tidal amplitude. This is the first evidence of aliased signals being produced from tidal ATML deformations.