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Impact of atmospheric pressure loading on the stability of reference frame and vertical motion rate derived by GPS

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The data of about 300 globally distributed continuous GPS stations are reanalyzed spanning 1994.0 ˜ 2003.0. Daily GPS time series are generated. The correlations of GPS height and atmospheric pressure loading displacement time series are analyzed. Large correlation coefficients appear mainly in the northern hemisphere. The amplitude ratio of atmospheric loading displacement to GPS height variation is also analyzed. The large ratio values appear also in high latitude northern hemisphere above N30 degrees. The atmospheric loading displacement correction is applied to the daily loosely constrained solutions before aligning the solutions to ITRF2000 by a 7-parameter similarity transformation. We compare the two cases with and without atmospheric loading correction. For the geocentric translation parameters, the differences have a sub-millimeter level scatter in three components, and show obvious seasonal variations. The linear trend of the geocentric differences is negligible. For the scale factors, the peak-to-peak differences can reach sub-ppb level, corresponding to a millimeter level height difference. The linear trend of the scale difference is also marginal. The comparison shows that applying atmospheric loading corrections to GPS solutions does not affect the long-term stability of the reference frame significantly. The effect of the correction on site vertical rate estimation is also evaluated. For this evaluation, about 200 stations with longer than 3 years of solutions and with high-quality time series are taken. The vertical rates are estimated by fitting the height time series together with annual and semi-annual waves. Offsets in time series are fitted as a step function. From the time series with and without atmospheric correction, the estimated vertical rates can differ at the level of sub-mm/year. For some

critical applications, such as monitoring the vertical land motion at tide gauges by GPS requiring 1mm/yr accuracy, this effect should be taken into account to meet the accuracy requirement.