



Sub-daily signals in GPS observations and their effect at semi-annual and annual periods

M.A. King (1), C.S. Watson (2) and N.T. Penna (1)

(1) School of Civil Engineering and Geosciences, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK, (2) Centre for Spatial Information Science, School of Geography and Environmental Studies, University of Tasmania, Hobart, 7001, Australia (m.a.king@ncl.ac.uk / Fax +44 191 222 6502 / Phone +44 191 222 7833)

Unmodelled sub-daily signals at certain frequencies have been shown to propagate into GPS coordinate time series at fortnightly, semi-annual and annual periods when computed in 24h sessions, with some observed admittances reaching up to $\sim 100\%$. These may bias the geophysical interpretation of coordinate time series. To investigate residual unmodelled sub-daily signals in GPS time series we have computed site coordinates for ~ 90 IGB00 sites at 5 minute intervals for the period 2000.0-2006.0. Apart from the higher coordinate estimation rate, a conventional precise point positioning strategy is implemented using the GIPSY v4 software using JPL orbits, clocks and earth orientation products. Despite modelling solid earth tides (IERS2003) and ocean tide loading displacements (TPXO6.2), we find significant energy at frequencies from once per day to the Nyquist frequency in each coordinate component. These signals have typical amplitude around ~ 1 -3mm yet often exceed ~ 10 -15mm in the semi-diurnal and diurnal bands, several times larger than predicted atmospheric loading displacements. The dominant signal periods include S1 (24.00h), K1 (23.93h), K2 (11.97h) and S2 (12.00h), with high frequency terms at periods of 8h, 6h and higher also present. The temporal and geographical pattern of the signal amplitudes is complex.

To assess the impact of these poorly understood and unmodelled signals on conventional GPS time series, we undertook time series analysis on a difference dataset derived from differencing the high rate solution from a standard 24h analysis. Differencing the two time series removes any geophysical signal and reveals residual signal at annual and semi-annual periods (amongst others). These spurious low frequency sig-

nals have typical amplitudes of 0.5-1.0mm, also with a complex spatial distribution. We interpret these signals as having their origin in the unmodelled sub-daily signals and suggest that present-day GPS-based estimates of annual and semi-annual signals are therefore likely to be biased at this level on a per-site basis.